'Telling Tales': Stories, Metaphors and Tacit Knowledge at the Fuzzy Front-End of NPD

Breakthrough ideas depend upon the generation of new knowledge, which emerge from the conversion of tacit knowledge at the fuzzy front-end (FFE) of NPD. The occurrence of stories and metaphors has been strongly linked to tacit knowledge, however, empirical studies that examine *how* stories *and* metaphors harness tacit knowledge in the FFE are lacking. In addition, how managers can use stories and metaphors to develop breakthrough product ideas is unclear. To address these gaps, an 'in-situ' empirical case study was conducted in the European subsidiary of a B2C multinational. This study investigated the role, characteristics and interplay of stories and metaphors emerging in discussions between managers and customers in a collaborative design workshop (CDW). Taking a knowledge management theoretical perspective, the data were analyzed using the well-known SECI framework. The results clearly show that significant new knowledge was created based on the discussions in a CDW and stories and metaphors were important mechanisms for this. Importantly, it was stories related to product usage triggered breakthrough ideas. The study extends the understanding of how breakthrough ideas emerge; it proposes a tentative conceptual framework; and it provides managers with recommendations of how to use stories and metaphors effectively during the FFE.

Introduction

The design of breakthrough products is dependent on new knowledge being generated during the *fuzzy front-end* (FFE) of new product development (NPD) (Dahan and Hauser, 2000; Maschitelli, 2000). Such knowledge is created through the interplay of *explicit knowledge* (which is easy to express and document) and *tacit knowledge* (which is difficult to express, and linked to experiences and unarticulated mental models) (Nonaka, 1994). The importance of tacit knowledge in the FFE of NPD has been recognized by many researchers (e.g. Leonard and Sensiper, 1998; O'Mara et al., 1999; Maschitelli, 2000). However, the ephemeral nature of tacit knowledge makes it difficult to manage and the creation of new knowledge in NPD becomes a daunting task (Bertels et al, 2011).

Different streams of literature have emphasized the value of *stories* and *metaphors* in the elicitation of tacit knowledge: the knowledge creation literature (e.g. Smith, 2001; Nonaka, 1994), the NPD literature (e.g. Maschitelli, 2000; Goffin and Koners, 2011), and the creativity literature (e.g. Couger, 1995; Runco, 2007). In a NPD context, stories are narratives that relate to individuals' experiences of using products. When stories are shared in discussions, they can lead to a deeper understanding of customer needs and, consequently, to more efficient product development (Escalas, 1998). Metaphors, on the other hand, involve perceiving a product in terms of another concept, through the use of an analogy or a comparison (Capelli and Jolibert, 2009). In FFE discussions, metaphors can potentially create new knowledge by juxtaposing abstract concepts with product characteristics (Nonaka, 1994).

Researchers have investigated the use of stories and metaphors in the later stages of NPD. For example, the role of stories and metaphors in communicating with customers and in advertising has been recognized (e,g, Gorry and Westbrook, 2011; Noble, Bing and Bogoviyeva, 2013). Similarly, the value of stories and metaphors in promoting project-to-project learning in NPD teams has been identified (Goffin and Koners, 2011). However, the role of stories and metaphors in the FFE of NPD is not well understood. Firstly, it is unclear how managers can utilize stories and metaphors in their discussions with customers (McConnell, 2014; Hoegl and Schulze, 2005). Secondly, extant research has largely viewed stories and metaphors as separate phenomena (e.g. Nonaka, 1994; Stewart, 1997; Sole and Wilson, 2002), rather than as, potentially, related phenomena. Thirdly, although it has been claimed that stories and metaphors lead to breakthrough products (Maschitelli, 2000), empirical evidence has not been provided. This leaves significant gaps in our understanding of the role of stories and metaphors in the FFE discussions—so it is not surprising that many researchers have said further investigation is of this area is urgently required (e.g. Teichert, von Wartburg, Braterman, 2006; Goffin and Koners, 2011).

This study first aimed to determine how stories and metaphors stimulate the generation of tacit knowledge and breakthrough ideas, in discussions between managers and customers in the FFE. Secondly, it aimed to identify the characteristics of such FFE stories and metaphors. Since empirical researchers have established that stories and metaphors have to be studied in real-time, as they emerge (Boje, 1991), observation was chosen as the main source of data. Unique access to a large multinational business to consumer (B2C) corporation and to one of its European subsidiaries was negotiated. This allowed a detailed study of one business unit to be made, with numerous market reports being inspected, and field visits to conduct ethnographic market research being shadowed. In addition, a *co-development workshop* (CDW)—where managers and customers developed breakthrough product concepts—was observed and video recorded. The data collected included video recordings; field notes; and copies of material shared before, during, and after the workshop. The data

were systematically analyzed using the Nonaka's well known *socialization, externalization, combination*, and *internalization* (SECI) framework of knowledge creation (Nonaka, 1994).

The present study contributes to the NPD literature by providing the first empirical evidence of the role of stories and metaphors in stimulating breakthrough product ideas. The research also contributes to knowledge creation theory by providing evidence of the interplay between stories and metaphors, their role in eliciting tacit knowledge, and the creation of new knowledge. For practitioners, the research indicates possible ways in which managers can use stories and metaphors during the FFE to stimulate ideas for breakthrough products.

The rest of the paper is presented in five sections:
- The relevant literature is reviewed to build a solid theoretical basis for the research.
- The research design is presented including the data collection mechanisms; and the process of analysis.
- The third section describes the empirical results.
- The forth section discusses the broader findings, conclusions and implications.
- The final section is a short summary of the research.

Literature Review and Theoretical Perspective

This section first reviews the NPD and creativity literatures, to provide a clear understanding of the FFE, including creativity and ideation, the processes involved, the actors, and CDWs. Secondly, the knowledge management literature is used to explain the phenomena that are central to this study: types of knowledge; Nonaka's SECI framework; stories, metaphors and tacit knowledge; and to provide a suitable theoretical perspective. Thirdly, previous empirical studies are discussed, to identify suitable methodological approaches. Finally, the conclusions reached from reviewing the different literatures are summarized.

The FFE of NPD

To be successful, organizations need to develop and launch breakthrough new products (Brown and Eisenhardt, 1995). Although NPD is a resource-intensive process, much of the value of the investment is lost because more than 75% of new products fail (Cooper and Kleinschmidt, 2007). A meta-analysis by Henard and Szymanski (2001) found that the activities that take place during the FFE are less resource-intensive and entail less risk than the later, more costly phases of NPD.

The FFE is the early part of NPD, from the identification of a market opportunity, through idea generation (*ideation*), to concept development (Cooper 1990; Smith and Reinertsen, 1991). At the FFE, it is necessary to identify customer needs by interpreting market data (Ulrich and Eppinger, 2000) and FFE ideation must generate two types of ideas. Firstly, ideas must emerge on the issues customers face (typically identified through market research). Secondly, ideas must be generated on how these customer issues can be solved. And, "most important in the innovation process is the problem creation moment. That is, the positioning of the correct problem, which allows the solution to be discovered" (Nonaka and Kenney, 1995: 68). If appropriate solutions can be discovered early, the whole process of NPD becomes more cost and resource efficient.

Ideas about how to solve customer problems can lead to the development of unique products. Morris (2006: 68) defines an *idea* as "a mental construct, an abstraction that tells a story". As an idea becomes more tangible and it is written down and accompanied by visual representations, it is termed a *product concept* (PDMA, 1998). New product concepts can range from incremental to breakthroughs ones (Mumford and Gustafson, 1988). Incremental

ones involve minor adaptations, whereas, breakthrough concepts are based on ideas that differ substantially from an organization's current practices and existing knowledge (Dewar and Dutton, 1986). Deep customer insights are needed if breakthrough products are to be developed (Deszca, Munro and Noori, 1999). Despite the importance of the FFE to overall NPD success, too little attention has been paid by researchers to understanding ideation (Khurana and Rosenthal, 1998).

