JOURNAL OF SMALL BUSINESS STRATEGY

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When objects are talking: How tacit knowing becomes explicit knowledge

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Keywords:

Tacit knowing, Externalization, Reflected knowledge, Boundary objects

ABSTRACT

The objective of this paper is to build a model of how tacit knowing is externalised and becomes reflected external knowledge. Knowledge Management (Nonaka, 1991, 1994; Nonaka, Toyama, & Konno, 2000) is an important field in Business Administration. Based on the model provided by Nonaka and his colleagues (Nonaka, 1994; Nonaka & Takeuchi, 1995; Nonaka et al., 2000) researchers and practitioners have fallen into the pipe dream that employees' tacit knowing can be coded and canned in computers (structural capital), eventually leading to the enterprise without humans. Earlier critics (Gourlay, 2002, 2006; Gourlay & Nurse, 2005, Grant, 2007; Philipson, 2016, 2019) of the knowledge management paradigm have shown that it does not understand Polanyi's concept tacit knowing and that it is much more complicated to "externalize" such knowing than presumed by KM. The understanding in extant management literature of this process has been very problematic. Building on concepts in philosophy, psychology, pedagogics, organizational science, and engineering, a model is built and exemplified. This paper develops a theoretical framework for how tacit knowing can be externalized, what is required for such an externalization, and discusses the problems in such externalization, limiting it.

Introduction

The understanding of how tacit knowing is externalised and becomes reflected external knowledge has been very problematic in extant management literature. It is important how such new knowledge is created, as "Organizational adaptation is also likely to be characterized by periods of dramatic revolution in which there are reversals in the direction of change across a significantly large number of variables of strategy and structure." (Miller & Friesen, 1980, p. 593). These changes are the response to new knowledge: "…scientific revolutions are inaugurated by a growing sense …that an existing paradigm has ceased to function adequately in the exploration of an aspect of nature to which that paradigm itself had previously led the way." (Kuhn, 1970, p. 92; Miller & Friesen, 1980, p. 608). Organizational innovation and organizational learning "…jointly to promote organizational entrepreneurship and to increase competitive advantages." (Garcıa-Morales, Llorens-Montes Verdu-Jover, 2006, p. 35).

However, extant literature normally presumes the fundamental micro-foundations of business research, without exploring them as such or how they function. Instead research focuses on the effects of these "given" on various phenomena. Examples of this are the use of "intuition" in Saiz-Álvarez, Carlos Cuervo-Arango and Coduras (2013), how information is transformed to knowledge, 'learning", how individuals in organizations learn (Pett & Wolff, 2016). In contrast, in this paper the objective is to develop a framework for one of these micro-foundations, how new knowledge is developed in an organizational context.

Building on concepts in philosophy, psychology, pedagogics, organizational science, and engineering, we build a model of how the externalization is done and exemplify this.

Journal of Small Business Strategy
2020, Vol. 30, No. 01, 68-82
ISSN: 1081-8510 (Print) 2380-1751 (Online)

APA Citation Information: Philipson, S., & Kjellström, E. (2020). When objects are talking: How tacit knowing becomes explicit knowledge. *Journal of Small Business Strategy, 30*(1), 68-82.

The text is organised by six major headers: Knowledge, Individual learning, Knowledge in an organizational context, Learning in an organizational context, the creation of new knowledge in an organizational context, and finally conclusions.

Litature Review

Knowledge is explicit knowledge that we can talk about, as it has a negotiated meaning in smaller or larger circles. Then how knowledge is acquired, learned, is discussed.

Explicit Knowledge

Knowledge means to understand the relations between cause and effect. It is the result of personal experience, socialization, and formalized study. The definition of knowledge is often not precise, as "…people use different definitions of knowledge." (Starbuck, 1992, p. 715).

Explicit knowledge is readily communicable, because it has a negotiated meaning in smaller or larger social circles; at least within a community of practice. But meaning is only temporal (Schalow, 2013).

How is Knowledge Acquired, Learned

Vygotsky (1970, 1987, 1993, 1994, 1997a, 1997b, 1998, 1999) focused on the affective aspect of learning: without the exploration of the relationship of the word to motive, emotion, and personality, the analysis of the problem of 'thinking and speech' remains incomplete (Mahn & John-Steiner, 2002). It pays attention to motivation and incentives of the individual human actor and to the operation of everyday activities within different contexts and time and requires "…researchers to engage in the core logic of how practices are produced, reinforced, and changed." (Feldman & Orlikowski, 2011, p. 1241; Pentland, Feldman, Becker, & Liu, 2012, p. 1484). "Vygotsky believed that affect and intellect are not two mutually exclusive poles, but two inseparable mental functions" (Levykh, 2008, p. 85). He emphasized that culturally developed emotions are socially constructed and internalized. They play a key role in shaping motivation and thought (Levykh, 2008; Mahn & John-Steiner, 2002). The individual emotional experience seems to be foundational (consciously, subconsciously, and unconsciously) to the person's perception, attention, memory, decision-making, behavioural mastery, and overall world orientation (Levykh, 2008). Motivation is the mediation between emotions and thought. Motive gives birth to thought, to the formation of thought itself, to its mediation in internal words, to the meanings of external words, and finally to words themselves (Mahn & John-Steiner, 2002,)

Knowledge is arising from practice (Dietzgen, 1973). Knowledge is internalized using psychological tools, as products of socio-cultural evolution, to which individuals have access by being actively emerged in the practice of the communities, of which they are part (John-Steiner & Mahn, 1996).

Knowledge and knowing emerges through the network of interactions and is distributed and mediated among the interacting humans and their tools (Cole & Wertsch, 1996, as cited in Lipponen, 2002).

