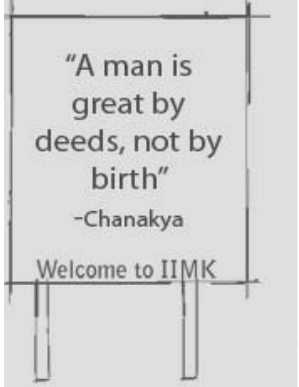

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Knowledge as practice - How Artificial Intelligence can create new knowledge?

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Knowledge as practice - How Artificial Intelligence can create organizational knowledge?

Abstract

This paper attempts to answer - how can breakthroughs in artificial intelligence benefit the process of organizational knowledge creation? In this paper, we enrich the SECI model of knowledge creation given by Nonaka and Takeuchi with the underpinnings of sociological theories of structuration and ethnomethodology to understand knowledge creation processes in a comprehensive manner. We argue that advent of artificial intelligence has given organizations the tool to incorporate this understanding in their artificial intelligence to be able to learn and guide the process of knowledge creation in organizations. By using a qualitative analysis, we studied knowledge creation activities across multiple industry sectors. A model for knowledge creation that uses artificial intelligence for understanding the interplay between knowledge agents and the organization structure is proposed. This research contributes by proposing an artificial intelligence-based model for creating a collective mind for organizational knowledge creation.

Keywords: Knowledge creation, artificial intelligence

Knowledge as practice - How Artificial Intelligence can create organizational knowledge?

Knowledge management is increasingly becoming important in organizations as the world is moving fast from a production-based economy to a knowledge-based one (Drucker, 2001). Nonaka captures the essence of this argument by surmising, "in an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge. When markets shift, technologies proliferate, competitors multiply, and products become obsolete almost overnight, successful companies are those that consistently create new knowledge, disseminate it widely throughout the organization, and quickly embody it in new technologies and products" (Nonaka, 1991: 1). Organizations need to understand the process for knowledge creation and utilization. However, traditionally knowledge management systems have been envisaged as large databases, where all documents are stored for retrieval. As technology advanced, organizations started storing rich media like audio and video. Various technologies like text search are used for searching across large volume of information stored in such databases. In all such cases, knowledge is considered as an object. Annotation by digital media and application of machine learning techniques to extract information from content is suggested as method for generating new knowledge (Ferreira Moreno, Sousa Dos Santos, Costa Mesquita Santos, & Fontoura De Gusmao Cerqueira, 2018). While explicit or discursive knowledge can be stored and accessed in such a system, tacit knowledge cannot be. Knowledge is different than "knowing"; Orlikowski suggests that "knowing is not a static embedded capability or stable disposition of actors, but rather an ongoing social accomplishment, constituted and reconstituted as actors engage the world in practice" (Orlikowski, 2002: 1). However, knowledge creation is complex in practice. Capturing and utilizing explicit knowledge has been relatively easier with advances in technology but creating and sharing tacit knowledge has always been difficult. This

paper delves into the question of how organizations create knowledge? It, thereafter, explores how artificial intelligence can help in knowledge creation?

Organizational knowledge creation has increasingly gained importance since the publication of Nonaka and Takeuchi's book, wherein, they presented the SECI model of knowledge creation that explains how tacit and explicit knowledge of agents in the organizational subsystem are converted into organizational knowledge (Nonaka & Takeuchi, 1995). SECI model has been widely used as a model that aptly describes knowledge as practice but it is understood in extant literature that more work is required to better elaborate upon the processes of knowledge creation in organizations (Tsoukas, 2009). Despite the large number of empirical investigations and the valuable insights that have been gained, there have been only a few studies done so far on the effect of artificial intelligence on knowledge creation (Hadjimichael & Tsoukas, 2019). Also, difficulties in integrating findings from many areas of study on knowledge management have arisen as a result of the field's inherent diversity. An integrative approach to understand knowledge creation is required to avoid a fractured view of organizational knowledge creation, in itself, and there have been calls in extant literature for investing in knowledge creation from a practice perspective (Argote, McEvily, & Reagans, 2003: 572). In addition, the focus of extant research on knowledge creation in organization has largely been on psychological, economic and social factors related to interpersonal trust, motivation and monetary incentives, but, the effect of artificial intelligence on knowledge creation and sharing has not been studied much. In the Industry 4.0, AI is anticipated to be a general-purpose technology - one that can be employed in a variety of contexts and have far-reaching effects, similar to what happened during advent of the steam engine and electricity in Industry 2.0 and that of computing and internet in Industry 3.0 (Crafts, 2021). As AI continues to proliferate, it is

believed that it, too, will usher in a period of significant change. In today's competitive environment, the knowledge sharing intentions of individuals are crucial (Hau, Kim, Lee, & Kim, 2013; Hsu & Chang, 2014), but AI is woven into the fabric as the majority of information is digitally stored and the interactions between individuals and with the structure are conducted primarily through the use of information systems. When it comes to the processes of creating new knowledge in organizations, artificial intelligence is rapidly becoming an associate agency alongside human employees (Neştian, Tiţă, & Guţă, 2020).

Knowledge can be classified into explicit knowledge and tacit knowledge (Nonaka and Takeuchi, 1995). Tacit knowledge is defined as the knowledge that we bring into use when performing an action but is difficult to express in any language (Hadjimichael & Tsoukas, 2019). Not only activities like driving, operating a machine or doing regular habitual activities are good examples of enactment of tacit knowledge, but also activities like conducting meetings, taking decisions, working in teams and so on also utilize tacit knowledge that is difficult to codify. However, these are some of important organizational activities, wherein AI is also embedded in organizations these days. In addition, AI becomes important in the context that utilizing knowledge that is not known by a single individual has always presented a challenge for organizations.

Therefore, according to the position that we take in this paper, knowledge is not just an artifact, but it gets practiced in the actions and interactions of agents in the societal subsystem of an organization. We explore knowledge in practice and employ it in organizations that employ AI to aid in creating knowledge. Typically, in an all human and no AI organization, no single agent can fully predict what kind of practical knowledge would be relevant and in what context. There is no overseeing ‘mind’ that manages these distributed knowledge systems (Tsoukas, 1996). In

this paper, we propose that this void can be filled by AI. It can accomplish this purpose by learning and incorporating how human routines and processes evolve, proliferate, and transform. Structuration theory is capable of explaining how human agents and structure (of any societal subsystem) recursively create and recreate each other. Also, ethnomethodology concerns itself with how human actors, who are knowledgeable agents, think and interact with each other in any societal subsystem. Therefore, we delve more deeply into the subject of organizational knowledge creation in this paper to explore how agents act and interact with others in an organization that could inform the process of knowledge creation and enrich it? Using the theories of structuration (Giddens, 1984) and ethnomethodology (Garfinkel, 1967) this paper researches the importance of human interactions with each other and with structures and functions (embodied in routines) of an organization to identify the process for knowledge creation and understand how AI could aid the process.