Creativity and Breakthrough Ideas in the FFE
The creativity literature evokes the notion of an idea being something original, unexpected, and sudden. New ideas can range from minor adaptations to existing products, to breakthrough products (Mumford and Gustafson, 1988). However, breakthrough ideas are substantially different from an organization's accumulated knowledge (Dewar and Dutton, 1986). A central assumption about the development of breakthrough ideas at the FFE is that these types of ideas are based on new knowledge. Such knowledge can emerge when experienced managers harness the potential of the tacit knowledge from their teams (Mascitelli, 2000). The literature has identified that breakthrough ideas often emerge from dialectic; for example, discussions based around the different perspectives and expertise of individuals within NPD teams (Harvey, 2014). However, research on how breakthrough ideas are generated has mainly focused on individuals rather than team cognitive processes; and on creativity techniques, for example, thinking in analogies/metaphors (Couger, 1995).

Significant research has been conducted on individuals' cognitive processes during problem-solving (e.g. Smith, Glenberg, Bjork, 1978). This stream of research dates back to Wallas (1926) who identified four stages in problem-solving: 1) A problem or issue is defined; 2) Data are collected; 3) After a period of unconscious thought, a solution emerges; and 4) Finally the solution is verified. Experimental studies started with *gestalt* researchers such as Max Wertheimer (1945). According to the gestalt tradition, a solution is viewed as a conceptual reorganization, a sudden transformation of thought, or the result of the individual understanding of the inner nature of things.

Most empirical studies of creativity have been conducted on individuals, in laboratory conditions and therefore are not applicable to real-world situations (Sternberg and Davidson, 1995), especially those involving teams (Simonton, 2003). Harvey (2014:328): states that "virtually no research to date has examined how some teams are able to come up with novel ways of understanding problems". This omission creates an important gap in the understanding of the FFE, where extraordinary levels of creativity are required (Amabile, 1988). Not enough is known about how teams identify customer problems, and how they identify potential solutions and thus ideas for breakthrough products.

FFE Actors
Scholars have identified the importance of different actors being involved at the FEE: both internal and external ones. Empirical evidence suggests that cross-functional teams with diverse perspectives and experience (knowledge) foster effective ideation (Morris, 2006; Khurana and Rosenthal, 1998; Dewar and Dutton, 1986). Such teams must facilitate effective communication and co-operation, to accelerate the overall NPD process and ensure the success of new products (Cooper, 2009; Knox and Mitchell, 2003).

Other researchers have stressed the importance of involving external actors in ideation, with the most obvious ones being customers. Customer involvement brings particular perspectives to the FFE, which can be different to those of managers and cross-functional teams (Morris, 2006; Knox and Mitchell, 2003). According to Nonaka and colleagues (Nonaka and Toyama, 2005; Nonaka et al., 2000), the dialogue between internal

and external actors (such as managers and customers) develops new perspectives and new knowledge. More specifically, customers can provide needs-related knowledge, as well as solution-related knowledge (Poetz and Schreier 2012). A meta-analysis conducted by Chang and Taylor (2016) has showed that involving customers in FFE ideation improves new product financial performance and accelerates time-to-market. Despite the recognition in the extant literature of the importance of external actors in the FFE, only sparse attention has been paid to the ways external and internal actors collaborate, their dialogue, and how this stimulates NPD ideas.

Collaborative Design Workshops
NPD scholars have stressed that internal workshops can be used to evaluate customer research data and generate new product ideas (Rosenthal and Capper, 2006; Khurana and Rosenthal, 1998; Leonard and Rayport, 1997). A survey among NPD practitioners from German-speaking countries showed that workshops are an effective way in which organizations can tap into tacit knowledge (Hoegl and Schuzle, 2005). Organizations typically involve different functional areas in collaborative workshops (Berger et al., 2005) but their influence on NPD is not well understood (De Luca and Atuahene-Gima, 2007).

Internal workshops are one approach but collaborating with customers can be very useful (Weber, Weggeman, Van Aken, 2012). Customers and managers can co-create new product ideas in *collaborative design workshops* (CDW—Plowman, Prendergast and Roberts, 2009). In such workshops, customers share their experiences and perspectives with managers. This provides the opportunity for knowledge to be shared, and ideation within the context of a particular project to take place (Mascitelli, 2000). Co-creating with customers has been widely acknowledged as a useful approach, especially for the generation of breakthrough product ideas (e.g. Weber, Weggeman, Van Aken, 2012; Von Hippel, Thomke, Sonnack, 1999; Brown and Eisenhardt, 1995). Although the empirical evidence presented is sparse, many scholars (e.g. Dewar and Dutton, 1986; Cooper and Kleinschmidt, 1987; Hoban, 1998; Ernst, 2002; Schultz, 2013) and practitioners (e.g. Jaruzelski, Dehoff, and Bordia, 2006) have claimed that customers with a deep knowledge of a product category can generate breakthrough ideas, whereas customers with less experience only create incremental ideas (Von Hippel et al., 1999). Interestingly, although workshops with customers are claimed to be vital sources of ideas, only one study has observed how managers and customers collaborate in a CDW (Roberts, Baker, and Walker, 2005). Unfortunately, though, the analysis provided by this study was purely descriptive and it did not consider the way tacit knowledge helps generate breakthrough ideas.

Knowledge Theory

The understanding of FFE ideation provided by the NPD and creativity literatures is incomplete. Therefore, it was necessary to find a suitable theoretical perspective to guide the research. The very substantial literature on knowledge management provided this, as it has identified different types of knowledge. Interestingly, research from a knowledge management perspective has noted that the NPD context is a particularly important one for knowledge generation.

Types of Knowledge
Knowledge is an eclectic mix of information embedded in interpretation, routines, processes and reflection (Davenport, 1993). A key perspective in the knowledge management literature is that breakthrough ideas are based upon *new knowledge*. Existing knowledge that has been

captured in documents, reports and databases (Nonaka, 1994) can only lead to incremental ideas. (For this study, breakthrough ideas are defined as the outcome of the generation of new knowledge.)

It is widely accepted that knowledge has two dimensions: explicit and tacit. Explicit knowledge can be embodied in a code or language that can be communicated, stored and shared in the form of manuals, reports, databases or drawings. Explicit knowledge is objective, rational, and created in the "then and there", whereas the tacit dimension of knowledge is subjective, experiential, and created in the "here and now" (Leonard and Sensiper 1998). Tacit knowledge is based on subconscious, experience (Zhang et al, 2015), experimentation, learning by doing (Polanyi, 1966), and so it cannot be easily shared or documented. When tacit knowledge is articulated, it can help reveal new cognitive perspectives (Polanyi, 1996) and enable NPD teams to solve challenging problems (Nonaka, Toyama, and Konno, 2000; Zhang et al, 2015). Therefore tacit knowledge is a key factor in the creation of new knowledge in NPD (Nonaka, 1994). "Tacit knowledge is paramount but [it] confronts organizations with the challenging task of spreading something that is in the minds of individuals" (Bertels, et al, 2011: 760).

The SECI Framework

Nonaka's much-cited SECI framework (1994, 2009) shows that the generation of new knowledge is dependent upon a continuous interplay between explicit and tacit knowledge among the individuals in a team—*knowledge conversion*. According to Nonaka's framework, there are four modes of conversion (SECI); each with a key triggering mechanism (Figure 1):

1) *Socialization* (from tacit to tacit) is where tacit knowledge is acquired by observing, imitating and practicing, or becoming socialized into a specific way of doing things. Knowledge is not explicit in this stage and the trigger for this mode of conversion is the formation of a team.

2) *Externalization* (from tacit to explicit) is the articulation of tacit knowledge by discussion and producing descriptions. Nonaka recognized triggers for externalization are *dialogue* within a team, and the use of *metaphors*.

3) *Combination* (from explicit to explicit) involves the reconfiguration of explicit knowledge through sorting, adding and re-categorization. Here the trigger is creating *documentation*.

4) *Internalization* (from explicit to tacit) is reframing or reinterpretation of explicit knowledge using one person's frame of reference in a way that knowledge can be understood and internalized by others. The trigger for this mode of conversion is learning through *trial and error*.

