Intuition: A New Knowledge Model for Knowledge Management

ABSTRACT

This paper introduces a knowledge model in which the types of knowledge are formed according to the nature of knowledge. There are two roots to our model: the first concentrates on a review and extension of the typologies of Polanyi and Ryle and adds new knowledge types; the second concentrates on a review of the intuition literature reformulating a range of different perspectives so as provide new insights. Subsequently we synthesize the extended typologies with our intuition findings into a new knowledge model which includes intuition as a knowledge type. This model distinguishes three types of knowledge, the facts, the skills, and the intuition; all three having focal and subsidiary parts. Moreover it is complete (i.e. it accounts for all kinds of knowledge), has great explanatory strength, and is easy to use. Thus we expect it to be useful for both researchers and educators in the field of knowledge management.

Keywords:

intuition, tacit knowledge, personal knowledge, knowledge typologies, knowledge modelling, knowledge representations

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> *ASMC: What are some good examples of companies that depend on intuition?*
> *Mintzberg: I don't know of any successful companies that didn't do it this way.*
> *(Campbell, 1991: 109)*

Although knowledge management has become a 'buzzword' in management research over the last few years, the importance of knowledge for companies was recognized long time ago. For example, Marx (quoted in Marcuse, 1964: 39) described the knowledge worker in the mid nineteenth century and almost four decades ago Drucker (1969) introduced the concept of *"knowledge economy"* to draw attention to the fact that knowledge had became the single most important resource of production. More recently Drucker (2002a: 135) announced that:

"The most important, and indeed the truly unique, contribution of management in the 20th century was the fifty-fold increase in the productivity of the MANUAL WORKER in manufacturing. The most important contribution management needs to make in the 21st century is similarly to increase the productivity of KNOWLEDGE WORK and the KNOWLEDGE WORKER."[1]

This paper aims to add a step towards this target assigned by Drucker, offering a model which facilitates better understanding of the nature of knowledge. This paper focuses solely on personal knowledge, taking on board Polanyi's (1962b) conception. This does not mean that we neglect the importance of knowledge for organizations as presented e.g. by Drucker (Drucker, 1969, 1993, 2002a), Senge (1990), Nonaka and Takeuchi (1995), Tsoukas (1996), Sveiby (1997), Davenport and Prusak (2000), Handy (2002), and Nordström and Ridderstråle (2002, 2004), nor that we neglect the effect of the organization on knowledge. Along with Tsoukas and Vladimirou (2001) we accept the Wittgensteinian conception that knowledge has profound social/organizational features, only these are out of the scope of the present paper.

This paper builds off a body of knowledge encompassing a number of existing research inquiries into the increase of *personal knowledge* (e.g. Polanyi, 1962b; Dörfler, 2005). Our aim in

[1] *Capitalization in the original.*

this paper is to develop a knowledge model that gives account for all kinds of personal knowledge and which is, at the same time, sufficiently simple to use.

First we give a brief overview of knowledge typologies in which types are formed according to the nature of knowledge (as opposed for example to levels or topics of knowledge) and then synthesized into a coherent whole. To do this we extend the existing models by introducing several new knowledge types; this is a temporary solution which makes the synthesis possible across the revisited models and also enables the transition to our new model. Then we describe intuition as a new knowledge type. Finally, we introduce our new model/typology in which the intuition is one knowledge type and provide several illustrations.

SOME KNOWLEDGE TYPOLOGIES

In this first part of the paper we review some knowledge typologies; specifically, as this inquiry is addressing the nature of personal knowledge, we discuss the typologies in which the classification is based on the nature of personal knowledge. These typologies are grouped into two clusters. The first contains the models that are based on and/or related to Ryle's knowledge model (which is extended here). The second is based on Polanyi's observation that we have different knowledge about what we focus on and what is out of focus. These two clusters of knowledge typologies will form, in the later sections, the building blocks of our new model, which incorporates intuition, as a new type of knowledge.

The motivation for constructing this new model is twofold: Firstly, we have noticed considerable similarities but also some differences between the existing models in the knowledge literature. Then, analysing them systematically (as presented later), we realized that the differences may be presented as a gap which may be covered by extending the models. Secondly, the moti-

vation stemmed from noticing discrepancies between what we experienced in our consultancy, research, and teaching on the one hand, and what could be found in the literature on the other hand; i.e. that not all knowledge is covered by the known models. These two starting points merged into a single problem when we found a solution[2], i.e. when we understood that establishing intuition as a new type of knowledge fills both gaps.

Knowledge of 'That', 'How', 'Why', 'What', and 'It'

The first knowledge typology to consider here was originally developed by Ryle (1949), who asserted that not all knowledge can be described as a set of facts and propositions. We may know how to do things, which we cannot necessarily formulate as a list of propositions. The knowledge of facts and propositions Ryle called *"knowing that"* and the knowledge of how to do things *"knowing how"*. According to the *"intellectualist legend"* (ibid: 22 ff) an act can only be considered intelligent if, and only if, the person is thinking what (s)he is doing while doing it; so the intelligent performance involves conscious observation of rules or application of criteria. It follows that the person first must acknowledge the rules or criteria, and then devise a plan about what to do; borrowing Ryle's (ibid: 30) example this would mean that:

"The chef must recite his recipes to himself before he can cook according to them."

This would mean that 'know-how' can always be traced back to 'know-that'. If we accept this for a moment as working hypothesis, we shall see that its implications lead to a contradiction (reductio ad absurdum); i.e. the assumption that we have to think in advance what to do before doing it, would presuppose that before that we have to devise a plan how to think what we will do, and so forth ad infinitum. There is another detail which is not explained by the "intellectualist

[2] It is important that we talk about 'a' solution and not 'the' solution – our model fills this knowledge gap but we are sure that there are also other valid ways to fill it.

legend": How do we know which maxims and propositions to consider, which are appropriate, rather than the thousands which are not appropriate? Finally the "intellectualist legend" also contradicts the observation that the person performing an operation well is often unable to tell the rules (s)he followed to perform an operation; e.g. a wit might be able to make good jokes but (s)he would not be able to tell us the recipes for them. Thus Ryle showed that 'know-that' and 'know-how' are both valid but distinct types of knowledge; the maxims are condemned to absurdity if they are to replace the golfer's skill or the poet's art. (Polanyi, 1962b: 31)

Anderson (1983) arrived at the same categories of knowledge as Ryle but coined different names for them; he speaks of *declarative* or *descriptive knowledge*, to emphasize that we store this kind of knowledge in form that can be verbalized; and of *procedural knowledge* to draw attention that this kind of knowledge manifests itself in the procedures we perform. It must be noted that performing certain operations correctly or efficiently or successfully does not necessarily account for knowledge of the performer. It is not enough if the action is well-regulated, the person has to be able to regulate her/his own action, to detect and correct lapses, to repeat and improve upon success, to learn from others' examples, etc. This distinguishes the act of a knower from a well-regulated clock or from a parrot.