We have used grounded theory for explicating the enactment of knowledge creation in an organization. Grounded theory takes an interpretive stance to examine social processes without using any a priori frameworks. This open-minded way of looking at a phenomenon helps in understanding perceptions, procedures, and tasks. The knowledge framework proposed in this study is developed by conducting qualitative research across diverse respondents and across various industries. Involvement of central as well as marginal actors in the study helps in understanding various perspectives.

This paper is structured as follows. We start with theoretical background on knowledge creation and a conceptual view of a knowledge agent, which is followed by an explanation of the methodology that we use. We conclude with discussions of the results and explication of limitations of this research and about future research directions.

This paper contributes to epistemology on the process of organizational knowledge creation and on the utilization of artificial intelligence in the process in two ways. Firstly, it empirically uncovers the key elements of knowledge creation that are being practiced in today's competitive world. By doing this, the study helps both practitioners and researchers; practitioners can act on the knowledge of these elements to enrich the processes of knowledge creation in their organization while researchers can probe further into these elements to understand the linkages of the SECI framework (Nonaka & Takeuchi, 1995) with structuration theory and ethnomethodology to uncover fundamental ways, in which knowledge creation process can impact these theories and to propose theoretical advancement of these theories. Secondly, this paper develops a framework that can exploit the advances in artificial intelligence for the purposes of knowledge creation.

Theoretical Background

In his knowledge-based view of the firm, Grant (1996) defines a company as an institution for integrating knowledge. He argues that there are four processes for integrating knowledge: norms and directives that regulate contact, activity sequencing, routines that help coordinate complicated patterns of interaction, and group problem solving and decision making. Similar to Garfinkel (1967), Grant proposes a notion of common knowledge that individuals bring to the organization.

Knowledge Creation

Many process models of knowledge creation have been proposed in the extant literature (Hedlund, 1994; Kogut & Zander, 1992), but for this paper, we choose SECI model by Nonaka and Takeuchi (1995) as it provides a comprehensive framework for creating knowledge in an organizational context. Knowledge creation is a spiral process that happens through four stages

of socialization, externalization, combination and internalization coined as SECI processes (Nonaka 1991; Nonaka & Takeuchi, 1995). The first stage is socialization that occurs when tacit knowledge is shared by individuals through interaction and communication with others. In the second stage of externalization, tacit knowledge is converted to explicit knowledge by creation of artefacts such as documents, reports and diagrams. The third stage of combination is about integrating of explicit knowledge to create new knowledge. This can involve combining different ideas, theories, or perspectives to create a new synthesis. The final stage of internalization ensures that new knowledge is incorporated into the individual and the organizational knowledge base.

Social structures and practices are both a medium for and a product of human agency, as per structuration theory. In other words, individuals (or agents) create and maintain social structures and practices through their activities, but these structures and practices simultaneously constrain and shape their actions. This implies that individuals have some degree of agency or freedom to act but they are also constrained by the social structures and practices in which they are embedded. Overall, structuration theory has the potential to offer a framework for comprehending the intricate interactions between human behavior and social structures for the purposes of producing and disseminating new knowledge. Because the problems that need to be solved by new knowledge are equally embedded in the structures and in the agents, who carry them, both the agent and the structure work together towards creating organizational knowledge.

As per structuration theory, any societal subsystem (like an organization) has a structure that guide agents about how they are expected to act and interact. The structure primarily comprises of “rules” and “resources” - rules comprises of regulations, norms, beliefs, shared value systems and an organizational world view, which could be codified as well as non-

codified, but are generally practiced through actions and interactions of the agents in a regular course in the organization. Resources, on the other hand, comprises of the power the agents have, by virtue of their status in the organization, to utilize organizational resources. Agents operating in an organizational context carry these rules and resources as memory traces. However, agents are not subservient to the structure. Agents operate based on two other sources of knowledge viz. the Freudian unconscious mind and the knowledgeability that comes from education and experience of other societal subsystems. Both memory traces and knowledgeability influence the behavior of an agent within an organization.

Typically, agents would continue to repeat what they have been doing based on their memory traces. However, every agent is capable of rationalization and reflection on their previous actions. Therefore, if the agent believes that a prior action was not beneficial to either themselves or to the organization, then there is a propensity to alter it. An agent will depend on their knowledgeability for such an aberration from the norm. This change in normal behavior would either be accepted or rejected by others in the structure. If the deviation is accepted then a new way gets legitimized in the structure; if it is not, then the change is rejected by the structure and the old structure prevails.

Also, agents not only interact with the structure but they interact with other agents, as well. Ethnomethodology, developed by Harold Garfinkel in the 1960s, refers to the technique of sociology that investigates how individuals and groups make sense of their shared social experiences. It examines the various processes involved in communication such as constructing meaning, interpreting context and understanding each other's intentions by looking at how people use language, roles, scripts and other methods to construct reality. The shared practices amongst agents, which take the shape of rules, norms, and roles, generate trust between them, and this

mutually reinforcing trust helps to keep the emergent structure stable. Agents typically play a script in their minds before getting into interactions with other agents. Not only are the scripts the frameworks for seeing and interpreting behavior, but they are also simultaneously the frameworks for planning and carrying out an action that is context-specific (Castelfranchi, 2012). It is possible for interacting agents to use scripts during interactions on expected lines. In such a case, the interaction will be as expected. However, if the scripts are not aligned, then there would be a deviation from the norm, which would necessitate conscious reasoning on the part of the agents to accommodate changes in the data or the context.

In the SECI process of socialization, externalization, combination, and internalization there is a constant conversion between tacit and explicit knowledge towards organizational knowledge creation. Agents interact with the structure of the organization and with the other agents, which are expected to affect these conversions. By using theories of structuration and ethnomethodology, we attempt to enrich the SECI framework by providing a theoretical lens to view these interactions. Because the pervasiveness of information systems and artificial intelligence (AI) technologies have the propensity to impact knowledge creation, it is crucial to comprehend how humans create knowledge in organizations. This understanding would help AI tools to effectively monitor, predict and suggest pathways for better interactions and knowledge creation.

