EXTENDING NONAKA'S KNOWLEDGE CREATION THEORY:

HOW WE KNOW MORE THAN WE CAN TELL
& TELL MORE THAN WE CAN KNOW

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Key words: knowledge creation, epistemology, Polanyi

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How we know more than we can tell & tell more than we can know

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Abstract

Nonaka and colleagues propose a theory of knowledge creation grounded in the epistemology of Michael Polanyi. Hence, acknowledging that much knowledge is tacitly created and difficult to articulate, they focus on tacit knowledge externalization, i.e. how the tacit knowledge of individuals may be transformed into more readily communicable organizational knowledge. However, both Nonaka (and colleagues) and Polanyi tend to leave part of the epistemology of collaborative knowledge creation unaccounted for. As a remedy we introduce the notion of knowledge as "unfathomable" (Bartley, 1987), rooted in the Popperian idea of "objective knowledge" (Popper, 1972). Once created, such knowledge has something of a life of its own, pregnant with possibilities for further development and use – to be explored collaboratively in market-like processes. In a sense we may thus "tell more than we can know" (Lindkvist, 2005). While the Polanyi (1966) maxim "we know more than we can tell" has intrigued Nonaka to consider how we could convert tacit knowledge into explicit knowledge, this complementary maxim points more clearly to the potential for future use that follow from knowledge's own unfathomable dynamic. Finally, we outline how the epistemological maxims of saying 'less' and 'more' than we can know, complement each other and suggest a summarizing 'knowledge generator' model.

INTRODUCTION

It is a fact that we often "know more than we can tell" (Polanyi, 1966). We may know how to play the piano, ride a bike or swim and yet be unable to verbalise our knowledge in a very precise manner. While it would be wonderful to attain the skills of expert pianists by just talking to them, this must remain a dream. However, it could also be that we "tell more than we can know". As teachers soon realise, what they say is seldom what students have learnt. Sometimes this difference is something regrettable, but it may also benefit the generation of new, interesting ideas – far beyond the imagination of the teacher. These examples serve to illustrate that, in everyday life, we cannot (and often need not) tell others what we know and that, when we speak, we do not know what we say.

In the world of firms and organization, where people typically interact subject to demanding norms of efficiency and innovativeness, the above quandaries raise a question of how communicative interaction and knowledge work bring about collective effort. More specifically, we wish to explore the epistemological basis of knowledge creation in such settings. In so doing, we take a point of departure in the works of Nonaka and colleagues. Their pioneering way of placing the epistemology of Polanyi at the centre court has lead them to suggest how tacit knowledge may be made explicit, thereby facilitating communication, and even to suggest a novel theory of the knowledge-creating firm. Thus, for Nonaka (1994, p. 20), "tacit knowledge held by individuals … lie at the heart of the knowledge creating process", which turns the conversion of such personal, tacit knowledge into useful organizational knowledge into the main problematic. Moreover, Nonaka (1994, p. 24) suggests that "the cross-functional team … serves as the basic building block for structuring the organizational knowledge creation process" in firms. In this paper, we take this appreciation of knowledge creation in such teams as a datum. While our basic concern is about more general epistemological matters, knowledge work in a project team context will be our empirical focus throughout the paper.

Based on our analysis, we conclude that both Nonaka (and colleagues) and Polanyi tend to leave part of the epistemology of collaborative knowledge creation unaccounted for. As a remedy, we introduce the notion of knowledge as "unfathomable" (Bartley, 1987), rooted in

the Popperian idea of "objective knowledge" (Popper, 1972). Once created, such knowledge is seen as having something of a life of its own, pregnant with possibilities for further development and use – to be explored collaboratively – in ways which are unimaginable and unfathomable. As discussed in Lindkvist (2005), this second view of knowledge would rather suggest the epistemological maxim "we tell more than we can know".

OUTLINE OF ARGUMENT

In a first section, we present a very brief, sensitizing, account of how the issue of knowledge integration and creation have been conceived in the team and project organization literature. In a second section we show how Nonaka (and colleagues) utilize the epistemology framework of Polanyi in featuring what goes on in such settings. We here assess how their conceptions mirror that of Polanyi, in particular regarding the much debated issue of tacit knowledge externalization[1]. We then listen to Polanyi, searching for useful epistemological material on 'knowledge creation' and 'externalization', accounted for and unaccounted for by Nonaka (and colleagues). We conclude this section by suggesting that there is still a need for additional epistemological grounding of such processes. We then introduce the notion of 'unfathomable' knowledge and discuss how it helps to illuminate interactive knowledge processes in projects. Finally, we outline how the epistemological maxims of saying 'less' and 'more' than we can know, complement each other and suggest a summarizing 'knowledge generator' model[2].

KNOWLEDGE CREATION IN PROJECT TEAMS

A cross-functional team comprises members, with different specialist competences, who have to manage a task or achieve a certain goal within limits set as to time and costs. Own studies of project-based product development in the telecom industry (Lindkvist et al, 1998), the packaging industry (Lindkvist, 2004) and the warehouse equipment industry (Enberg et al, 2006), as well as the famous development of a bread-making machine in Nonaka and Takeuchi (1995), exemplify such contexts, calling for a significant amount of new knowledge creation. Apparently, the diversity of team member specialisms, should provide fertile soil for creativity and innovation (Sydow et al, 2004; DeFillippi et al, 2006). However, the downside of functional diversity is that it renders the process of knowledge integration more difficult. Hence, investing in "constructing, articulating and redefining shared beliefs" as suggested by Huang & Newell (2003, p. 167), may well pay-off. As argued by Carlile (2004), the existence of common knowledge is a vital precondition for people to be able to share and assess each other's domain-specific knowledge.

Grant (1996) however, warns that transfer of knowledge between organizational members may be exceptionally difficult and costly, in particular when most of the relevant knowledge is tacit. Instead, the knowledge integration issue should be solved by choosing appropriate organizational mechanisms. Thus, whereas contingencies such as minimal interdependencies and limited complexity allow for the use of cheap mechanisms such as rules, roles and routines, severe "team interdependencies" (Van de Ven et al, 1976) would call for expensive and communication-intensive mechanisms, such as "group problem solving and decision making" (Grant, 1996, p. 114). While this view is framed in a knowledge integration terminology, it would no doubt implicitly cover also the creation of new knowledge. Other authors, such as Hargadon and Bechky (2006), specifically adhere to a knowledge creation terminology in analyzing knowledge processes in project teams. In their model they suggest that four types of social interaction (help-seeking, help-giving, reflective reframing and reinforcement) that precipitate the creative recombination of existing, 'old' ideas.

Hence, the issue of knowledge creation in cross-functional teams or projects has received some attention. The approach taken, however, seems predominantly to be organizational, i.e. to suggest appropriate organizational mechanisms or processes. As it seems, not much is written about what kind of epistemological issues might be involved in such contexts. As said before, Nonaka and colleagues are among the few who take on this challenge we now turn to their knowledge creation theory. As their framework is often reiterated in the literature, our visit will be highly selective and pinpoint features that are related to its epistemological grounding - or lack thereof.

