Developing a Framework for Managing Tacit Knowledge in Research using Knowledge Management Models

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Abstract

This research investigates whether and how selected models from Knowledge Management (KM) can be used to devise a framework for building coherent and rigorous methodologies for research in the creative and practice-led disciplines (CPD).

This research has arisen from methodological problems of research in art and design in the UK concerning how, and the extent to which, non-propositional and tacit kinds of knowledge (e.g. experiential, procedural) can be included and communicated within research. The proposed research builds on previous studies by the authors into the role and relationship of different kinds of knowledge in research (Niedderer, 2007a, 2007b), and into how knowledge management (KM) and creative disciplines provide complementary insights on how knowledge can be managed and transferred (Imani, 2007).

The research investigates whether and how the SECI model (Nonaka & Takeuchi, 1995; Nonaka, 2000) can be used to develop a framework for managing different kinds of knowledge in research. Our research goes beyond existing approaches by offering a generic and flexible framework which researchers can use to better understand and build their own research methodologies and to integrate individual methods with regard to managing different kinds of knowledge.

Problems with Knowledge in Research

This research investigates whether and how selected models from Knowledge Management (KM) can be used to devise a framework for developing coherent and rigorous methodologies1 for research in the creative and practice-led disciplines (CPDs).2 The need for such a framework has arisen

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[1] By methodology we mean the sum of methods used in any one research project, and the underlying logic that connects them and determines their coherence and validity.
[2] As a matter of clarification, we wish to make two limitations explicit concerning our approach. Firstly, while we believe that core issues of methodological problems concerning the use of practice in research are common to all creative and practice-led disciplines, we recognise that problems and methodological approaches differ across the range of discipline areas. This is part and parcel of the framework that we propose, which aims to be generic and flexible enough to provide guidance to all CPDs. In our discussion we will emphasise on these core issues, while using examples from art and design for demonstration. Secondly, although our

from the continuous debates about conduct, standards and quality of research in CPDs in the UK, which is mirrored in many other countries. (Dash & Ponce, 2005; Durling, et al, 2002; Frayling, 1993; Green & Powell, 2005; Langrish, 2000; Niedderer, 2005; 2007a; Barrett & Bolt, 2007; Biggs, 2003, 2005; Mäkelä & Routarinne, 2004; Scrivener, 2004; Sullivan, 2005).

Current debates in the UK have been sparked by the integration of vocational colleges into universities in the 1990s. Through this integration, CPDs were required to adopt the academic frameworks of research and, to some CPDs (such as Art and Design), research funds were available through participation in the Research Assessment Exercise for the first time. However, since little prior research culture existed, in many cases creative practice[3] was offered as a substitute for research, which caused problems and debate about what role creative practice might have in relation to research (Durling, 2002; Durling et al, 2002; Niedderer, 2007b:4).

To clarify the situation, in the UK, bodies such as the Research Assessment Exercise (RAE), and the Arts and Humanities Research Council (AHRC) have defined research as production of new knowledge, to include professional practice as a significant part of the research process, and to treat the various forms of knowledge production equitably (AHRC, 2007; RAE, 2005). While this clarification has ameliorated the situation in terms of the formal acceptance of practice as part of research, it has not provided an understanding of the internal relationships between research and practice, and the contribution to knowledge, which is needed to achieve this equity (Niedderer, 2007a:2, 2007b:1).

The insufficient understanding and definition of knowledge in research has caused ambiguity about what constitutes a contribution to knowledge and about what may count as research under research regulations and within peer-assessment (Niedderer 2007a:2, 2007b:1). This is of particular relevance for CPDs where often part of the knowledge gained is tacit and professional/creative practice is used to include or communicate tacit knowledge within research (Niedderer, 2007b:5).

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research has evolved from the debates in the UK, it is important to recognise that there have been similar developments in many other countries worldwide. This has contributed to an international debate, which centres on common issues and principles even though some of the details may differ from country to country. Our discussion seeks to reflect these common issues while focusing on the UK perspective due to the limited scope of this paper.

[3] A further aspect that might need clarification is the distinction between research and practice, which we use in this paper. As distinguished previously (Niedderer 2005b, p.3), the term 'research' is being used to denote the systematic inquiry to the end of gaining new knowledge, and a 'researcher' is a person who pursues research (e.g. in art and design). 'Practice' is used to refer to professional practice (in art, design, etc.) or to processes usually used in professional and creative practice to produce work for any purpose other than the (deliberate) acquisition of knowledge. 'Practitioner' accordingly refers to anyone who pursues professional/creative practice. Sometimes there is confusion between these terms, because one may occur in the context of the other. For example, a practitioner might also work in the academy and pursue research to inform their practice. This study will therefore be concerned with the relationship of practice and research in general, and the role of practice within research in particular regarding its use for the purpose of generating and communicating (experiential) knowledge.

This ambiguity has resulted in a strong focus on the use of practice as research methods. However, its use is often characterised by a lack of understanding of how to link the knowledge gained into an overall research methodology. As a solution, we propose to understand knowledge as the common basis between individual methods. It is therefore important to clarify how different kinds of knowledge relate, how they occur in different stages of research, and how the flow of knowledge can be managed using different kinds of methods.

The proposed framework aims to provide this clarification by offering a holistic approach to understanding knowledge within research, and integrating different forms or modes of knowledge at different stages of research through different methods. In this way, the framework could aid researchers in CPDs with building coherent and rigorous research methodologies, based on a clear understanding of the flow of knowledge within individual methods and within research as a whole.