"Learning is based on long-term collaboration, because participants need to feel safe enough to enter what could feel as a strange community" (Jones & Issroff, 2005, p. 403). Learning communities grow out of the recognition that the human mind is limited, making collaboration with other humans and with things a necessity, rather than a luxury. Through conversation, learners construct knowledge, filter it, discover individual differences and strive toward mutual understanding. Mutually agreed-upon concepts become community assets (Hung & Nichani, 2002).

Individual Learning

Under this header we discuss how tacit knowing is acquired and what tacit knowing "is".

Acquiring Tacit Knowing

Sensory cues and the actions of the individual and others in the communities of practice, in which they participate, leads to experiences, nodes in the brain. These nodes are related in labile mental structures, based on the commonalities between different nodes, be they cognitive, emotional, colours, odours, or all other parts of the memory of the experiences. Cognitively unrelated phenomena can be related by a common odour or a colour, which years later can make the individual sensing that the two phenomena are related.

Sensory cues evoke mental imagery, based on earlier experience (Holbrook, 1982). This imagery is the essence of the concept tacit knowing. The sense of a word is the aggregate of all psychological facts [Gestalt] that arise in our consciousness, provoked by the word (Wertheimer, Brett, King, Peckler, & Schaef, 1992). Polanyi (1962) is drawing on Gestalt psychology in his attempt to establish the logic of tacit knowing.

Sense is a dynamic, fluid, and complex formation that has several zones that vary in stability. Meaning is often conceptualized as external and sense as internal. Meaning can be viewed as explicit knowledge and sense as tac-

it knowing. The way we endow our own utterances with meaning and our attribution of meaning to the utterances of others are acts of tacit knowing. They represent sense-giving and sense-reading, within the structure of tacit knowing (Polanyi, 1962). Meaning is only the most stable and precise zone of sense (Mahn & John-Steiner, 2002).

Tacit Knowing

Conscious tacit knowing. It is not readily communicable, even if the holder wants to communicate it, as it has yet no, or not enough, shared meaning with those they want to communicate. To negotiate meaning is itself a difficult task, facing the designer who wants to interact within their community of practice. To theorize is to focus on those entities and relationships in reality that are believed to be central to the phenomena observed – and largely to ignore the rest (Nelson & Winter, 1982). Such focusing means that we try to grasp tacit knowing by delimiting the focused experiences from the rest of the tacit knowing, in which it is embedded.

Unconscious tacit knowing. It is not accessible for the individual herself. It is not in, what Polanyi (1962) calls, focal awareness. It must be revoked by means unknown to the individual and it is even more difficult, if not completely impossible, for another person to provoke the making conscious of such knowing (cf. the role of the psychotherapist). Intuition fills the gap left open in the dynamics of tacit knowing (Polanyi, 1962).

There is no absolute distinction between conscious and unconscious knowing. As the individual's experience grows and deepens, old experiences retreat to the background and new ones take the foreground. Neither is there a garbage can at the end of this displacement, other than dementia. Subdued unconscious knowing can come to the foreground again, provoked by new experiences or tacit inferences to old ones. The distinction between explicit, conscious, and unconscious tacit knowing is therefore fuzzy. This is illustrated in Figure 1. Explicit knowledge, conscious tacit knowing, and unconscious tacit knowing.

However, "…Polanyi… said little about the processes of acquiring or learning tacit knowledge." (Taylor, 2007, p. 61), which is why we need a psychological theory.

Knowledge in an Organizational Context

What is knowledge in an organizational context? Does it differ in character from the knowledge of individuals?

In contrast to Huber (1991), we hold that knowledge is not information. The latter can be described as "food for thought", but is not knowledge. The knowledge-based ap-

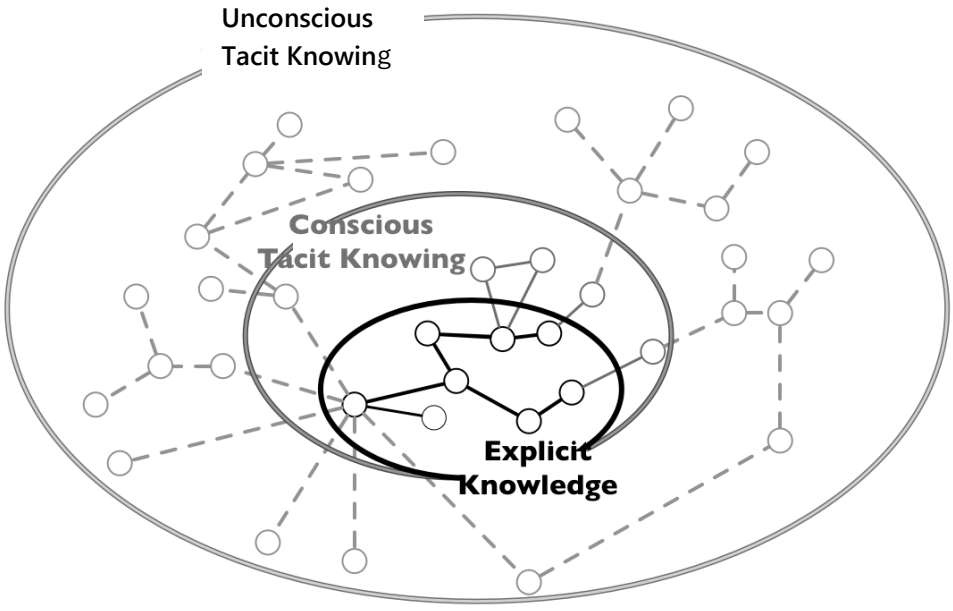

Figure 1. Explicit Knowledge, Conscious Tacit Knowing and Unconscious Tacit Knowing, Own.

proaches argue that organizations have capabilities for creating and sharing knowledge that cannot be readily gathered through markets. Knowledge is built around the recurrent tasks performed by the organization and shaped by the paths chosen in the past.