NONAKA ON KNOWLEDGE CREATION – IN PROJECT TEAMS

- Locus of the creative force

In their view of knowledge creation, Nonaka (and colleagues) identify two types of actors, individuals and organizations, with slightly different, but interrelated roles. Their division of labour is stated by Nonaka (1994) as follows: "It is argued that while new knowledge is developed by individuals, organizations play a critical role in articulating and amplifying that knowledge" (p. 14). The first part of this sentence clearly recognizes its heritage in the epistemology of Polanyi, which places an utmost importance onto the creative powers of the individual. Like Polanyi, they also recognize that much or most of that people know is only tacitly known, and the famous Polanyi (1966) maxim "we can know more than we can tell" (p. 4) is explicitly referred to. Such tacit knowledge is seen as personal, deeply rooted in action and commitment, involving both body and mind; "tacit knowledge is highly personal and hard to formalise" (Nonaka et al, 2000, p 7).

However, for Nonaka (and colleagues), there is also a role for the organization, in 'articulating and amplifying' the knowledge created by the individuals. In fact, the whole framework suggested by Nonaka (and colleagues) is advertised as being about 'organizational knowledge creation'. This is a bit surprising considering, as we shall see, Polanyi's insistence that all new knowledge is tacitly created by individuals. If so, it would appear that Nonaka's famous Seci-model, is actually an "engine" for managing knowledge that in a sense is already created, i.e. for converting that knowledge into forms that are useful in an organizational context. So, while the Seci-model, portraying the creation of new knowledge as resulting from a continuous dialogue between tacit and explicit knowledge, we should be cautious in forging a strong link to the epistemology of Polanyi. Of course this does not demerit the model as such, but raises the question of how Nonaka (and colleagues) think about knowledge creation in the various modes of conversions taking place in the "engine".

The Seci-model identifies four knowledge conversion modes, i.e. socialization (from tacit to tacit), externalization (from tacit to explicit), combination (from explicit to explicit) and internalization (from explicit to tacit). Ideally, all modes should be in place to accomplish a well-functioning "spiral" of knowledge creation. While each of the modes is supposed to have the capacity to create knowledge separately, two of them do not rely on 'dialogue' between tacit and explicit knowledge. Nonaka (1994, p. 20) also clearly points out that both combination and socialization have demerits. For him, pure combination, is merely a matter of putting well-known things together, as when a "comptroller of a company collects information from throughout the organization and puts it together in a financial report" Nonaka (1991, p. 99). Such a process would thus not involve tacit knowing or personal knowledge. Thus, it would "not really extend the company's knowledge base either" (p. 99).

Pure socialization, on the other hand, would instead be impaired as the 'sharability' of knowledge created may be difficult to apply in fields beyond the specific context in which it was created (Nonaka, 1994, p. 20). Hence, on its own, "socialization is a rather limited form of knowledge creation", says Nonaka (1991, p. 99). Moreover, scant attention is paid to the internalization mode, which in common with the above two modes, is seen as already rather well covered in extant literature. This means that it is the externalization mode that is of prime interest if we wish to create new knowledge. Thus for Nonaka, "tacit knowledge held by individuals … lie at the heart of the knowledge creating process" (1994, p. 20) which turns the transformation and amplification of the individuals' tacit knowledge into useful organizational knowledge into the main problematic.

> Among the four modes of knowledge conversion, externalization holds the key to knowledge creation, because it creates new, explicit concepts from tacit knowledge. (Nonaka and Takeuchi, 1995, p 66)

-A two-step externalization process

As pointed out initially, Nonaka (and colleagues) relies strongly on (self-organizing) teams to bring about the lion's part of the knowledge creation that takes place within firms. Moreover, as we have just seen, out of the four 'boxes' of the Seci-model, it is first of all the externalization phase that is associated with a significant power in that respect. Projects thus serve as a social context, or a "field" of interaction, where individual perspectives may be articulated and turned into higher-level concepts.

> In the business organization, the field for interaction is often provided in the form of an autonomous, self-organizing "team" made up of several members coming from a variety of functional departments. (Nonaka, 1994, p. 23)

Referring generally to previous observations, he also states that successful project teams in Japanese firms tend to comprise 10-30 members, out of which 4-5 members are "core" members with a longer and more diversified experience. Hence, it would appear that the kinds of teams he has in mind are fairly similar to the ones mentioned earlier. For Nonaka (and colleagues), projects provide a field of interaction where we should expect to find the most potent triggers of knowledge creation. Projects, it is assumed, do this through two (largely sequential) process phases.

1. In the first phase, projects facilitate the building of mutual trust and accelerate the creation of an implicit perspective shared by members as tacit knowledge. Shared experience is here seen as a key way of building trust, while at the same time such practicing together facilitates the creation of common (but still tacit) perspectives.

> … tacit knowledge can be acquired only through shared experience, such as spending time together of living in the same environment (Nonaka et al, 2000, p 9).

As pointed out by Nonaka (1994, p 19), such processes of sharing tacit knowledge may well proceed silently; "One important point to note is that an individual can acquire tacit knowledge without language". As it seems, this idea is closely paralleling the 'communities of practice' idea (Wenger, 2000), with its reliance on socialization to bring about tacit knowledge transfer and knowledge base similarity among its members (Lindkvist, 2005). Nonaka et al (2000, p 15), however, state that the communities of practice idea has little to do with the creation of new knowledge, since it merely refers to places "where members learn knowledge that is embedded in the community". Yet, it seems that both conceptions basically re-iterate well-known practices of 'enculturation' processes, enabling the transfer of tacit

knowledge and bringing about homogeneity of knowledge, but say little about the creation of new knowledge. In practice, of course, socialization or enculturation processes may bring along all sorts of new ideas, but this is quite another matter, unaccounted for in the frameworks as such. Hence, this first phase is mainly a kind of preparatory phase, and we should now rush to the second one, where Nonaka and colleagues approach knowledge creation as externalisation.

2. In the second phase, the now homogenized tacit knowledge, shared among team members, need to be put into words through dialogue. Face-to-face communication among persons is here put forward as a main recipe for developing these conceptions. This idea is substantiated with reference to well-known ideas about the virtues of such interaction as well as a set of rules which should be beneficial to bringing about a good dialectic process. More generally, Nonaka (1994) claims that induction and deduction are of limited use here, where radically new concepts should to be created. Instead he advocates the use of abduction, which is seen as a reasoning process which centres on the use of metaphors – stating that "it is very useful to pursue creative dialogue and to share images through the metaphorical process of merging perspectives, i.e. tacit knowledge" (p. 25). Judging from this rather convoluted statement, Nonaka and colleagues think highly of the use of metaphors as a way to trigger a 'merger' of team members' tacit knowledge that will result in novel higher-order concepts. This appreciation of the role of metaphorical thinking is hardly something many would deny, albeit many would probably not forge such a close link to abduction. The idea of metaphor is also central to Nonaka and colleagues in another way – as a way of conceptualizing what comes out of the externalization phase. In Nonaka and Takeuchi (1995, p. 66) they present the following quote from Nisbet (1969) as evidence – "much of what Michael Polanyi has called tacit knowledge is expressible - in so far as it is expressible at all – in metaphor". So, for Nonaka and colleagues, knowledge creation is not only a metaphor-driven process; it is also the case that the knowledge that is created has the nature of metaphor. Hence, the newness to be associated with externalization may be seen a matter of converting what is tacitly known into a "new" metaphor.