Ryle (op cit: 40-41) describes two different ways of learning to play chess. Usually the chess player learns the basics by receiving verbal instructions about the rules; (s)he learns them by heart and can cite them on demand. During her/his first games (s)he usually has to go over them aloud or in her/his mind, sometimes asking how the rules should be applied in a particular situation. Gradually (s)he becomes able to follow/apply the rules without thinking of them. At this stage the learner usually loses her/his ability to cite the rules. According to the other description, one may also learn chess without ever hearing or reading about the rules. One may observe how

others play; starting to play by observing which of her/his moves are accepted and which are rejected. Gradually one may pick up the art of playing correctly without ever being able to propound the rules. The first type of learning chess focuses on an increase of ‘know-that’ but only at the beginning, until the pupil learns the rules of chess. Later in the first type, and all along in the second type, the ‘know-how’ is increased; furthermore, the ‘know-that’ is gradually converted into ‘know-how’ as the pupil becomes unable to quote the rules anymore. This second type of increasing our knowledge of chess is how we acquire most of our common sense, as contrasted to special knowledge (Minsky, 1988: 22):

“Common sense is not a simple thing. Instead, it is an immense society of hard-earned practical ideas – of multitudes of life-learned rules and exceptions, dispositions and tendencies, balances and checks. If common sense is so diverse and intricate, what makes it seem so obvious and natural? This illusion of simplicity comes from losing touch with what happened during infancy… when we try to speak of them in later life, we find ourselves with little more to say than «I don’t know.»”

If we dig deeper, we can find further knowledge categories that are not covered by ‘know-that’ and ‘know-how’. We may know how to perform a certain operation and detect and correct the mistakes and even improve the process; this belongs to the domain of ‘know-how’. Albeit, this does not necessarily mean that we would also be capable of creating this ‘know-how’ from scratch. The ‘know-how’ only means that we know how to do it, perhaps how to adapt it to changing circumstances provided that the changes are not fundamental. But to create a genuinely new ‘know-how’, to essentially alter an existing ‘know-how’, to apply it in radically different circumstances, the ‘know-how’ is not enough. So there seems to be a deeper understanding, which is necessary to create a novum, although, we can polish an existing process without it. This kind of deeper knowledge means our appreciation of the fundamental principles; it goes beyond knowing how to do things in a certain way, it also includes knowing why things should be done in that certain way. To adopt a similar term to ‘know-that’ and ‘know-how’ this new

knowledge category could be named *'know-why'*; this is the knowledge of the problem solver.[3] Extending Ryle's previous example of the cook: if you do not have garlic, knowing why garlic was part of the recipe might help you find a substitution, e.g. in some dishes you may use ginger instead. We must admit that Gurteen (1998: 5) recognized this knowledge type earlier than we did:

"In fact, know-why is often more important than know-how as it allows you to be creative – to fall back on principles – to re-invent your know-how and to invent new know-how."

To find a shortcut to the next missing knowledge category consider once again the cook from the previous examples: he can make a Cordon Blue main course and a strawberry parfait (amongst others) without reciting the recipes to himself, as he 'knows how'. But, which one to make *tonight* for *her*? This is different from knowing *how* to make them or *why* they should be made a certain way, let alone the *that*-knowledge of the recipes. This is about *what to do* – thus we call this new knowledge category *'know-what'*. Drucker (2002a: 145) found this type of knowledge to be an essential part of the knowledge workers assets to which knowledge managers must pay special attention if they want to increase the performance of the knowledge workers. The knowledge workers own the means of production; the job needs them more than they need the job. The relationship of the organization with the knowledge workers is a partnership. You do command the knowledge workers. You ask them what the task is, you use their 'know-what'. (Drucker, 2002b: 86-87) Steve Jobs (quoted by Davenport & Prusak, 2000: 50) had a similar statement:

"It doesn't make sense to hire smart people and then tell them what to do; we hired smart people so they could tell us what to do."

[3] *The problem solver here indicates the creative person, solving ill-structured problems by creating new solutions.*

The increase of ‘know-why’ and ‘know-what’ is somewhat similar to the increase of ‘know-how’, there is, however, an important difference: The increase of ‘know-how’ is gradual (albeit there may be step-changes in it); the other two knowledge types seem not to increase for long time, i.e. the knowledge increase is not manifest. The reason for this is that ‘know-why’ and ‘know-what’ both belong to deep knowledge. This can be noticed from the previous descriptions of these two knowledge types; i.e. both are *beyond* the more apparent ‘know-how’. Deep knowledge builds on previous knowledge of other types and consists of more complex cognitive schemata (Mérő, 1990: 153-155). The non-manifest nature of increase of ‘know-why’ and ‘know-what’ is one of the reasons that these types of knowledge increase virtually always happen in a master-apprentice relationship. Only the master can recognize the almost unnoticeable signs of the increased knowledge of the apprentice. Later, apparently all at once, the apprentice shows a great leap in performance, often surprising everybody, including herself/himself. Only not the master.

There is only one additional distinct knowledge type that we want to add to the Ryle-model. Let’s return to the chef one last time; when we left him previously, he had to decide what dinner to make tonight for her. If she tastes the dinner prepared by the chef, she might not know the name of the dish (which would be a ‘know-that’), she probably would not know how it was prepared or why a particular ingredient was used (unless she is a chef herself), and if she had an idea what to make for someone for a dinner it almost certainly would have nothing to do with what the chef decided to make for her. But, tasting the dish, she will have the experience *what it is like* – as we already used the “what” we can call this knowledge type *‘know-it’*. The ‘know-it’ is the personal experience of an event; its important feature being the personal nature of the experience. An essential feature of this knowledge type is the existence of qualia, the part of our ex-

perience that appears in our consciousness, accessible only via introspection and describable only in subjective terms. (Eliasmith & Mandik, 2006) The term qualia, introduced by Lewis (1929), is probably easiest to understand through Jackson's (1982) famous thought experiment about Mary and the rose. Mary had grown up in a completely black-and-white environment; she was never allowed to leave her room and to see Nature. She had never seen any colour apart from black and white. She had been educated about the colours, about the perception, about the biology of seeing. She had learned everything that can be learned about the colours from others without actually experiencing anything in colour. Then she leaves her room; she sees a red rose and passes out. There is something that cannot be explained, something that needs to be experienced personally. (See also Chalmers, 2003)

As it can be seen from the previous description, the 'know-it' increases by experiencing the qualia. This is exactly what Russell (1948: 109-118) used as a starting point for his classification: The *non-verbal* or *sensational* knowledge is what we personally perceive or we expect to perceive in the immediate future, without the need for words. Russell uses the example of a slamming door for illustration; we see a door slamming and we close our eyes anticipating what is going to happen, if someone stops the door, we will be surprised. We already experienced the qualia. All other knowledge is acquired by the intermediation of words, that is, spoken words of someone, a book, a hypertext, etc. This category is the *verbal* or *narrative* knowledge. You cannot explain to someone, who did not experience it, what does it feel to be in love or, as in Mary's example, what the colours are like.

If we assume we have covered all knowledge types, now we can try to further deepen our understanding of them. One means of doing so is to look at knowledge representations[4]. In fact, these knowledge types served as basis for developing these knowledge representations. Rumelhart and Norman (1988) distinguish three[5] categories of representation and the following descriptions of these representational systems are largely based on Rumelhart and Norman's description.