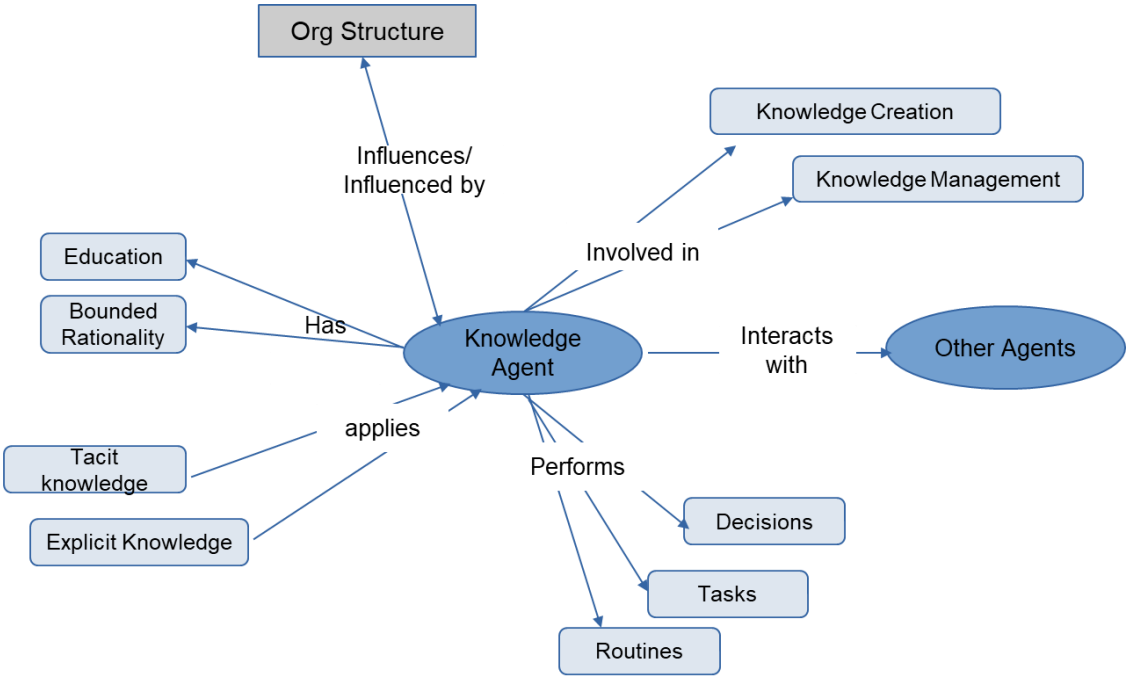
Knowledge Agent

"Mutual intelligibility is not something that people have, rather it is something that people enact" (LeBaron, Christianson, Garrett, & Ilan, 2016) - Garfinkel suggests that ordinary individuals are knowledgeable and derive from tacit and explicit knowledge to interact and enact many social structures. Any employee (henceforth referred to as knowledge Agent or KA)

interacts with other employees in the organization. As discussed earlier, this social interaction can be viewed using the structuration theory (Giddens, 1976). Structuration theory, which is positioned at the intersection of structuralist and functionalist perspectives, can explain the interaction between a knowledge agent and the structure they are embedded in. In addition, structuration theory inculcates in it the Freudian thought of the unconscious realm of the human mind, thus befitting the explanation of the way a knowledge agent works. The structure of organization influences knowledge agents, while the agents continuously recreate or enact their environment. Giddens argues that we enact our actions with two main consciousness - practical consciousness (tacit knowledge) and discursive consciousness (explicit knowledge). Therefore, following Garfinkel and Giddens, we can infer that a knowledge agent has education, experience and motivation that is intrinsic to them. They bring in discursive and pre-conscious knowledge to any interaction. KA is also circumscribed by bounded rationality (Simon, 1991); they are constrained by the amount of knowledge that can be retained and analyzed to be used for tasks, activities, routines that they perform while enacting a role within an organization. Please refer to figure 1 that depicts a conceptual map of this knowledge agent.

FIGURE 1

Knowledge Agent



The information sharing behavior of agents is influenced by a number of elements including demography, organizational setting, technology, and an individual's agency (Hsu & Chang, 2014; Razmerita, Kirchner, & Nielsen, 2016). Individual actors' behavior to share, organize, and transmit knowledge is evaluated along three aspects of - social dimension, scientific dimension, and creative dimension (Nakamori, 2011). Firstly, the social dimension relates to an individual's agency in getting involved in knowledge sharing activities with others. It is typically characterized by individual traits of openness, enthusiasm and trust. Secondly, the scientific dimension is about the inherent capability of individuals related to technical and functional skills and experience needed. An individual's attitude with respect to scientific

dimension can be logical, rational and objective. Lastly, the dimension of creativity is about cognition, insight and judgements. An individuals' ability of imagination and intuition are key for this dimension. These three dimensions influence an individual's abilities and agency in a specific situation. Willingness to share this knowledge is dependent on this agency of the agent as well as on the rules and resources of the structure, which is embedded as memory traces in the mind of the agent.

Creative Environment - Ba & Hypertext Organization

The environment, where knowledge creation, happens is known as "Ba" in the SECI framework - Ba is a Japanese word which means "place" (Nonaka & Konno, 1998). Ba is the creative environment, where knowledge creation happens. Ba need not be a physical place. It can also be a virtual space. The concept of Ba is central in SECI framework for knowledge creation; according to SECI Model, there is no knowledge creation without reference to the context. In this regard, the knowledge generation process parallels structuration theory, in which context is fundamental to any sociological setting alongside agents; sociological processes are carried out by agents within a space-time context. From ethnomethodological perspective, individuals behave in a specific manner that is in accordance with their social context. In group interactions, the mutual intelligibility is enacted by understanding and adapting to the actions of others. An investigation of the practices of coordination can reveal how shared culture and meanings emerge. The intersubjective social environment provides a window into this mutual comprehension outside the individuals' mind.

Knowledge agents work together in various settings. Virtual meetings, which were rare in the early 2000s, are becoming a norm. Geographically dispersed teams, increasing travel costs, lower productivity are some factors that have reduced the face-to-face meetings. It is not

uncommon for people to be in the same physical location but connect online for a meeting. Even when the meetings are physical, these are conducted over shared screens and are recorded. Virtual meeting tools like Zoom, Webex and Teams are being used for such meetings and these tools are connected to the enterprise directory, providing a rich source of data for analyzing not only the participation and contribution by members but also why the actions and interactions of and among agents are expected to happen in certain ways.