In conclusion, face-to-face communication and the use of metaphor, analogy and models is no doubt a major feature of what goes on in projects. Moreover, while promoting a good dialogue and engaging in abductive thinking may well be advisable, these recipes appear to have little to do with tacit-explicit knowledge interactivity or Polanyian epistemology. Hence, there is a need to continue our search for an epistemology of knowledge creation as a collective process. We now turn to Polanyi himself, to get more food for thought, and we start by letting him speak largely un-interrupted.

LISTENING TO POLANYI

-Knowledge creation is always a process of 'tacit knowing'
For Polanyi, the idea of tacit knowing is grounded in his view of our human faculties, and more specifically in our tacit powers of shaping and integrating knowledge, "the great and indispensable power by which all knowledge is discovered, and once discovered, is held to be true". (Polanyi, 1966, p 6). These powers are deeply rooted in the constitution of our mental faculties and, as such, skilfully made us of already early on as shown below regarding our way of learning to read and write.

> Remember also how readily and well children learn to read and write, compared with hitherto illiterate adults. There is enough evidence here to suggest that the highest powers of an adult may not exceed, and perhaps actually fall short of those of an animal or an infant …. (Polanyi, 1959, p. 19).

So, while certainly an adult may perform better than a child (or an animal), this is rather due to their greater experience and cultural equipment than differences in tacit powers. Genius, he continues, would then "seem to consist in the power of applying the originality of youth to the experience of maturity" (p. 19).

What is remarkable is that Polanyi so strongly underlines that all knowledge is tacitly created. While Polanyi (1958, p. 70) does acknowledge that "the acquisition of formal instruments of thought" in society has brought about an enormous increase of aggregate mental powers, he sees our tacit knowing as their sole origin. "Fundamental novelty can only be discovered by the same tacit powers which rats use in learning a maze" (Polanyi, 1959, p. 18). It is clear, says Polanyi (1958, p 83), that the mere manipulation of symbols does not in itself supply any new information, but is effective only because it assists the inarticulate mental powers …". In the process of new knowledge creation, our articulate intelligence is thus subordinated to our inarticulate intelligence.

> Words convey nothing but a previously acquired meaning, which may be somewhat modified by their present use, but will not as a rule have been first discovered on this occasion. In any case our knowledge of the things denoted by words will have been largely acquired by experience, in the same way as animals come to know things, while the words will have acquired their meaning by previously designating such experiences, either when uttered by others in our presence or when used by ourselves. (Polanyi, 1958, p. 92).

Formal language is thus a tool or an "instrument skilfully contrived by our inarticulate selves for the purpose of relying on it as our external guide." (Polanyi, 1958, p. 131). Our whole articulate equipment, then, is 'merely' a tool-box, a supremely effective instrument for deploying our inarticulate faculties (Polanyi, 1959, p. 25). We should also recognize its lack of precision in accounting for our knowledge – and "strictly speaking nothing that we know can be said precisely" (1958, p. 87-88).

Yet, language allows us to profit from information received at 'second hand' and from the 'communications of the dead', which certainly increases our mental powers (Polanyi, 1959, p 24). In fact, the 'educated mind', will develop its conceptual framework mostly by listening and speaking, and this will usually entail decisions to use words in a novel fashion, says Polanyi (1958, p. 104-5). With reference to Piaget, he notices that the subsumption of a new instance under a previously accepted conception would be a matter of *assimilation*; whereas *adaptation* would signify the formation of new or modified conceptions. While the first type of process is merely a routine performance, the second is a heuristic one akin to poetic phrasing and work of art. This idea of thinking about words and language as basically works of art is carried forward in Polanyi and Prosch (1977, p. 75-81), where the use of metaphor is extensively analysed and appreciated as a most powerful way of moving and intriguing us. Again, it is the formidable tacit powers (of integrating clues into a focal whole) of individuals that enable them to make sense of ever so linguistically complex and poetically sparse metaphor expressions. Hence, his discussion about 'listening and speaking' is presented predominantly from the perspective of how an individual may benefit from engaging in such processes. While, processes of interpersonal communication are certainly implied in a background fashion, they are not put up-front.

In sum, Polanyi thinks highly of our tacit knowing or thinking abilities and presents them as the sole source of new knowledge – of knowledge creation. Moreover, what we tacitly know is known with greater precision than that what we know explicitly. Yet, he also recognizes that "we can critically reflect upon something which is explicitly stated, in a way that we cannot reflect on our tacit awareness of an experience." (Polanyi, 1959, p. 14). We turn next to the possibilities of making that what is hidden from us, explicitly recognized.

Tacit knowledge need not be ineffable knowledge
While man's "capacity to think" is his most outstanding attribute (Polanyi, 1959, p 14), constitutive of our ability to create new knowledge, we need also recognize that our attention-focusing capacity is severely limited. To be able to focus on a certain phenomena or problem we rely on our tacit powers to provide the complementary background knowledge, i.e. the kind of integration of particulars that is relevant in providing meaning to the comprehensive entity we attend to. As phrased by Polanyi (1966, p. 13), "… we comprehend the entity by relying on our awareness of its particulars for attending to their joint meaning". We may know a person's face, and recognize it among a thousand, indeed among a million, Polanyi explains, and yet we usually cannot tell how we recognize a face. We know the face by attending to it, and we know the face-producing particulars by relying on our tacit awareness and integration of them. Thus, to know a face is to know the comprehensive entity and the tacit 'particulars' that builds the face. In recognizing and knowing a face as a specific person's face, we simultaneously attend *from* (or disattend) the particulars *in order to* attend *to* the face. Hence, as phrased by Polanyi, all our thinking and knowledge creation has a from-to-structure. Tacit knowing, thus functions as a teleological tool, something we use in order to achieve something else.

In approaching the basic question of whether tacitly known particulars may be explicitly specified, it is important to make a distinction between two kinds of 'unspecifiability'.

> One type is due to the inability of tracing the subsidiaries – a condition that is widespread but not universal; the other type is due to a sense deprivation that is *logically* necessary … (Polanyi & Prosch, 1977, p. 39).