A competence or resource-based theory of the firm focuses on concepts, such as core competence (Prahalad & Hamel, 1990), core rigidities (Leonard-Barton, 1992), and core capabilities (Teece, Pisano, & Shuen, 1997). Assets, even when they are a manifestation of economics of scale in a mature market, seldom lead to competitive advantage, because assets that can be bought in the marketplace as commodities do not have the potential to differentiate the company as a basis for competitive advantage (Grant, 1996). Capabilities are often seen as associated with a specific plant or equipment of the firm and derive from the firm's coordination of individual and functional expertise (Nahapiet & Ghoshal, 1998). Knowledge of an organization is thus a system of coordination that combines relations and tasks into productive performance (Nelson & Winter, 1982). Knowledge is created through generation and selection of skills, processes, and products in an internal procedure, even if it reflects external factors (Loasby, 2001).

High-Performance-Work-Systems, play an important role in the resource-based view. They found dynamic capabilities, increase organizational ambidexterity and increase innovation (Coder, Peake & Spiller, 2017). What we explore here, communities-of-practice of professional teams, can be considered high-performance work systems.

Knowledge of an organization should therefore be discussed in terms of both the competences of the individuals, i.e., the tacit knowing and the organizing principles that structure and coordinate individuals and teams. Knowledge about specific applications of technology is based on both tacit knowing and explicit knowledge (Zander & Kogut, 1995). However, structural capital is costly to keep, and the knowledge of an organization is different from the knowing possessed by the individuals. Penrose (2009) held that the expectations of an organization and how it interprets its environment is a function of how internal resources are operated.

Internally generated knowledge is necessary to give organizations the tools to achieve, create and allocate resources efficiently. The knowledge structures consist of individual 'schemata', which are representations of persons, things, and events as well as "scripts", consisting of frequently occurred events that have been stored in the memory (O'Reagan & O'Donell, 2000).

Learning in an Organizational Context

Then what is learning in an organizational context? Does it differ in character from individual learning? The conditions for organizational learning are discussed under the header Professional teams with learning intentionality; communities of practice.

Learning is seen as the alteration of behaviour as a result of experience. Cognitive, emotional, and environmental influences, as well as prior experience, play a part in how understanding is acquired or changed, as well as how knowledge and skills are retained. "The term learning is comprehensive, covering a wide range of activities and modes of learning: Learning by trial and error (Thorndike, 1874-1949), learning by conditioning (Pavlov, 1849-1936; Skinner, 1904-1990), learning by insight, i.e., by understanding or perception of the situation (Köhler, 1887-1967), and learning by imitation (Miller, 1909-2002; John Dollard, 1900-1980)." (Kjellström, 2019, p.112).

Organizational learning has hitherto been viewed as 'bundles' of individual learning under the monitoring of top management. March's (1991) concept of organizational learning is based on a view, where the individuals are more or less unrelated competitors in the organization. Several factors influence the probability to learn, such as corporate culture, strategies allowing flexibility, and structures promoting innovativeness and environmental insights (Fiol & Lyles, 1985).

Learning is to a large extent achieved within the social and collaborative processes that involves the development of shared experiences in communities of practice, within which learning takes place (Lam, 2014; Lave & Wenger, 1991; Wenger, 1998). Communities of practice are "… groups of people informally bound together by shared expertise and passion for a joint enterprise." (Wenger & Snyder, 2000, p. 139).

The individuals' learning activities are facilitated or inhibited by organizational learning (Argyris, 1977). The difference between individual and organizational learning corresponds to the difference between knowledge memorized in the mind of the individual, and the memory housed in a project group or stored in documents or computer files. For an extensive treatment of organizational learning see Kjellström (2019).

Organizational Learning

Organizational learning has been defined as "…the capacity …to maintain or improve performance based on experience." (Dibella, Nevis, & Gould, 1996, p. 363).

Organizational learning has hitherto been viewed as "bundles" of individual learning under the monitoring of top management. Organizational learning refers to processes by which information is found, acquired, and used (Hedberg, 1981). To further qualify organizational learning, it could be seen as enabling new opportunities to be identified and thereby defined as "…the process within the organization by which knowledge about action outcome relationships and the effect of the environment on these relationships is developed…" (Weick, 1991, p. 120).

Argyris' (1977) definition of organizational learning as the process of 'detection and correction of errors', must be seen as paying attention also to the capacity that implicitly knows if and when the process is unable to detect and correct errors. Trouble arises when the technology is ineffective and fundamental assumptions underlying the existing ways of doing work must be questioned (Senge, 1992). The increasing uncertainty of the environment requests an organization able to focus on 'double-loop learning' (Argyris, 1977; Argyris & Schön, 1978) or 'generative learning' that anticipates goals and processes, reacting to changes and complexity. Double loop learning "… will confront the validity of the goal or the values implicit in the situation", which "…confronts the basic assumptions behind ideas or present views and that publicly tests hypotheses." (Argyris, 1976, pp. 32, 34)

To communicate and understand relevant knowledge, the organization relies on its accumulated experience (Zander & Kogut, 1995). The organization's knowledge and its information processing capabilities are shaped by the nature of the tasks and the competitive environment that it faces. "The term "capabilities" emphasizes the key role of strategic management in adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competencies to match the requirements of a changing environment" (Teece, Pisano, & Shuen, 1997, p. 515). Cohen and Levinthal (1990, p. 128). hold that "… the ability to exploit external knowledge is a critical component of innovative capabilities." They argue that the ability to evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge. Absorptive capacity, the ability of a firm to recognize the value of new information, assimilate it, and apply it to commercial ends, is critical to the firm's innovative capabilities. Cohen and Levinthal (1990) only discuss this phenomenon as a function of individual or organizational knowledge. They characterize the factors that influence absorptive capacity at the organizational level, how an organization's absorptive capacity differs from that of its individual members, and the role of diversity of expertise within an organization. Organizational learning, as based on March (1991), is based on a view where the individuals are, more or less, unrelated competitors in the organization. There is no real collaboration in his theory.