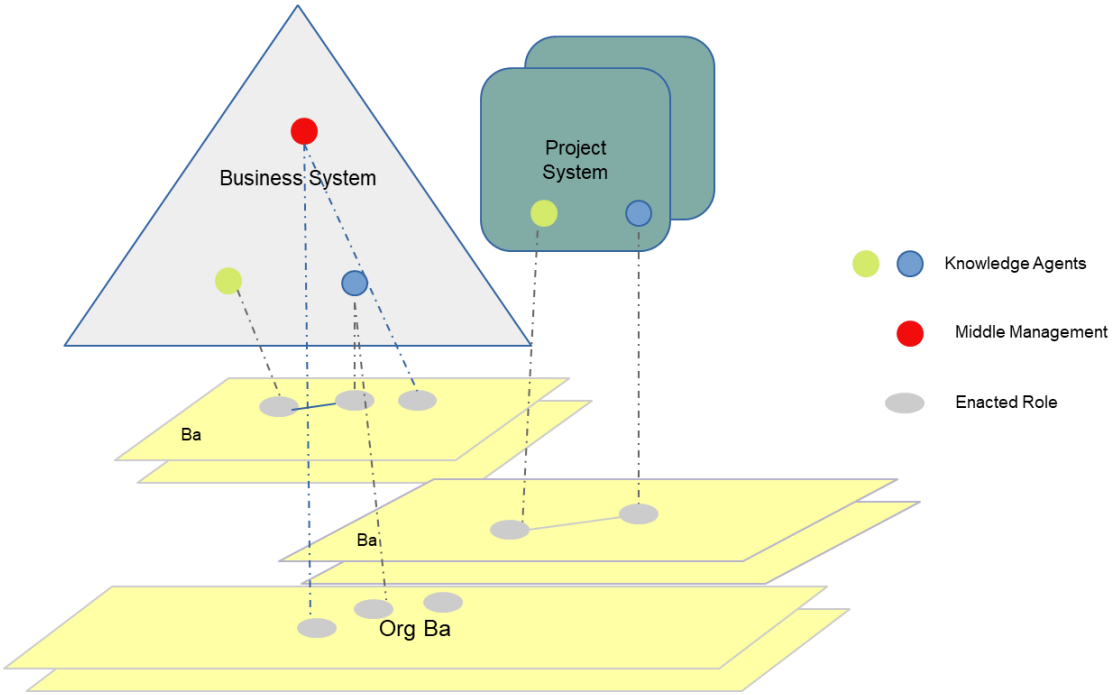
The importance of knowledge is even more crucial in the services sector. In this sector, where knowledge agents constitute a major portion of an organization's resources, there is a prevalence of a matrix-based structure. Knowledge agents typically belong to a division that has homogenous skills. They are assigned to project teams, which are created based on requirements from the customer. At any given point of time any employee is part of two systems – a business system (BS) and a project system (PS). The business system has a typical hierarchical structure while the project systems vary depending upon the type of work and expectations from the customer. Knowledge creation happens when a KA interacts with other KAs and the systems (BS or PS). In today's digitalized organization, many of the social interactions are recorded as the medium of communication is digital like emails, telephonic conversations, virtual meetings and so on. In addition, KAs enact organizational policies, routines and tasks through digital means by operating applications such as ERP, CRM and so on. However, not all interactions can result in new knowledge creation and as digitalization has increased in organizations, there is a problem of too much information and too many recorded interactions. There is continued interest in the academia and practice of utilizing Big Data for sensemaking and prediction. However, data alone is insufficient as the context for a routine or task that generates the data is critical for sense-making and prediction. Most of the time this context is lost when knowledge gets degraded to

information or just data. This paper suggests that organizations should move from "Data Science" to "Knowledge Science".

Figure 2 shows Ba in relation to the typical business system and project system. Ba is a dynamic environment, and it gets created every time an interaction happens between knowledge agents. It exists at various levels right from small meetings to group meetings to organization wide meetings.

FIGURE 2

BA AND HYPERTEXT ORGANIZATION



Artificial Intelligence

Artificial intelligence (AI) has a long history, beginning with a conference at Dartmouth college in 1956 (Collins, Dennehy, Conboy, & Mikalef, 2021), where the term was officially coined. John McCarthy defined it as "the science and engineering of making intelligent machines". It is classified into strong and weak AI based on cognitive capability. An intelligent

machine that can perform complex cognitive reasoning, comprehend natural language, and operate in a way that is indistinguishable from a human is defined as strong AI. While the initial goal of AI was to build such machines that exhibit general intelligence, there was little progress in the 21st century.

AI has gone through many "summers and winters" and has seen a resurgence since 2010 due to three breakthroughs - (1) the introduction of a much more sophisticated class of algorithms; (2) the arrival on the market of low-cost graphics processors capable of performing large amounts of calculations in a few milliseconds; and (3) the availability of extensive, correctly annotated databases allowing for more sophisticated learning of intelligent systems. Unlike the grand goals of the 1950s, where artificial intelligence was considered a stepping stone to general intelligence by trying to mimic the human mind, today's AI solutions are more centered around narrow use cases, classified into automation or augmentation (Krakowski, Luger, & Raisch, 2022). Some of the typical functions of AI are expert systems, machine learning, robotics, natural language processing, machine vision and speech recognition. AI is considered more a tool for automation or optimization, and scholars from computer science and operations research use various algorithms to improve their forecasting or prediction techniques. In the case of automation, the AI system reduces manual effort, whereas, in case of augmentation, the system works collaboratively with the human operator. Most automation cases can be classified as "weak AI" as these are specific to the problem domain while most augmented cases can be classified as “strong AI”. It is in this latter domain that we envisage in this paper, that has the ability to be utilized in the knowledge creation process.

AI-based systems differ from traditional information systems in multiple ways. However, one of the fundamental differences lies in its ability to learn. Traditional IT systems are designed

to operate deterministically; so, for a given set of inputs and predetermined rules, the output is always the same. The rules governing this transformation from input to output can be changed only by a human. An AI-based system can learn from historical data and also from the human operators and modify the rules of transformation. AI systems can also learn from each other and improve their performance. In many areas like speech recognition or computer vision, AI systems have far exceeded the capability of traditional IT systems.

Between the 1950s and 1990s, the researchers suggested the symbolic learning approach to build AI systems; however, its usage was limited. A new class of algorithms developed in the early 2000s. From the simplistic approach of changing the rules, today's AI systems can also identify patterns from data and create their own rules. This capability is also termed as "machine learning" (Goodfellow, Bengio, & Courville, 2016). The advancement of artificial intelligence and the development of machine learning algorithms necessitated the creation of methods for mapping the information gained throughout the learning process to final predictions. This need prompted the creation of methodologies classed as representation learning, in which characteristics are changed into an intermediate representation containing meaningful information, rather than just being modified. When such representation models are stacked into a hierarchy, a deep learning model is created (LeCun, Bengio, & Hinton, 2015). Machine learning algorithms can reveal complex patterns between X and Y without any a priori structure.

Multiple distinctions exist between symbolic learning and deep learning. While symbolic learning is transparent and requires less data, deep learning can learn from ambiguous data but is a black box. Researchers are trying to combine both approaches to develop stronger AI. Utilizing language, logic, or symbols to represent information and figure out solutions to issues is an example of symbolic learning. Processing natural language, making decisions, and playing

games are just some of the applications that make use of symbolic learning algorithms. These algorithms are built on logical rules and concepts. Natural language processing (NLP) is a branch of AI that strives to give computers the ability to understand spoken and written words. NLP provides a set of syntactic and/or semantic rule- or statistical-based processing methods that may be used to parse, segment, extract, and analyze text data. There is a significant difference between text mining and natural language processing methods in that text mining analyses the words themselves as a unit of analysis. In contrast, NLP methods analyze the underlying metadata, including content and phrase patterns. NLP enables computers to understand and analyze human language in a way that is similar to how humans process language. This involves understanding the meaning of words and how they are used in context, as well as the structure and organization of language. As more and more textual and audio data gets collected NLP can be used for extracting insights and knowledge artifacts. NLP programs can identify connections by clustering similar information together and identifying patterns in data.