The *propositional representational systems* were for a long time considered the only kind of representation in the same way as the declarative knowledge, the 'know-that', to which it corresponds, was considered to be the only knowledge type. When it was recognized that this kind of representation cannot be described using predicate calculus, based on Chomsky's (1957) prior work on syntactic and semantic structures, Quillian (1967) developed the conception of semantic networks. In this model knowledge is represented by a directed graph, where the nodes are concepts and the relations are associations; the idea is to capture the meaning of a concept in a node from the pattern of its relationships. Although this model fails to account for metaphors, it does a good job with most concepts, and is widely accepted today. The easiest mode of knowledge increase in a propositional representation is to add new propositions. However, if we think in terms of semantic networks, we can add new concepts (symbols) and/or new relations. If we think of the meaning of a concept in connection with the pattern of its relationships with other concepts,

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[4] *Knowledge representations refer to what is stored in the long-term memory (LTM). The term "representational systems" indicates that they include, beside knowledge representations, also the processes that operate upon these representations. (Rumelhart & Norman, 1988: 516)*

[5] *Actually Rumelhart and Norman speak of four categories but the distributed representational systems are not really a different kind of representation regarding the nature of knowledge; rather it is a conception underlying any or all of the other three. The role of distributed representations is to contrast the idea of superpositional to local models; meaning that the different pieces of knowledge are not stored locally but somehow everything is stored everywhere. In this paper we do not wish to investigate this aspect of knowledge representations.*

the picture becomes richer: by adding a new concept and/or new relationships the meaning of the existing concepts may be altered as well.

The *procedural representational systems*, as the term suggests, correspond to procedural knowledge, to 'know-how'. It is possible to argue in the background of any procedural representation there is a propositional one; the basis for this argument is founded upon computers, where programs and data are stored in the same way. However, it seems that knowledge of processes is represented in a different form than propositions. As Rumelhart and Norman (ibid: 562-566) argued (see also Winograd, 1975), distinctive characteristics can be observed for at least some processes. These processes are not available for personal inspection (e.g. kicking a football, Rumelhart & Norman, ibid: 561), they are remarkably efficient, there are heuristics encoded in them, we are able to incorporate new knowledge within the same structure, etc. Thus we may distinguish the 'real procedural representations' from those with a propositional representation 'in the background'. In terms of knowledge increase, the two versions would correspond to the two different ways of learning chess described earlier in this section. In the chess example we have seen that we can acquire the rules in the form of propositions (by verbal instructions), we can also acquire them without words (by observing and practicing). The opposite is not true; there are some procedures that can only be acquired in the second way; Davenport and Prusak (2000: 71) report of Prusak's attempt to learn hitting (baseball) from Ted Williams' book. His performance actually improved somewhat but, years later, he attributes this improvement to his increased self-confidence. He claims that baseball cannot be taught through books. This can be explained if we suppose that hitting in baseball is the 'real' kind of procedural representation.

The conception of *analogical representational systems* was originally developed by Shepard and his collaborators (see e.g. Shepard & Cooper, 1986) and Kosslyn (see e.g. Kosslyn, 1986) to

account for the handling of images. There are certainly some parts of our knowledge that are not like symbols (concepts) and their relations (such as in propositional representations) but rather like images; such as pictures or 3D objects. The analogical representations not only account for standstill images and objects but also images and objects going through various transformations. These mental transformations seem to have something important in common with real transformations, more precisely with how we would perceive the real transformations (e.g. there is a limited spatial extent, so we do not 'see' the two opposite sides of a cube at the same time). The analogical representations are usually explained and examined using real images or physical 3D objects but Rumelhart and Norman (1988: 556-557) suggest to extend the use of analogical representations to *"smell of bacon and eggs"* and to *"sounds of a symphony orchestra"*; and thus they offer the term *"mental models"* instead of images. It is probably clear so far that mental models are the representations corresponding to 'know-it'. However, there is also evidence that the mental models can be causal models and that they have some abstract components as well (ibid: 557); thus we might assume that entirely abstract mental models also exist. These abstract mental models could be the knowledge representations of 'know-why' and 'know-what'; as these are newly introduced knowledge types, the corresponding representations have not yet been investigated. It is possible that new knowledge representations will have to be developed for a proper description but the idea of abstract mental models sounds promising. We do not investigate the knowledge representations corresponding to newly introduced knowledge types; we discussed them only to inform our research on knowledge typology.

The obvious way of increasing knowledge in analogical representations is through experiencing; e.g. by seeing the objects and their transformations. However, there are less straightforward cases as well. We do not only remember transformations that we have previously seen but we

can create other transformations by only imagining them; Rumelhart and Norman (ibid: 556-557) call these "mental simulations". An extreme example here is the maverick-inventor Nikola Tesla, who was well-known for developing and perfecting his inventions 'in his mind' and building new machines without committing his ideas to blueprints (Tesla, 1919: 11-12):

"Then I observed to my delight that I could visualize with the greatest facility. I needed no models, drawings or experiments. I could picture them all as real in my mind... Invariably my device works as I conceived that it should, and the experiment comes out exactly as I planned it. In twenty years there has not been a single exception."

This means that using mental operations that operate on analogical representations, the problem solver increases her/his knowledge without external input. We may also acquire a new procedure operating on the analogical representation or some new view or a new transformation of an existing mental model, which increases our knowledge in that analogical representation. There is still another way of increasing knowledge in analogical representations: In the master-apprentice relationship the master often uses parables, metaphors, and symbols to describe some abstract complex mental model. By doing so the master actually does not describe the model itself, but the parable somehow invokes the mental model. A similar case for figurative mental models would be when we hear a song or a poem about a landscape, the song or the poem does not actually describe the landscape in detail but still invokes the mental model of it. These kinds of phenomena cannot easily be brought under scientific examination – this is why Maslow (1966) and Grof and Laing (both quoted in Capra, 1989) argue that we need a new language for science, a depictive rather than a descriptive language.

In this section we have revisited Ryle's model distinguishing 'know-that' from 'know-how'. We have added three additional categories, 'know-why', which unknown to us had already been identified by Gurteen, along with 'know-what' and 'know-it' which are contributions of this paper. The knowledge types reviewed in this section so far will be the building blocks of the syn-

thesized model. In the second part of this section we review some other typologies based on Polanyi's distinction of focal and subsidiary awareness; these will be used later in putting together the previously identified building blocks.

Focal and Subsidiary Knowledge

To understand the distinction of the focal and subsidiary awareness, and the focal and subsidiary knowledge based on this distinction, we need first to review the conception of tacit and explicit knowledge. In his various works Polanyi has developed a series of models about human knowledge; probably the most cited one is the *tacit-explicit* (the latter is also referred to as codified) knowledge (Polanyi, 1966: 4)[6]:

"I shall reconsider human knowledge by starting from the fact that we can know more than we can tell… So most of this knowledge cannot be put into words."

For the complete picture it should be noted that Nickols (2000) added a third category to this model, the implicit knowledge, which is tacit knowledge that can be made explicit. It is impossible to know ex ante which part of the tacit knowledge can be made explicit, only ex post, that is, once it already has become explicit. Thus this third category is not a category per se and as such it is not considered in the present research. However, it carries an important message that there is a transfer between the tacit and the explicit domain (see later in this section).

Building on a number of experiments (face-recognition, expecting an electric shock while looking at senseless syllables, using a probe to explore a cavern, the use of a stick by a blind, unawareness of particular muscles during a movement, use of tools), Polanyi (op cit: 7-19) defines the structure of the tacit knowing borrowing metaphors from anatomy (ibid: 11):

[6] *Interestingly, Polanyi actually never used the term "tacit knowledge" in his celebrated "The tacit dimension"; he talked about "tacit knowing".*

"... we are aware of the proximal term of an act of tacit knowing in the appearance of its distal term; we are aware of that from which we are attending to another thing, in the appearance of that thing."