While each of the four modes of knowledge conversion can potentially create new knowledge independently, Nonaka (1994, 2009) suggested that it is the continuous spiral of knowledge conversion that drives the generation of new knowledge. Furthermore, Nonaka said that new knowledge involves novel (i.e. previously unknown) understandings. A large amount of new knowledge will be generated during FFE ideation but teams action only the new knowledge that is the most appropriate for the organization—Nonaka termed this *justified knowledge*. And the *ultimate outcome* of new knowledge is the generation of new products (Nonaka et al, 2000; Nonaka 1994).
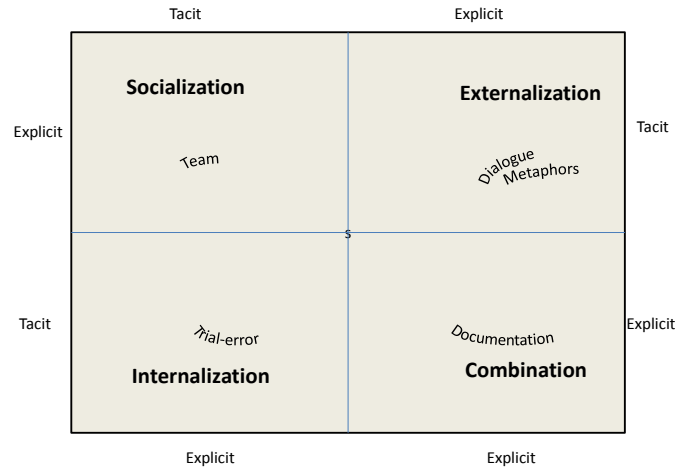
Figure 1: Nonaka's (1994) Knowledge Creation Framework

<u>Stories, Tacit Knowledge and Breakthrough Ideas</u>
Converting tacit into explicit knowledge has been described as trying to find a way to express the inexpressible (Stewart, 1997). Individual memory is largely episodic (Schank, 1990) and so stories can trigger memories and the articulation of tacit knowledge (Stewart, 1997). The knowledge management literature views a story as "a tiny fuse that detonates tacit understanding in the mind of the listener" (Institute for Knowledge Management, 1999). Stories have a beginning, middle, and an end (Escalas, 1998), exhibiting a plot line and a protagonist (Thompson, 1997; Woodside et al., 2008).

Nonaka described the need to create environments in which individuals interact, exchange their knowledge and produce new knowledge (*interactive fields*—Nonaka's concept of *ba*). In such environments, stories can trigger the transformation of tacit to explicit knowledge (Smith, 2001; Wong and Radcliffe, 2000). It has been argued that listening to customers' stories gives deeper market understanding (Gorry and Westbrook, 2008), although only secondary examples were presented in support of this argument. Others have identified the value of stories for marketing campaigns that can build customer engagement (Escalas, 1998). Despite potential value of stories, it has been found that practitioners do not use storytelling in their work, as they do not know how to employ them effectively (Hoegl and Schuzle, 2005).

<u>Metaphors, Tacit Knowledge and Breakthrough Ideas</u>
Knowledge management researchers have acknowledged the power of metaphors to convert tacit into explicit knowledge (Nonaka, 1994). Metaphors allow concepts that are far apart to be connected, stimulating imagination and new meanings (Tsoukas, 1991). Metaphors link "two knowledge domains by performing a transaction between them; to speak metaphorically is to relate two entities or terms through the verb "to be" or the copula "is" (Teichert, von Wartburg, Braterman, 2006: 452) and occasionally with the words "like" or "as".

From a marketing perspective, metaphors are known for their value in communicating new product benefits (Zaltman, and Coulter, 1995). Experiments across product categories have shown the value of metaphors in conveying the brand positioning in marketing campaigns in the later stages of NPD (Noble, Bing, Bogoviyeva, 2013). Although the knowledge management literature acknowledges the role of metaphors in juxtaposing concepts and creating new knowledge (Nonaka, 1994), empirical evidence is sparse.

Empirical Studies

Tacit knowledge is known to be crucial to NPD but, as it is a complex, ephemeral concept, there have been relatively few empirical studies. Table 1 shows that there have been nine main studies of tacit knowledge and NPD; these are listed chronologically, starting with the early work of Nonaka. The table summarizes key points about each paper including the methodology and sample; whether the FFE was considered; the types of knowledge investigated; whether stories and metaphors were studied; and main findings.

The first point to note from Table 1 is that although the role of tacit knowledge has been investigated in NPD, most of these studies look at later stages. For example, Richtner et al (2013) looked at product development rather than ideation and FFE. Another study, Goffin and Koners (2011) investigated the final stage of NPD—post-project reviews. Although these two studies did not consider the FFE, both used qualitative methodology in a systematic way that will be discussed later.

Five main studies have looked at tacit knowledge in the FFE. Nonaka, and Takeuchi (1995) used illustrative cases to provide support—rather than direct evidence—for the SECI theory. Hänninen and Kauranen (2006) used a single case study to investigate how a product concept must be built on a mix of knowledge from different functions. Although the paper stressed the importance of tacit knowledge "many essential forms of tacit knowledge… were not measured in the study" (p407); and the study was conducted retrospectively. Schulze and Hoegl (2008) used a survey of 33 firms to show that socialization (S) and internalization (I) were positively correlated to the novelty of (new) product ideas; whereas externalization (E) and combination (C) were negatively correlated. Their research created survey items to measure SECI modes, based on the ideas of Nonaka. The study by Bertels, Kleinschmidt and Koen (2011) stressed the importance of tacit knowledge in the FFE and used a survey of 116 business units to look at whether geographically dispersed teams can share such knowledge. They found that *communities of practice* (groups with a common professional interest, which share experience, information, their insights and tools—Bertels, Kleinschmidt, and Koen, 2011) and an open business climate supported the spread of tacit knowledge. The latest piece of research on tacit knowledge in the FFE is from Zhang, et al (2015). Unfortunately, the sample selected for this work was students and so, although it looked at the factors that impact ideation, it cannot be considered as having directly studied in the direct context of the FFE (and so the results should be treated cautiously). Considering both the rigour and content of the papers on tacit knowledge in the FFE, the main findings are the positive impact of socialization and internalization and groups exchanging practices.

From a methodology perspective, the nine studies of tacit knowledge have either taken a quantitative—mainly survey-based— approach (e.g. Nonaka et. al. 1994; Schulze and Hoegl, 2008); or a case study approach (e.g. Goffin and Koners, 2011; Richtner et al, 2013); or used an experiment (Zhang, et al 2015). A quantitative approach potentially allows a wider sample to be investigated but studying a difficult concept such as tacit knowledge using a questionnaire is not without challenges. Nonaka constructed a set of questions to identify tacit knowledge and these have been extended by others (e.g. Schulze and Hoegl, 2008) for survey-based research. It should be noted that Nonaka used the occurrence of metaphors as an indication of externalization. Unfortunately, Zhang, et al's (2015) experiment did not provide insights about real NPD teams.

The way case studies have been used to investigate tacit knowledge in NPD provides ideas on how to construct more valid and reliable research. Although Nonaka has had huge influence on thinking, the evidence he has produced using cases has limitations. He has said it "has been constructed mainly on the basis of hands-on research and practical experience of Japanese firms" (Nonaka, 1994: 459), rather than applying sample selection logic and a

systematic case study protocol. Interestingly, Richtner et al. (2013) decided that Nonaka's ideas for survey questions could be adapted to code qualitative data against SECI. A qualitative study by Goffin and Koners (2011) employed the emergence of stories and metaphors as a proxy measure for the creation of tacit knowledge. However, this study focused on post-projects reviews and did not use the SECI model (although it would have enabled triangulation with the stories and metaphors). Table 1 shows that no previous study has utilized both stories and metaphors as a means to investigate tacit knowledge in the FFE.

Key Conclusions

The review of the literature led to the following four conclusions:
1) The FFE is critical to the success of NPD. There is a consensus in the literature that the FFE is dependent on the generation of new knowledge, and consequently on tacit knowledge being converted.
2) Breakthrough ideas can be generated through discussions between managers and customers in collaborative design workshops. However, in-situ empirical evidence of the novel understandings that can arise in such workshops is lacking.
3) The occurrence of stories and metaphors has been strongly linked to the elicitation of tacit knowledge. However empirical studies that examine *how* stories and metaphors harness tacit knowledge in the FFE are sadly lacking.
4) Despite the wide acknowledgement of the value of stories in NPD, practitioners do not use storytelling, as they do not have adequate know-how on how it could be employed.