Among them, the second-mentioned 'logical unspecifiability' may be illustrated by what happens as we practice as skill. As we engage in riding a bike, playing the piano, or swimming, we have to rely of our tacit integration of relevant subsidiary particulars, or put differently, observe "*a set of rules that are not known as such to the person following them*" (1958, p. 49). Yet, this only means that the two forms of awareness - from-awareness and focal-awareness – are mutually exclusive. When we are focally aware of something we must attend-from the particulars, and know them only tacitly. From this follows merely that the tacit particulars, at the time they are put into active use, are inaccessible to us; but our inability to simultaneously attend to particulars while carrying out certain performances, does not imply ineffability. Indeed, we may state as a corollary to this type of logical unspecifiability, that what functions as tacitly known particulars in one situation - might be specifiably known or the focus of attention - in another situation.

But unspecifiability may also be a matter of our inability to trace the particulars – simply because we do not know them. Apparently, to find the particulars in practical settings – where the knowledge of individuals is both tacit and personal – is typically no minor challenge. For Polanyi, tacit knowing is also a process of personal knowing. Tacit awareness is not something that comes with observation or perception per se, but instead a matter of 'indwelling', where particulars become interiorized and integrated with the persons body and

personality; "we incorporate it in our body – or extend our body to include it – so that we come to dwell in it" (1966, p. 16). Our tacit knowledge is thus very much the outcome of our attempts at tacitly making sense of our own experiences, of our way of reorganizing our experience as to gain intellectual control over it, in brief, in our understanding of it (Polanyi, 1959, p. 20). However, his or her integrative powers must also rely heavily on the experiences and achievement of their predecessors. And although language has its demerits, it is likely to be a main repository of knowledge accumulation of those that came before us, says Polanyi (1966). Our own experience is both limited and fragmented and must therefore merge with tradition to enhance our tacit creative powers. As easily realized, a complete and accurate specification of life-long learnt personal knowledge will be something of a job for Sisyfos.

Yet, while this second-type unspecifiability is a widespread condition, it is not seen as universal. This should encourage us to take a closer look at what are the chances of hitting at least some luck in tracing particulars in practical settings. As it seems, Polanyi is quite interested in this issue and while he surely acknowledges that severe difficulties may prevail, he also presents quite a few examples which signifies a non-neglible amount of optimism regarding such tracing endeavours. Returning to the example of tacitly knowing a face, Polanyi (1966) notices, that the police has recently introduced a method by which we can 'communicate much' of this knowledge. (p. 4). Similarly, in the context of machine operation, tacitly known skills may not be immune to analysis. Here, the ability to operate a machine in a skilful manner may be due to set of tacitly integrated particular, achieved by the "usual process of unconscious trial-and-error by which we *feel our way* to success and may continue to improve on our success without specifiably knowing how we do it …" (Polanyi, 1958, p 62). However, the operator's actions may also be understandable, by an engineer, in terms of explicitly stated relations of bodily movements that mirror the prevailing set of machine particulars.

Analysis and the search for particulars, however, will tend to be a destructive means, depriving the particulars of their meaning as illustrated in Polanyi's (1966) piano playing example. Knowing how to play piano excellently is something intimately related to the pianist, and something this person manages to do without knowing explicitly what produces its admirable artistic features. Should the pianist try to attend to the particulars, e.g. by attending to the fingers, this could easily have a paralyzing effect and turn artistic work into something which is mechanical at best. Focusing on particulars, means depriving them of the meaning they had as they served as subsidiaries. However, they may also be tacitly re-interiorized and reintegrated, as when the pianist's fingers are used again with his mind on his music. Such destruction and re-integration is for good or bad. It is a risky undertaking, and will of course never be undone, but it may also lead to improved performance.

> this recovery never brings back the original meaning. It may improve on it. … But the damage done by specifying the particulars may be irremediable (Polanyi, 1966, p 19)

Particulars may also be explicitly reintegrated, recovering their meaning, which was destroyed by focusing our attention to them, says Polanyi (1966, p 19). Taking the case of machine operation, Polanyi explains how sometimes an engineer's understanding of its construction and operation could provide insight far beyond that of tacit integration. Similarly, he states that the physiologist's theoretical knowledge, is far more revealing than our practical knowledge of our own body, and that the formal rules of prosody may deepen our understanding of a poem.

In sum, we should recognize that our tacit knowledge is not immune to analysis. Focusing on the particulars and their relation to a comprehensive entity, is a conceivable, albeit a risky undertaking. Trying to specify the particulars can sometimes reveal significant parts of our tacit knowing, as indicated by police and engineer technology examples. Furthermore, reintegration can sometimes be achieved, tacitly or explicitly, and while explicit integration certainly cannot replace its tacit counterpart, it may sometimes, by involving highly skilled intellectuals, provide profound insight – in science as in the field of prosody. So, while we "know more than we can tell" – as we rely on our tacit powers – we may also sometimes be able to say something about that what we tacitly know – as we refocus our attention.

A NEED FOR EMPOWERING THE 'ENGINE'

As we have seen, both Nonaka and colleagues and Polanyi provide a rather individualistic account of knowledge creation. While the role of individuals is to create knowledge, the role of the organization is to articulate and amplify it, says Nonaka (1994). A similar view is expressed by Simon (1991), in noticing that all learning "takes place within human individual heads …" (p. 125) and by Grant (1996), favouring the idea that "knowledge creation is an individual activity" (p. 112). Polanyi strongly underlines that our tacit powers lie behind our abilities to 'shape and integrate' particulars into meaningful wholes. For him, without these individual processes of tacit knowledge creation there would actually be no production of 'raw material' for further elaboration. Yet, we should observe that these individual level processes, which constitute the prime focus in the writings of Polanyi, are not a part of Nonaka's famous 'engine' – which is about organizational knowledge creation.

For Nonaka (1994), cross-functional project teams have a central role as knowledge creation arenas within firms. Their creational activities, it is assumed, comprises two largely sequential phases. The first (socialization-like) phase is featuring 'shared experience' as the only way of acquiring and sharing tacit knowledge. This view, however, is not entirely in line with the view of Polanyi, who thinks of personal knowledge as an amalgamation of the individual's own limited and fragmented experiences and the knowledge accumulation that inhere in tradition. But more importantly, the growth of knowledge in this preparatory phase seems clearly limited.

In the second (externalization) phase, starting when the team has reached enough homogeneity of tacit understandings, the individuals should try to convert this communal knowledge into explicit knowledge and conceptions. For Nonaka, it is the systematic use of metaphor, analogy and models that hold the key to externalization, and as it seems new metaphors are also the outcome proper of such processes. Such new conceptions may thereafter be subjected to justification efforts at super-ordinate levels of the organisation; but this next stage is beyond the scope of this article. Hence, the parts of the engine that are of prime importance to knowledge creation in his project teams are thus socialization and externalization – but apparently not combination. This exclusion may come as a surprise as many think of combination as a way of promoting 'synergy' and knowledge increments. However, as discussed earlier, for Nonaka, combination is a very simplistic process of putting together pieces of explicit knowledge, without any involvement of the individuals' tacit and personal knowledge. Such a conception of combination is thus not very Polanyian, in that it contradicts his view that all our thinking has a from-to structure and that thus all explicit knowledge relies on a tacit counterpart.

