Tacit Knowledge, its Codification and Technological Advancement

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Abstract: The paper addresses issues related to the confusion surrounding conceptual understanding of tacit knowledge and its transferability in organization's realm from an original perspective. Lately, at every level: country, industry and organization, attention to knowledge has intensified due to the realization that in "post-capitalist society" (Drucker, 1993) knowledge is increasingly replacing traditional driving forces of economy: labor, capital and natural resources as the primary factor in economic growth. Knowledge use is now considered as imperative in all aspects of an organization. In literature there exist various typologies of knowledge, however, in organizational science most common classifications of knowledge include two general types: tacit and explicit. This paper brings clarity to the concept of tacit knowledge, nexus between tacit and explicit knowledge and effects of advances in technologies on the codification capability of tacit knowledge. It argues that many types of tacit knowledge that were considered as inexplicable just recently thanks to new technologies have become transferable. Drawing examples from knowledge science literature the author questions the rigid belief of some scholars in ineffability of tacit knowledge. The author also claims that organizations need to reassess their knowledge related strategy, particularly, in relation to tacit knowledge if they would like to develop sustainable competitive advantage from effective knowledge use. **Findings:** The author shows how new technologies are changing our perception of tacit knowledge and why it is time for organizations to reevaluate their knowledge strategy. **Originality/Value:** By showing a clear correlation between technological advancement and tacit knowledge transformability the paper contributes to the theoretical understanding of tacit knowledge.

Keywords: tacit knowledge, knowledge use, knowledge transferability, knowledge strategy, knowledge codification, technological advancement

1. Introduction

Thanks to advances in technologies, the economy and the organizations are undergoing an unprecedented transformation. These changes are influencing on organizational culture, processes, resources and capabilities drastically. The emergence of the knowledge-based economy is forcing the organizations to revaluate their resources where knowledge is increasingly perceived as the most critical factor. While knowledge is gaining significance across the board its definition, conceptual understanding and typology is still stuck in the pre-knowledge-based-economy paradigm.

Until 20th century, for last two millenniums or so the subject of knowledge has been studied mostly by philosophers in epistemology, the branch of philosophy related to the theory of knowledge, and considered as propositional and personal. With the advent of technology era, growth of knowledge economy and realization of organizations that knowledge is a key resource in their quest for competitive advantage the field of knowledge study has augmented largely and now covers organizational and social spheres along with previous focal point of personal knowledge. However, there still remains significant ambiguity and dispute around definition, classification and perceptual understanding of knowledge among the knowledge scholars and knowledge management practitioners.

Ever since the printing machine was invented knowledge transformed into a commodity, industrial revolution created a fertile ground for knowledge to become collective and with further economic growth safeguarding knowledge through patents, trade secrets and intellectual property rights become imperative, these factors along with many others have contributed to the change in epistemological perception of knowledge.

In early last century, for the first time philosophers start to think about knowledge differently. Heidegger is one of the first philosophers who call the then concepts of epistemology as scandalous. In his lectures "Logic: The Question of Truth" he writes for humans to live their life and get by doing everyday cores, they require skills and knowledge gained from experience. This knowledge is no less valuable than propositional knowledge (Heidegger, 1925).

However, the argument whether knowledge is “justified true believe”, where truth depends on either contingence or on the necessity, whether knowledge evolves from experience or reasoning and distinctions is

decidedly alive and exacerbated recently with the increased need of organizations to capture, retain, transfer and use a vital part of their knowledge domain – tacit knowledge.