In the following, we first review some of the existing approaches to methodology in CPD research, and we extract some of the conceptual and methodological challenges. Subsequently we propose to understand knowledge as the common denominator between the different aspects of research. We review relevant KM theories to find ideas and concepts for managing knowledge holistically, and we evaluate and adapt Nonaka's SECI model for this purpose. Finally, we identify relevant parameters from generic research requirements in relation to characteristics of knowledge identified by Niedderer (2007a, b), and we apply the aspects of the SECI model to these parameters to build the framework.

Research Methodology in CPDs: Current Situation and Problems

As indicated in the introduction, the problem of research methodology in CPDs, and in particular in art and design, has evolved from their integration into the academic system. This meant that traditional academic positions were applied to art and design research such as philosophy and history at one end, and engineering at the other. However, for many CPD researchers it has been difficult to identify with either of the established positions, because the established positions (and thus their contributions) remain bound to just their disciplines, rather than making a genuine contribution to the disciplines from which individual CPD researchers are coming. For example, using a firmly historical or philosophical approach is unlikely to deliver results that contribute to the creative development of a new design and its understanding, unless integrated in an appropriate design research methodology. In this section, we therefore review what positions have emerged in CPD research, and what the conceptual and methodological challenges are concerning methodology in CPDs.

Over the last twenty years, a number of different approaches to methodology and the problem of using practice within research have emerged. One of the first attempts towards a discipline specific methodology comes from March (1984) who, referring to Peirce's notions of deductive, inductive and abductive reasoning (also: productive reasoning) (Hartshorne & Weiss, 1998,

vol. 5: §171), proposes that the latter is the most appropriate for design. This is based on Peirce's understanding that

Deduction proves that something must be; induction shows that something actually is operative; abduction merely suggests that something may be. (Hartshorne & Weiss, 1998, vol. 5: §171)

Peirce defines abductive reasoning further as the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new idea;… (Hartshorne & Weiss, 1998, vol. 5: §171)

Presenting the concept of abductive reasoning in the context of design methodology, March (1984: 269) argues that this mode of reasoning is most appropriate as framework for design knowledge, because of the nature of design as a creative and conjectural process. We regard his work as most important because it provides sound philosophical foundations for understanding research methodologies in design.

Further, the book by Cross (1984) and some of Cross' subsequent publications (Cross, 2001, 2003) have influenced design research and how designers work. Cross' aim to differentiate between a genuine design approach and a scientific approach, as one would find in engineering (Cross 2001), is of importance here. In this approach, Cross refers to Schön's concept of the 'reflective practitioner' (Schön, 1983). Together with Polanyi's notion of 'tacit knowledge' (Polanyi, 1966), the notion of the 'reflective practitioner' has been hailed as the solution for CPD research. However, where the concept is taken at face value, research has, at times, been of variable quality which has led to reservations to using Schön's concept as methodological foundation for research (e.g. Durling and Niedderer, 2007). Where Schön's concept has been applied with more caution, a number of useful research studies have been developed, which have set precedents for research in design to date. Among these are studies by Whiteley and colleagues (2000; Rust & Whiteley, 1998), Wood (2004), and Niedderer (2007c) where the creative potential of designing is used to generate insights and/or new solutions.

Taking another slant, Frayling (1993) has proposed the three categories: "research into design", "research for design", and "research by design", with the latter category trying to introduce the idea of research by practitioners for their field. Similar approaches can be found in the arena of fine art practice. For example, Scrivener (Scrivener & Chapman, 2002; Scrivener, 2004, 2007) is developing a framework for research in Fine Art suited to appreciate the experiential and aesthetic contribution of fine art practice within research. Biggs (2002, 2005) has further advanced the theoretical discussion about these issues, questioning the role of the artefact within the philosophical tradition of research. Barrett and Bolt (2007) investigate the same issue from an Australian perspective, and Crouch (2007) looks at the contradictions of practice-based research in terms of the institutional perspective.

Although a general acceptance of the use of practice has been achieved through the various approaches, which has also been integrated in current definitions of research funding bodies (e.g. RAE, 2005; AHRC, 2007) and in some university research regulations, the discussions have continued, indicating that there is still a lack of widespread consensus about discipline-

specific methodological approaches and how to integrate practice within research (Durling et al, 2002; Green & Powell, 2005; Rust et al, 2007). This is further confirmed through various recent conferences and doctoral events on this theme e.g. DeMontfort, UK: *In Theory*, 2007; UIAH, Finland: *The Art of Research*, 2007; and SDN, Switzerland: *Focused*, 2008.

It seems that current literature emphasises on the various methods of using creating practice, and of communicating the outcomes of research through practice. Key questions in this debate are whether certain methods could or should be used and if so, when and how. For example how can creative practice be used as a valid research method (e.g. Rust, 2004)? And what is the relationship between textual and non-textual methods of communication of research (e.g. Biggs, 2003)? Although there are increasing numbers of studies that use these methods and integrate practice successfully into their research (Wood, 2004; Whiteley, 2000), there seems to be an absence of literature that offers to bridge the gap between research requirements such as the contribution to knowledge, and the pragmatic issues of research practice.

Niedderer (2007a, b) has argued that the joining force for establishing coherence and bridging this gap is the holistic management of knowledge in research. In the next section, we therefore provide an overview of understanding of knowledge within research and how it affects each of these three parameters. We thereby keep March's understanding of 'productive reasoning' in mind as philosophical foundation for developing the proposed framework.

Knowledge as Key to a Holistic Understanding of Research

In this section, we discuss how a holistic understanding of knowledge can provide the bridging logic between all parts of research. First, we examine the current understanding of knowledge in research. Then, we investigate how explicit and tacit knowledge relate, and what their different roles are in research.