It is probably easier to understand these terms through an example: When exploring a cavern using a probe, one concentrates on the end of the probe which is in one's hand, and on feelings in one's fingers. So one focuses on the near end (proximal part) of the probe. But one is not really interested in the vibrations in one's hand caused by the probe but in that which is at the far end of the probe (distal part), the cavern. This way one soon forgets having a probe in one's hand and starts to picture the cavern. This is what is meant by attending *from* the proximal *to* the distal. Thus (see Polanyi, 1966: 18) knowing the proximal is tacit (we do not identify it) while knowing the distal is explicit (we can identify it). This description of the structure of tacit knowing is also along the line with Neisser's (1967) idea of the constructive approach to cognition, which is probably the best expressed by the example he quotes from Hebb (p. 94 for perception and p. 285 for remembering): we perceive/remember fragments of bones and we see a dinosaur.

Polanyi (op cit: 6-19) originally described the increase of tacit knowing as a tacit process; and that the structure of the process of knowledge increase can be described in the same manner as tacit knowing, in terms of proximal and distal parts. For instance in an experiment, the subjects were presented with a large number of senseless syllables and administered an electric shock after certain syllables. The subjects after a short period of time showed symptoms anticipating the electric shocks after these syllables, without ever becoming aware of it. An important form of increase of tacit knowledge is the previously mentioned master-apprentice relationship. There is a precondition, the disciple must believe that the master knows (Polanyi, 1962a: 69):

"... the methods of scientific inquiry cannot be explicitly formulated and hence can be transmitted only in the same ways as an art, by the affiliation of apprentices to a master."

The obvious way of acquiring explicit knowledge is by means of words, i.e. explicitly; henceforth this kind of knowledge increase will be called *learning*. Apart from learning, as it was indicated at the start of the section, explicit knowledge may also increase by *"articulation"*, when some tacit knowledge may become explicit. An example for 'articulation' is the tacit knowledge of a domain specialist, (a part of) which may become explicit as the domain expert teaches a novice. Similarly, some explicit knowledge may become tacit by *"internalization"*. (Nonaka, 1991: 4) For instance, when we learn a grammatical rule in a foreign language, we can put it into words – so it is explicit. Later we forget the rule (we cannot articulate it anymore) but we still use it perfectly when writing – it has been 'internalized'.

When describing the act of knowing Polanyi (1962b: 55-65) realized that we are differently aware of proximal and distal. Polanyi considered the example of hammering a nail; what is in the focus of our act, he called *"focal awareness"*; in this case we have focal awareness of driving in the nail; of everything else, in this case of the feeling in our palm, of the hammer, etc., we have *"subsidiary awareness"*. While reading, the meaning of the text is in the focus and there is a subsidiary awareness of the letters, grammatical rules, etc. This conception comes very near to front-of-mind (focal) and back-of-mind (subsidiary) attention as expressed by Davenport and Beck (2001).

What is in focus requires focal attention and we can pay that kind of attention only to one thing at a time. (Cherry, 1953; Broadbent, 1958; Deutsch & Deutsch, 1963; Treisman, 1964; Sullivan, 1976; Anderson, 2000) This also means that the rest of the 7±2 'slots' (Miller, 1956) in the short-term memory (STM) can only belong to the subsidiary attention. This also fits Polanyi's previous example about hammering a nail; we can pay subsidiary attention to 6±2 particulars and focal attention to one whole entity. Merging the focal-subsidiary attention with the proximal-

distal metaphor, we can say that we pay focal attention to the distal and subsidiary to the proximal; and as we found that knowing the proximal is tacit and knowing the distal is explicit, we can also say that focal attention is characterized with explicit knowing while subsidiary attention is accompanied by tacit knowing. This basically means that we can identify what we are paying focal attention to, but we do not identify what we pay subsidiary attention to (Polanyi, 1966: 18).

The above discussion follows from the literature. However, in this paper we are engaged with modelling knowledge not knowing. As was noted earlier, knowledge is mental content, a potential that can be transformed into actual performance through the act of knowing. Knowing is a process in which knowledge is used, such as learning, thinking, or applying knowledge. Let's consider the example of writing. What we can learn or teach about writing in a classroom? We can teach letters, words, and rules of grammar. But we cannot teach how to write a good poem or a grand novel. As we said above, what can be acquired by learning (by means of words) is explicit knowledge and what can only be acquired tacitly is tacit knowledge. Obviously, letters, words, and the rules of grammar correspond to the particulars, to the proximal part, and thus to subsidiary attention, while the poem corresponds to the distal, and thus to focal attention. So, the knowledge of the proximal, the subsidiary knowledge, is explicit and the knowledge of the distal, the focal knowledge, is tacit. (More precisely the subsidiary knowledge may be explicit, cf: 8-9, the example of learning chess.) This can happen as the subsidiary knowledge of the particulars is integrated into the focal knowledge of a whole entity (Polanyi, ibid: 18-21). The tacit-explicit relation is now reversed: while we can identify what we are focusing on (focal knowing), we are unable to tell what knowledge it belongs to (focal knowledge); conversely, we cannot identify the particulars of the subsidiary attention (subsidiary knowing) but, if someone would identify these for us, we might be explicit about the content of these particulars (subsidiary knowledge).

It is important to note that if talking about knowledge we deal with the tacit-explicit *nature of the content* of knowledge; while, if talking about knowing, we are tacitly-explicitly *pointing to this content*. Henceforth we only deal with focal-subsidiary knowledge, not with knowing.

Two groups of knowledge typologies have been reviewed in this section; the types from the first group ('that', 'how', 'why', 'what', and 'it') will be used as building blocks for our knowledge model, while the focal-subsidiary distinction from the second group will help how to put these building blocks together. Before we can introduce the synthesized model, we need to speak briefly about intuition and establish it as a new type of knowledge.

INTUITION

Intuition is one of those topics that everyone knows something about, everyone uses the term, there is a vast amount literature available (see Osbeck, 1999 for a historical overview) but there is little agreement within the realm of management research (or other disciplines) on what intuition really is. The importance of intuition is generally accepted in the (knowledge) management literature (Barnard, 1938; Nonaka & Takeuchi, 1995; Simon, 1997; Davenport & Prusak, 2000). It is also recognized by researchers of knowledge and consciousness; indeed, according to Chalmers (1998: 110) the problem of intuition is so central to the problem of consciousness that denying intuition means denying the phenomenon of consciousness altogether. Polanyi (1969: 106) compares it to a sleeping monster, which, once awakened, may destroy our view of knowledge altogether. Trying to capture the essence of intuition in this section we will briefly review how it is understood from a variety of backgrounds. Similar to 'knowledge', we do not aim for a precise definition but rather we examine the features of intuition to grasp a fuzzy picture. Based

on this review, in the second part of this section, we relate intuition to the previously introduced knowledge types.

Describing Intuition

Why is there so much confusion about intuition? One of the reasons seems to be that there are several ideas covered by the term. According to Behling and Eckel (1991) there are at least six different conceptualizations behind one label. Woźniak (2006) showed differences in approach between various disciplines (e.g. philosophy, psychology, management science) as well as between East and West cultures. There have been some attempts to resolve the ambiguity which gives rise to the confusion. For instance, Gerard (cited by Vaughan, 1979: 66) distinguished four levels of intuition: physical, emotional, mental, and spiritual. As this paper focuses on personal knowledge, we will concentrate upon mental intuition; although we acknowledge that the existence of different levels of intuition may explain the emotional charge and the bodily effects often accompanying intuition (see e.g. Hayashi, 2001; Dane & Pratt, 2007). Another attempt to resolve the confusion was Goldberg (1983b), who classified the manifestations of intuition into six categories, namely discovery, creativity, evaluation, operation, prediction, and illumination. The common denominator of these manifestations in the case of mental intuition is knowledge. The line of authors accepting intuition as a valid type of knowledge can be traced back to the ancient philosophers/scientists such as Hermes Trismegistos, Pythagoras, Plato, and Aristotle. In the western philosophical tradition Spinoza (1677, Part 2, Proposition 40, Scholium 2) distinguishes three kinds of knowledge: opinion or imagination being the first, reason being the second, and intuitive knowledge being the third kind; he considers, without much explanation, intuitive knowledge to be the most powerful of the three (ibid: Part 5, Proposition 36, Scholium). Bergson (1946) similarly argued that intuition is a superior form of knowledge. Another distinction that

seems to be necessary (Osbeck, 2001; Dane & Pratt, 2007), is between the *intuitive processes* and the *outcomes* of such processes – both usually referred to as intuition. In this section we examine both the mental intuitive process (following Dane and Pratt we call it *intuiting*) and the outcome of it, which is the intuitive knowledge (this is what we call *intuition*) to achieve better understanding of the concept. In the following section, as the topic of this paper is personal knowledge, we concentrate on intuition.