No.	Reference	Methodology / Sample	Factors Considered					Key Findings
			Tacit Knowledge	**Fuzzy FFE**	**New Knowledge**	**Stories**	**Metaphors**	
1	Nonaka et. al. 1994	Survey of convenience sample of Japanese managers	Yes	No	No	No	Yes	Validation of the SECI model
2	Nonaka, and Takeuchi, 1995	Illustrative case studies of Japanese companies	Yes	Partially	No	No	Yes	Validation of the SECI model
3	Hänninen and Kauranen, 2006	Single case study	Yes	Yes	No	No	No	Verbalization of tacit subjective associations, can be used as indicators of cross-functional integration and as suitable indicators of tacit knowledge
4	Schulze and Hoegl, 2006	Survey on 94 projects from 33 companies	Yes	No	No	No	No	Socialization is positively related-Externalization is negatively related to new product success
5	Schulze and Hoegl, 2008	Survey of 33 companies	Yes	Yes	No	No	No	Positive relationships between socialization/ internalization and novelty of ideas & negative relationships for externalization/ combination
6	Goffin and Koners, 2011	5 case studies (interviews and observation) in German companies	Yes	No	Yes (Stories and metaphors)	Yes	Yes	Comprehensive list of lessons learned by NPD teams.
7	Bertels, Kleinschmidt and Koen, 2011	Survey of 277 respondents in 174 business units in the US	Yes	Yes	No	No	No	Proficiency of dispersed collaboration is not related at all to FFE of innovation performance in business units with low support for communities of practice.
8	Richtnér et al., 2013	Case studies of 6 Swedish NPD projects	Yes	No	Yes (SECI)	No	No	The creation of new knowledge in NPD is susceptible to changes in organizational slack
9	Zhang, et al 2015	Experiment with students	Yes	Not directly	No	No	No	Tacit knowledge and challenge pressure have a significant positive effect on idea generation

Table 1: Previous Empirical Studies of Tacit Knowledge in NPD

Research Design

Based on the conclusions from the literature review, two research questions were defined:

- RQ1: *How do stories and metaphors stimulate the generation of breakthrough ideas in discussions between managers and customers during CDW discussions in the FFE?*
- RQ2: *What are the characteristics of stories and metaphors that trigger breakthrough ideas in the FFE of NPD?*

The nascent state of theory on tacit knowledge, stories and metaphors during the FFE and the type of research questions selected were considered. Based on the guidance of Edmondson and McManus (2007), it was clear that an exploratory, qualitative approach was necessary. In addition, the particular characteristics of the FFE and of knowledge needed to be considered in deciding the most appropriate methodology.

Method

Previous researchers have identified that collecting data at the FFE is particularly difficult (Koen et al., 2001), as activities are informal, ambiguous, and largely go undocumented (Barzcak, Griffin and Kahn, 2003; Smith and Reinertsen, 1991). In addition, studying knowledge creation is challenging as managers typically do not articulate their understanding (Polanyi, 2006), and therefore the emergence of new knowledge is neither planned, nor formally documented. Extant research has mainly relied on second-hand or third-hand accounts of the usage of stories and metaphors. However, it has been clearly recognized that they can only be accurately understood when are studied directly as they emerge, in situ (Boje, 1991).

Case study methodology with embedded non-participant observation (Silverman, 2003) was selected as the most appropriate approach. Non-participant observation is a common research approach to acquire an in-depth first-hand experience of a situation and recording of what is observed. The method has been increasingly adopted in recent NPD research (e.g. Occhiocupo, 2011; Berchicci and Tucci, 2010; Stuer, Husig, and Biala, 2010).

Sample

Due to the exploratory nature of the study and the level of access required, a single case was selected. Case study methodology recognizes the value of single cases, where a phenomenon is being studied for the first time (as in this research), and where there is an opportunity for theory-building. One recent piece of research used a single case and ethnographic approaches to study product ideation in a design consultancy (Stigliani and Ravasi, 2012). In contrast, the focus of *this* research was deliberately chosen how FFE ideation occurs in a manufacturing company, as opposed to a consultancy company's processes.

To select the company for our study, the first criterion was that the company should have a strong focus on NPD and market research (including using CDWs)—accordingly the FMCG industry was selected. The second criterion was that the company should have a significant FFE project that could be studied 'live'. The European subsidiary of a Fortune 500 multinational B2C manufacturer was chosen and it will be referred to as *Corporation A*. This company makes significant investments in NPD in the household cleaners sector. *Corporation A* typically conducts substantial market research and the company website stresses that its products are designed to solve customers' real needs and that the corporation has special ways of achieving this. (Absolute confidentiality was a requirement for cooperation on the research and so the description of the case company has been made

generic.) The third criterion in selecting the case company was that it would be conducting a CDW to generate breakthrough product ideas. *Corporation A* had recently decided to use CDWs in one of its divisions and this enabled the researchers to study stories and metaphors as they occurred. It should be noted that the product ideas which emerged during the CDW were identified by *Corporation A* as potentially breakthrough ones (and new to the organization). Due to the commercial sensitivity of FFE ideas, *Corporation A* only allowed access to one project and thus only one CDW.

Data Collection

The research team was granted unusually wide access to inspect confidential documentation on customer needs, and observe market research work in real time. Data collection took place before, during and after the CDW.

Extensive data were collected over a three-month period before the CDW. This consisted of a confidential market research report on customer needs; observations of product managers' visits to customers (using ethnographic market research principles); the video ethnographic data; and a summary report based on the ethnographic data. The data included 250 presentation slides on market trends and customer needs. Additional material shared by the company participants prior to the workshop was also collected.

The CDW was organized by the marketing managers of a FFE team of *Corporation A*. The workshop lasted seven hours and had 12 participants: a facilitator, 8 managers from different functions (two from marketing [a brand manager and assistant]; two from communications [the account director and an account manager]; the R&D manager; and the manufacturing manager); three customers (Customers A, B, C) and one designer. The workshop was observed in *real time* by one of the authors, making field notes and making a video-recording. Video-based fieldwork is an appropriate data collection medium as it enables researchers to review events offline, and with new perspectives. It is particularly suitable for studies that investigate sequences of events (Goldman and McDermott, 2009). Further material collected at the workshop included flipchart notes and the designer's sketches. It should be noted that the CDW workshop was observed (i.e. the researcher adopted a passive role) and so all of the discussion, the stories and the metaphors were spontaneous and unbiased.

After the CDW, the research team was still allowed access. That allowed verification that each of the previously unknown customer needs and the initial products concepts that were developed in the CDW were all considered important enough to be proposed as *Corporation A* NPD projects. It also allowed key findings to be discussed with managers.

Unit of Analysis

A key element of case study research is deciding the *unit of analysis*. In this study, the focus was on new knowledge, as the literature review showed a consensus that breakthrough product ideas are based only on new knowledge. Therefore, in this research *new knowledge* was operationalized as new (i.e. *previously unknown*) customer needs that emerged directly from the CDW; and which were actioned by *Corporation A* as potentially breakthrough ideas.

Eight new customer needs emerged in the CDW, none of which was found in previous *Corporation A* documentation. Each of these could be identified on the video-recording, and then the discussions that led to them could be analyzed offline, in detail, by multiple researchers. Therefore, for RQ1, the unit of analysis was the needs identified in the

CDW. For RQ2, the units of analysis were the occurrences of stories (n=18) and metaphors (n=33).

Data Analysis

The data analysis was conducted by the three authors and involved six main steps:

1) All of the data collected prior to the CDW were analyzed to see where customer needs were mentioned. This analysis included coding the business reports for every mention of customer needs. This work generated a 'List of Customer Needs—Prior to the CDW'. This list summarized the 19 distinct customer needs known to *Corporation A* prior to the CDW.

2) The video recordings from the CDW were transcribed by the one of the authors and this resulted in 181 pages.