Research has been widely defined by research agencies, research funding bodies, and universities. One of the key requirements of research, which internationally appears in research regulations (e.g. AHRC, 2007:19; Curtin, 2001:2, 3; Indiana, 2005: 19, 50) and which has shaped the logic of research, is the requirement for the 'contribution to knowledge'. This gives research a central purpose, and knowledge a central role within that purpose. Surprisingly, in none of the definitions knowledge is further defined. However, Niedderer (2007a:6) has shown that these definitions implicitly prioritise what is known as propositional knowledge. Because CPD research often draws on other kinds or formats of knowledge, this implicit understanding has caused uncertainty where practice has been used to integrate non-propositional (experiential, procedural) or tacit knowledge (Niedderer 2007a:8, 2007b: 6,10). To understand this, we need to look at the nature of propositional knowledge and how it determines the nature of research.

Propositional knowledge is most commonly defined as "justified true belief". Grayling (2003:37) says,

> *this definition looks plausible because, at the very least, it seems that to know something one must believe it, that the belief must be true, and that one's reason for believing it must be satisfactory in the light of some criteria – for one could not be said to know something if one's reasons for believing it were arbitrary or haphazard. So each of the three parts of the definition appears to express a necessary condition for knowledge, and the claim is that, taken together, they are sufficient.*

Despite the continued criticism, the definition of knowledge as "justified true belief" has remained the prevailing definition, and Niedderer (2007a:7) has shown that this understanding of propositional knowledge is implicit in the definition of research because of additional requirements such as the textual/written presentation of an intellectual position (proposition, thesis – 'true belief'), because of the logic of verification and defence of this intellectual position through argument and evidence (justification), and the requirement for explicit and unambiguous communication.

This model of knowledge in research has long dominated scientific thinking in the natural sciences as well as the humanities. Because it embraces the logic of propositional knowledge and the related prioritisation of explicit expression through language, this model traditionally does not recognise non-propositional knowledge because of the tacit nature of some of its content (Niedderer 2007b:9). Although the importance of non-propositional knowledge in research is by now recognised (e.g. Neuweg, 1999; Higgs & Titchen, 2001), and Niedderer (2007b:10) has shown that there is not actually a problem with the justification of non-propositional knowledge in research, the problem with non-propositional knowledge persists because, its essence being tacit, personal, and situated, it is difficult to communicate and share. The problem that this poses for research relates to the aim of research to make a contribution to knowledge that is beneficial for, and can be communicated to a wide audience. However this argument needs further scrutiny, because according to Polanyi the problem of tacit knowledge even pertains to propositional knowledge, which commonly is taken to be wholly explicit and communicable by language:

The ideal of a strictly explicit knowledge is indeed self-contradictory; deprived of their tacit coefficients, all spoken words, all formulae, all maps and graphs are strictly meaningless.… The false ideal of a strictly explicit knowledge was pursued with the greatest zeal in the twentieth century by modern positivism. (Polanyi 1969: 195)

Polanyi (1962:17) explains that tacit knowledge is the "personal coefficient" part of any explicit knowledge, which is essential for the understanding and comprehension of any knowledge. The same applies to non-propositional knowledge, part of which can be made explicit, e.g. the experience can be named and its quality indicatively described, but the essence of this experience cannot be communicated (e.g. the description of pain cannot make you actually feel the pain) and therefore any interpretation of the experience remains grounded in 'tacit knowledge'. This explicit – tacit divide is visualised in Fig. 1.

Knowledge	Propositional knowledge	Non-propositional knowledge	
		Experiential Knowledge	Procedural Knowledge
Explicit dimension	Verbal/textual account, description	Verbal/textual account, description	Verbal/textual account, description
Tacit dimension	Comprehension	Quality of experience which gives the experience meaning & allows interpretation	Quality of experience which gives the activity meaning & allows execution of activity

Fig 1: A simple model of the explicit and tacit modes of knowledge

To advance this discussion we need to consider where knowledge creation occurs in research, before examining how the tacit dimension can be recognised within research alongside its explicit dimension, and how we can manage both.

The clearest current model of research in the Arts and Humanities in the UK seems to be that of the AHRC. This model specifies and explains the generic stages of research as research problem/ question, context, methods, and outcomes/findings (AHRC, 2007: 19). Within these stages, knowledge plays a number of different roles (fig. 2).

Stages of Research	Roles of knowledge
Research Problem/Question	Draw on/integrate knowledge as a starting point for research
Research Context	Draw on/integrate knowledge as a starting point for research
Research Methods	Integrate and utilise knowledge
	Create knowledge
Research Outcomes	Elicit knowledge
	Communicate knowledge
	Post Research: Apply knowledge to enhance practice, or Draw on knowledge as a starting point for research…

Fig 2: Relating the different roles of knowledge to the stages of research

Firstly, existing knowledge *generates a research problem* worth of investigation. This can be a gap in existing knowledge, or contradictions which need resolution, etc. Thereby, knowledge may be of any one or all kinds, e.g. of propositional, experiential, or procedural nature. For example, it may arise from contradictions between different propositional statements, or it may arise from some experience.

Secondly, knowledge of a situation or phenomenon and of its *context* will be required. This will most likely be based on propositional knowledge in explicit format as this is most widely available and accessible, although any interpretation of the material will require a certain input of experiential knowledge (tacit dimension).