There seems to be an overall agreement (though not necessarily about the details) regarding some of the common features of intuiting/intuition: it happens instantly, it is spontaneous, it is gestalt, the person feels confident about it, it is tacit and apparently non-logical.[7] We shall briefly discuss these features to gain better understanding of intuiting and, based on this, of intuition:

1. **Intuiting is instant or, at least, very-very fast.** In this respect it is similar to guessing (Dane & Pratt, 2007: 40) but it is different in being *"frequently correct"* (Simon, 1983: 25). According to Richard Abdoo (quoted by Hayashi, 2001: 61) by the time we gather sufficient information to be pretty certain about a decision it has already become obsolete. To cope with such situation, when the time is short, the situation is complex and the response needs to be correct, intuition is necessary or, at least, beneficial (Patton, 2003: 992). Because, as Agor (1984: 6) argues, intuiting *"is a highly efficient way of knowing. It is fast and accurate. Our system will... give us an instantaneous cue how to act."* How is intuiting so rapid? According to Prietula and Simon (1989: 121-122) intuiting is a leap by which the expert bypasses the analytical steps and overcomes limitations of attention and of memory (both STM and LTM). As Klein and Weick (2000) describe it, we become aware of the right answer before consciously realizing it by relying on our experience without having to analyze everything. This could be one of

[7] *These features correspond closely to those described by Sadler-Smith (2008: 13).*

the reasons that intuition is so useful when we need to improvise. (Leybourne & Sadler-Smith, 2006)

2. **Intuiting is spontaneous.** It does not require effort, at least at the moment when it happens; according to Agor (1984: 75) intuiting happens *"at times when you are in some relaxed state, such as after awakening from a dream, driving across the desert, watching the sun go down at night, or showering in the morning."* As Isaack (1978: 918) observes, it also cannot be produced at will. Hard work is needed beforehand, and then the intuiting happens in this relaxed state (see Hadamard, 1954 for numerous examples); as Mozart (quoted by Goldberg, 1983a: 178) confesses: *"Whence and how they come, I know not, nor can I force them."* The work needed for good intuition is not limited to the work on the particular problem; it includes all the previous work in the discipline, as intuition only appears at high levels of knowledge. (Prietula & Simon, 1989) As Perot (quoted by Rowan, 1986: 83) says, intuition is about knowing your business, *"It means being able to bring to bear on a situation everything you've seen, felt, tasted, and experienced in an industry."* Mintzberg (quoted by Campbell, 1991: 109) says that *"it is grounded in the context in which it is relevant and based on experience of that context"*, therefore we cannot be intuitive about something we know nothing about.
3. **Intuition is gestalt***;* it is a *"holistic hunch"* (Miller & Ireland, 2005). This means that it is about a whole entity not about the parts; it *"immediately brings together various ideas which have been associated with that particular subject before"* (Beveridge, 1957: 73). Perhaps this is why it is so important in unstable business environments (see e.g. Agor, 1986b; Khatri & Ng, 2000 for empirical studies) or, as Weick (1995: 88) puts it, *"as turbulence goes up, so too does the use of intuition and heuristics"*. Sinclair and Ashkanasy (2005: 357) characterize in-

tuition by the *"non-linear, non-sequential nature of holistic processing"*, in which the internal (in memory) and external (in environment) resources are assembled, and then the 'big picture' suddenly emerges. Similarly, according to Morris (1967: 158), intuition means responding *"somehow to a total conception of the problem"*. Hayashi's (2001: 64) interviewees agreed that *"good intuitive skills must summon the entire mind"*.

4. **Intuitives are confident about their intuitions.** Jung (1921: §770) distinguished four psychological functions: thinking, feeling, sensation, and intuition. He emphasizes that intuitive knowledge *"possesses an intrinsic certainty and conviction"*. This certainty is one of the most common features of intuition emphasized by great scientists; one of the most often quoted examples is Poincaré's story (e.g. Hadamard, 1954; Polanyi & Prosch, 1977; Vaughan, 1979; Goldberg, 1983b; Damasio, 1994); probably because it is striking that his intuition 'told him' the opposite of what he was trying to prove previously and later he proved this opposite. Dean and Mihalasky (1974) have shown that the executives who are good at using their intuition believe in intuition. Probably the most beautiful formulation of this feature of intuition is typically attributed to Agor: *Intuition is what you know for sure without knowing for certain.*
5. **Intuition is tacit.** Hayashi (2001: 60) asserts, based on numerous interviews, that top executives cannot describe the process of intuiting much beyond labelling it *"professional judgment"*, *"intuition"*, *"gut instinct"*, *"inner voice"*, or *"hunch"*. Dane and Pratt (2007: 36) characterize intuition as nonconscious, meaning that the outcomes of intuiting are accessible to conscious thinking but how one arrives at them is not. It seems that, as in the case of any tacit knowledge, there is no meta-cognition, or it is not accessible. This feature of intuition is closely related to the next one.

6. **Intuiting is alogical.** According to Kahneman and Tversky (1982: 124) *"a judgment is called intuitive if it is reached by an informal and unstructured mode of reasoning, without the use of analytic methods or deliberate calculation."* Intuiting is a non-linear mode of thinking (Vance et al., 2007). Barnard (ibid: 301 ff) calls intuition a non-logical process to contrast it to the logical process, i.e. reasoning. Similarly, Rowan (1986: 84) defines intuition as *"knowledge gained without rational thought."* Simon (1987) builds his case for intuition based on this previous work of Barnard; he also assigns an important role to intuition in decision making but he disagrees with Barnard in that (ibid: 61) *"... intuition is not a process that operates independently of analysis; rather, the two processes are essential complementary components of effective decision making systems."* Even more explicitly, he states (ibid: 63) that *"Intuition and judgment – at least good judgment – are simply analyses frozen into habit and into the capacity for rapid response through recognition."* Mintzberg (1994) challenges Simon's conception, arguing that intuition is about synthesis and you will never get synthesis from analyses. In the next section we discuss whether it is possible that all of them are right.

Some of the described six features apply to intuiting, some to intuition. The intuiting process is instant, spontaneous, and alogical. The outcome of this process, the intuition (intuitive knowledge) is gestalt, tacit, and it is accompanied with the sense of certainty. Having described the concept of intuition through its peculiarities, we can establish it as a knowledge type.

Intuition as a Knowledge Type

To establish intuition as a type of knowledge in this section we do two things: We describe the areas in which intuition is used, to recognise that there are two different kinds of intuition; these are sufficiently similar to be considered the same type of knowledge, but the distinction will be useful to establish the relation to the earlier described knowledge types. After this we ex-

amine intuition in terms of particulars and whole entity, linking to the earlier discussion of focal and subsidiary knowledge.