Yet, in an overall sense, there is considerable unity in the way which Nonaka (and colleagues) and Polanyi think about articulation/externalization. While both believe that moving from tacit to explicit knowledge may be a difficult journey, none of them rule out that this may sometimes be a possible and a worthwhile undertaking. We should notice though that Polanyi's idea of personal knowledge is not only a matter of the person's own experience and tacit talents within a specific craft or intellectual field. Being a member in a number of socialities, such as the society, a firm, a project team, etc, also means that the individual will 'dwell' into and commit to a number of traditions. Much of such tacit knowledge is acquired as life-long learning and as such it could be deeply rooted in the individual; this part of tacit knowledge appears next to impossible to put into words. With reference to Collins (2007) we could thus differentiate between somatic-limit tacit knowledge and collective tacit knowledge. The first type then refers to knowledge that is tacit due to our limited cognitive abilities to operate on explicit knowledge, i.e. because of the way humans are made.

> The point is that the rules of bike-riding, as described by Polanyi, are not tacit because they cannot be formalized, but because they cannot be made use of by humans when they ride bikes. … Imagine that our brains and nerve impulses were speeded up a millionfold! Perhaps we would then be able to follow the formally expressed rules. Or, consider the complement of this: suppose we slowed everything down enormously. (Collins, 2007, p. 258-9)

Such knowledge, Collins contends, can often be converted into explicit rules; for example, bikes-riding robots do exist. Collective tacit knowledge, on the other hand, refers to the kind of social sensibility and improvisational abilities that can only be acquired through social embedding in the society, something machines may never imitate. While somatic-limit tacit knowledge has to be tacitly known by individuals due to the *limitations* of their brains and bodies, it is the unique *possibilities* of their brains and bodies that allows acquisition of tacit knowledge from various socialities (Collins, 2007).

It would appear that it is this kind of somatic-limit tacit knowledge that Polanyi has in mind as he discusses how modern technology may help the police or when he talks admiringly of the deep insights into machines and bodies that may flow from the use of experts. In conclusion, conversion of such more 'technical' tacit knowledge appears as a possible task for both Nonaka (and colleagues) and Polanyi. Tracing of such hidden particulars could well be something that firms find it reasonable to spend money on, as illustrated by Nonaka's bread-making machine project.

Both Nonaka and colleagues and Polanyi also preferable visit linguistic literature for guidance regarding how tacit knowledge may be made explicit. Both also strongly idealize metaphorical thinking and metaphors as a deus ex machina for offering a comprehensive shorthand explicit expression of (loads of) highly complex tacit understandings. Finally, they are similar in that neither of them says much about how new knowledge can emerge out of interpersonal communication and interaction. Nonaka and colleagues do refer to general organization theory literature regarding the virtues of face-to-face communication, dialogical interaction, etc. But in doing that, they do not relate their discussion to the ideas of Polanyi, nor do they ground them in any other basic epistemology.

So, inspired by the discussion on articulation in Polanyi, Nonaka's engine is constructed to mainly perform 'conversion', that is to convert the communal tacit understandings from phase one into powerful explicit conceptions, and then preferable as metaphors. And while metaphors no doubt bring potent fuel to Nonaka's 'engine', a singular focus on catching tacit

knowledge in such abbreviated form, may distract our attention from other kinds of fuel, less associated with the personal knowledge of individuals. Bartley is interesting here as he discusses knowledge of the opposite kind, i.e. non-personal knowledge, with something of a life of its own as it is proliferates during processes of interpersonal interaction.

BARTLEY'S UNFATHOMABLE KNOWLEDGE

-Knowledge set free

Where much of what people know is a matter of personalized tacit knowledge, organizations could find it difficult to make full use it. Converting such knowledge into explicit knowledge will then be a natural recipe to make it more 'organizational' and in a sense, less 'personal'. Such knowledge will be better suited for communication, interaction and be more readily manageable. Yet, as we have seen, the Polanyian epistemology does not provide much food for thought regarding the proliferation of such knowledge, nor does Nonaka and colleagues turn to other epistemologies that could further illuminate the interactive dynamics taking place in cross-functional teams.

In our view, taking a complementary point of departure in the notion of "unfathomable knowledge" as discussed by Bartley (1987, 1990), represent an interesting way of thinking about knowledge as a decidedly non-personal and autonomous thing. This notion is firmly based in Popperian epistemology, and in particular, the idea of 'objective knowledge' (see Popper, 1972). A basic idea is here that knowledge, once created, takes on a life of its own. While the generation of knowledge certainly involve 'knowing subjects', the knowledge produced takes on the character of 'objective knowledge', i.e. something which is freed from its creators into an exosomatic artefact. From there on it loses its relationship with specific knowing subjects and may enter its own developmental trajectory. Thus, once put forward, the authors lose control of their theories.

> Bodies of knowledge, while created and explored by men, do not bend and yield like slaves to those who would create and master them. ... After their birth, bodies of knowledge remain forever unfathomed and unfathomable. They remain forever pregnant with consequences that are unintended and cannot be anticipated. (Bartley, 1987, p. 32)

Obviously, it would be in vain for authors to try to spell out the ramifications of their theories. What happens to them will depend on what others do with them in the future. New ideas may die in silence or give great inspiration to further theorizing, as could be exemplified by the fate of Einstein's theories. Such consequences are both unforeseeable and unimaginable and far beyond the reach of the intentionality of knowledge producers. As explained by Bartley this takes us beyond ordinary (Popperian) fallibilism which asserts that we can never know anything with certainty and that the thing called knowledge can only represent our best guesses for the time being. The idea of unfathomable knowledge also implies that we cannot even know or understand our existing theories. Even the creators of theories and hypotheses do not and cannot understand them, which taken to the limit means that "*we do not know what we are saying or* (since of course we act partly in terms of what we know) *what we are doing*" (Bartley, 1987, p. 33)

What is interesting about objective or unfathomable knowledge is thus that it is pregnant with future possibilities for being understood or utilized in some way that has not yet been imagined. In a sense we may thus "tell more than we can know" as suggested by Lindkvist (2005). While the Polanyi (1966) maxim "we know more than we can tell" has intrigued

Nonaka to worry about how we could convert tacit knowledge into explicit knowledge, this complementary maxim points more clearly to the potential for future use that follow from knowledge's own unfathomable dynamic. Below we return to our cross-functional project teams to spell out its empirical ramifications.

-Team interaction as key

A cross-functional team consists of people who know different things. This allows the team to expand its knowledge base and reap the benefits of specialisation. While certainly some common ground is called for (see Grant, 1996; Carlile, 2004), heavy investments in making individual knowledge bases similar, tend not only to be prohibitively costly and time-consuming, but also to counteract the mere rationale of cross-functional effort. In addition, where projects are fairly short and where a new mix of team members is assigned for each new project, people are forced to engage in "swift socialization" (Goodman and Goodman 1976; Meyerson et al., 1996) leaving little space for developing deep social relations. Hence, cross-functional teams of this kind may not become "well-developed groups" in the traditional sense with shared values, shared understandings, a shared knowledge base, in any strong sense (Weick and Roberts, 1993).