The classical theorists of organizational learning see the importance of identifying the incongruities in routines or reacts to them. The team is absent. Contrariwise, we hold that it might even be more productive to employ teams, rather than individuals!

Professional Teams with Learning Intentionality, Communities of Practice

What are the circumstances required for organizational learning to be achieved? We hold that when professional teams in for-profit organizations have a mutual intention to learn they are communities-of-practice, even though Wenger (2000) holds otherwise.

Knowledge does not reside in the individual's head, but in the communities of practice, in which they participate. The concept of community of practice (Wenger, 2000) indicates a functioning team, a group of professional individuals, together performing a set of organizational tasks, where there is a collaborative learning; in contrast to March (1991), where the knowledge attribution is made by socially unrelated individuals; a Robinson Crusoe way of learning. These collaborative processes are necessary to be able to understand complex organizational problems because different settings provide different opportunities for learning that "…are more fluid and interpenetrative than bounded, often crossing the restrictive boundaries of the organization to incorporate people from outside." (Brown & Duguid, 1991, p. 49).

A team and a community-of-practice are different concepts. The distinction is that a community of practice is a group of specialists that learn together, while a team is defined by the joint task they must accomplish (Farnsworth, Kleanthous & Wenger-Trayner, 2016; Pandey & Dutta, 2013; Wenger & Snyder, 2000). Communities of practice are emergent, they exist within a business unit or stretch across divisional boundaries (Wenger & Snyder, 2000). Learning involves becoming "…a member of a community of practice through apprenticeship." (Kolb & Kolb, 2005, p. 200). It means that teams of employees and groups of professional individuals are exposed to collaborative learning, while they perform routines of organizational tasks in the light of others' tacit knowing.

Tacit knowing plays an important role in all individual and group thinking, being the enabling condition for explicit knowledge. This has not been clearly developed in knowledge management that did not fully respect the subjective side of Polanyi's (1961, 1962, 1968) tacit knowing as it

had the roots in Nonaka and Takeuchi's (1995) theory "… that undermined the claim to pure objectivity." (Mooradian, 2005, p. 105)

In line with psychological research, we recognize that knowledge and learning are to a large extent only achieved within a community of practice (Borthick, Jones, & Wakai, 2003; Brown & Duguid, 1991; Kinginger, 2002; Lave & Wenger, 1991, as cited in Amin & Roberts, 2008; Orr, 1996; Vygotsky, 1999; Wenger, 1998). When teams have the intentionality to learn, they are communities of practice, in which the individual can tentatively try to externalize fragments of her tacit knowing and negotiate a common meaning, to formulate a collectively reflected externalized knowledge.

Knowledge does not reside in the individual's head, but in the communities of practice in which they participate. "Learning is thus a process of becoming a member of a community of practice through legitimate peripheral participation (e.g. apprenticeship)" (Kolb & Kolb, 2005, p. 200). It is not as simple as to observe and be part of, as Nonaka (1991), seems to believe, but to negotiate meaning in this community of practice. i.e. internalize the experience of the other, to get a more objective experience. This negotiated understanding is explicit knowledge.

A community of practice is a system of relationships between people, activities, and the world which is developing over time and in relation to other communities of practice (Lave & Wenger, 1991). Learning on a team level is not possible without the sharing of intentionality, i.e. sharing the goals, as the team is intended for common action, practice, the team members must share a common intentionality for the shared actions, which are the objective of the learning. Wenger (1998, 2000) traced the link between situated practice and learning/knowing to three dimensions of "community" – mutual engagement [negotiated meaning, our comment], sense of joint enterprise [intentionality, our comment] and a shared repertoire of communal resources [a set of tools – embodied or not – for common action, our comment]. (Amin & Robert, 2008, p. 354).

Our use is at odds with Wenger (2000), who holds that "community-of-practice" and "team" are different concepts (Farnsworth et al., 2016), where a team is defined by a joint task that they must accomplish together, while a community of practice is a learning partnership related to a domain of practice. Thus, such a learning partnership around a practice is a different structuring process than working on a joint task according to Wenger (2000). Nonetheless, many teams consist of professionals that themselves interpret their professionalism. And it is just for this reason that they have certain tasks in the organization. Their relative independence from management is a necessary qualification for their job. Yet, even when management sees the personnel as arms and legs, rather than thinking and learning beings, the employees often are not satisfied with playing this role. This is the case recognized by the third wave of routine studies (Feldman 2000; Feldman & Pentland, 2003; Pentland & Feldman, 2005; Pentland & Rueter, 1994), in that the performance of routines is not completely "managed". Wenger's (2000) requirement of a common intentionality in the community of practice might be modified by a statement by the originator of the concept, Star (2010, p. 604), who tells that her "…initial framing of communities-of-practice was motivated by a desire to analyse the nature of cooperative work in the absence of consensus." We propose the introduction of a new concept, "conditional intentionality", similar to the concept "conditional trust", introduced by Philipson and Philipson (2016, p. 320). It would mean that humans participate in a community-of-practice with a conditional intentionality of the community as a learning environment. Only if experience in the team negates such conditional trust of common intentionality will it cease. "Shared collective behaviour is a genuinely *social* phenomenon, and that it is present in almost all social behavior" (Shotter, 1995, p. 70; emphasis in original)

Another issue, with which we disagree with Wenger (2000), is that he holds that management has power over the team, but does not subsume them (Farnsworth et al., 2016). This is pure idealism. It is evident that he does not understand the concept "subsum". Everything is subsumed. Even Leonardo da Vinci, the most well-known artist of all time – and already in his time – had to do paintings for money, to be able to pursue "pure" art.