As it emerged in the previous discussion, there are two major areas where intuition is important in management: decision taking (judgment) and creative problem solving (creativity). When Barnard (1938: 235) describes intuition as being an important part of the executive process he talks about decision taking:

"It transcends the capacity of merely intellectual methods, and the techniques of discriminating the factors of the situation. The terms pertinent to it are «feeling», «judgment», «sense», «proportion», «balance», «appropriateness». It is a matter of art rather than science, and is aesthetic rather than logical."

Agor's work (see e.g. Agor, 1984; 1989) was also aimed at decision takers. As Hadamard (op cit) shows through a number of examples, the importance of intuition in creative problem solving (in his case in mathematical discoveries) is a rule rather than a curiosum; Popper (1968: 8) agrees and adds that *"... there is no such thing as a logical method of having ideas, or a logical reconstruction of this process. My view may be expressed by saying that every discovery contains «an irrational element», or «a creative intuition», in Bergson's sense."*

Sadler-Smith and Shefy (2004: 81), Vance et al. (2007: 169-170), and Dane and Pratt (2007: 40) observed the same distinction, but they reserved the term 'intuition' purely for the area of judgment (which they were interested in) and intuition in creative problem solving they called 'insight'. Similarly, Agor (1986a: 11-14) found three ways how executives use intuition: as an explorer, i.e. *"to foresee the correct path to follow"* which corresponds to intuition as judgment; as a *"synthesizer and integrator"* which corresponds to intuition as insight; and as what *"might be termed eclectic"*, which is a combination of the previous two. These distinctions are very similar to the two kinds of intuition described by Polanyi (Polanyi & Prosch, 1977: 96 ff). The one he calls the *"strategic intuition"* points to a direction which is worth pursuing; this is what

we use when taking decisions (judgment). This intuition gets us nearer to understanding the problem. This type of intuition corresponds to 'know-what' (cf: 7). The other type of intuition Polanyi calls *"concluding intuition"*, which gets us to a novum, to a solution to a problem, using a shortcut (insight). This type of intuition corresponds to 'know-why' (cf: 9-10). Earlier we found certain similarities between 'know-why' and 'know-what'; now we see that both types belong to intuition – this explains the similarities. Examining great creatives (Gardner, 1993) and great leaders (Gardner, 1995) from a cognitive perspective Gardner (1995: 11 ff) finds the creatives and the leaders to be similar. The explanation may well be that both use intuition, although of a different kind.

We can now return to the seemingly contradicting statements whether intuition is logical or not. We use the term logic in Russell's (1946: 379) sense, as the general principles of reasoning regardless of the subject matter. In this sense 'logical' means following these general principles of reasoning, 'illogical' means contradicting these principles, and 'alogical' means being independent of the principles, i.e. neither following nor contradicting them. The term rational is often used as synonymous to logical. Jung's (op cit: §772) description may serve as a starting point:

"Although intuition is an irrational function, many intuitions can afterwards be broken down into their component elements and their origin thus brought into harmony with the laws of reason."

If we add this description to Polanyi's structure of tacit knowing (cf: 17-18) we can gain a better understanding of intuition. The proximal part of intuition, to what we pay subsidiary attention, is the subsidiary intuition. Jung's "component elements" belong here; they correspond to the particulars of tacit knowing (the hammer when nailing or the knowledge of letters and grammar when reading). Similarly to all subsidiary knowledge, the subsidiary intuition is logical and can be put into words. The whole, the distal part that we pay focal attending to, is the focal intuition. It corresponds to the whole entity in tacit knowing (when nailing the nail was in the

focus and when reading, the meaning of the text). As all focal knowledge, the focal intuition is tacit, and alogical.

This would be completely in line with de Bono's (1993: 16-17) explanation of lateral thinking; i.e. that all valuable creative ideas are logical with hindsight but only with hindsight. The lateral stream of thought is invisible from within the mainstream. Sonenshein (2007) arrived at a similar model in the special case of moral decisions. As Korthagen (2005: 375) notes, the intuitives are also often good at coming up with an ex post 'logical' version of the story. However, listing numerous examples, Gladwell (2005) warns that we have no evidence that the ex post explanation has anything to do with the way how the intuition got to the judgment or novelty. Gladwell's observation seems valid but it does not decrease the importance of the explanation; for instance the whole idea of scientific publications is based on explanation (De Bono, 1993: 110):

"Logic is the way of scientists, or other people, have to present their ideas. Even if a scientific breakthrough came out through hunch or chance it must be presented as if it were the result of logic. Otherwise ideas cannot be accepted."

Although we agree with Isaack (1978: 919) that *"intellect cannot completely understand the intuition since the artificial tools, preconceived categories, and symbols used by the intellect only represent reality and are not the substance of reality"*, we believe that an attempt, even if only sufficient for partial understanding, is useful. Now all the details are ready to present the synthesized knowledge typology model.

THE SYNTHESIS

In the previous sections we have prepared the elements that will constitute our knowledge model. The knowledge types introduced in first part of the section discussing typologies will

serve as building blocks, the focal-subsidiary distinction from the second part of that section will help to classify them, and intuition will become a type of knowledge. Instead of going through a process of how the constituting elements can be brought together, in the first part of this section, we immediately introduce the final form of the model, and then we show how the elements fit into it. In the second part we provide some illustrative examples of the power and the simplicity of the model by applying it to well known phenomena which are not, or not easily, explained by the known models.

The New Model

In our new model we define three types of knowledge: *facts*, *skills*, and *intuition*[8]; each having *focal* and *subsidiary* subtypes. (Figure 1)

Insert Figure 1 about here

In the following paragraphs we will describe each type, establishing the relationships to the previous typologies; the summary of these relationships can be found in Table 1 and the discussion follows the columns of the table.

Insert Table 1 about here

The focal part of facts is the *event*. This corresponds to the 'know-it' (cf: 11-12 above); this knowledge is tacit, the representation is analogical, it increases by experiencing events. (Table 1) The subsidiary knowledge of facts is the *evaluation*, i.e. the rules of evaluating; this is a 'know-that', which is explicit, the representation is propositional, it increases by learning. For example, the jump of a pole-vaulter is a fact. Its subsidiary part is the knowledge about the measuring

[8] *As noted above, the rationale for the terms will be developed in the forthcoming paragraphs.*

standard and how to use it. The focal part is our experience of the jump; this includes that the bar did not fall down. As we see, the focal facts are something much richer than what is usually called facts. The reason for this is that we usually call facts only those that we can be asked for, i.e. whether the bar fell or not; these facts we call (based on De Bono, 1976: 12-14) second-hand facts and they belong to the domain of propositions, i.e. they will not be focal but subsidiary facts. We can tell an endless list of propositions of any experience; so we can create countless second-hand facts about any focal fact. The essence of the second-hand facts is not the correspondence to the reality but the controllability; e.g. we can check in lexicons that Lee Harvey Oswald killed Kennedy, so it is a fact even if we cannot be sure if it is true. When someone tells us a second-hand fact we perceive in addition a first-hand fact; it contains the experience of the speaker, the environment, our own mood, etc. These may help later to recall the fact we were told.