Methodology

The objective of this research is to understand the mechanism of knowledge creation in an organization. This study uses a qualitative methodology to better understand the process of knowledge creation and individual perspectives about knowledge management. The study follows a systematic approach for developing a grounded model (Gioia, Corley, & Hamilton, 2013) for knowledge creation.

Data Collection

Accessing data about knowledge creation activities across any organization is difficult as there are multiple avenues and methods. Also, each organization differs in its mechanisms of

knowledge creation. We interviewed thirty-five respondents across various industries - IT services, financial services, manufacturing, and business process outsourcing. In order to get diverse viewpoints, we interviewed across various managerial roles and functional areas. Traditional grounded theory approaches suggest that no a priori knowledge should be obtained through a literature review to avoid any preconceived notions of the phenomenon. For this study, however, a basic literature review was conducted to provide a foundation for comprehending knowledge creation.

Considering the diverse nature of the research question, semi-structured interviews were conducted. The type of questions was open ended with an objective of understanding the phenomena as enacted in their respective organizations. Following was some of the questions asked

Question 1: How does your organization prepare you for any role?

Question 2: How does the management help in knowledge creation?

Question 3: How do subject matter experts share their knowledge? How does the organization enable such knowledge sharing?

Question 4: How are your meetings conducted? How many of the meetings are virtual?

Question 5: How do you think technology can help in knowledge creation?

Question 6: How do you prepare for launching any new service/ product/ project?

The interview protocol was customized on ground, while the interview was underway, based on the responses of the respondents. Many respondents provided their view of knowledge management, heavily utilizing the practitioners' vocabulary. Most of the respondents spoke about

the individual's discretion in sharing the knowledge. Some recognized the lack of time but many suggested a lack of motivation from employees. Following are some comments verbatim:

> *Individual motivation is important for knowledge sharing. Many individuals are keen to share knowledge but some are not. ...*

Another respondent spoke about subject matter experts (SME) and suggested that SMEs carry critical knowledge, which should be made available for others

> *Many SMEs (Subject Matter Experts) may decide to keep their expertise with them as they consider it as their unique selling point. Some SMEs have time constraints and find it difficult to share their expertise*

Some respondents talked about knowledge sharing and creation that happen, when there is a new service that is being offered or when the organization is entering into a new geography. The typical method involved setting up of workshops and off-site meetings, where cross functional teams were called. The participants in such meetings were not only senior members or knowledge experts but also people who are working on the ground.

> *Sometimes we enter into new areas. It could be a new market, like .., my organization right now is trying to strengthen its footprint in China and other emerging markets in Southeast Asia.... So, what needs to happen is that we need to get some subject matter experts together. We may even call expert consultants, who know these countries. They can suggest which knowledge is not relevant for China but is relevant for Indonesia, Thailand, Malaysia. They can also connect us with right persons within or outside our organization. Then we all get together for planning, brainstorming, white-boarding, etc to come up with the knowledge about how credit risk and money be managed for say, the loan portfolio for China.*

All the respondents were quite conversant with the concept of explicit and tacit knowledge and expressed their limitations in capturing the tacit knowledge. While all of them would want to find a way for capturing the tacit knowledge, few could think of ways other than organizing knowledge sharing sessions. Following statement by one of the respondents' sums up the challenges faced by his industry.

> *I have so many subject matter experts, we invest heavily in them. So, they are really the best of the best in their areas of ..... Now let's continue with the example of risk. There are certain SMEs there at the firm asset division, we heavily invest in them. And we understand that when this person walks out the door…., I'm going somewhere else. Tacit knowledge will go away...*

Data Analysis

A grounded theory-based approach was adopted to analyze the interview data. The interview data were coded into first-order concepts that use the respondents' terms and vocabulary. These were then grouped, and second-order themes were created using the theory. There were eleven second order themes derived from the interviews which are: (1) Knowledge creation and sharing (2) Training and Education, (3) Organizational routines and policies, (4) Knowledge Capturing, (5) Tacit Knowledge, (6) Recency of Knowledge, (7) Middle management role, (8) Cross-functional Teams, (9) Artificial Intelligence, (10) Un-supervised Learning

Following table (TABLE 1: Second Order Theme) provides some evidence for the second order themes.

TABLE 1: Second Order Theme

Second Order Theme	Supporting Evidence
Knowledge creation and sharing	"Ours is a product company, and in a product company there are two components, one is the technology part and second is the analytics part. Primarily the start point of the knowledge creation is when either somebody thinks about it, or a customer asked for an idea and that gets propagated for them"
Training and Education	"When someone new joins the team or his/her role is changing, we generally have a list of trainings that the person needs to undergo before he/she can start working in the new role" "today, the pressures on managers are that they should be data savvy. Even if they're not doing data analytics themselves, they should be able to understand data loss so that they can take data related decisions, etc. So, for that organization spend a lot in terms of education, so they could send you for some certification courses, they could ask you to attend some conferences. They could even put you through some internal training because all large organizations today they have their own large internal training universities and all that there is anything relevant, that will put you through that.
Organizational routines and policies	"Classical example was the issue on data privacy, what did we do solve that problem only the team and perhaps the project manager knows. If the project manager leaves then the knowledge is lost. So, every discussion is monitored in the format of discussion, outcome and next steps with responsibility as a grid, right. So, by every project meeting gets documented on that into the system" "companywide session once in a quarter where some summary of all the ideas all the discussions are shared. And then the team actually propagates it" "instead of making it as a part of a KPI, we have made it as a part of an incentive program, okay. So, what we do is we incentivize people as long as it is appropriate and we leave it to the manager to decide whether it is appropriately done or not right. So, there is an incentive and the incentive is a yearlong incentive and it is not necessarily cash incentive. "
Knowledge Capturing	"We always record our zoom meetings or non or physical meetings, which again goes back into the repository."
Tacit Knowledge	"So, what we have been trying to do at a project level is a person as a shadow member, that is the only way we have tried to look at it. And we tried to project it in an unwritten rule that more contribution done means you are on the right track to growth."