3) The CDW videos were then coded to identify every occasion where customer needs were discussed—a total of 27 distinct needs. This led to a 'List of Customer Needs—From the CDW'. The two lists of customer needs were compared carefully and 8 *previously unknown customer needs* were found that emerged in the CDW (which were potentially breakthrough ideas for *Corporation A*). It was observed that at the end of the CDW, each of the *previously unknown customer needs* was clearly described, including the designer's sketches, with ideas on how the issue could be solved using technology i.e. each need was developed into an initial product concept. The marketing managers took these 8 initial breakthrough product ideas forward to be considered as *Corporation A* NPD projects (justified knowledge, in Nonaka's terms).

4) The next step was to analyze the genesis of each of the 8 *previously unknown customer needs*. The complete video and transcript were coded looking for knowledge conversion (SECI) and the usage of stories and metaphors. The two coding schemes used at this stage were:

    a) Richtner et al's (2013) SECI coding scheme was used to identify knowledge conversion connected to the 8 previously unknown customer needs. (All explanations of the SECI coding scheme and abbreviations are presented in Appendix A.)

    b) The incidence of stories and metaphors connected to the 8 previously unknown customer needs was identified (using an operationalization summarized in Appendix B).

The frequency of each code was determined. This analysis identified incidents of knowledge conversion, new knowledge, and justified knowledge. The rules for operationalizing and anchoring the different types of knowledge are presented in Appendix B.

5) To identify links between stories, metaphors and new knowledge, a check was made of where the creation of new knowledge chronologically matched the narration of a story and/or the expression of a metaphor.

6) Next, the characteristics of each story and metaphor were identified using coding and timing approaches:

    a) Each story was assigned a title and coded (including the storyteller; protagonist; plot and duration) (See Appendix B.)

    b) To check how the stories and metaphors were connected to customer needs and to products, a product-related coding was applied on stories and metaphors (Goffin et al., 2012). (All explanations of the product related coding scheme and abbreviations

are presented in Appendix C.) The number of product codes that were related to each incident of a story/metaphor was determined.

c) A 'level' of impact was assigned to each story: 'strong trigger', 'medium trigger' or 'non-trigger'. (See Appendix B.)

d) Finally, the length of the narration of each story was measured.

Validity and Reliability

Two crucial aspects of case study research are validity and reliability (Miles and Huberman, 1984) and so these were carefully considered during the research design. Five main actions were taken to maximize the validity of the study. Firstly, the current study built on proven analysis methods: an existing coding scheme was used for SECI (Richtner et al, 2013); and an existing coding scheme for identifying aspects related to customer needs was also applied (Goffin et al, 2012). Secondly, multiple criteria were used to determine when new knowledge emerged and was justified during the CDW (customer needs that were previously unknown; and which were later adopted as potential breakthrough projects). Thirdly, the use of two main coding schemes in parallel, allowed the chronological relationships between different phenomena (for example, the relationship between the emergence of stories and breakthrough ideas) to be determined. Fourthly, the analysis was critiqued by colleagues not involved in the study. Lastly, the recommendations for practitioners that emerged from the research were shared with the CDW facilitator, to check her views on their validity.

To ensure reliability, three main actions were taken. Firstly, the data coding was conducted by two of the authors in parallel searching for not only confirmatory but also contradictory evidence. The weight of evidence was discussed and agreed with the third author as recommended by Miles and Huberman (1994). Secondly, anchoring rules were developed for the levels of impact. These anchoring rules were discussed and agreed among the three researchers and are presented in Appendix B. Stories and metaphors with 'high' and 'medium impact' were labelled as 'strong triggers'. Stories and metaphors with low or no impact were labelled as 'non-triggers'. Thirdly, as the CDW was available on video, this allowed enough time to be given to the coding and interpretation; and it allowed all the three authors to perform multiple confirmation checks.

Empirical Results

Although it was not the main focus of the research, the ability to attend a CDW allowed the way it way it was conducted to be observed. It was seen that the CDW enabled lively debate between *Corporation A*'s managers and the customers. So, it did create an interactive field where new knowledge was created (c.f. Nonaka's *ba*), as evidenced by the many SECI codes, which were assigned (as will be discussed). The pivotal role of the external, professional facilitator was noted and there were five distinct phases to the workshop:

Phase 1: Introductions and Brainstorming. Here the whole group of participants introduced themselves and their background, sharing their ideas about the product category and the brand, and conducted some initial brainstorming.

Phase 2: Brainstorming and Justification. The group divided into small teams and managers shared the results of the ethnographic market research report. There was dialogue and some sketches were made, thus sharing different perspectives on customer needs. Ideas were capturing in writing on flip charts.

Phase 3: Presentations. The whole group listened to the presentations of new ideas from each small team.

Phase 4: Screening. The whole group was involved in dialogue: justifying and screening the new ideas. The ideas were evaluated by the whole group, based on the following criteria: a) uniqueness/new to the organization, b) commercial potential, and c) relevance to the brand. All generated ideas were screened based on these criteria and 8 (the breakthrough ideas) were shortlisted.

Phase 5. Crystallization. In this last phase, the whole group was involved in detailed discussion on the selected ideas, producing sketches and thumbnails for refining the breakthrough ideas. Thus Phase 5 produced initial product concepts, based on 8 previously unknown needs.

Research Question 1

The first research question was: *How do stories and metaphors stimulate the generation of breakthrough ideas in discussions between managers and customers during CDW discussions in the FFE?* Answering this consisted of working back from the 8 previously unknown customer needs that were documented as initial product concepts in Phase 5 of the CDW. The discussions connected to each customer need could be identified through multiple viewings of the video data, and coding the transcript. The process was complex, systematic and iterative and it is summarized in Table 2 (which, from left to right, reflects the chronology of the CDW).

Table 2 shows that the 7 hours of CDW video recordings corresponded to 181 pages of transcripts. Multiple viewings of the video data, in conjunction with reading the transcripts, led to SECI codes being identified, which were connected to the 8 previously unknown customer needs—a total of 429 incidents of knowledge conversion. It appeared that as customers and managers interacted, knowledge conversion took place. Linked to the incidents of knowledge conversion, a total of 18 stories (coded as E-US—externalization using stories) and 33 metaphors (coded as E-UM—externalization using metaphors) were identified. These appeared to stimulate the discussion and lead to the externalization of tacit knowledge (externalization codes: n=139). In addition, using Nonaka's definition of new knowledge, a total of 53 incidents of new knowledge emerged (code C-I&I—see Appendix A). These were mostly captured on flipcharts by the facilitator (and collected at the end of the CDW). Notes on the flipcharts described customer problems, such as the limitations of current products. Examples included: *"Cleaning sponges become very dirty… "they end up being germ collectors!" I would like my cleaning utensils to engage in active cleaning".* Later, the discussions in the CDW led to the most important ideas being selected (justified)—leading to 8 previously unknown customer needs (*justified knowledge* in Nonaka's terminology) and 8 breakthrough product ideas. Interestingly, metaphors mostly emerged in the context of stories. Stories and metaphors, therefore, functioned synergistically in the elicitation of tacit knowledge, with metaphors adding clarity to certain elements of the stories.

CDW Data	Knowledge Conversion	Externalization of Tacit Knowledge	New Knowledge (C-I&I)	Justified Knowledge (CDW Phase 5)	Ultimate Outcome (Post CDW)
7 workshop hours 181 pages of transcripts	Frequency of SECI codes (n=429)	- Externalization (n=139) - Stories E-US (n=18) - Metaphors E-UM (n=33)	Customer needs and product ideas (n=53)	Previously unknown customer needs (n=8)	Breakthrough ideas proposed as NPD projects (n=8)

Table 2: Overview of Findings on Knowledge Conversion (SECI) to Breakthrough Ideas

An example of how previously unknown customer needs were analyzed is given in Table 3. This is the idea for a 'Color-changing Formula'; a kitchen cleaning product that would indicate when germs had been eradicated. The idea emerged from a single story but one that was powerful enough to galvanize group discussions. One customer explained that her family particularly likes chicken recipes but, after preparing meat on a work-surface, she worries whether there could be residual salmonella even after cleaning. Here she embellished the story with her professional experience as a clinician, knowing that bacteria are a huge issue in hospitals that microbiologists must deal with. In discussion linked to the story, 7 metaphors emerged (coding E-UM), one of which was about the product changing from "*pink to blue...* [to say] *'I've killed all the germs'"*. Another metaphor was that the product would be, "*a color detection system... Sherlock Holmes* [for germs]". As shown in Table 3, at the end of the workshop the group created an initial product concept, including a flipchart description; a designer's sketch of possible product packaging; and the R&D Manager's description of the chemical reactions that could be used to make a color change possible (truncated in Table 3 for reasons of confidentiality).