2. Review of tacit knowledge literature

Tacit knowledge, a key concept in organizational knowledge management, is understood as subjective, informal and internalized – it is related to our social and physical experiences, our cognitive abilities, somatic skills and mental and physical perceptions. It is more personal, experiential, context specific and hard to formalize (Saviotti, 1998; Leonard and Sensiper, 1998). Tacit knowledge gets embodied in people by learning from experience, insights, heuristic procedures etc. and according to many scholars it is difficult to express and codify in a manner so that it could become transferable (Polanyi, 1962b; Reed and DeFilippi, 1990). Others conclude some tacit knowledge is impossible to pass on due to its extreme stickiness (Szulanski, 1996), but most tacit knowledge is transferable (Nonaka and Takeuchi, 1995; Collins, 2010). At an organizational level, tacit knowledge is present not only in an individual but is also available in processes, culture and values (Haldin-Herrgard, 2000). Tacit knowledge is not easy to aggregate or disseminate. It embodies knowledge that creates sustainable competitive advantage in part through innovation. That's why managing this type of knowledge is of utmost strategic importance for an organization (Grant, 1996).

Tacit knowledge is fundamentally different from explicit knowledge. The knowledge which is general, conventional and easy to express in commonly comprehensible language and possible to share, codify and convert as principles, formulae, data, processes and information is called explicit (Polanyi, 1962a; Nonaka and Takeuchi, 1995). Explicit knowledge is easy to access and transfer and also refers as "knowing about", subjective or declarative knowledge (Kogut and Zander, 1992). Although, it is a necessary prerequisite for innovation and value creation, unless protected by patents, copyrights or vigilantly guarded, it is also easy for competitors to imitate, thus any competitive advantage gained from using explicit knowledge as a result, becomes short-lived (Dierick and Cool, 1989).

Several prevailing views regarding conceptual notion of the term tacit knowledge exist. The first view is that tacit knowledge is part of knowledge that has not been codified as yet (Ambrosini and Bowman, 2001; Boisot, 1995; Davenport and Prusak, 1998; Leonard and Sensiper, 1998; Nonaka and Von Krogh, 2009). This epistemological dyadic perception places tacit knowledge as a phenomenon directly opposite to explicit knowledge.

The second view is tacit knowledge by very definition is tacit – ineffable. Any attempt to convert it to explicit is a futile effort. Tacit knowledge is the background or subsidiary knowledge of the focal knowledge of the act at hand. Because of this, it is not reducible to the level of explicit as it is only relevant to a specific context (Tsoukas, 2006: 410; Tsokas and Vladimirou, 2001: 973-93; Cook and Brown, 1999; Brown and Duguid, 2000; Jones and Miller, 2007).

The third view that corresponds with our suggestion in this paper: In any context where knowledge is applied, a part of tacit knowledge, which is overlaid on top of all the knowledge being utilized, will always stay ineffable and cannot be codified. We can call this fragment of knowledge the “meta tacit”. Apart from this, most tacit knowledge, depending on the degree of difficulties in codification, its viability of codification and the availability of required resources could be codified. Collins shows eight different possible reasons or "Cannot" ranging from inconvenience to impossibility to clarify what types of tacit knowledge are not explicable. (Collins, 2010 pp. 88-96)

The concept of the tacit knowledge in management science found its impetus in Polanyi's ideas elaborated in a series of lectures that were collected as a book under the name “Personal Knowledge, Towards a Post Critical Epistemology” in 1958. From Polanyi’s works, we can deduct three primary theses related to conceptualization of knowledge. The first one says, strictly logical and explicit approach cannot lead to genuine knowledge as scientific discoveries cannot be explained just by rules and analysis, second, knowing is highly personal and third, explicit and tacit knowledge are correlated and inseparable. (Sveiby, 1997) Polanyi asserts that explicit knowledge is knowledge, which is articulable and tacit, which is not and "All knowledge is either tacit or rooted in tacit knowledge. A wholly explicit knowledge is unthinkable". (Polanyi, 1969, p.144.) While Polanyi was clear in formulating his perception of explicit, his notion of tacit knowledge is quite equivocal. (Hall, 1997)

Parallel to his tacit and explicit dimensions of knowing, he also offers a view differentiating two distinct kind of awareness: focal and subsidiary in the process of performing any action. Focal awareness relates to the consciously focused object of action and subsidiary awareness provides the background knowledge and skills needed to perform the action. In this context according to Polanyi, the focal awareness is the explicit knowing and subsidiary awareness is the tacit knowing. (Polanyi, 1962a)

As interest in knowledge management science increased over the course of time, there has been significant development in the understanding of tacit knowledge, its domain and its use in organizational sphere. Nelson and Winter (1982) Referring to Polanyi's concept of tacit knowledge denote that prevailing economic theory is flawed as it does not consider the dynamic change occurring within the organization. March (1991) asserts that the organization develops certain operational processes that are difficult to articulate and these are organizational equivalent of personal tacit knowledge.