Although such a group is not so tightly knit, it still has to bring about a team effort, which is something different from a mere addition of individual efforts. This means that its member must be both willing and able to work as a self-organizing 'enquiring system'. Following Ash (1952; 251, 258) this presupposes that there are group goals that are "held and cherished" by the participants and that each of them have a "representation that includes the action of others and their relations". So, if members experience of sense of having a common destiny, know what others know and the relations between knowledge bases, self-organization processes may emerge. Yet, as is too well known, this is not always happening. Sometimes conflicts of interest, the abuse of power, and opportunistic behavior paralyze collaboration efforts. As for example shown by Weick (1990) regarding the cause of the Tenerife disaster, prevailing authority relations in the cockpit prevented the development of 'respectful' communication among crew members. And, similarly regarding the Mann Gulch disaster (Weick, 1993), although necessary knowledge for survival was available among the members, it was not used by the group as interpersonal relations were not developed enough for such communication to occur. Evidently, enabling a well-functioning process is associated with both cognitive and relational preconditions. To limit discussion, we below focus specifically on the cognitive side well aware that distrust and conflict may often constrain any effort of collaborative knowledge work.

As a result, we approach knowledge work in cross-functional teams, as primarily a matter of taking advantage of knowledge complementarities, guided by the principle of "well-connectedness of knowledge bases" (Lindkvist, 2005). Now, if 'connectivity' is key to achieving this it seems like knowledge which is possible to 'release' from its creator has its virtues. Our ability to use language, making our ideas exosomatic and explicit should then be appreciated (Popper, 1975). First, language makes possible collaborative investigation and criticism. Second, it also encourages story telling and creativity, something which is best illustrated within the field of science.

> It is one of the novelties of human language that it encourages story telling and thus *creative imagination*. Scientific discovery is akin to explanatory story telling, to myth making and to poetic imagination. (Popper, 1975, p. 78)

This view of language as a powerful resource in creating new knowledge, however, does not imply that we know what we say. As discussed earlier we cannot know what we say, in that we do not know how those listening to us interpret our statements, or what they and their followers in turn will make of it. As a result the idea content of what we say, once it is made an object outside of us, will start entering its own unfathomable trajectory. Hence, a good conversation could be one where,

> ... the meaning is open, being transformed by a recipient into a more interesting message than was anticipated by the sender. Precision destroys conversation; misunderstandings enrich it. (March and Weil, 2005, p. 59)

Communication thus benefits the circulation of set-free explicit knowledge among team members. Yet, it no doubt also promotes the mobilization and exchange of tacit knowledge. As we approach others and engage in communication, it is likely that we do not only wish to know their explicit theories, but it could also be that it is the (Polanyian) tacit particulars that we are after. Sometimes, we rather hope to find out how others think, than hear what they say, as we listen to how they speak.

-Team interaction as market-like

In cross-functional projects, where much ambiguity prevails, where deadlines are tightly set, team members rely heavily on processes of trial-and-error and spontaneous interaction and communication (Lindkvist, 2004). As people interact, they assumedly cannot know what they are saying and by making their thoughts explicit they may hence also unknowingly and unintentionally inspire new thoughts in their fellow team members. Now, if such individual utterances are unfathomable, but potentially constitute a rich well of possibilities, a next question is how this idea would affect how we may think of knowledge generation as a collective undertaking, such as the accomplishment of a project goal.

Bartley here suggest we may use an epistemological metaphor inspired from economics – that of the "free market of ideas".

> People need one another and the competitive exchange process to help probe and objectify their ideas and other products - and thereby to discover their potentialities. Especially, we need to be able to give and receive criticism and correction – not in order to dominate or humiliate one another, but to learn better what we have already produced. In science, and intellectual life generally, this is supposed to happen through the marketplace of ideas. (Bartley, 1990, p. 46)

Although, of course, projects are not markets, it is informative to think of problem-solving processes within projects as taking place within an intellectual "marketplace", where ideas compete for attention and where individuals interact and communicate, continuously look for new ideas and criticism that might help them solve their problems and hence to attain individual and collective goals. In spelling out this metaphor Bartley builds on Hayek's (1945) classic essay "The Use of Knowledge in Society". The problem Hayek was concerned with in the late 30s, says Bartley, was how uncommon *existing* dispersed knowledge could be fully utilized. However, this conception may also be generalized and corrected in full harmony with Hayek's intentions to cover not only such existing knowledge but also how to elicit new knowledge that *none* of the participants in the process possesses initially.

> In their interaction, the various participants can bring to bear their dispersed, specialized, individual, and different knowledge on the unknown and unfathomable object-product, and in this process they may

discover more of its potentialities and utilize it accordingly... That is the market process elicits or creates not-yet-existing knowledge about the already existing products, as well as creating new products. (Bartley, 1987, p. 440)

In Bartley's conception of markets as involving a discovery process, the primary focus is on how market actors need and use each other as resources in a knowledge generation process. Hence, this is something completely different from the traditional interest in market-clearing prices or markets as mechanisms for resource allocation. Instead this view of markets stresses their often neglected qualities in guiding the energetic efforts of real market actors to "know more" by talking to others. Markets are thus of interest as mechanisms for coordinating and growing knowledge. As discussed by Potts (2001, p. 418) markets are experimental spaces, "spaces where existing knowledge is coordinated and where new knowledge is tested". In such social settings, says Loasby (1993, p 213), people take on the character of scientists, relying on a "system of conjecture, criticism (voice, as well as exit) and testing, which is interpersonal rather than impersonal". In such a discovery context, market prices are but signals, telling people "that what they are doing, or can do, has for some reason … become more or less demanded" (Hayek, 1976, p 187); i.e. signals to be interpreted along with a myriad of other signals, guiding markets actors what to do.

In our view, Bartley's Hayek-inspired view of markets, as social organizations, involving a discovery-process, is informative for understanding collective knowledge creation in cross-functional teams. First, by pointing out how a freely accessible 'market-place of ideas', may serve to make the most of 'uncommon knowledge' (Hayek, 1945), i.e. its potential to take advantage of existing local, idiosyncratic individual knowledge in a team. Second, by pointing out how knowledge, as 'unfathomable', may grow as it is being circulated among communicating actors in a largely self-organizing project team. Third, by pointing at the basic sequential nature of (all) knowledge processes. In markets, as in project teams, actors have to consider, at each stage, what is known and to consider how their own knowledge and skills would fit in. This presupposes that what is known is visible or accessible to those involved. In markets, prices as well as other informative signals from customers, colleagues or competitors are constantly looked for, and in projects people will need to be regularly up-dated about progress in functional 'interface' units as well as regarding more collective attainments.