Externalization of Tacit Knowledge	Knowledge Conversion		New Knowledge	Justified Knowledge (Product Concept)
Story: *The microbiologist who kills all the germs* **Beg: Presentation of situation (yes)** **Middle: Inciting incident (yes)** **End: Resolution (yes)** **Metaphor:** *"The bleach tells you: ok, now that I have become pink from blue it means that I've cleaned, I've killed all the germs…"* **Externalization (N=28) and internalization (N=25) of knowledge were most frequently used by the workshop participants to combine new knowledge. To externalize knowledge (from tacit to explicit), numerous metaphors (N=7) were mentioned and a story (N=1) was initiated and co-created (N=1).**	S-WO S-WI S-TTK **TOTAL SCL** ------------------------- E-UM *(Metaphors)* E-DCC E-DCM *E-US (Stories)* **TOTAL EXT** *(E-AS Co-creation* ------------------------- C-AI C-SP C-D C-I&I **TOTAL COMB** ------------------------- I-PE I-RWKA I-SE I-VWKA *I-NKAW* **TOTAL INTR** ------------------------- **TOTAL SECI**	n= 3 n= 0 n= 0 **n= 3** n=7 n= 16 n=4 *n=1* **n= 28** *n= 1)* n= 0 n= 6 n=1 n=10 **n=17** n= 2 n=16 n= 7 n=0 *n= 0* **n=25** **n=75**	Customer need: *"I need to be certain, I want proof of the disinfecting effect on certain surfaces that have many and dangerous germs and bacteria."* [Customer A]	Color-changing formula: *"The new bleach not only has a disinfecting effect, but also offers visual proof of its effectiveness. The color changes where the product comes in contact with germs. It has a sensing system to let us know where the germs are and gets to them. Guaranteed results."* [Customer A] The product could be based on chemical reaction XXX. It would use skin-friendly chemicals. [R&D Manager] The packaging should be easy to hold so it can 'target' the stains. [Designer]

Table 3: Example Analysis for the 'Color-changing Formula' Product Concept (see Appendix A for an explanation of the coding.)

Using the same process described for the Color-changing Formula, all previously unknown customer needs were analyzed. The analysis traced back through the video data and showed that the first stories (n=11) emerged in the Introduction/Brainstorming phase of the workshop (Phase 1). Some of these were powerful enough to influence the thinking throughout the CDW. Other stories (n=7) emerged in the screening and crystallization phases (Phases 4 & 5). A higher number of SECI codes appeared to be associated with more radical ideas (e.g. the 'Color-changing Formula' idea exhibited SECI n=75, whereas the 'Carpet Cleaning Product' only exhibited SECI n=46.

Research Question 2

The second research question was: *What are the characteristics of stories and metaphors that trigger breakthrough ideas in the FFE of NPD?* The answer to this question was based on analyzing all 18 stories and 33 metaphors that emerged in the CDW. The analysis looked at their characteristics and their relationship to product discussions (using the product coding scheme), and breakthrough ideas.

Stories, Tacit Knowledge and Breakthrough Ideas
The characteristics of stories are summarized in Table 4, contrasting those that triggered new knowledge with those that did not. In total, 12 of the 18 stories were 'strong' or 'medium' triggers of new knowledge. All 18 stories were short and narration took approximately 3 to 8 minutes.

Analysis showed that the stories with the most impact were told by workshop participants with extensive experience with the product category, either from their work at *Corporation A* (e.g. the Product Manager)*,* or from the perspective of a customer who regularly uses the products (e.g. Customer A). Perhaps for this reason, the protagonist in the impactful stories was always the storyteller themselves. All 12 impactful stories had plots that involved the storyteller's relationship to a product, and the storyteller's narration skills played a role. The most impactful stories had plots based on engaging real-life experiences, some of which were unexpected, accompanied by a product-related issue that needed resolving. Stories became triggers for ideas, particularly when they included a novel, unexpected twist that related to the product category. A common characteristic of the non-trigger stories was the lack of a product-related solution to a problem. Finally, it was evident from the data that 10 out of the 12 trigger stories were co-created with other participants who had different backgrounds and perspectives from the storyteller. It should be noted that all 12 impactful (trigger) stories led to product ideas but only 8 of these were selected in Phase 5 of the CDW as breakthrough ideas.

Trigger-Stories	Non-Trigger-Stories
▪ Context-related and condensed plots	▪ Could be longer
▪ Told by storytellers who experience with the product category	▪ Less demonstration of product knowledge
▪ Storytellers show narrative ability	▪ Storytellers do not demonstrate narrative ability
▪ With engaging and unexpected incidents	▪ Incidents not engaging
▪ Involve the resolution to a product-related problem	▪ Less related to product problem
▪ Can inspire a sequel	▪ Do not lead to sequels

Example Trigger-Story	Example Non-Trigger Story
Assigned Title: 'Shoes in the Rain'.	**Assigned Title**: 'My Grandmother's Allergy'.
Storyteller: Customer A (female; 35+ with family, lots of household experience).	**Storyteller**: Finance Manager (female, 30+, with family, 7 years' working experience).
Co-creation: Finance Manager	**Co-creation:** Customer A, Facilitator, Account Director, Customer B
Quotes from Plot: *I want something like magic. A magic product to polish, to clean. To do all these for the shoes. For me this one will be magic. All in one. Because cleaning the shoes of my family is like climbing the Golgotha mountain. I want something to do everything, to clean, to polish, to dust, to disinfect* [storyteller shows with her hands how she performs the household chores]. *Because shoes have so much accumulated dirt. I have purchased a kind of magic sponges that are supposed to dust, to polish and at the same time to clean. However, cleaning is questionable. After the rain, streets become so watery; when you walk on the watery streets of the city you have a problem: shoes become* [storyteller shows a facial expression of disgust]. *So, I need something like a wipe, brush, liquid, crème. Maybe it has to be a soaked brush, like a soaked sponge…a soaked sponge which will have all those three things in one. This means that by apply it onto the shoe; this will become clean, polished and disinfected!* [storyteller moves her hands indicating a sign of closure].	**Quotes from Plot**: *"My grandmother gets sick very easily…she is old and gets tired easily. She needs to clean very well all her appliances and utensils of course but she never uses bleach; otherwise she goes to the hospital … This product may cause damage to the skin or breathing problems. It can be so dangerous. It is very bad* [storyteller's tone of voice is low and slow].
Duration:4 minutes	Duration: 2.5 minutes

Table 4: Characteristics of 'Trigger' versus 'Non-trigger' Stories

Metaphors, Tacit Knowledge and Breakthrough Ideas

A surprising result was that metaphors in isolation appeared not to trigger of new knowledge. Instead they emerged within the context of stories. It appeared that a lone metaphor does not convey the understanding and richness of a story and so cannot generate breakthrough ideas in the way that a story does.

The data showed that metaphors helped resolve ambiguous points during the crystallization phase of the workshop. Each metaphor linked two mental domains, one of which was product-related. By linking a product to an unrelated or unfamiliar concept, metaphors helped clarify vague or complex new ideas, as it is evident from this example, Metaphors also triggered the narration of a new story. For example, the metaphor *"We want little crystals in the formulation of the product to do some kind of exfoliation… peeling on the surface"* inspired the story 'Little Crystals in My Shower' that, in turn, led to the breakthrough idea of a new cleaner for bathroom mold. Overall, it appeared that within the context of a specific story, metaphors helped to generate ideas on how customer problems could be solved in novel ways. Metaphors also helped make these solutions more understandable, enabling discussions that led to new product concepts.