Schein (1994) focuses on the aspects of organizational culture and argues that organizational culture is embodied by unarticulated assumptions which being tacit are highly salient in an organizational structure. Winter (1987) argues that tacit knowledge facilitates competitive advantage for firms.

Kogut and Zander (1992) posits that value of the organization depends on its available knowledge and differentiated tacit and codified knowledge. They also write about the easier transferability of tacit technological knowledge within a firm's units thanks to shared values and understandings as oppose to outside partners. Grant (1996) propagating knowledge-based theory of the organization writes that knowledge is strictly individual, and organizations should focus more on knowledge application rather than knowledge creation.

Numerous scholars have contributed to the development of knowledge management theory, but Nonaka and Takeuchi's (1995) theory of knowledge creation and the models described in their work have managed to become the most well known and widely cited tome in knowledge based organizational strategy literature (Choo and Bontis, 2002 p. ix). In their seminal work, they postulate that explicit knowledge and tacit knowledge are complementary. The dynamic interaction of these two types of knowledge causes a knowledge conversation that in turn creates knowledge. Their SECI model – so far the most accepted model in the knowledge management – includes four different modes of knowledge conversion. Socialization – transfer of knowledge by means of intermingling which results tacit to tacit knowledge conversation. Externalization – knowledge transfer by means of codification of tacit knowledge to explicit. Combination – knowledge conversion from explicit to explicit and finally, Internalization – adoption of knowledge through learning (Nonaka and Takeuchi, 1995).

In a recent book, Harry Collins (2010) sets to demystify some of the confusions related to the term tacit knowledge. In order to bring clarification to the concept, he proposes a categorization of three distinct types of tacit knowledge.

Relational Tacit Knowledge comprises knowledge that is tacit because some of its attributes are subjected to interpersonal interaction or attention. The examples are knowledge such as trade secrets, knowledge kept hidden deliberately and unrecognized knowledge.

Somatic tacit knowledge consists of knowledge that is tacit due to our body's inherent physical limitation and abilities. Riding a bicycle without navigating in traffics, Collins call it bike-balancing is an example of this type of knowledge.

Collective tacit knowledge consists of knowledge that is ingrained in society and depends largely on how the society works. One of the possible examples of collective tacit knowledge is the implicit clue of an anecdote that only people with shared culture might understand.

With this taxonomy Collins tries to differentiate explicable – both rational and somatic tacit knowledge fall into this category – tacit knowledge from the collective tacit knowledge that is context dependent and cannot be codified.

Kikoski and Kikoski (2004) stress that tacit knowledge evolutionarily predates explicit knowledge. This could be the reason why we cannot transfer everything that we know. According to them there are two types of tacit knowledge: fast tacit knowledge and slow tacit knowledge. Fast tacit knowledge works using implicit cognitive process and reflexes. The survival instinct of animals is an example of fast tacit knowledge. The other tacit knowledge "slow" is unique to humans. The sudden bust of epiphany and heuristic hunch are examples of slow tacit knowledge. Fast tacit knowledge is more somatic dependent and slow tacit knowledge is mental and intellectual. Tacit knowledge is automatic and depends on subconscious.

Once the tacit and explicit classification became the dominant views of knowledge classification, the organizations stumbled upon the dilemma, what should be their knowledge related strategy.