Thirdly, the use of appropriate research *methods* will *draw on, utilise, and integrate* existing knowledge in research. Once more, in this role, knowledge will be present in explicit and tacit form. Knowledge that the research draws on can come out of the contextual research in form of propositional knowledge or in form of prior tested experience, for example, Niedderer (Niedderer, Johns, and Harrison, 2006) has been a silversmith for nearly 20 years and knows (has experientially learned) how standard sterling silver behaves within practice, and therefore can compare it to the behaviour of other alloys. Similarly, when utilising knowledge within the research process through the use of research methods, part of this knowledge will be explicit/propositional, and some of it will rely on prior acquired skill (procedural knowledge) and judgment (based on experiential knowledge). The conduct of research will also lead to the *creation* of new insights. In the process, these insights (true belief) become knowledge (justified true belief) when they have been evaluated (justified) in an appropriate way. However, here too, the explicit and tacit dimensions join: while the formulation of new knowledge may take the form of propositional knowledge in its explicit form, the actual process of evaluation may be strongly based on tacit knowledge as shown by Niedderer (2007b:6).

The fourth issue is closely related to the third and concerns the *elicitation* and *communication* of new knowledge that is the *outcome of research*. While the communication of the explicit part of knowledge coincides with its formulation and therefore seems unproblematic, Collins shows (1985) that explicit knowledge alone is at times not sufficient to transfer research knowledge. Collins has further shown that where subsequent *application* is required, an extended period of contact is required between expert and learner for transfer of tacit knowledge, usually through mentoring or coaching. This seems the most problematic part for research, because it cannot be widely disseminated and thus evades this core principle of research.

Having discussed the different roles of knowledge in the different stages of research, we now examine how tacit knowledge can be recognised within research alongside its explicit dimension, and what methods we have for managing it. In order to do so, in the next section, we introduce some ideas from knowledge management which deal with this issue.

The Notion of Tacit Knowledge in Knowledge Management

In this section, we turn to knowledge management to find some guidance on how to understand and manage the different roles of knowledge in the different stages of research as a basis for developing the proposed generic methodological framework.

Knowledge management (KM) is concerned with the enhancement of knowledge-based processes in organisations. A recent surge of interest in

knowledge other than explicit knowledge is due to the emerging recognition that

even the most theoretical form of knowledge, such as pure mathematics, cannot be a completely formalised system, since it is based for its application and development on the skills of mathematicians and how such skills are used in practice" (Tsoukas, 2003: 142).

This recognition mirrors that in CPDs, and is also based on Polanyi's suggestion (1962:17, 195) that knowledge has two dimensions: explicit and tacit; the latter being the "personal coefficient" part of any explicit or theoretical knowledge.

KM has further problematised individual tacit knowledge and social tacit knowledge aiming to offer ways in which they can be captured or 'converted' into explicit knowledge. In this regard, KM offers a number of perspectives, which provide complementary and at times competing insights. Mainstream KM perspectives include *the knowledge integration theory* (Grant, 1996a, b, 2002), *the communities of practice* (Brown & Duguid, 1991; Lave & Wenger, 1991; Wenger, 1998, 2000), and more recently, theories which draw from *complexity sciences* to explain the complex dynamics of knowledge-based processes in organisations (e.g. Allen, 1998; Anderson, 1999; Englehardt & Simmons, 2002; Harkema, 2003; McElroy, 2000, 2003; Snowdon, 2002; Stacey, 2001, 2003, 2007).

However, by far the most influential perspective in this field is Nonaka and colleagues' knowledge conversion theory (Nonaka, 1991, 1994; Nonaka & Takeuchi, 1995; Nonaka & Konno, 1998; Nonaka et al, 2000), which draws on Polanyi's theory of knowledge. Their work in turn, and not always uncritically, has inspired a large number of other scholars (e.g. Boisot, 1998; Choo, 2002; Conner & Prahalad, 1996; Davenport & Prusak, 1998; Dixon, 2000; Glisby & Holden, 2003; Grant, 1996a; Nahapiet & Ghoshal, 1998; Ray & Clegg, 2005; Spender, 1996; Styhre, 2004; Tsoukas, 2003; von Krogh et al, 2000).

In this paper, we focus on Nonaka's knowledge conversion theory (SECI model). As argued before, our intention is to explore the extent to which this model can provide pointers for describing management of knowledge in different parts of the research process within CPDs. In the following, we first introduce the theory. We then discuss the criticisms of the SECI model. Finally, we discuss how we adapt the theory for the purpose of this research.

The Knowledge Conversion Theory (SECI)

Nonaka et al (2000: 42) argue that the assumed objectivity or 'truthfulness' in the Western theory of knowledge (epistemology) produces an "absolute and, static and non-human view of knowledge" which "fails to address the relative, dynamic and humanistic dimensions of knowledge". Nonaka and colleagues' theory (Nonaka & Takeuchi, 1995; Nonaka et al, 2000) offers a dynamic view of knowledge based on the main assumption that tacit and explicit knowledge can convert into each other. As part of this theory, the SECI model is developed with its four stages of knowledge conversion:

Socialisation- tacit to tacit

Externalisation- tacit to explicit

*C*ombination- explicit to explicit

*I*nternalisation- explicit to tacit

According to Nonaka et al, *Socialisation* is the process by which new tacit knowledge is created through shared experiences. It usually takes place in apprenticeships or through interaction with others (Nonaka et al, 2000). Through *externalisation,* tacit knowledge is articulated providing a base for new knowledge. The use of metaphors, analogy and models facilitates this process (ibid.). "Concept creation in new product development is an example of this conversion process" (ibid: 45).

Through *combination* processes explicit knowledge is converted into more complex sets of explicit knowledge (ibid.). The final process, *internalisation,* "is closely related to learning by doing" (ibid: 45). In a broad sense, it can include reading, creating (which could include the use of simulations), and reflection. People have different interpretations of the same information (ibid.). These processes could take place simultaneously.