Discussion and Conclusions

NPD is crucially dependent on ideation but there have been few studies that have been able to study ideation in real time and in-situ. This exploratory study offers a rare glimpse into knowledge generation in a CDW during the FFE, and how this new knowledge evolves into breakthrough product ideas.

Theoretical Contributions

The study contributes to NPD, creativity and knowledge management theory in different ways. Firstly, the study demonstrated empirically that plenty of knowledge conversion takes

place during FFE discussions (e.g. SECI n=75 for the 'Color-changing Formula'), with stories and tacit knowledge triggering the generation of new knowledge generation. The data showed that tacit knowledge tapped by stories helped uncover identify previously unknown customer needs. Metaphors, in turn, were found to stimulate ideas for solving customer problems and so to lead to breakthrough product concepts. Although other researchers have said that FFE is dependent on the conversion of tacit knowledge to generate new knowledge (e.g. Maschitelli, 2000), the current study is the first to show this empirically, documenting the genesis of 8 breakthrough product ideas in a CDW. Importantly, this study extends the findings of Goffin and Koners (2011), which showed the importance of stories and metaphors at the end of NPD, to the FFE.

The research also contributes by identifying the characteristics of impactful (trigger) stories during the FFE. In contrast to previous research on storytelling in marketing (Woodside et al., 2008), the current study showed that trigger stories in FFE discussions are not lengthy narratives but rather condense plots. The findings also showed that 'trigger stories' are told by storytellers who had specific experiences with products (either professionally or as a user), accompanied by a natural ability to narrate (and thus capturing the attention of their audience). Moreover, the study showed that trigger stories were mostly co-created by two or more participants, who enriched the stories with incidents from their own experience. The findings on stories particularly contribute to the knowledge management literature. They extend Nonaka's knowledge creation framework (1994; 2000), which only focused on metaphors.

Another original finding is that although stories and metaphors both trigger the externalization of tacit knowledge, they appeared to play different roles in the creation of breakthrough ideas. Stories led to the identification of previously unknown customer problems whereas metaphors helped spark ideas on the ways in which the customer problems could be solved. The current study extends previous NPD research (Noble et al., 2013) by showing how metaphors can complement stories in the generation of breakthrough ideas.

The current study also adds clarity to previous NPD studies that mention the importance of workshops (e.g. Leonard and Rayport, 1997; Khurana and Rosenthal, 1998; Rosenthal and Capper, 2006), by providing details as to how such a workshop is structured, the discussions that took place, and the ideas that emerged. Similarly, the results contribute to the knowledge management literature, demonstrating that a CDW does provide a vehicle for interaction.

Tentative Conceptual Model
The study focused on different phenomena and the data gathered indicated relationships between these phenomena, as indicated by Figure 2. This tentative conceptual model shows that a storyteller's experiences, narrative skills and their category knowledge all influence the stories they tell in a CDW, and the way they tell them. Other participants may help create the storyline, and the stories cause enable previously unknown customer problems to be identified. Interwoven with the stories, metaphors spark ideas for ways in which to solve customer problems, and this lead to breakthrough product ideas. The whole 'process' appears to be closely related to the externalization of tacit knowledge and generation of new knowledge through SECI modes (as indicated by the dark grey shading). In addition, metaphors linked to the stories enable CDW participants to discuss ways in which customers' problems can be solved.
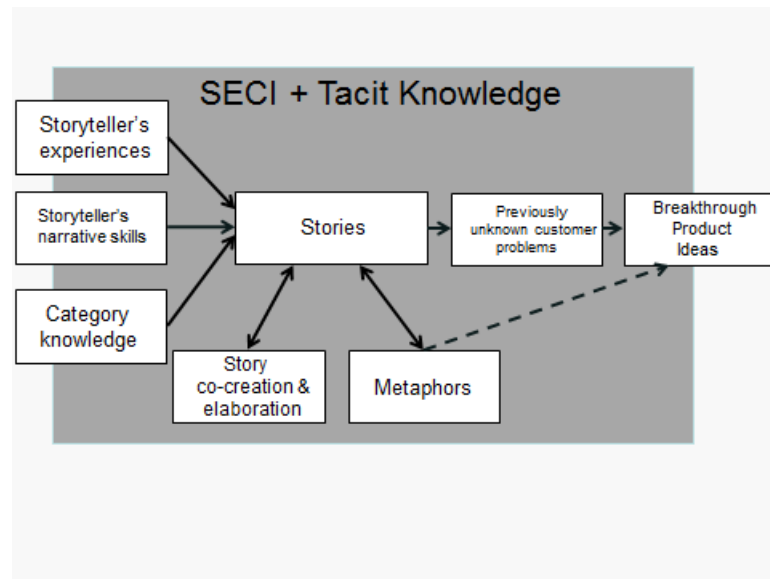
19

Figure 2: A Model of Stories and Metaphors in the Creation of Breakthrough Ideas

Limitations and Further Research

Although extreme care was taken to design a valid and reliable study, it had significant limitations, which must be acknowledged. Firstly, only a single company with one CDW could be studied. This was because the collection of confidential data was only possible after protracted negotiations and *Corporation A* did not want further CDWs to be observed. Therefore, there is a need for similar studies to observe more CDWs and wider FFE activities, to study the role of tacit knowledge, stories and metaphors. As *Corporation A*'s FFE activities may not be typical, future research needs to observe more CDWs, determining their structure, and the impact of the facilitator on the generation of breakthrough ideas. Such studies would provide the evidence to confirm or challenge the findings of the current study (including the tentative conceptual model—Figure 2). Much previous research on tacit knowledge has been via survey work, whereas the authors of this study believe the real insights about ideation must come from similar in-depth observations of the phenomena as they occur.

The data collected only opened a partial 'window' on *Corporation A*'s FFE; observation of the day-to-day interactions between NPD team members was not possible. Ideally, a full ethnographic study is needed, with constant observation of the NPD team throughout the FFE. Then the full context in which the new knowledge emerges during the FFE could be better understood. Such a study would require several months of on-site data collection and thus even greater access than granted for the current study. Obviously, the presence of a researcher could have some impact on the phenomena being studied. In the present study, the presence of the researcher and video camera during the CDW could have influenced the behavior of the workshop attendees. To minimize this, the camera was fixed (with a wide-angle lens) to make it less intrusive and the researcher remained at the back of the room taking notes.

The current study adopted a perspective from knowledge theory. In general, more FFE studies need to adopt a knowledge theoretical perspective stories and metaphors with other research methods in the creation of new knowledge. Lastly, the study extends the methodological ideas of previous empirical qualitative studies that have taken a knowledge theory perspective in NPD research (Goffin and Koners, 2011; Richtner et al., 2013) and has

again demonstrated the viability of qualitative coding schemes based on SECI, stories and metaphors.

Managerial Implications

The results are based on a single case study and so further studies are needed to confirm them. However, the importance of the FFE to NPD and the current dearth of advice for practitioners on how to stimulate tacit knowledge mean that recommendations need to be made (albeit tentatively). Tacit knowledge, stories and metaphors all apparently make valuable contributions to the creation of new knowledge in a CDW. This means that such workshops should be exploited more often by companies, as they can develop breakthrough rather than incremental ideas. Also, the current study suggests that care should be taken with selecting CDW participants. They should have extensive experience of the particular product category (either professionally or as a regular user); they should be good narrators; and a good facilitator is also crucial.

Within a CDW, stories appear to spur the identification of previously unknown customer needs and so managers should encourage customer and NPD teams to integrate storytelling into CDWs. Creativity theory points to the value of metaphors in problem-solving (Cougar, 1995) and so they should be encouraged within the context of stories, rather than in isolation. Another useful idea from the current study is that videotaped triggering stories can be stored in databases and shared among teams to serve as valuable tools later in NPD, in developing brand positioning and marketing communications. The recommendations for practitioners are summarized in Table 5.