3. Objectivist and subjectivist views of knowledge

The seemingly opposite views of knowledge, and tacit knowledge, in particular, stem from the philosophical dichotomy of objectivism and subjectivism. Objectivist view considers knowledge as an object that human personally or collectively possesses but can also exist externally in explicit form. All textual and codified information fall into this category (Hislop, 2009). This perception is deeply rooted in the objectivist ontology that postulates reality exists independent of the human mind and positivist epistemological view that claims reality can be perceived empirically. So proponents of the objectivist view reckon that for an organization to create economic value from knowledge resource the focus should be on the explicit and transformable knowledge. Within the organization, valuable knowledge is located in various information bins. There is also vast amount of knowledge that can be tapped from external sources like customers, suppliers, market data and information from competitors, and knowledge contents from other public and private resources. Emphasize also should be on transferring tacit knowledge to codified form for further effective use and create value. Naturally, this approach considers technology such as knowledge management system is a key enabler in knowledge related activities.

According to the subjectivist point of view, as far as knowledge is concerned, the source of competitive advantage and innovation is the tacit knowledge embodied in the minds of workers. As this knowledge is inherently personal and difficult or impossible to codify, in order to capture, develop and use highly valuable tacit knowledge an organization needs to hire talents, foster a culture conducive to knowledge sharing and promote mentoring and apprenticeship. Their approach to technology use is confined within systems like talent management, community of practice and experts yellow pages.

4. Technological advancement and tacit knowledge

Much of the growth in the organization can be attributed to its ability to capture, retain and exploit knowledge effectively. With the rapid development of new technologies, the potential for creating, aggregating and using new knowledge has increased substantially. However, the question of how to maximize the use of massive amounts of tacit knowledge residing within the organization and its workers and create economic value still remains unclear. If an organization wants to improve its potential use of tacit knowledge, it needs to undergo a paradigm shift and evaluate available knowledge from more technology-centric point of view. Many types of knowledge earlier considered as tacit and ineffable have become explicable thanks to the advancement of new technology. As our perception of tacit knowledge changes, we recognize and adopt new approaches in relation to how we handle tacit knowledge. To illustrate our view, we have outlined several examples of explicable tacit knowledge considered inexplicable in previous knowledge related literature.

To demonstrate the principle of ineffable tacit knowledge, Polanyi uses topographic anatomy as an example. He writes "The major difficulty in the understanding, and hence in the teaching of anatomy, arises in respect to the intricate three-dimensional network of organs closely packed inside the body, ...it is left to the imagination to reconstruct from such experience the three-dimensional picture of the exposed area as it existed in the unopened body, and to explore mentally its connections with adjoining unexposed areas around it and below it." Then continues, "The kind of topographic knowledge which an experienced surgeon possesses of the regions on which he operates is therefore ineffable knowledge" (Polanyi, 1962a, p. 92).

This was certainly a good example of ineffable tacit knowledge of the period when the text was written, but today, thanks to the technological advancement, this topographic knowledge is readily available to all students. In fact, thanks to recent 3D technologies we can study any part of our body from every possible angle. As we

can see, in this particular example, Polanyi indirectly supports our view that a large portion of tacit knowledge considered as ineffable today may become explicit with further technological advancement.

Tsoukas – a proponent of ineffability of tacit knowledge – argued in his paper "Do we really understand tacit knowledge?" the interpretation of tacit knowledge as knowledge waiting to be codified is a flawed perception. Tacit knowledge should not be perceived as the complete opposite of explicit knowledge, but rather two sides of a same coin. Tacit knowledge being a subsidiary of focal knowledge cannot be separated and articulated. To support his view he shows an example, taken from Polanyi, of the use of geographical maps. He notes that if even we are proficient enough with maps to use them, we need to know how to relate a map with the real world (Tsoukas, 2003). In order to get from one place to another, we first need to identify our current position, then to find the itinerary on the map and finally to actually go to the intended place we will require proceeding by following various recognizable landmarks identifiable on the map (via Tsoukas, 2003; Polanyi and Prosch, 1975:30; Polanyi, 1962a: 18-20). He continues, "a map, no matter how elaborate it is, cannot read itself; it requires the judgment of a skilled reader who will relate the map to the world through both cognitive and sensual means" (Tsoukas, 2003).