Interestingly, this idea of collaborative processes as proceeding 'step-wise' is rather closely paralleled in Polanyi's notion of 'mutual adjustment' or 'self-coordination' that takes place in markets, in science – as well as among a team of jigsaw puzzle-solvers.

> Such self-co-ordination of independent initiatives leads to a joint result which is unpremeditated by any of those who bring it about. Their coordination is guided by 'an invisible hand' towards the joint discovery of a hidden system of things. … this kind of cooperation can only advance step-wise and the total performance will be best possible if each consecutive step is taken by the most competent to do so. … We may imagine … a jigsaw puzzle … if each helper watches out for any new opportunities arising along a hitherto completed part of the puzzle, and also keeps an eye on a particular lot of pieces, so as to fit them in wherever a chance presents itself. (Polanyi, 1962, p. 55)

So, Polanyi too, actually via his ideas about economics rather than via his epistemology of tacit knowing, recognizes the virtues of such market-like step-wise collaborative knowledge work. Considering his view that all knowledge creation is a matter of personal and tacit knowing, it is interesting to find here such an importance laid on 'visibility', and specifiably known results at each stage of the process.

As it seems, although cross-functional work in practice is an immensely messy endeavor, it basically relies on combining and creating knowledge in largely self-organizing and sequential manner. Here, knowledge is set free as people interact and cannot-help helping each other each other – while benefiting from a collectively accessible signal system, regularly up-dating what has been achieved and other changes in circumstances. While, personal tacit knowing and articulation of communal tacit knowledge constitute vital part of such a process, the notion of objective, unfathomed knowledge used in interaction and communication, we contend, add to our understanding of how new knowledge grows in a cross-functional context.

CONCLUDING DISCUSSION

Returning to Nonaka's view of knowledge creation in cross-functional project contexts, we thus question whether his engine has enough power. This model has been found wanting in a number of respects. Only two of the 'cylinders' of the engine are seen as operative within his two-step view of knowledge processes in cross-functional teams. Here, socialization has a preparatory role of building trust and making the individuals' tacit knowledge more similar. While this may well happen to some extent its contribution to the creation of new knowledge is likely to be meager, as also recognized by Nonaka (and colleagues). Taking Polanyi's view of knowledge as strongly personal as a datum, it is questionable whether much optimism in such a homogenizing endeavor would really be warranted.

Externalization is no doubt the process or 'cylinder' that Nonaka (and colleagues) put most faith in as a trigger of knowledge creation in project settings. Generating powerful explicitly stated metaphors capable of covering large amounts of complex tacit knowledge lie at the core of such externalization processes. As we have seen, tracing and externalizing particulars is a plausible idea according to Polanyi, although it may often turn out to be an effort that is in vain or not worth the cost. Polanyi also strongly underlines the power of metaphors, while urging us to think of their generation as a work of art (Polanyi and Prosch, 1977, p. 75-81). One may here object that as all our language is, more or less, metaphorical, the metaphor recipe is not very specific nor really needed (see Gourlay, 2006). Yet, a deliberately chosen, 'good' metaphor may well serve as a kind of collective goal or vision, which inspires and serves as a guide to action in team work. Here, the Polanyi/Nonaka preference for metaphors, suggest a way of thinking about project goals as subsuming a significant amount of the individuals' tacit knowledge. Visionary and 'good' metaphor formulations such as 'tall boy' (see Nonaka, 1991) may thus be a way of bringing about a coherent 'sense of direction' in cross-functional projects. Moreover, metaphors and analogies may constitute a powerful means to create conceptual 'distinctions' (Tsoukas, 2003) which could help understand and solve problems encountered in project work. The explicitly formulated metaphors as such also constitute new knowledge in the sense that they represent something previously not available in this form. As it seems, however, in the writings of Nonaka (and colleagues) there is little creative dynamic involved in externalization; the image promoted is rather one of a one-way conversion process where the same tacit knowledge shared among team members is now made explicit.

Turning briefly to the 'combination' cylinder, it may at first sight seem strange that this one is left out of the project arena; as pointed out in Sydow et al (2004, p. 1481) cross-functional projects would appear to be ideal sites for collective creativity and synergistic knowledge growth. But the answer may simply be that explicit-explicit combinations, lacking any

association to the ever-present underlying tacit particular components would not be about personal knowledge and not be Polanyian at all. So this cylinder is generally a very simple and weak one, which shares the fate of the socialization cylinder in that it does not really add anything new, as also admitted by Nonaka (and colleagues). Like Nonaka, we leave the fourth 'internalization' cylinder to limit the discussion in this paper.

In sum, the above discussion has served to show how far one gets in understanding knowledge creation and communication in a cross-functional team context – by relying on and spelling out the ramifications of the "we know more than we can tell" maxim. This has led us to appreciate the fundamental significance of individual knowledge creation, as well as provided clues as to how what is presently hidden from us, as tacit knowledge, may be and externalized and specifiably known. However, neither Polanyi or Nonaka (and colleagues) provide much guidance regarding our search for epistemological grounding of how interaction and communication processes operate to generate novelty. As it seems complementary maxims would be in demand.

Hence, we suggest that we need to recognize that we can say both less and more than we can know and that the two maxims in combination would allow for a more comprehensive view of knowledge creation in the context of cross-functional projects. Here, the "know more than we can tell" maxim reaches from individual knowledge creation to externalization and goal setting in a project context. From there on, covering how interactivity contributes to further knowledge creation the "tell more than we can know" maxim takes on its complementary role. While the first maxim informs how we may conceive of processes which promote tacit knowledge homogeneity and its 'conversion' into powerful metaphors, the second maxim somewhat contrarily, focuses on the diversity of knowledge among team members and the benefit of not eradicating such differences as they interact and communicate.

A summary model
Knowledge creation in cross-functional projects is no doubt a major source of prosperity for many firms as proposed by Nonaka and colleagues. While there are many studies of what goes on in such settings, there are few attempts to ground the analysis in basic epistemology; the Polanyi-inspired view of Nonaka and colleagues here provides a prominent exception. Yet, while many facets of their knowledge creation theory are reasonably well in line with the inspirational origin, the 'engine' cylinders are found wanting in their capacity to illuminate knowledge work in cross-functional project teams. First, they do not cover processes of individual knowledge creation. Second, none of its cylinders provide much food for thought as to we may think of interactive or collective modes of knowledge creation in epistemological terms. As a result there is a need for an upgraded engine or model that makes justice to the views of Polanyi as well as provides complementary epistemological grounding where needed.