	"very difficult to capture tacit knowledge. We ask somebody to write document he/she can create but 90% of the knowledge is lost. .... knowledge built upon years and years of experience, exposure, education, your own observing game values, beliefs, etc. is difficult to document"
Recency of Knowledge	"Knowledge after a period of time perhaps becomes stale, it may not be as useful"
Middle management role	"It is primarily the middle managers, who run the organization. So, they are the drivers of the organization. A senior management is the face of the organization" "And the middle management typically plays an important role in this kind of knowledge dissemination. We have some kind of a template or a blueprint on the basis of which our teams can work. This is when middle managers come into play"
Cross-functional Teams	"We have a cross functional cohort that actually meet. This cross functional cohort is not necessarily people of CXO level, it consists of persons who matters and who are knowledgeable. So, it is it could not be the head of analytics, but the actual analytics person or actual UI UX designer along with a couple of leadership team" "Like when we kick off an audit, now, we have a brainstorming form that is a part of the planning phase of the audit. And in this planning phase, now, we will not only have the people who have been allocated to the audit, but we will also have subject matter experts now, who have been asked to contribute their expertise to this there will be no other people who may have worked on this audit or similar audits in the past we will look for artifacts from the past or know what are publicly available, which kind of influence and color the scope of the audit we will bring it all to them and we will have two or three quite lengthy workshops to find out really ..."
Artificial Intelligence	"Since ours is a product company and our IP is basically product knowledge, we have by way of looking at keywords search and all we can do we run on voice clips and find out if you want to pick up an old discussion, because we will not have that person discussing or remembering after a while. So, that system has been to search on keywords"
Un-supervised Learning	"Any exchanged information through the system needs to be intelligent enough where the emails between employees and outside are actually by using keywords and AI start slotting those emails and the attachment appropriately right for a future reference. Only an AI system can do something like that"

Results and Discussion

The second order themes and the aggregate dimensions were derived from the first order concepts as explicated in the Gioia methodology(Gioia et al., 2013). The first order concepts were derived from the interviews and then mapped for the emergent second order themes as in Table 1, as explained before. Further, the second order concepts were grouped together based on how they appeared to cluster together to give rise to aggregate dimensions following Gioia Methodology, which can be referred to in the Data Structure in Figure 3. There are five aggregate dimensions that emerged viz. a. Agency, which had the underlying second order theme of Knowledge Creation and Sharing, b. Structure and Routines, which had the underlying themes of Training and Education, Organizational Routines and Practices and Policies, and Knowledge Capturing c. knowledge as practice, which had the underlying themes of knowledge capturing, tacit knowledge, recency of knowledge and cross-functional teams, d. middle management and e. artificial intelligence which had underlying themes of artificial intelligence and un-supervised learning. Below we describe each of these aggregate dimensions with their constitutive second order themes -

Agency

Every employee in an organization is a knowledge agent, as described earlier in the paper. The agent is driven to act both by their memory traces as well as by their knowledgeability. This aspect can be seen in how knowledge creation is considered to be a voluntary process. However, simultaneously, it is considered to be dependent upon the “kind of organizational bandwidth” that is there to share this knowledge and the “incentives that the organization places on the sharing of knowledge”. It is also dependent the context of interaction between agents, wherein, “agents are in contest with each other for presenting the best solution and being awarded for it”.

Knowledge creation and sharing

First dimension is that of the knowledge agent, who with their education and experience brings a reservoir of tacit and explicit knowledge, as well as who is circumscribed by the organization bandwidth and incentive mechanism, and is expected to partake in the process of knowledge creation. An individual's motivation and ability to share knowledge is heterogeneous. In addition to the intrinsic motivation, relationships with other knowledge agent(s) determine the level of collaboration and knowledge creation. While performing tasks, every KA interacts with other KAs. Routines guide the task execution. In some cases, KA performs his/her tasks using information systems. For example, while creating a new purchase order for procuring items, a KA would interact with an ERP system and also with his manager while following the procurement process. This procurement process is established by the organization and confirmed by repetitive execution by his peers and himself. Any nuances, for example with a specific supplier that he is not aware of, can be understood from the peers, if not already codified in the ERP system or if not explicitly stated in the procurement process handbooks. But whether this KA is able to take the help of their peer or not and to what extent is dependent on the ability and the motivation of the agent. An individual's agency has a significant impact on the knowledge creation activity. Knowledge creation activities are typically not considered as part of an individual's performance metrics; hence, any contribution towards organizational knowledge creation is considered to be completely voluntary where organizational structure does not consciously build incentives for it. Agency theory suggests the conflict between organization's goals and individual goals as a critical problem for any organization. Grant suggests that "..the organizational problem common to all forms of social organization is that of cooperation: reconciling the conflicting goals of organizational members" (Grant, 1996: 121).

Structure and Routines

Organizations typically have well defined structures and routines for knowledge creations.

Organizational routines

Every individual has some level of education; however, the organization specific know-how is missing. Most organizations have a structured process of socializing knowledge with new team members. The knowledge imparted during these structured programs is generally at an organizational level. As an individual joins any team, the team specific know-how is learned by interactions with other team members. Most of the knowledge that is required for functioning in the team is tacit. As one of respondents mentioned:

> *When someone new joins the team or his/her role is changing, we generally have a list of trainings that the person needs to undergo before he/she can start working in the new role*

Training and Education

As organizations mature, many of the learnings on training and knowledge acquisition are reified by policies and routines. These processes ensure that employees are imparted knowledge when they join and also at regular intervals. As mentioned by one respondent:

> *Companywide session once in a quarter where some summary of all the ideas all the discussions are shared. And then the team actually propagates it.*

Knowledge Capturing

Organizations collect information on periodic intervals and during specific events like completion of a project. Such data collection is typically determined by organizational policies and processes. Many a times there are incentives given to employees for sharing their

knowledge. Stringent processes or through incentives individuals are motivated to documenting their learnings; thereby converting their tacit knowledge to explicit knowledge

With digitalization, most of the documented knowledge resides in a digital format like text, audio and video. Sharing and collaboration platforms are utilized for creating, storing, retrieving, searching and publishing of digital content. This type of documentation, however, is insufficient as it focuses more on know-what and less on know-how

Knowledge as Practice

The importance of tacit knowledge is felt by all the respondents, and they emphasized the "practice" nature of knowledge. The proliferation of digital tools for communication and for executing business processes provides a non-intrusive source of data for creating new knowledge.

Knowledge Capturing

Knowledge is not created by dedicated individuals but by everyone. For example, a sales executive understands the nuances of the territory assigned to him by interacting with prospective customers. He also understands the distribution peculiarities in delivering products or services. This knowledge is tacit. Sales managers, through their interactions with the executives and by use of technology can develop routines for generating new knowledge. As one respondent suggests -

Sales executives provide an account of their interaction by recording voice after their meeting with customers

Project meetings are recorded using tools like Teams, Zoom, Webex

Tacit Knowledge

As, individuals enact their agency and the organizational processes while interacting with information systems and other individuals, non-intrusive data in the form of audio and video recordings gets collected. This kind of data is different than codified knowledge as it is not consciously created but derived from live recordings. Tools like artificial intelligence and machine learning can then be utilized for extracting knowledge, identifying patterns from this data. As mentioned by one respondent:

> *"Keywords from the conversation can be used for searching, retrieving and understanding"*

Terms like "on the job training" or "apprenticeship" demonstrate the need for new team members to learn by observing what others are doing.