Let's see how this possibly would work today, using a “smart” device supported with an Internet connection, GPS and Google Maps. Our location is identified by Google Maps automatically thanks to the embedded Geo-location feature. Once we insert our destination and select our route, the GPS will take us to the end point without having any need of us to recognize any landmarks. Again, it becomes evident that with technological advancement something that was considered tacit knowledge – our ability to navigate using a map – became downright explicit.

One of the most commonly cited examples from Polanyi's work on tacit knowing is bicycle riding, where he claims that we learn to ride a bike without being given any explicit rules of riding. Although, we may know how to ride a bike we cannot explicate the process how exactly we do it. This means the ability to ride a bike is tacit knowledge. Collins (2010) writes that the way Polanyi explained the rules of bike riding it is actually bike-balancing that can be easily codified. The human difficulties of acquiring the skill of bike-balancing is related to the nature and limitation of our brain and body. However, the real problem seems to be maneuvering through the traffic while riding a bike. This, according to him, is tacit knowledge that is not transferable. However, Google's driverless car travelling guide system proves that, with advances of technology, even this seemingly complex type of tacit knowledge can also become fully transferable.

Collins (2010), to illustrate another point of ineffability of collective tacit knowledge, gives an example from the well-known TV series "Star Trek: The Next Generation". In one episode, Commander Data- the fictional android- learns to dance from fellow crew Doctor Crusher. He not only manages to copy every movement instantly and repeats when it was shown to him, upon request from Dr. Crusher he also improvises additional new steps. Collins writes: "This is where "Star Trek" goes wrong, because it shows Data managing improvisation as flawlessly as he had managed the initial steps". According to Collins "improvisation is a skill requiring the kind of tacit knowledge that can only be acquired through social embedding in society" (Collins, 2010, p. 124). We argue that this is not exactly the case!

If we understand that improvisation is a deliberate extemporaneous composition and execution of novel action (Moorman and Miner 1998a), then Data has indeed demonstrated his capability for improvisation in multiple occasions in various episodes of "Star Trek". Not to mention, just to engage oneself on a human level of conversation requires a functional improvisation capability. Besides, Artificial Intelligence researchers are already experimenting with a dancing robot named "SpiderCrab" which is capable of improvising while dancing with a partner, albeit in a limited scope (Wallis, et. al., 2010).

Not too long ago, putative notion was that grand master level of chess playing is the epitome of human brains capability of knowledge retention, calculation and use of strategic and tactical judgment. These skills are developed by practices and as such are tacit knowledge. Hubert Dreyfus (1972) famously proclaimed that no computer could ever beat a grand master in chess. As it turned out with the advancement of technologies it was not a difficult task at all when Deep Blue, developed by IBM did beat the world champion handily in 1997. Dreyfus may still argue that machine uses brute force – its sheer size of memory and calculative power – and by no means correspond or represent grand masters' unique cognitive process, moreover, it just follows the algorithm embedded in it by people, technically there is no supremacy of machine in this. However, from

knowledge management perspective we are more interested in the outcome of the use of technology as this and Watson's win in Jeopardy – a game requiring intense level of cognitive analytical ability demonstrate new possibilities and open new horizons in relation to technology utilization in knowledge enhancement, codification and transfer.

It is not just direct intervention of technology that can make highly tacit knowledge explicit, technology may also play rather supportive role in some contexts. The advancement of technology has allowed us to access a vast amount of new knowledge momentarily. This constantly evolving new knowledge base helps us making knowledge use better and new discoveries faster. There are many activities that augment organizational knowledge base and enhance organization's innovation capacity such as research and development collaboration, patenting and licensing, merger and acquisitions, training and consulting, spin-offs and new market entry, knowledge publication and diffusion. In all of these areas technology plays a crucial role and makes transmuting tacit knowledge within the organization and outside of it possible.