A good model should cover much ground with a limited set of conceptions, and the below simple image may be used as a summary of the discussion. The model is picturing the knowledge creation in three different processes, individual knowledge creation, articulation and interaction – which taken together honor the epistemological maxims of "knowing morethan we can tell" and "telling more than we can know".
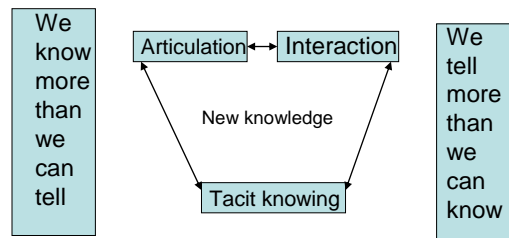
Figure 1. The knowledge 'generator'

Tacit knowing then is our first process, featuring individual knowledge creation. Such powers of the highest form we should find among scientific and artistic geniuses, says Polanyi (1966), while granting somewhat less of such powers to people with more mundane intellectual and practical skills. Scientists making a discovery rely on their special anticipatory gifts, displayed in their imagination and intuitions (Polanyi and Prosch, 1977).

> It seems plausible to assume, then, that the two functions of the mind are jointly at work from the beginning to the end of an inquiry. One is the deliberately active power of the imagination; the other is the spontaneous process of integration which we may call *intuition*. (p. 60)

As shown above, a similar appreciation of the role of imagination in science is put forward by Popper (1975), who holds that scientific "discovery is akin to explanatory story telling, to myth making and to poetic imagination" (p. 78). Such processes of tacit knowing, whether language-mediated or not, would hardly be possible to re-construct in a logical and step-wise manner. Instead the mix of previous experience, pre-conceptions, suddenly emerging intuitions, will turn them into highly personal and indeterminate processes, where leaps-of-faith will have to fill in gaps unsubstantiated by reason or evidence. In project contexts, where action and thinking is triggered by the dynamic weight of the approaching deadlines, such individualized tacit knowing would surely be a commonly relied-upon feature.

Articulation, following Polanyi, is basically a process of (linguistic) art work, building on the raw-material generated by individual processes of tacit knowing.

> Denotation, then, is an art, and whatever we say about things assumes our endorsements of our own skills in practicing this art. (Polanyi, 1958, p. 81)

Great poets are put forward here as exemplary and Polanyi and Prosch (1975) discuss admiringly and at length how their use of metaphor is enabling them to connect diverse matters into a comprehensive whole (p. 75). Again, such processes would imply much tacit knowledge work and the chances to reconstruct them would indeed appear slim. Yet, as discussed earlier, the particulars that make up the novel ideas or discoveries may sometimes be identified – if not in poetry - more likely so in project settings. In industrial settings, such

reflective analytical activity geared at finding out what people know only tacitly may well pay off. Furthermore, the explicit formulation of tacit knowledge into a metaphor, could provide with much inspiration and function as a visionary goal or a boundary object (Carlile, 2002), that facilitates knowledge work among team members with different functional expertise.

Interaction, in turn, would benefit from the above processes of individual tacit knowing and articulation. Such individual level processes thus make up a vital resource base for and co-exist with the inter-personal interaction process in cross-functional projects, wherein set-free knowledge with something of a life-of-its-own, constitutes a dynamic force. Here, goals, visions or metaphors, guide and constrain the knowledge work of team members as try to "know more" as by interacting in a spontaneous and sequential way; such processes do not only make the most of prevailing distributed knowledge, but enable knowledge creation and discovery as well.

These three processes of tacit knowing, articulation and interaction will thus tend to go on simultaneously and iteratively, hopefully 'spiraling', sometimes clock-wise forward and other-times backwards, into a state of knowing that brings collective work into a successful conclusion. However, it may also stop when time is out and nothing much has been accomplished.

Footnotes

1. The externalisation idea has been met with both enthusiasm and criticism in such a large number of articles that an overview of them is far beyond the scope of this article. As discussed at length elsewhere, (see e.g. D'Eridita and Barreto, 2006) some posit that tacit knowledge is essentially ineffable (Tsoukas, 2003; D'Eridita and Barreto, 2006) while others expect some success in such endeavours (see e.g. Spender, 1996; Davenport and Prusak, 1998). In the paper we posit that the Nonaka/Polanyi appreciation of externalisation possibilities, and their advocacy of the use of metaphors, help to explain how we may think of new knowledge creation as well as what should count as new knowledge. However, we also agree with authors that recognize the need for additional epistemological grounding – in particular regarding the social or collective basis of knowledge creation. Gourlay (2006), for example, brings in Dewey's (1916) notions of non-reflective and reflective behaviour and suggests that each of these behaviours bring about new knowledge as a 'consequence'. Hence, new knowledge creation, whether of the know-how or know-what kind, should be seen as a matter, not of knowledge conversion, but of managing the two modes of social practices mentioned above. Tsoukas and Vladimirou (2001) and Tsoukas (2003) instead seek the inspiration from Wittgenstein (1958) and suggest that "although skilful knowing is ultimately ineffable, it nonetheless can be talked about" (p. 122). We thus need forms of talk and social interaction that 'remind' ourselves of how we do things – thus drawing our attention to distinctions that were not previously noticed. New knowledge, says Tsoukas (p. 123), "comes about when our skilled performance – our praxis - is punctuated in new ways through social interaction."

2. More generally, we thus propose that the philosophies or epistemologies of Polanyi and Popper should be seen as complementary and that by connecting them we arrive at a richer understanding of organizational knowledge creation. Basically, their views differ in that Polanyi stresses the personal nature of knowledge and the need for personal commitment in knowledge creation, whereas Popper is focusing exosomatic knowledge, i.e. knowledge that has left its creator. Herein lies a potential for arriving at a more comprehensive view of knowledge creation, whereas at the same time this proposed marriage is not without problems. A basic one is that these authors do not refer much to each others works. Polanyi, in particular in his early works, is far more concerned with expressing his own ideas than comparing them to those of any competitor epistemologists. Popper, on the other hand, hardly

ever comments on the views of Polanyi. As it seems, his major concern is with Polanyi's emphasis on the need for personal commitment in knowledge creation. This has led him to think of (both Kuhn and) Polanyi as fideists; "Polanyi's fideism: the theory that a scientist *must* have faith in the theory he proposes …" (Popper, 1988, p xxxii), whereas Popper assumes that researchers realize that their theories will sooner or later be superseded. Yet, this difference seems like less of an obstacle in that Polanyi also readily admits that the individual's commitment to his tacit knowing may be highly subjective and that the "discovery itself, may turn out to be a delusion" (Polanyi, 1966, p. 26). This adds a certain flavour of fallibilism to his philosophy and brings it somewhat in line with Popper's evolutionary epistemology wherein what we know are basically fallible guesses.

Moreover, as is evident throughout their works, the epistemologies of both Polanyi and Popper are strongly anti-positivist. Yet, neither of them proposes relativism; Popper openly states his adherence to realist ontology, and evidence of such an idea is also found in Polanyi, who states the "effort of knowing is thus guided by a sense of obligation to the truth; by an effort to submit to reality" (Polanyi, 1958, p. 63). More generally, as often pointed out, Polanyi, Popper and Hayek were all fierce critics of Soviet top-down authoritarianism, and proponents of a "free society" in science as well as in the economic field. So, while there is no doubt room for interpretative variation in their accounts, we try to substantiate our view of the feasibility of this eclectic marriage with a fair amount of quotes from both parties.

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