New members of a team, while can learn from existing team members of the current on-goings, the past decisions and knowledge are restricted to codified artefacts. Moreover, the search for past knowledge is driven by an individual's agency and constrained by the availability of artefacts. Another aspect of knowledge creation pertains to the temporal exploration. It is presumed that knowledge creation is a path-dependent evolutionary process involving the recombination of knowledge acquired over time as Nerkar (2003) suggests that "Old is Gold". A balance of temporal exploration and exploitation of knowledge resources determines the impact of new knowledge. Temporal exploration being the extent of time spread that is utilized for gathering knowledge and then recombining it to create new knowledge. Temporal exploitation is about the recency of knowledge where history has less significance.

Recency of Knowledge

The transient nature of knowledge is emphasized by the rapid evolution of both the business environment and the processes within organizations. Prior-created knowledge may no longer be applicable in the current context. Even if the information is still relevant, it must be modified. As mentioned by one respondent:

"Documentation becomes old very soon"

"Usability of old documents for newer projects is very low"

The challenge for organizations is to balance the temporal exploitation and exploration for deriving maximum knowledge creation capability.

Middle management role

The knowledge that individual members of a team possess is confined to a particular area of expertise that they specialize in, and these members' knowledge is further constrained by the boundaries that are imposed by the organization. The realization of the organization's vision falls under the purview of the management team, and in particular of the middle management. When compared to other employees, managers have a deeper comprehension of the organization's long-term goals and objectives.

"it is primarily the middle managers who run the organization. So they are the drivers of the organization…"

In organizations with project teams working in diverse areas, knowledge creation between projects and with the larger organization is primarily driven by middle managers. One of the ways of bringing all the knowledge together is forming of cross-functional teams.

"We have a cross functional cohort that actually meets now, this cross functional cohort is not necessarily people from those CXO, it is person who matters and who is

knowledgeable. So, it is it could not be the head of analytics, but the actual analytics person or actual UI UX designer along with a couple of leadership team"

Artificial Intelligence

Many respondents were aware of the advances in artificial intelligence and suggested ways to capture metadata related to interactions between knowledge agents. For example, metadata about emails being exchanged can be utilized for identifying connections between knowledge agents.

AI Tools

Information technology can play a critical role in knowledge creation. While software tools have been used for digital record keeping, the advent of newer category of applications based on artificial intelligence and machine learning (AIML) can automate and augment knowledge creation. As mentioned by one respondent:

"any exchanged information through the system needs to be intelligent enough where the emails between employees and outside are actually by using keywords and AI start slotting those emails and the attachment appropriately right for a future reference. Only an AI system can do something like that"

Firstly, with digitalization the amount knowledge is increasing exponentially. AIML tools can help in identification, classification, promotion, demotion of knowledge without much human intervention. Secondly, identifying patterns across dimensions of temporality, geography, hierarchy, departments and across organizational boundaries can only be achieved using machine learning algorithms. By increasing the search across these dimensions, organizations can avoid the issues due to tendency of managers for finding local and recent solutions to the problems

encountered. Un-supervised learning uses induction instead of deduction for making sense of the data. Another approach that has improved AIML tools is reinforcement learning, where a combination of deduction and induction provides better and faster learning from a given data set. As mentioned by few respondents:

> *Technology helps to gather information and process it. It also helps with automatic categorization and thus provides with easy-to-access information and accelerated learning.*
>
> *Knowledge creation would still be a human thing for me. Technology could be a tool to make it more analytical to understand its usability and to figure out closer resemblances to what might have been created earlier. Technology would also help to make this knowledge more accessible*

Un-supervised Learning

The ability to identify patterns and create connections between data using artificial intelligence can be exploited for generating new knowledge. Because technology is becoming more integrated into people's everyday interactions, the newly emergent social structures, scripts, rules, and standards are beyond the comprehension of any one intellect. Without employing any kind of a priori framework, unsupervised learning is able to discover relationships between actors and structures, ascertain how knowledge is used, and recombine previously acquired information.