Previous business research has largely pursued the individualistic myth of the great genius as the source of creativity. However, scholars of innovation, such as Dougherty (2006) and Schumpeter (1942), recognize that innovative outcomes seldom are the product of individual genius, but a collective and systematic approach (Farjoun, 2010), or least as part of a community of dialogue, as in the case of Newton and Leibniz, corresponding about their common and parallel discovery of the Calculus (Sastry, 2006), the discussion between Newton and Goethe (Fine, 2015), Renoir father and son (Crêpy-Boegly, 2018), or Mattisse and Picasso. The latter two continuously dialogued both in real life and in reference to the other's paintings (Scemama, 2018). Behr, Negus and Street (2017) give ample examples on how classic and modern masters have sampled music of previous composers.

The mind-set of practice has little room for heroic autonomous individuals. A well-developed organization, capable of reliable performance, is thoroughly social and built on interpersonal skills that enable people to represent and

subordinate themselves to communities of practice (Weick & Roberts, 1993); Wenger, 2000). Our approach corresponds to what Dibella et al. (1996) calls informal collective learning. Thus, to understand organizational learning, the team as the level of analysis, which is almost always absent in business research, is actually essential.

The Creation of New Knowledge in an Organizational Context

How is new knowledge created in organisations? The dominating paradigm is knowledge management, which has major shortcomings. Specifically concerning the issue of how tacit knowing can be transformed into explicit knowledge. We hold that an immediate transformation is not possible and that hence mediators are required. As a consequence of the hitherto discussion a framework for externalizing tacit knowing is presented.

Knowledge Management and its Shortcomings

Knowledge Management (KM), is an important field in Business Administration. The paradigm of the field was founded by (Nonaka, 1991, 1994; Nonaka et al., 2000). Knowledge management tend either to understand "knowledge as an asset" or "knowing as a process" (Empson, 2001), a view also referred to as "product versus process view" (Massingham, 2014a, 2014b, p. 1077).

Furthermore, knowledge management disregards the external context. The knowledge-based approach, seeing the firm as a bundle of heterogeneous resources (Foss & Foss, 2000), focuses on how firms themselves can create and improve resources, rather than rely on resources that are purchased on the factor markets (Grant, 1996; Teece et al., 1997). However, stored knowledge does not have much meaning until it is used by someone for some purpose, "… knowledge requires active participation of the knower and is hence knower dependent." (Virtanen, 2013, p. 122) Even the questions remain whether and how tacit knowing is regarded in the processes of creating or purchasing resources. To establish a difference that could be sustained, the competitive advantage must grow out of the entire system of activities (Philipson, 2016).

KM view of tacit knowing is flawed. Earlier critics of the knowledge management paradigm (Gourlay, 2002, 2006; Gourlay & Nurse, 2005, Grant, 2007; Philipson, 2016, 2019) have shown that Nonaka (1991, 1994) and Nonaka et al. (2000) do not understand Polanyi's (1961, 1962, 1968) concept tacit knowing. It is much more complicated to "externalize" such knowing.

Grant (2007) examined some 60 papers from three major knowledge management journals and demonstrates that Polanyi's work on tacit knowing has been misinterpreted, especially by Nonaka and Takeuchi (1995), who just extended the personal knowledge to organizational knowledge in a corporate organisational setting. Transferability without participation of a knower is a misinterpretation of the texts of Polanyi that misguided the whole knowledge management literature and practice (Chauvel & Despres, 2002; Crane & Bontis, 2014, 2002; Gourlay, 2006; Virtanen, 2013).

Of all citations in three major KM journals (from first publication to the end of 2003), Polanyi's (1961, 1962, 1968) works were collectively the second most cited source after the works of Nonaka (Nonaka, 1994; Nonaka & Takeuchi, 1995; Nonaka et al., 2000) in the meta-review of Serenko and Bontis (2004). Of all the KM articles in the same journals "…only about one third of the papers demonstrated clearly that Polanyi's work had been read and almost half (42%) were unlikely to have read it, based on their use of the related concepts. Further, some 23% seem to significantly misrepresent Polanyi's work." (Grant, 2007, p. 176) "… where Polanyi saw tacit and explicit as different but inseparable aspects of knowledge, the de facto use of the SECI model was dualistic, rather than dialectical." (Snowden, 2002, p. 4).

KM view on externalizing tacit knowing. The externalizing tacit knowing is very problematic and not just a simple mimicking of the master, as in Nonaka's 1991 baking example: "The Osaka International Hotel had a reputation for making the best bread in Osaka. …Tonaka trained with the hotel's head baker to study his kneading technique. She observed that the baker had a distinctive way of stretching the dough. After a year of trial and error, working closely with the project's engineers, Tanaka came up with product specifications – including the addition of special ribs inside the machine – that successfully reproduced the baker's stretching technique and the quality of the bread she had learned to make at the hotel. The result: Matsushita's unique "twist dough" method and a product that in its first year set a record for sales of a new kitchen appliance." (Nonaka, 1991, p. 98).

This classic narrative has led several generations of knowledge management researchers and managers to the very simplistic view that tacit knowing can easily be converted into structural capital – conveying the ardent pipe dream of companies without employees.

KM view on context, ba. "For organizational learning more important is the concept of how groups create new knowledge." (Nordberg, 2007, p. 7). Nonaka introduced

the term "ba" as a shared context, in which knowledge is shared, created, and utilized (Nonaka et al., 2000, p. 14). The authors ascribe 'ba' to the Japanese philosopher Kitaro Nishida in 1921. Nonaka et al. (2000) are conscious that communities of practice and ba are related, but they fail to identify the real source of knowledge in "communities of practice" (cf. Nonaka et al., 2000), and sets out to identify the difference between them. However, because of the profound lack of understanding of both knowledge and "communities of practice", they fail to do so. All the characteristics that they ascribe as particularities of ba, except the presumption of a physical space, are present in Vygotsky's concept "zone of proximal development", which is Vygotsky's term for the community of practice of a student group (Kolb & Kolb, 2005; Kinginger, 2002). The zone of proximal development is a social space and not a physical space (Nordberg, 2007; Schalow, 2013).