The focal part of skills is the *action*, the 'know-how' with the procedural representation. The subsidiary part is the set of *rules of practising* and second-hand facts about practising, which, similar to the subsidiary facts, is 'know-that' with propositional representation. E.g. the act is movement with the bicycle with the subsidiary rules of keeping the balance. The subsidiary skills can be increased by learning; although it is not the only way of acquiring the rules of a skill, as we have seen in the case of the chess player. The increase of subsidiary skills does not necessarily improve the focal skills (e.g. knowing much about the engine does not necessarily make you a better driver); superfluous subsidiary skills may even destroy the focal skill, as Polanyi (1966: 19) claims, they may do *"irremediable damage"* in case of subjects like history, literature and philosophy. Focal skills are increased by practising. However, for mastering a skill, practising is not enough (De Bono, 1993: 4):

"A journalist who types with two fingers will still be typing with two fingers at the age of sixty. This is not for lack of typing practice. Practice in two-finger typing will serve only to make that person a better two-finger typist. Yet a short course in touch typing at a young age would have made that person a much better typist for all his or her life."

This is what we do in elementary mathematics when we try to apply the learned formulas in textually described tasks. The teacher helps us increase the subsidiary skill (e.g. how to add x to both sides of an equation), which will enable us to perfect the focal skill. Besides, practising the focal skills may also be increased by intelligent imitation in the master-apprenticeship relationship but this can also be broken down to an observing (experiencing events) and a practising part. Experiencing events and practising skills are both experiences but while the former is passive the later is active. This kind of knowledge increase is often referred to as *"learning by doing"*. (Anzai & Simon, 1979)

The focal intuition is the *hunch*, when one senses the direction or the solution; respectively the 'know-what' and the 'know-why' belong here (cf: previous section), both with analogical representation; this maps closely to Sadler-Smith and Shefy's (2004: 85) work where they speak about imagery in relation to intuition. The subsidiary intuition is the ex post *explanation* which has to follow the rules of formal logic strictly, regardless whether it was how the hunch happened or not; similarly to the previous two subsidiary knowledge types, the explanation uses second-hand facts. The subsidiary intuition is 'know-that' with propositional representation and can be increased by learning. To use these rules we also need practise, though this will not lead to intuition but to a skill of using the rules; thus we can learn to use inductive and deductive logic, and predicate calculus. Although the focal intuition is abductive (tacit reasoning), by applying rules of logic to come up with an explanation we gain, at least, some understanding of how intuition works. It is a useful image to describe hunch as applying a number of rules tacitly at the same time, as Simon did (cf: previous section). For now we must accept that we know very

little about the increase of focal intuition; we believe that attempts to find the 'best way to improve intuition' (e.g. Behling & Eckel, 1991: 51 ff) remain futile. What we know is that one with deeper knowledge in a certain discipline will have a better sense for the essence; as Einstein (1933: 12) said: *"There is only the way of intuition, which is helped by a feeling for the order lying behind the appearance, and this Einfuehlung is developed by experience."* Simon (interview by Ross, 1998) uses the example of Mozart to describe the importance of the experience: *"Mozart composed for 14 years before he wrote any music you'd regard as world-class."* So the hunch both builds on experience and transcends it in the 'Eureka!" moment; it often can be observed when experienced experts wander into new unexplored territories. (Sadler-Smith, 2008: 257) To contrast increase of focal intuition to the previous two types of focal knowledge we can say that those were both external experiences while the hunch increases by inner experiencing. This, as described by Polanyi (cf: previous section) for science and confirmed by Quinn et al. (1996) for management, normally happens by imitating the master's way of thinking and by practising to think differently. The master also provides the small but necessary instructions to keep the disciple on the right track (this is a similar role to the type-writing teacher in case of skills from the previous example) but, as Prietula and Simon (1989: 123) warn this is *"neither a shortcut nor a substitute for experience"*.

To summarize, we identified three types of knowledge: facts, skills, and intuition. Each has a focal and a subsidiary subtype. Each subsidiary knowledge type is 'know-that' with propositional representation; it always consists of some kind of rules (evaluation, practice, and explanation respectively) and second-hand facts. As the subsidiary knowledge can be articulated, it can be characterized as explicit (although it may not be always explicit, e.g. internalized). The typical increase of subsidiary knowledge is by learning and by articulation, although, as we have seen in

Ryle's chess example (cf: 8-9), it may also happen by observing others. The three focal knowledge types correspond to the remaining four types from the extended Ryle-model. Focal skills are 'know-how' with procedural representation; focal facts ('know-it') and focal intuition ('know-why' and 'know-what' corresponding to the two types of intuition) both use analogical representations. All focal knowledge types are tacit and they all increase by various kinds of experiencing; facts by experiencing events, skills by practising, and intuition by inner experiencing. In the second part of this section we provide several illustrative examples demonstrating the ease of use and the explanatory power of our model by applying it to well-known phenomena.

Illustration

Having defined three types of knowledge (with focal and subsidiary subtype each) we can realize that most acts of knowing are not limited to a single subtype, not even to the focal and subsidiary parts of the same type. Examining the earlier reading example, allowing multiple knowledge types at the same time, we can find the following: the knowledge of letters, while reading, belongs to subsidiary skills, while the perception of words, appears to be a very complex process; it is shifting between the focal skill and the focal intuition, i.e. recognizing the word is a focal skill and understanding the meaning of the word is a focal intuition (further types could be added to include the knowledge of grammar, previous experiences that we utilize for constructing the meaning, etc.). This multi-knowledge-type description can provide e.g. a simple explanation why we often do not notice that a word is mistyped: we want to get the message of the text, so the focal intuition (to understand the meaning) and the focal skill (to recognize the words) work together to get us the message. (If we are doing proof-reading the situation can be radically

different, unless we find the text interesting.) An often quoted example can be seen in Figure 2. (Typing the first 'sentence' gives you 36,300 hits in Google.[9])

Insert Figure 2 about here

Another example of the use of the model would be logically opposite to the one above; it concerns the Müller-Lyer and similar illusions. There is an argument from those opposing the constructivist approach to perception (i.e. that what we see emerges from the interaction of reality and personal knowledge, cf: 15) and, according to this argument, the Müller-Lyer illusion is a counter-example that falsifies the constructivist conception. Most people look at Figure 3 and see the left arrow longer than the right one. The argument goes that if you are *told* that the two arrows are of same length, you will still *see* the left arrow to be longer, so the knowledge (i.e. that they are of the same length) does not affect the perception.

Insert Figure 3 about here

The previous argument is deceiving. The knowledge of the (second-hand) *fact* that the two arrows are of the same length does not affect the perception. The reason for this is that seeing the length of the arrows is not a factual knowledge but a *skill*. And it can easily be experienced that if one practises seeing the length of different arrows in such situations, one's perception will improve. Furthermore, it seems that 'seeing through' these illusions is a kind of generic skill; the person practising several illusions becomes better at seeing the 'right picture' in cases of other illusions as well. So, by identifying that seeing the two arrow lengths and knowing the fact that they are of equal lengths belong to two different kinds of knowledge, our synthesized model

[9] *That is, typing the first sentence in quotes, so matching the exact text only; the full text reduces the number of hits to around 300 – obviously this text can also be mistyped. (Searched on 05/07/2007.)*

shows that the counter-constructivist argument is simply not valid – it draws conclusion about one knowledge type based on the properties of another type. Similar examples can be easily found and we believe that if we identify what type of knowledge some real-life act belongs to, we can gain better understanding of its nature and thus how it could/should be handled.