The figure (Fig. 1) shows the linear correlation between advances in technology and knowledge tacitness. For knowledge, which is tacit but easily explicable, an example would be an analytical feedback from an expert, the technology required to codify is not as complex as a highly tacit knowledge such as knowledge related to improvisation or emotion would need. The graph takes in consideration that to codify any knowledge for future use requires a minimum level of technology input.

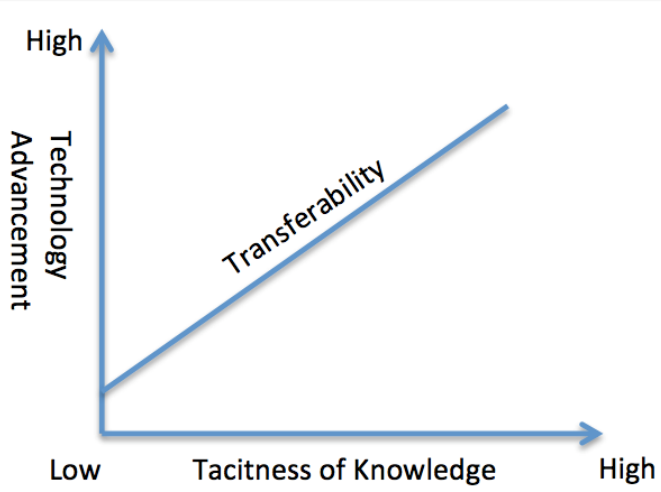

Figure 1: Relation between advances in technology and tacitness of knowledge

5. Tacit knowledge and organizational knowledge management

These examples demonstrate that organizations need to take a hard look at much of the knowledge they consider as tacit and ineffable. While it might be difficult to cope with the ever-emerging new technologies and assess their capabilities related to knowledge management, organizations need to be vigilant. As to stay competitive they have to augment their capabilities of tapping into and using knowledge available to them effectively, particularly in spheres like innovation.

The confusion about the tacit knowledge transformation stems from two generalized beliefs: all knowledge is inherently personal and most important tacit knowledge can be transferred only with the help of socialization. The first assumption finds its root in historical epistemic ideologies and the second one transpires from overly simplified but archaic vision of knowledge domain. The epistemological perception of knowledge being solely personal was justified before the commencement of knowledge economy. Until organizational knowledge became a product of economic value, knowledge residing in machines, organizational processes and systems, and collective knowledge did not have viable weight. With expanding significance of knowledge economy and with the advancement of technologies two things are happening. It is becoming impossible for a single person to have all knowledge necessary for performing increasingly more complex, multifarious and knowledge-driven tasks. At the same time, machines thanks to technological advancements are becoming more sophisticated in executing knowledge-demanding works.

While there are many types of tacit knowledge that can be shared with the help of socialization effectively, technology is indeed capable of facilitating in many seemingly difficult to codify tacit knowledge transferable. One example is, until recently it was considered that the verification and cross references of trial cases are possible to conduct effectively only with the help of knowledgeable and experienced law clerks, now a program called e-discovery armed with predictive analytics does this work better than humans (Katz, 2013).

Analysis of Big Data is another of the apparent examples of works that is impossible for human to perform. Organizations are collecting an enormous amount of data about their products, services, customers, suppliers, business processes and competitors. Thanks to the proliferation of the Internet use, advances in mobile devices and social networks information captured in various organizational silos will continue to grow exponentially in the near future. This massive pool of data contain a vast amount of tacit knowledge that can be extracted, analyzed and used to improve services, streamline business processes, develop innovative products and services and as a result improve an organization's performance. Big Data means a large pool of data that because of its sheer size cannot be aggregated, stored, managed and analyzed using conventional database tools and software applications. To take advantage of the potential of this phenomenon, new types of technologies, systems, platforms and data handling capabilities are emerging. Early adopters, organizations that are taking advantage of new technologies and exploiting the vast potential of big data are having a colossal competitive advantage in comparison to peers (Brynjolfsson, Hitt and Kim, 2011).