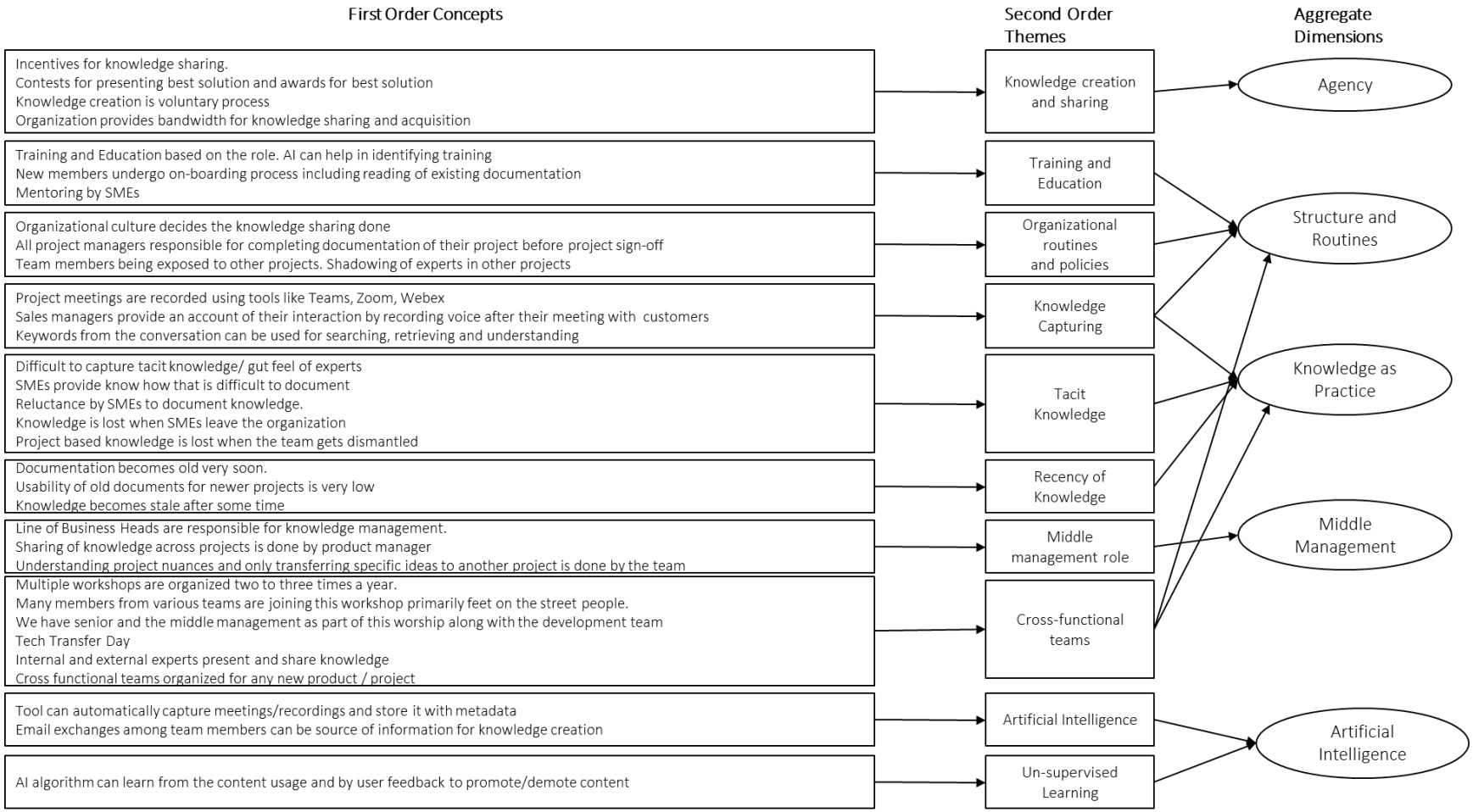


FIGURE 3: DATA STRUCTURE

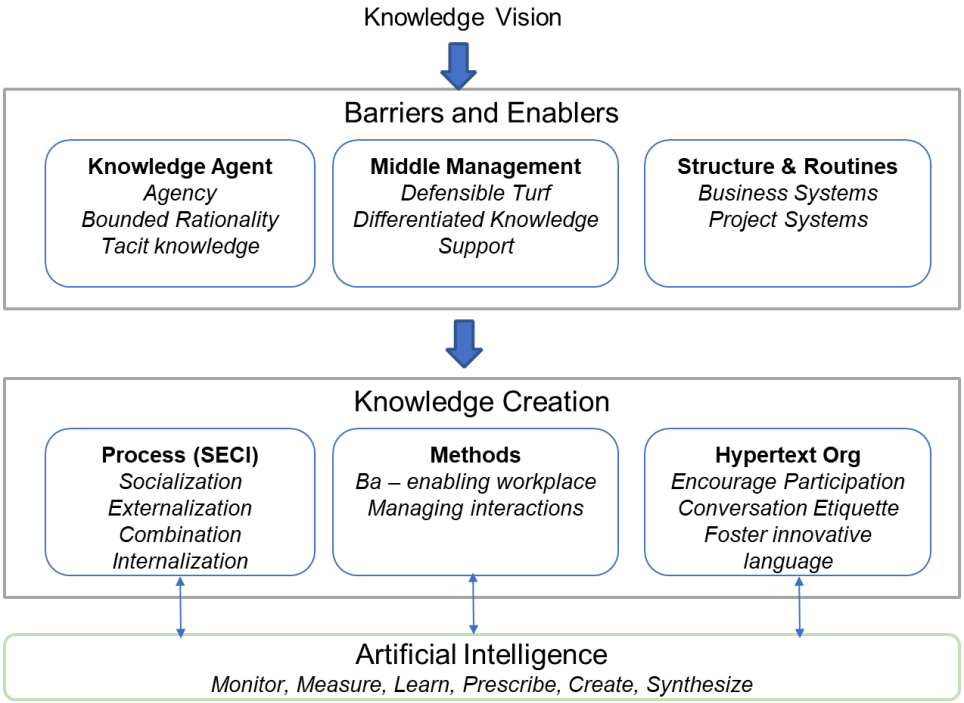
AI enabled model of knowledge creation

The Figure 4 represents a model of knowledge creation that has been derived from the aggregate dimensions. Organizations understand the need for knowledge management and typically have a vision that drives the entire knowledge building exercise. Many times, this vision may not be well documented but it exists. There are industry norms that organizations tend to follow.

The "barriers and enablers" have been categorized into three dimensions of knowledge agent, middle management, and structure. Firstly, every agent is pivotal to the knowledge creation. While an agent brings knowledgeability and agency to any interaction he/she has bounded rationality (Simon, 1991). This limits an agent’s ability to understand and make sense of the complex environment. An organization through its structure influences the number and quality of the interactions between knowledge agents.

Figure 4

Knowledge creation framework



Secondly, middle-management can either constrain or enable interactions between knowledge agents. Four generative elements of socialized agency, defensible turf, organizational support and differentiated expertise are suggested as critical elements that determine the success of creating new practice areas in management consulting firms (Anand, Gardner, & Morris, 2007). These elements also show up in our interviews and are modeled under the category of middle management. Middle managers have a crucial role, according to Nonaka and Konno (1998), as they comprehend and communicate the leaders' vision to the team below and are in charge of reporting team progress and any risks to top management. Middle managers are also responsible for abstracting knowledge that gets generated in their respective projects and make it

available for the entire organization to consume. Thirdly, the organization structure plays an important role in executing the knowledge vision of the organization. Typically, the structure consists of a business system layer which is hierarchical and project system layer which flatter. The business system layer is generally responsible for setting up and executing routines and normal tasks. The project system layer is where many cross-functional teams are working and is responsible for new knowledge creation. A project system would also have routines and normal tasks, however such processes would be nuanced and context specific. Knowledge creation happens in both the systems.

It is suggested that three constituents of knowledge processes, structure and methods that utilize artificial intelligence would benefit an organization's knowledge creation. The interactions in SECI process can be monitored, measured, predicted and improved by the use of AI. For example, AI can suggest possible alternatives to a decision-making process by providing data about past decisions and the expected impact. The place of knowledge creation can also benefit by AI as it starts augmenting the interactions with relevant and timely information. The construction of "Ba" in a real or virtual setting can be recommended by AI based on prior success. Finally, the creation of a dynamic organizational structure is not possible without a collective mind that suggests connections between individual agents for better collaboration. This collective mind can learn from all the interactions without any supervision and recommend knowledge creating pathways

Practitioners can use this framework to identify barriers to eliminate and/or reduce them. By incorporating AI into their information systems, businesses can get insight from the interactions occurring between knowledge agents as well as those occurring between knowledge agents and

the structure. These insights can help in developing better processes and structures that are not only effective but also flexible.

Conclusion

Given the increasing importance of knowledge management and the diversity of research themes coupled with ever increasing digitalization, this study attempts to understand the phenomenon of knowledge creation and develop a conceptual model. We contribute to the theoretical underpinnings by synthesizing diverse theories of knowledge creation, structuration, and ethnomethodology. This study also emphasized the nature of knowledge, wherein it is not considered as an object or a thing but is exercised by individuals while performing their tasks. Agency plays a pivotal role in determining the knowledge contribution of any individual. The inherent capability of any individual which is a function of education and expertise are important ingredients for organizational knowledge creation. However, while individuals are at the heart of knowledge creation activities organizational context plays an even important role in the actual contribution by any individual. Middle managers are responsible for creating the context by implementing organizational policies, developing routines, and communicating top management vision.

Practitioners need to reduce barriers of knowledge creation across three dimensions of knowledge agent, middle management's role and structures. By utilizing the advances in artificial intelligence and machine learning, they can implement better knowledge creation processes and methods. Organizational structures are typically static or change very infrequently constraining the knowledge sharing and re-combination activities. By promoting dynamic and flexible structures, organizations can enable more efficient knowledge creation processes.

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