The third example provides us with an illustration of the transfer of tacit knowledge; however, some background details are first necessary. As it was indicated earlier, the conception of tacit knowledge was put forward by Polanyi (1966) in his famous *"The Tacit Dimension"*; however, as Tsoukas (2005: 142) observes, it was Nonaka and Takeuchi's (1995) *"The Knowledge Creating Company"* that made the idea so popular that it is *"nearly impossible to find a publication on organizational knowledge and knowledge management that does not make reference to or use «tacit knowledge»."* Tsoukas (ibid) asserts that *"Nonaka and Takeuchi assume that tacit knowledge is knowledge-not-yet-articulated: a set of rules incorporated in the activity an actor is involved in, which it is a matter of time for him/her to first learn and then formulate."* which he considers a part of the *"Great Misunderstanding"* (ibid: 154).

In the case study provided by Nonaka and Takeuchi (op cit: 95-123) and cited by Tsoukas (ibid: 152-153) the developers of Matsushita's Home Bakery, the first fully automated bread-making machine, sent Tanaka, a software developer, to learn bread making from the famous head baker of Osaka International Hotel, so that they could build a superior machine. At one stage Tanaka was telling the engineers, who were also brought to the hotel to gain some experience in kneading and baking, what would be needed to make the bread better. Tsoukas argues that this does not mean that Tanaka's tacit knowledge has been made explicit.

Thus, as it was said earlier, we can provide endless lists of statements (subsidiary knowledge) about any focal knowledge but this does not mean that the tacit focal knowledge is completely

articulated; in this our model agrees and supports Tsoukas' argument. However, additionally it can provide further details: we can argue that Tanaka's focal skill ('know-how') was not transferred to the engineers but she referred to their shared experience, which the engineers interpreted on the basis of their focal intuition ('know-why') and based on this developed the machine. We can further generalise this argument to explain why in master-apprentice relationship the master does not create a replica of herself/himself but rather (s)he helps the development of a new master. The focal intuition of the master is not transferred to the apprentice but a new focal intuition is gradually developed involving all the personal peculiarities of the apprentice (cf: Intuition section). Of course, there will be common parts of the intuition of the master and the intuition of the apprentice, but they will by no means be the same. The same argument can explain the case study of Davenport and Prusak (2000: 84 & 95) concerning an attempt to capture the knowledge of the world's best aerial photos' analyst in an expert system (ibid: 95): *"When the project ended, the expert system was useless, but the system designer was said to be the second best analyzer of aerial photographs in the world!"*

The aim of the previous examples was only to illustrate the explanatory power of our model; the list could be infinitely expanded. We believe that this explanatory power is, apart from its simplicity, what really makes our model valid and important.

CONCLUSIONS

As usually in the case of intuition, this model was not perceived in the way as presented in this paper. First we intuitively arrived at the model and then spent months of work slicing, dissecting it to understand its nature to finally put it back together. It is fair to argue that by analyz-

ing we lose something; but, together with Pirsig (1974: 87), we believe that something is also gained:

"When analytic thought, the knife, is applied to experience, something is always killed in the process. That is fairly well understood, at least in the arts… But what is less noticed in the arts – something is always created too. And instead of just dwelling on what is killed it's important also to see what's created and to see the process as a kind of death-birth continuity that is neither good nor bad, but just is."

The first aim we wanted to achieve with the presented model is completeness; i.e. we wanted a model into which all kinds of knowledge fit. We have tried hard to find counter-examples (by applying the model to our day-to-day observations) and, indeed, we had several minor revisions, but the model now appears to be all-inclusive. The same completeness could have been achieved by simply adding the three new knowledge types to Ryle's original model but our model also integrates these together, and this integration provides additional understanding e.g. of the various roles of 'know-that' in the three knowledge types that we introduced. We showed a few examples how the model directly facilitates better understanding by providing simple explanations to well-known but poorly explained phenomena; thus we believe that the explanatory power of our model is great and it directly supports our better understanding of personal knowledge. Finally, we wanted a model that is simple enough to be widely used by academic researchers in the field of knowledge, and also by the educators of knowledge workers and knowledge managers.

Our idea of further use of the model is twofold: On the one hand, we would like to give a useful starting point for management researchers pursuing their inquiries into (or through) the field of knowledge; on the other hand, we try to provide a comprehensive tool for the educators of the knowledge workers. The first is only possible if the model is general, i.e. independent of the specific field in which it is used; the second requires that the model is applicable directly in business environment.

According to our plans, the present model is only the first one in the series of models on knowledge and knowledge increase. We aim at a dynamic model of knowledge and then at a dynamic model of cognition. In relation to the present model there are several questions to be addressed in order to take steps towards those more general models: What is the relationship(s) of the knowledge types and the knowledge levels? We know that intuition appears only in people with deep knowledge in a discipline, and having shown intuitive capacity in one field does not invoke intuition in other fields, however, this relationship needs to be clarified. It was said that the semantic network model of propositional representations does not account for metaphors. It is possible that a model simply based on knowledge cannot account for metaphors; perhaps a proper explanation also needs to include other cognitive potentials, such as feelings and emotions. It is clear that we have a long way to go if hoping to get at the dynamic model of cognition, however, this first step, the model of knowledge types, is already useful in itself. It may happen that we shall never achieve our general goal but we will certainly produce some more useful models along the way.

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FIGURE 1
Facts, Skills and Intuition

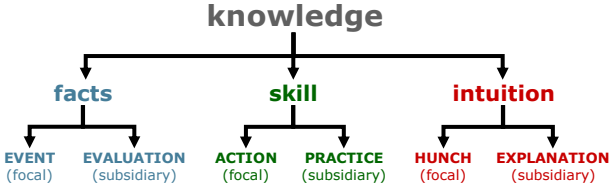

FIGURE 2
Is Spelling Important?

I cdnuolt blveiee taht I cluod aulaclty uesdnatnrd waht I was rdanieg The phaonmneal pweor of the hmuan mnid Aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it deosn't mttaer inwaht oredr the ltteers in a wrod are, the olny iprmoatnt tihng is taht the frist and lsat ltteer be in the rghit pclae. The rset can be a taotl mses and you can sitll raed it wouthit a porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe. Amzanig huh? yaeh and I awlyas thought slpeling was ipmorantt!

FIGURE 3
The Müller-Lyer Illusion (http://eluzions.com/Pictures/Illusions)

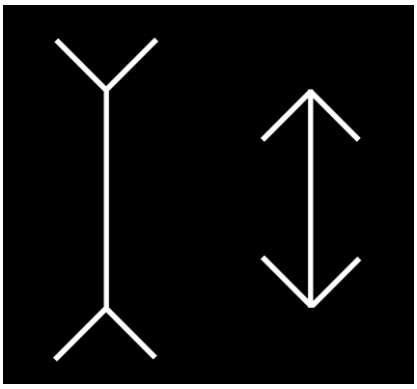

TABLE 1
Knowledge Typologies Synthesized

	PERSONAL KNOWLEDGE					
Type	Facts		Skills		Intuition	
Subtype	Focal facts: EVENT	Subsidiary facts: EVALUATION	Focal skills: ACTION	Subsidiary skills: PRACTICE	Focal intuition: HUNCH	Subsidiary intuition: EXPLANATION
Tacit-explicit	Tacit	Explicit	Tacit	Explicit	Tacit	Explicit
That/How/ Why/What/It	Know-It	Know-That	Know-How	Know-That	What / Why	Know-That
Representations	Analogical	Propositional	Procedural	Propositional	Analogical	Propositional
Knowledge increase	Experiencing events, internalization	Learning, articulation	Practising, internalization	Learning, articulation	Inner experience, internalization	Learning, articulation