This model explains how knowledge can be managed in a rather neat and orderly fashion, which may appear oversimplified. To explain their model of knowledge conversion further, Nonaka et al argue that

> *knowledge is created in the spiral that goes through two seemingly antithetical concepts, such as order and chaos, micro and macro (individual and environment), part and whole, mind and body, tacit and explicit, self and other, deduction and induction, creating and control (Nonaka et al, 2000: 43).*

This statement acknowledges that knowledge has a complex nature that includes antithetical concepts, which can be transcended and synthesized through dialectical thinking offered with their model. Therefore, if one understands the model not as a single spiral, but as a multitude of spirals at micro and macro level, the model offers some interesting opportunities.

To further refine their model, Nonaka et al (Nonaka and Konno, 1998; Nonaka et al, 1999, 2000) have introduced the concept of "ba", borrowed from Japanese philosophy (Nishida, 1921). Ba is a Japanese word literally meaning "place" but Nonaka et al define it as "the shared space for emerging relationships where knowledge is embedded" (Nonaka et al, 2000: 49), which simultaneously includes space and time (ibid: 49-54). Bas exist at different ontological levels and they may be connected to create a bigger ba. Ba is especially important in socialisation and externalisation processes, as it provides the place, the impetus, and the quality of conversations (ibid.). In short, ba can be physical (office space), virtual (email, teleconferencing), mental (shared ideals, ideas, experiences), or any combination of them (ibid.).

In this way, the concept of ba provides the context for the SECI model and its practical implications, pointing out where and how interactions take place and how it facilitates the creation or conversion of knowledge dimensions. There are further a number of `energising ba' methods as well as the third part of the theory, the organisational assets. However, these apply mainly to management practices within social groupings and organisations, beyond the scope of this paper.

A Critique of the SECI Model

There have been a number of critical reviews of this theory. Some argue that despite its universal claim, the SECI model is highly embedded in Japanese culture (Glisby & Holden, 2003; Ray, 2001; Ray & Clegg, 2005), and that Japanese work practices on which this theory is based are incomprehensible to the Westerners, limiting its applicability (Ray, 2001; Ray & Little, 2001). However, this is countered by some empirical studies in non-Japanese contexts, which confirm the theory's applicability (Krogh et al, 2000; Schulze & Hoegl, 2006), and its adoption by practitioners (Brand, 1998; Kikawada & Holtshouse, 2001).

A second criticism asserts that Nonaka has misunderstood Polanyi's notion of *tacit knowledge* and *knowing* (Gourlay, 2006a; Stacey, 2001; Tsoukas, 2003) and that in Polanyi's theory (1962), tacit and explicit are dimensions of knowledge, not modes in which knowledge can move freely from one to another. This has led to debate about the extent to which tacit knowledge can be made explicit, i.e. whether it is 'convertible' because Polanyi's account itself is ambiguous and open to multiple interpretations (Hedlund, 1994; Day, 2005: 632). Initially, Polanyi defined tacit knowledge as a process of knowing (Polanyi, 1962), but later expanded it arguing that "it was possible to 'know' parts explicitly" (Gourlay, 2004: 92).

Tsoukas (2003:122) proposes that "tacit and explicit knowledge are not the two ends of a continuum but the two sides of the same coin: even the most explicit kind of knowledge is underlain by tacit knowledge". He further says that tacit knowledge is "ineffable" (inexpressible), and acquired through socialisation, observation and imitation. Nevertheless, he concedes that "although skilful knowing is ultimately ineffable it nonetheless can be talked about" (p.157).

These debates coincide with our discussion of knowledge in section 3 and guide our understanding of knowledge in relation to the SECI model as follows:

Explicit and tacit knowledge are different dimensions of a unified concept of knowledge. The explicit and tacit dimensions of knowledge coexist all the time.

All knowledge has an explicit dimension that can be communicated by conventional means, but cannot fully convey the tacit dimension of knowledge.

The tacit dimension of knowledge is ineffable. It cannot be converted into explicit knowledge. In order to share it, it has to be transferred or evoked in other ways in its tacit form.

Mindful of the original purpose of the SECI model, we need to explain how we adapt the model for the development of our proposed framework. In consequence of the above, we understand and use the SECI model not as a model of knowledge conversion, but of *knowledge transfer*. In using SECI, we understand research as the context (ba) in which the knowledge creation processes occur. This is based on the SECI model's main assumption that knowledge is first created at individual/micro level, which then progresses through interactions to the collective or organisational macro level. For this current research, we focus mainly on the individual level.

Integrating the SECI model into the process of research to build a generic methodological framework for research

In this section, we discuss how the SECI model helps us to understand and manage knowledge transfer within research and to construct the proposed framework. The key to our approach is the recognition that explicit and tacit knowledge are concurrently present, and therefore have to be managed at every stage of research. The importance of the SECI model in this is that it can help to understand the knowledge transfer processes at and between each stage of research.

For the two processes of *socialisation* (tacit-tacit-transfer) and *combination* (explicit-explicit-transfer) the principle of transfer through appropriate methods seems clear. However, if knowledge cannot be 'converted' the question is what happens at the stages of *externalisation* and *internalisation*. We suggest that these two stages can now be understood as a shift of emphasis from tacit knowledge content to explicit knowledge content and vice versa. This, too, is a process that needs specific actions and methods, such as reflection (for externalisation) to make experiential knowledge explicit and allow its use as evidence in the propositional construct of research.