KM view of organizational learning and canned knowledge. Based on the model provided by Nonaka (Nonaka, 1994; Nonaka & Takeuchi, 1995; Nonaka et al., 2000) researchers and practitioners have fallen into the trap to dream that employees' tacit knowing can be coded and canned in computers (structural capital), eventually leading to the enterprise without humans. "…as Malhotra, Majchrzak, Carman, and Lott (2001) conclude, rather than focusing on systems to codify knowledge, we should instead concentrate on systems that facilitate collaboration between knowledge holders and those needing the knowledge." (Taylor, 2007, p. 71). Philipson (2016) has shown that employees' critical tacit knowing must be retained by empowering them, rather than canning their knowledge in information systems.

Mediators for externalizing tacit knowing (cf. Phillpson, 2019)

Making explicit is to externalize (Borthick et al., 2003). Tacit knowing can partly be transformed to explicit knowledge through externalization. Externalization is made in written or oral language, visualization, and behaviour; even with odour, fragrance, scent, and aroma. However, such transformation is always incomplete; we cannot transfer the rich sense of tacit knowing into explicit knowledge, since the latter becomes a mere shadow of the former.

To be able to show how tacit knowing is transformed to explicit knowledge, we use the concept of sketches, introduced by Ferguson (1992). A sketch is the engineer's, the architect's, or the artist's endeavour to make an illustration, based on her tacit knowing. Ferguson identifies three kinds of sketches to identify the role of sketches in creative design groups: the thinking sketch, the talking sketch, and the prescriptive sketch; showing how imagination is a creative transforming activity, which moves from one form of concreteness to another (Vygotsky, 1998). Images may prove to be powerful means for calling forth, exciting, and relieving different feelings (Vygotsky, 1999). That drawings are usually accompanied by verbalizations, supports the idea that sketches only partially represent ideas in the mind. In general, a drawing act in sketching is not an attempt to represent a solution as such, rather it is a notational device that helps its creator to reason with complex and labile mental structures (Van Der Lugt, 2005).

Thinking sketches refer to designers making use of the drawing surface in support of their individual thinking processes (Ferguson, 1992). Engineers use the thinking sketches to focus and guide nonverbal thinking (Van Der Lugt, 2005). Authors writing and rewriting of text, are examples of such thinking sketches. The externalization of conscious or semi-conscious tacit knowing creates a virtual "other", with which to dialogue. This dialogue can provoke semi-conscious and unconscious tacit knowing to surface to higher level of consciousness. "Doodling, drawing, modelling. Sketch ideas and make things, and you're likely to encourage accidental discoveries. At the most fundamental level, what we're talking about is play, exploring borders." (Kelley, 2001, p. 38)

Talking sketches refer to designers making use of the (shared) drawing surface in support of the group discussion. Talking sketches, spontaneously drawn during discussions with colleagues, will continue to be important in the process of going from vision to artefact. Such sketches make it easier to explain a technical point, because all parties in the discussion share a common graphical setting for the idea being debated (Ferguson, 1992). The discussions between what has been perceived as "lone geniuses" are examples of discussing around talking sketches. A pregnant example of talking sketches are the "crime scene doll-houses", with which Frances Glessner Lee revolutionised criminology in the 1940s and 50s (Atlas Obscura, 2017). Around such crime scene models, criminal investigators discussed how the scene had evolved (Francetvinfo, 2018). Of course, these models are today digitized.

This process is the negotiating of meaning; it is to be able to express and dialogue around previously individual conscious tacit knowing, but now (as explained above) made explicit knowledge, in a limited community of practice, a team. The characteristics of the team as a community of practice is that it has a very detailed and profound negotiated meaning, developed from a common professional education and common practice. For others in the group, an intervention might provoke a discourse based on explic-

it, conscious tacit knowing, or provoke unconscious tacit knowing to surface to consciousness. This dialogue can develop new knowledge, but the discourse itself is limited by what can be made explicit.

Prescriptive sketches. Refers to the designers communicating design decisions to persons outside of the design process, hence outside the community of practice referred to earlier. The communication must be based on a negotiated meaning, limited by a common culture. The architect builds a physical model of the proposed building; and with present computer-generated imaging, it is possible to walk around in the building before it exists. This is also why early prototyping is advantageous for the success of innovations. Visualization techniques that support the involvement of diverse stakeholders in the process, a user-centred approach to complement top-down methods, fast prototyping to rapidly test models in practice (Mulgan 2009, as cited in Hillgren, Seravalli, & Emilson, 2011). Good prototypes don't just communicate – they persuade (Kelley, 2001).

Carlile (2004) presents a framework of boundary objects between teams, cf. prescriptive sketches, but does not problematize how and whether knowledge is built in the teams. Thus, his framework is focused on management according to the theory of constraints.

The same holds true for verbal externalization; first we write for ourselves; then we need to communicate it in a community of practice, whether it is family, kinship, or close friends for everyday experiences, or a community of professional practice for a scientific article under construction. Finally, we need to communicate through a prescriptive text or speech for a broader audience. The talking sketches and their language equivalents are the mediation between tacit knowing and explicit knowledge. The essence of the dialogue in this mediation process is problematizing (Alvesson & Sandberg, 2011, 2013) or problem-probing. These mediators, whether sketches, words, gestures, body language, or what else, are boundary objects. Boundary objects do not convey unambiguous meaning, but have a kind of symbolic adequacy that enables conversation without enforcing commonly shared meanings (Boland Jr & Tenkasi, 1995).