In order to retain, use and simulate the critical knowledge of an expert, organizations often use expert systems within their knowledge management strategy. Mere use of expert systems does not always bring the expected outcome in revealing highly tacit knowledge. One solution for a new type of knowledge management systems is to combine expert systems with searchable multimedia knowledge files, where the expert's decision making process is documented in a visual format and the aspects that he considers most crucial is also explained step by step with physical demonstrations captured in multimedia format. By using a combination of these approaches along with other components of a knowledge management system, the capacity of the capturing process of expert's tacit knowledge can be increased significantly (Richer, 2012).

Knowledge management is the methodology and system-based strategic approach of managing an organization's knowledge-related activities. Its goal is to achieve organizational objectives of creating economic and social values by implementing knowledge exploration and exploitation strategies. The technological solution that enables managing knowledge related activities such as knowledge integration, expansion, maintenance and diffusion is called knowledge management system (KMS).

Perception of what type of knowledge management system is required for an organization differs significantly from organizational unit to unit. In order to maximize the benefits of a knowledge management system, priorities should come from the organization's leadership. The prevailing focus areas of knowledge management systems are business process management, decision support systems, business analytics, repository systems, and various others. Many of these systems are an excellent source of primary tacit knowledge (Nissen, 2006) and should be integral parts of a knowledge management system. However, in relation to tacit knowledge embodied in humans, the required technologies are those which can support, capture and enhance activities such as group work, guided experiments, simulations, meetings, mentoring, apprenticeship and online and offline socialization. Importance should be given not just to have these activities captured in multimedia and other repositories but the knowledge management system must also facilitate integration and access to all these information upon request in a simple user-friendly manner. The technologies that can deliver answers to a significant portion of the challenges we are encountering in this regard are already available. Semantic web and its supportive technologies, predictive analytics, Artificial Intelligence agents, cloud computing and distributed databases are a few of them (Kabir, 2013).

6. Conclusion and direction for further research

A substantial and critical portion of organizational knowledge base is composed of tacit knowledge. Its effective use contributes positively to almost all areas of an organization from culture to strategy and operation to customer service. To take lasting advantage from tacit knowledge and maximize the creation of economic values from this, organizations require working relentlessly in improving its use. This means organizations must put conscious efforts in making tacit knowledge available in its domain explicable and accessible when needed. Achieving desired effects from knowledge use, whether it is explicit or tacit, require

efficient management of organizations knowledge related activities such as knowledge acquisition, aggregation, maintenance and dissemination. Enhancement of the capabilities of these activities produces greater momentum to innovation and competitiveness of an organization. Without proper understanding of the concept of knowledge, its typology and its contributory ability managing knowledge activities become a difficult task.

This article analyzes prevailing notions related to tacit knowledge and using examples from knowledge science literature demonstrates that new technologies are indeed capable of codifying tacit knowledge that was considered earlier as impossible to explicate. The author developed a theoretical model that shows a clear correlation between the use of technological advancement and ability of organizations to convert tacit knowledge to an explicit form. However, we need to test this model empirically in order to perceive the extent of this relation.

The author argues that to take full advantage of tacit knowledge residing in various organizational silos and embodied in the employees, organizations should adopt advanced technologies that are capable of improving management of knowledge related activities and deliver better organizational performance. While many studies have been done on the impact of information technology and knowledge management systems on organizations performance (e.g. Chang and Lee, 2008; Cantner, Joel and Schmidt, 2009), there is still a need for more research on what kind of effect a revolutionary advanced technology can have on a firm's knowledge management and consequently on innovativeness, competitiveness and financial performance. In this paper the author also mentioned several technological advancements that are already being used in managing various knowledge related activities, empirical researches are necessary to observe and understand their effectiveness as well.

This paper also suggests that organizations contemplating on what should be their knowledge strategy indubitably need to focus on bringing efficiency and effectiveness in managing their knowledge activities by using knowledge management systems since better knowledge base and access to the right type of knowledge allow firms to develop sustainable competitive advantage.

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