Having explained how we understand the model in relation to research, we now need to look at how the model can be applied to research, and its different stages. As indicated in section 4, the SECI model (Nonaka and Takeuchi, 1995: 62) with its four modes of *knowledge transfer* (originally: *knowledge conversion*) can be understood at individual as well as organisational levels. In the first instance, we are interested in applying the model at the individual level of research comprising:

knowledge base and generation at the individual level of the researcher who conducts research using various methods of investigation (socialisation),

eliciting the newly generated knowledge in the research process (externalisation),

communication and dissemination of the research to peers e.g. through conferences etc. (combination), and

application of the research findings in new research and/or professional practice (internalisation).

The SECI processes are contextualised through ba, which here might be seen to pertain to research as a process with its four stages: contextual review/problem-setting, methods-stage, elicitation of knowledge, and communication of outcomes. Taking the three aspects together (SECI modes, knowledge processes in research, 'research-ba'), one can visualise these relationships in the 'knowledge cycle' as shown in Fig. 3.
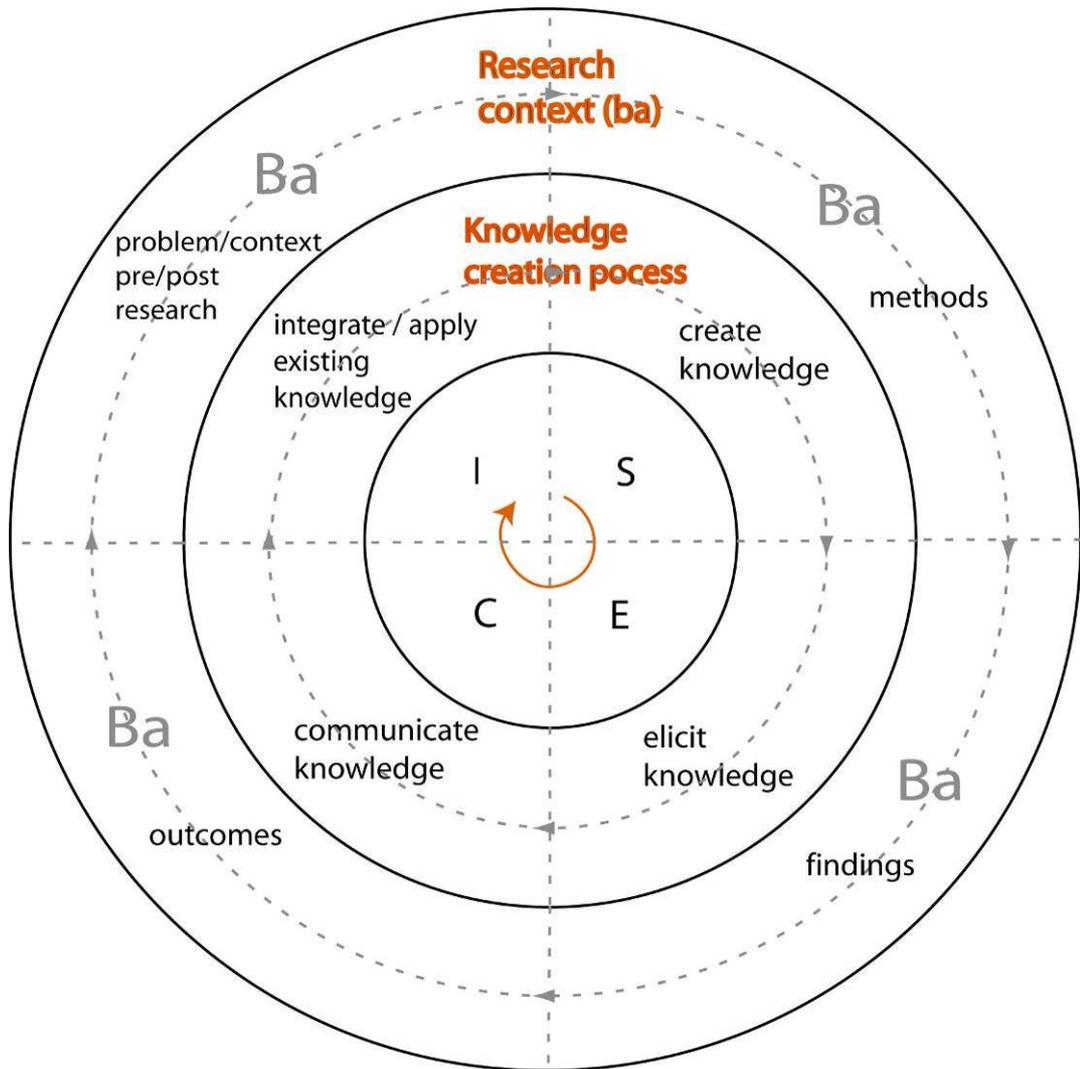
Fig. 3: Knowledge Cycle in research (first level) based on the four modes of knowledge conversion in the SECI model (Nonaka & Takeuchi 1995: 62).

A second level of reading, which could be a sub-level of the above, relates the SECI model (at least partially) to each individual stage within research in order to understand how the two dimensions of knowledge are managed within each stage. For example, at the methods stage of research, methods are applied (internalisation), methods are processed and knowledge is created (socialisation), and the resulting findings are elicited and evaluated through writing or discussion with other researchers (externalisation). Some of these stages/processes may even exist concurrently. This level is added in Fig. 4.