Framework for Externalizing Tacit Knowing

In Table 1 our framework for externalizing tacit knowing is presented.

Organizational learning, competitive advantage, and the role of routines in building and ultimately exploiting learning, cannot be understood without introducing the team, the community of practice, as the focal point of study. This idea is not completely new, as these patterns of inter-

Table 1.
Framework for externalizing tacit knowing, own

Level	State-of-mind	Activity	Type of knowledge	Boundary objects	Outcome
Organization; Bundle of routines	Enabling; Supporting	Strategizing: Identifying competitive advantage in newly externalized tacit knowing			
Boundary between community-of-practice and organisation or outside world				Prescriptive sketches	Knowledge transfer
Community-of-practice; functioning professional teams; Routines	Conditional intentionality, Leaning	Problem probing; Externalizing tacit knowing by negotiating meaning in discourse on all senses	Reflected knowledge; Externalized tacit knowing with common meaning		
Boundary between individuals in the community-of-practice				Talking sketches	Reflected explicit knowledge
Externalization of tacit knowing				Thinking sketches	Explicit knowledge
Individual; Micro foundations of routines	Intentionality; Leaning	Living experiences	Tacit knowing; Sense		

action are resident in group behaviour, though certain sub-routines that may be resident in individual behaviour (Teece et al., 1997). The term "resident" seems to indicate that they do not see the team to be the active part in developing these routines.

However, we hold that without a common intentionality, learning on the team level is not possible. Top-down managerial control will necessarily be questioned as a result.

Individuals, the ego, are social animals, the id, developed within a first community of practice, the superego (Freud, 1974), by internalizing (Vygotsky, 1970, 1987, 1993, 1994, 1997a, 1997b, 1998, 1999) the community of practice (Bourdieu, 1976; Dietzgen, 1973; John-Steiner & Mahn, 1996; Weick & Roberts, 1993; Wenger, 2000), and its symbolic representations.

The mass of the experiences in all the communities of practice that each individual has participated in, before and concurrently now, constitute their tacit knowing (Polanyi, 1961, 1962, 1968), or sense (Mahn & John-Steiner, 2002; Polanyi, 1961, 1962, 1968; Wertheimer et al., 1992).

Tacit knowing includes conscious and unconscious tacit knowing, as well as explicit knowledge, embedded in and understood within tacit knowing. To modulate ideas and thoughts, the individual needs to externalize them, objectify them with psychological tools, such as language, symbols, drawings, etc. (Herrenkohl & Guerra, 1998; Herrenkohl, Palincsar, DeWater & Kawasaki, 1999; Levykh, 2008; Palinscar & Herrenkohl, 2002), to negotiate meaning with oneself; cf. thinking sketches (Ferguson, 1992; Van Der Lugt, 2005). These tools are mediators for the individuals negotiation of meaning and sense (Mahn & John-Steiner, 2002), prior to the negotiation of meaning in a community of practice.

The complete framework in Figure 2 shows how the individual, as a result of internalizing the practice of the first community-of-practice, the family, and other communities-of-practice (including in education) in the lived experience, develops a tacit knowing of the world as they know it. Actions acquire their meaning in relationship to prior and