A preliminary version of the recommendations for practitioners given in Table 5 was shown to the CDW facilitator at the end of the research for her views. She confirmed certain points and suggested others, thus increasing the validity of the recommendations. For example, she stressed the importance of stories accessing tacit knowledge, saying too many companies are, *"using models based on explicit knowledge… [which] confines their thinking to… the well-known and misses the opportunities that could be explored with processes capitalizing on tacit knowledge."* She proposed that stories and metaphors need to become part of the 'thinking culture' within an organization: *"Metaphors and stories are the toolkit through which executives can challenge existing paradigms and can take their understanding of customers' needs and a product's impact to a much richer perspective."*

#	Topic	Tentative Recommendations
1	Using stories	▪ Encourage participants to think about stories that capture their experiences around the use of products. ▪ Ask particularly for stories with unexpected incidents, or ways to resolve product-related problems. ▪ Urge participants to co-create stories. ▪ Remind participants that all good stories have a beginning, a plot, and an end. ▪ Requite storytellers to be concise. ▪ Have facilitators try to recognize 'non-trigger' stories, so that dead ends can be avoided. ▪ Ask the participants whether they think this is new thinking (knowledge). ▪ Make stories (and metaphors) part of the 'thinking culture' of the organization.

2	Using metaphors	- After a story has been told, encourage participants identify the product-related problems it illustrates. - Encourage participants to think of metaphors that match the product-related problems raised by the story. - Use metaphors to trigger ideas for potential solutions to customers' problems.

Table 5: Tentative Recommendations for Using Stories and Metaphors within CDWs

Summary

The fuzzy front-end (FFE) is the crucial ideation phase of innovation, where tacit knowledge plays a central role. However, few studies have looked at how tacit knowledge emerges and how it can lead to breakthrough ideas. Addressing this gap in the literature, a single case study looked at how a company used a collaborative design workshop (CDW) to generate breakthrough ideas. Using a knowledge management perspective and systematic coding scheme for the video data, this research empirically demonstrated for the first time how stories are a mechanism by which tacit knowledge can be shared and can identify previously unknown customer needs. Within the CDW data, 8 breakthrough ideas were identified and the stories and metaphors associated with each of these was analyzed. Interestingly, metaphors in isolation were not found to trigger breakthrough ideas; rather metaphors were interwoven within stories and helped articulate ways in which customers' problems could be solved. This study contributes to the knowledge management and NPD literatures by demonstrating empirically how stories and metaphors harness tacit knowledge leading to new knowledge and breakthrough ideas. The results also led to recommendations that can help practitioners use stories and metaphors effectively in discussions with customers. Although the research generated many insights, further research is needed because the FFE is much more dependent on storytelling—telling tales—than previously thought.

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APPENDIX A
Final SECI codes & Abbreviations

1. Socialization (SCL)
Tacit to Tacit
Through sharing experiences, observing others, and practice, training sessions, labs, team discussions.
S-WO Extra-firm social information collection (wandering outside)
The extent to which managers and/or project participants gather information from sales and production sites, share experiences with suppliers and customers, and interact with external experts and have informal meetings with competitors.
S-WI Intra-firm social information collection (wandering inside)
The extent to which managers and/or project participants gather new information, on for instance new strategies and market opportunities, by wandering inside the firm.
S-TTK Transfer of tacit knowledge
The extent to which managers and/or project participants create a working environment that allows peers to understand craftsmanship and expertise through practice and demonstrations by a master.

2. Externalization (EXT)
Tacit to Explicit
stories and metaphors; writing ideas on paper
E-UM Use of metaphors The extent to which managers and/or project participants use metaphors, concepts, prototypes, or models, in dialogue and concept creation. Refers to the activity of using the information (in the form text, models, concepts, metaphors) in a dialogue.
E-US Use of stories The extent to which managers and/or project participants use short or long stories in dialogue and concept creation. Refers to the activity of using the information (in the form stories) in a dialogue. (addition by the authors of this study)
E-AS Addition in the stories/Co-creation The extent to which managers and/or workshop participants add short input in the stories used by others in dialogue and concept creation. Refers to the activity of using the information (in the form of short additions/refinements in the stories) in a dialogue. (addition by the authors of this study)
E-DCC Dialogue in concept creation
The extent to which managers and/or project participants perform facilitation of creative and essential dialogue. Refers to all activities and practices that facilitate dialogue (such as, e.g., sitting close together).
E-DCM Dialogue about concepts and models
The extent to which managers and/or project participants involve industrial designers in teams, and the use of "abductive thinking."

3. Combination (COMB)
Explicit to Explicit conversion-New Knowledge
creating manuals, documents, drawings and databases
C-AI Acquisition and integration
The extent to which managers and/or project participants are engaged in planning strategies and operations, assembling accumulated data, both internal and external, by using published literature, computer simulations, and forecasting, and market research. Refers to the task of gathering the information.
C-SP Synthesizing and processing
The extent to which managers and/or project participants process the data by creating manuals, documents, and databases on products and services or build up material by gathering management figures or technical information from all over the company. Refers to the task of collating (analyzing and synthesizing) the information that has been gathered.
C-D Dissemination
The extent to which managers and/or project participants engage in planning, implementation of presentations, to transmit newly created concepts.
C-I&I New Knowledge discovery
The extent to which managers discover and share new consumer needs and new product ideas.

4. Internalization (INTR)
Explicit to Tacit
sharing mental models and technical know-how; explaining consequences; learning by doing
I-PE Personal experience The extent to which managers and/or project participants engage in "enactive liaising" activities, which take place when people from different functional departments are put together in cross-functional development teams in order to create overlapping competencies in product development. In these teams the participants search for and share new values and thoughts.
I-RWKA Real world knowledge acquisition
The extent to which managers and/or project participants share and try to understand accumulated customer needs through communications with fellow participants in the organization.
I-SE Simulation and experimentation
The extent to which managers and/or project participants facilitate prototyping, benchmarking, reversed engineering, and test marketing. Refers more to physical prototypes, and the process of creating them, including activities such as demonstration, prototyping, crafting initial new product designs and so on.
I-NKAW New knowledge acquisition through writing (addition by the authors of this study)
I-VWKA Virtual world knowledge acquisition
The extent to which managers and/or project participants form virtual teams and conduct experiments and share results with their entire department.

Adapted from Richtnér, Åhlström, and Goffin, 2013.

APPENDIX B
Operationalized Measures & Anchoring Rules

Explicit documented knowledge
Customer needs identified in market research reports.
New knowledge
New customer needs that were discussed by the team
New justified knowledge
New customer needs that were novel to the Corporation A and were agreed in the workshop and written on flipcharts by the facilitator

Stories
During the workshop and each narration was measured by the type of the protagonist (storyteller or other fictional/ real character) and the type of the plot. Plots include incidents, experiences, summaries of person-to-person and/or person-to-product relationships, and resolutions.
Metaphors
Metaphors were measured when incidents during dialogues involved two different words or meanings that were connected by the verb 'to be' of the copula is/as. Metaphors were also measured when incidents during dialogues included analogies using the word "like" or "as".

Strong triggers
New crystallized knowledge includes 3 (or more) product codes of those firstly mentioned during the narration of the story/metaphor.
Medium triggers
New crystallized knowledge includes 1-2 product codes of those firstly mentioned during the narration of the story/metaphor.
Non-Triggers
New crystallized knowledge includes 0 product codes of those firstly mentioned during the narration of the story/metaphor.

APPENDIX C
Final Product-related codes & Abbreviations

1. USES-**USE** All of the different uses to which product or service is put
2. MISUSES-**MISUSE** Uses of the product or service in a way other than that intended by the manufacturer or provider
3. WORKAROUNDS-**WKARD** Ways in which product/service limitations are overcome by the user through, for example, modifications of the product
4. PROBLEMS-**PROB** Issues encountered in using the product or service
5. PROCESSES-**PROC** The process by which the product or service is used
6. ACQUISITION-**ACQ** Reasons and methods for acquiring the product or service
7. TRIGGERS-**TRIGG** Reasons for using the product or service at a particular time
8. NEW BENEFIT/FEATURE **NEW BEN/FEAT** *New benefit and/or feature generated by the managers/customers (addition by the authors of this study)*

Source: Goffin, Vaernes, Koners, and Van Der Hoven, 2012