A third level, describing the organisational macro structure of research can also be distinguished. However, to deal with this third level is beyond the scope of this paper.
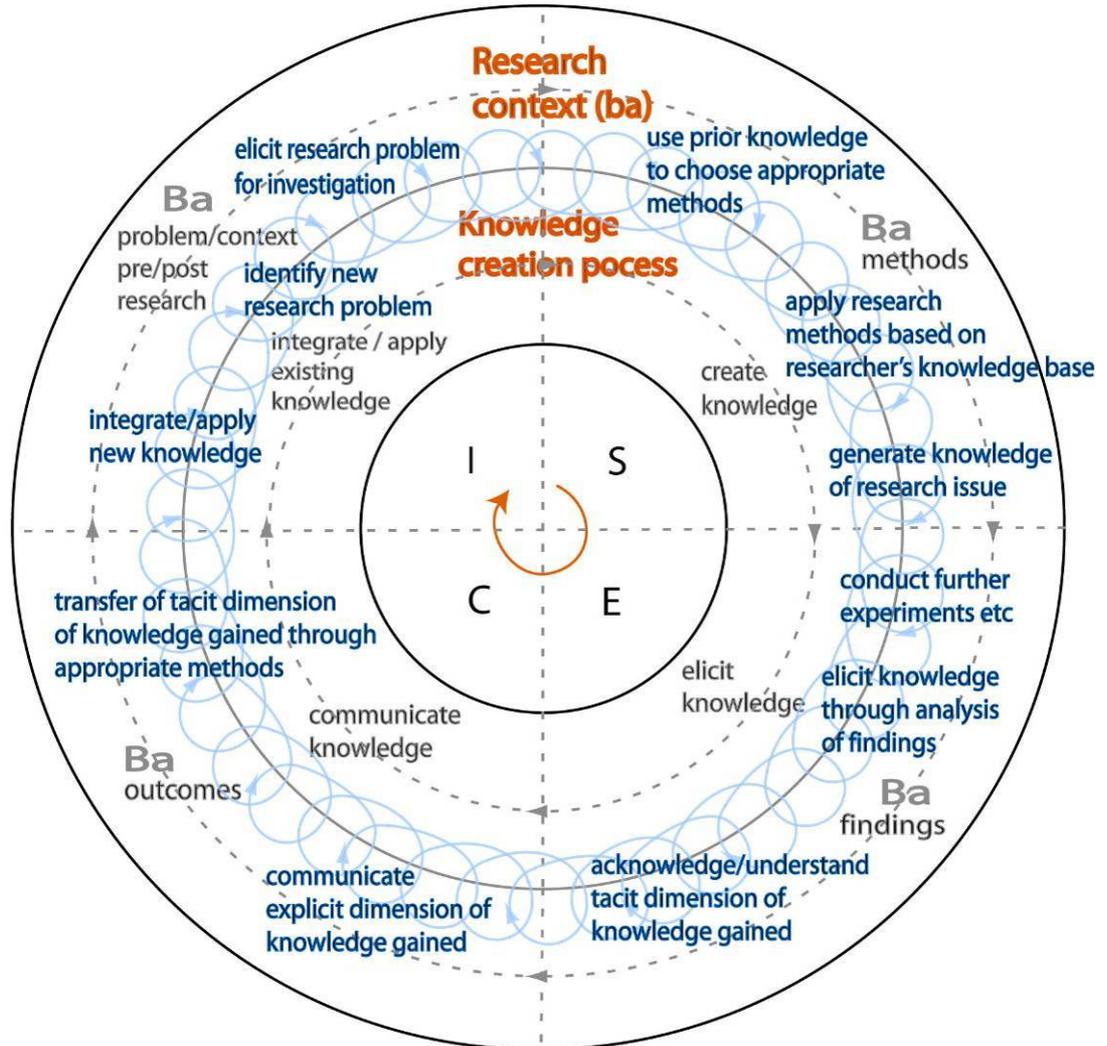
Fig. 4: Knowledge Cycle in research (second level) based on the four modes
of knowledge conversion in the SECI model (Nonaka & Takeuchi 1995: 62).

The Knowledge Cycle(s) show(s) how the four modes can be related to the
different processes and contexts of research. Once again, the understanding
of knowledge transfer is that there is not the belief that explicit and tacit
knowledge can convert into one another, but that both dimensions co-exist.
The SECI model in this sense is about how to manage this co-existence and
the flow of each knowledge dimension between the different stages of the
process.

By applying the SECI model in this way to the process of research, we finally
derive a generic framework (Table 1) which offers an understanding for how
explicit and tacit knowledge co-exist in research, and how the emphasis shifts
between the different stages of the model/of research. The shift of emphasis
offers pointers towards the importance of each dimension at any particular
stage and/or difficulties in managing them, e.g. in applying explicit
knowledge or transferring tacit knowledge from one stage to the next.
Because of its generic nature, the framework provides the flexibility of using
discipline specific methods as appropriate. In order to give our framework
practical relevance, we include a list of the kinds of methods that can be

used for managing knowledge at each stage, including methods and processes to facilitate the integration/application, creation, elicitation, communication/transfer of knowledge.

Table 1: Knowledge framework for research based on the four stages of research and the four modes of knowledge transfer in the SECI model (Nonaka & Takeuchi 1995: 62).