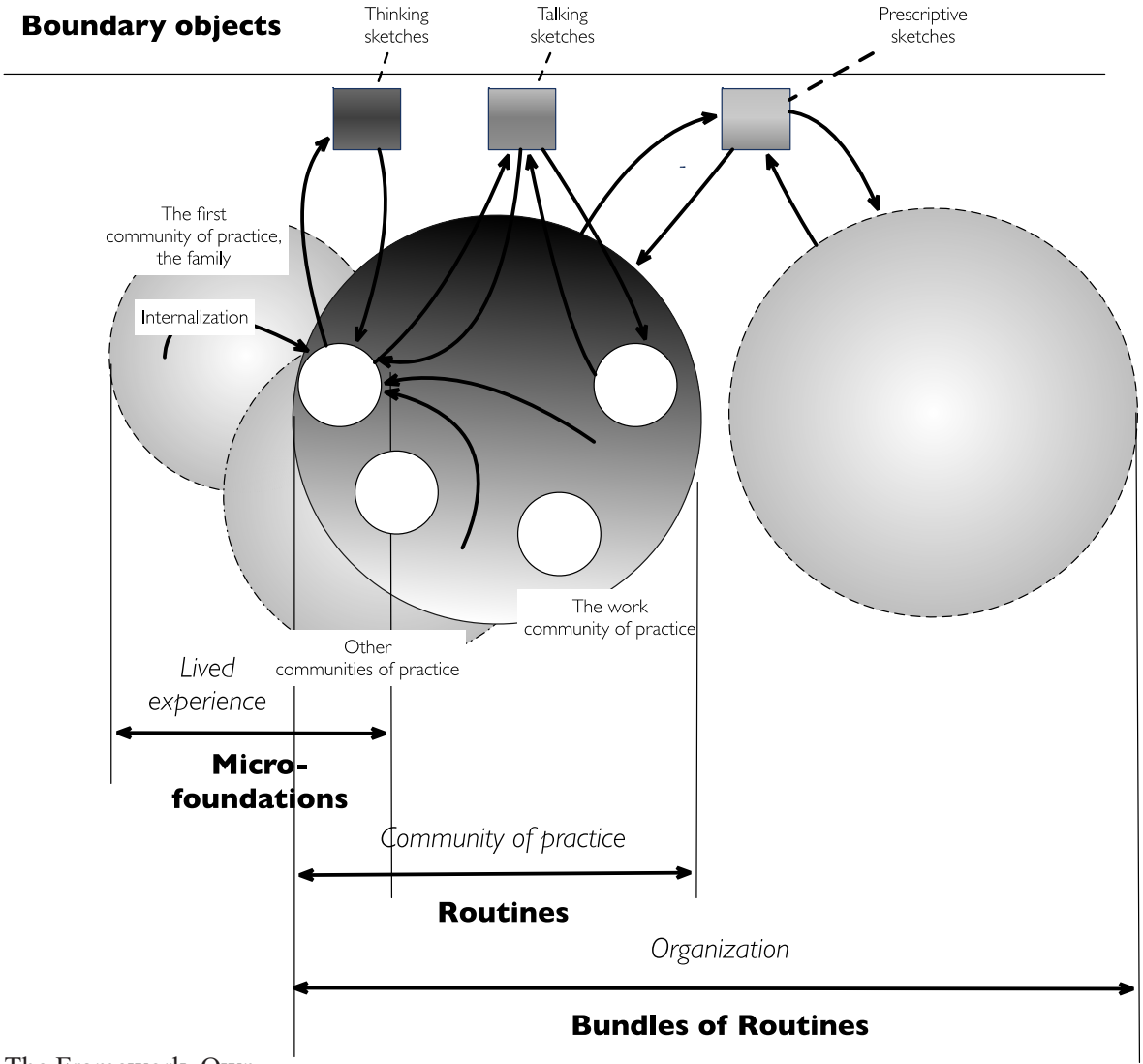

Figure 2. The Framework, Own

subsequent actions (LeBaron, Christianson, Garrett, & Ilan, 2016).

To externalize the tacit knowing and negotiate a common meaning in the professional community, the team, and other members of the team need mediators, in the form of sketches, prototypes, gestures, symbols, and a probing discourse. Going outside of the community-of-practice of the team the team needs other boundary objects to effectively communicate with people, who don't share the team's common understanding.

When negotiating meaning within the community of practice, the tool needs to be constructed with an understanding of the other, empathy, as a conduit; cf. talking sketches (Ferguson, 1992; Van Der Lugt, 2005). The learning within the community of practice is consequential of the quality of the dialogue, collaborative sketching, and experimental work in the community of practice. The negotiating of meaning normally results in the individual's need to reconcile the "truce" (Nelson & Winter, 1982) with tacit knowing – or to re-negotiate.

To negotiate a common meaning with other communities of practice in the organization at large, the dialogue takes place over boundary objects (Boland Jr. & Tenkasi, 1995), or talking sketches (Ferguson, 1992; Van Der Lugt, 2005. Boundary objects are at once temporal, based in action, subject to reflection and local tailoring, and distributed throughout all of these dimensions (Star, 2010).

When an individual identifies an anomaly in the output of a part of the routine, not perceived as the mere result of faulty performance, they try to use (1) explicit knowledge or (2) tacit knowing to formulate the problem (problem probing). When the problem is recognized as new and not resolvable based on earlier experiences, (3) the individual must take the problem to the community of praxis. In many cases (3a) the existing explicit knowledge of the group, or (3b) the tacit knowing of some member of the group can frame the problem and eventually solve it. Conversely, when the problem is genuinely new, it is difficult for the individual not only to formulate, but to describe the problem. They must first dialogue with themselves, by means of thinking sketches, even to be able to try to give meaning to what they sense. In most cases this process is not straight-forward, and they must revise it in a series of thinking sketches – (4) the final of which is becoming a talking sketch, when presented in the community of practice to dialogue around; to negotiate a common meaning in formulating the problem. As is the case for the individual, it will usually require a series of talking sketches made by the original identifier that there is a problem, or by other members of the community of practice. (5) Finally, if the dialogue is successful, the problem is formulated in a prescriptive sketch, a "boundary object", that is used to mediate, to negotiate a common meaning in multiple communities of practice in the organization, often including the organization's commitment of resources to resolve the identified problem.

As a consequence of our framework, we hold that:

a. Learning in organizations occurs when teams, communities of practice with a common task, discover glitches in routines.

b. Analysis implies that teams not only solve problems, but formulate them, and probe for them.

c. To learn, teams must develop boundary objects, in sketches, prototypes, symbols, gestures, and language.

d. Boundary objects are necessary tools to externalize tacit knowing, in negotiating common meaning of hitherto unarticulated experiences.

e. Common intentionality is a prerequisite for learning.

Conclusion

The implications of the need of boundary objects to externalize tacit knowing are fundamental to the understanding of organizational functions regarding knowledge and innovation. Teams that meet the conditions discussed here, can identity incongruities, learn what problem(s) these result from and thus innovate the routines to manage a changing world or create new offerings.

Sensory-rich and extensive experiences build tacit knowing, with potential to create innovations. Extensive means experiences in many communities of practice, different cultures, and physical environments. Sensory-rich experiences allows a more complex network of synapsis that relates different experiences, and makes it possible to retrieve experiences from non-active memory.

To build on tacit knowing to create new knowledge, the individual must create a virtual other in the form of a boundary object, to play with the implications of ideas that occur from the synapsis between seemingly unrelated experiences. Based on Ferguson (1992), we call such a boundary object thinking sketches. However, the thinking sketch is still completely embedded in the individual's tacit knowing.

To externalize the tacit knowing the individual, after a series of sketches, presents the most developed idea in the form of a talking object in her community of practice. Both

to negotiate meaning and to provoke the externalization of other team members tacit knowing. The dialogue around many team members' talking objects, leads to a negotiated meaning in the form of externalized knowledge; the team's knowledge.

Communicating outside the community-of-practice, with the organization at large or with the public, requires a prescriptive sketch, the object of which is not to develop the idea, but still to communicate to people's tacit knowing, as it represent new knowledge, which cannot necessarily be readily understood in the context of their existing knowledge.

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