Stages of Research / SECI stages, level 1 (fig 3)	Roles of knowledge (fig. 2)	Methods for knowledge management related to SECI (level 2, fig. 4	
		Explicit Knowledge	**Tacit Knowledge**
Research Problem: *Combination / Internalisation* **Research Context:** *Combination / Internalisation*	**Drawing on/Integrating knowledge as a starting point for research** *Knowledge is collected in various ways and analysed to ascertain a knowledge gap.* In the process, the emphasis shifts from explicit knowledge (easy to research & communicate) to tacit knowledge (comprehension, intuition), and back again to explicit knowledge for evaluation.	**Collect explicit knowledge** (combination) in form of verbal/textual account or description of propositional, experiential, or procedural knowledge through methods of data collection such as literature search, archival searches, recorded interviews, questionnaires, etc. **Integrate knowledge** (internalisation) through formal methods of knowledge acquisition and data analysis such as literature review, reading, analyses (of various kinds), comparison, etc. **Identify Knowledge Gap** (socialisation) through reflection individually or in dialogue with others.	**Collect tacit knowledge** (internalisation) from observation through field trips, museum & exhibition visits, or from observation of own practice etc. **Elicit knowledge** (externalisation). Tacit knowledge acquired through observation will have to be made explicit through description and documentation to be available for methods building on explicit knowledge. **Identify Knowledge Gap** (socialisation) through individual reflection – according to Polanyi (1966: 22), this stage is also strongly routed in tacit knowledge (intuition).
Research Methods: *Internalisation / Socialisation*	**Integrate and utilise knowledge** *Knowledge is applied in form of methods within the process of research.* Available knowledge is being internalised through the shift from explicit to tacit knowledge until it can be used within (research) practice.	**Utilise knowledge** (combination) in form of verbal/textual account or description of propositional, experiential, or procedural knowledge of theories & models of paradigms, methodologies, and methods to devise a specific methodology for a specific study. **Integrate knowledge** (inernalisation) by creating knowledge structures (methodologies) that guide the (tacit) process of applying or conducting research methods in the process of research.	**Integrate knowledge** (internalisation). Some tacit knowledge may already have been internalised (e.g. experience from practice). In other cases tacit knowledge may still need to go through the stage of internalisation, and tacit knowledge may need to be learned or absorbed through empathy, through imitation, through own experience, through 'learning by doing' (Nonaka et al, 2000: 45), or through expert training, coaching and mentoring (Ball et al 2004; Miles et al 2005) before it can bee applied in form of research methods. **Utilise knowledge** (socialisation), both explicit and tacit, that has been internalised in the conduct of research through the experiential and skills-based application of research methods.

Research Methods (continued)	Create knowledge *The chosen methods are used to ascertain new knowledge.* Tacit knowledge is applied and/or tested and in the process extends, generating 'new knowledge'.	Create explicit knowledge (externalisation). The creation of tacit knowledge is intertwined with reflection in action and reflection on action (Schön 1983, Cowan 2006) to make individual processes conscious and available for evaluation, and to adjust the use of methods during the process as required.	Create tacit knowledge (socialisation) through the experiential and skills-based application of research methods, and – according to Polanyi (1966: 22), this stage is routed in tacit knowledge (intuition).
Research Outcomes: *Externalisation / Combination*	Elicit knowledge *The explicit dimension of the (as yet tacit) new knowledge is articulated in order to evaluate and share it.* In the process, the emphasis shifts from tacit knowledge (rich, complex) to explicit knowledge (conscious analysis).	Elicit knowledge (externalisation) –happens in the phase following knowledge creation through (Schön 1983), and through various methods of analysis. Through *externalisation*, tacit knowledge is articulated providing a base for new knowledge. "Concept creation in new product development is an example of this conversion process" (Nonaka et al 2000: 45).	Elicit knowledge (externalisation). Through *externalisation*, tacit knowledge is articulated providing a base for new knowledge. While the tacit dimension of knowledge can be described, but not articulated, it it required to facilitate comprehension.
	Communicate knowledge *New knowledge is communicated and/or transferred on both explicit and tacit level to disseminate and share it.* The communication of both dimensions of knowledge is equally important. Explicit communication serves dissemination; tacit transfer serves comprehension and subsequent application.	Communication of knowledge (combination). Through *combination* processes explicit knowledge is converted into more complex sets of explicit knowledge (Nonaka et al 2000: 45). It can be communicated through various language based means such as papers, seminars, conferences, books, teaching materials etc.	Transfer of knowledge (socialisation): In order to transfer tacit knowledge, it may need to be learned or absorbed through empathy, through imitation, through own experience, through 'learning by doing' (Nonaka et al, 2000: 45), or through expert training, coaching and mentoring (Ball et al 2004; Miles et al 2005). The use of metaphors, analogy and models can support the transfer of tacit knowledge (ibid).
	Post Research: Application of new knowledge *This can be the starting point for new research or for application of new knowledge in practice.*	Knowledge is available (combination) for sharing, consumption and further use independent of individuals through storage in books, databases etc. Application of explicit knowledge (internalisation) will be dependent on its comprehension through complementary experience and tacit knowledge.	Integrate knowledge (internalisation). Some tacit knowledge may have been internalised (e.g. experience from practice). In other cases tacit knowledge may still need to go through the stage of internalisation, and tacit knowledge may need to be learned or absorbed through empathy, through imitation, through own experience, through 'learning by doing' (Nonaka et al, 2000: 45), or through expert training, coaching and mentoring (Ball et al 2004; Miles et al 2005) before it can be applied in practice, or become the basis for new research.

Conclusion

In this research, we have first discussed the problems of knowledge and practice in Art and Design Research as an example of CPD research. Second we have investigated and determined the understanding of knowledge in research and knowledge management as holistic with a concurrent explicit and tacit dimension, which allows for the much-needed recognition of tacit knowledge in research. Finally, we have discussed and adapted the principles of the SECI model to create a generic and flexible framework for understanding the flow and management of both dimensions of knowledge in research.

The contribution of the framework is that it relates the different stages of research, the different kinds of knowledge, their role(s) in the process of research, and different methods to manage the different kinds of knowledge. Thus the framework provides a tool which researchers can use to interrogate their own research process, to determine the role and choice of their research methods.

Future research may be concerned with a further analysis of methods in relation to the framework, and with the application of the SECI model at the macro level (organizational level) of research

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