Creativity in Applied Enterprise - Bringing Impetus to Innovation

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Avhandling för Filosofie Doktorsexamen i psykologi, som med vederbörligt tillstånd av Samhällsvetenskapliga fakulteten vid Göteborgs universitet kommer att offentligt försvaras fredagen den 12 september 2003, kl. 10.00, Sal F1, Psykologiska institutionen, Haraldsgatan 1, Göteborg.

av

Per Kristensson

Abstract

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Creative ideas bring impetus to innovation. The 'early idea' phase stands out as critical to increased new product development performance. Nevertheless, the management of creativity, despite persistent competitive advantage for enterprising organisations, remains one of the least understood aspects of innovative endeavour. In the present investigation, the extent to which computer-mediated communication may affect the creative performance of small groups (Studies I and II) and how external communication in terms of user involvement may yield original and valuable ideas (Studies III and IV) was studied. In Study I and Study II, two experiments were carried out in order to assess the effects of two modes of computer-mediated communication (Chat and Video conference) versus face-to-face upon creative performance. In study I, the results regarding the creative product indicated that groups in the face-to-face condition generate more ideas. Regarding the creative process, the Video conference condition scored significantly lower on incubation. Participants in the face-to-face group reported themselves to be more satisfied with both their product and process than the participants in the computer-mediated groups. In study II, the face-to-face group proved to have a better preparation phase. Furthermore, the small groups produced significantly more incubations than the individuals in the creative process and, in line with this, they also showed significantly higher flexibility. Accordingly, the participants in the face-to-face group reported themselves to be more satisfied with the process, but not with the product, than the participants in the computer-mediated conditions. In Study III and Study IV, the merit of user involvement for purposes of innovation was investigated experimentally. In Studies III and IV, different types of users and professional product developers were given the task of creating ideas for future mobile phone services. In Study III, the results indicated that creativity-trained users generated significantly more original ideas than professional developers. In Study IV, the results indicated that ordinary users generate significantly more original ideas than professional developers and advanced users. Professional developers and advanced users created more easily realizable ideas and ordinary users the most valuable ideas. The findings of each of the four studies are discussed in the context of how divergent thinking may be facilitated in order to improve the management of new product and service development.

Key words: Creativity, Innovation, Computer-mediated communication, User involvement, Divergent thinking.

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There is nothing more difficult to take in hand, more perilous to conduct or more uncertain in its success than to take the lead in the introduction of a new order of things.

Niccolo Machiavelli, "The Prince" 1532

Abstract

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Preface

The thesis consists of this summary and the following four studies, which will be referred to by their Roman numerals:

I.   Kristensson, P. & Norlander, T. (In press). The Creative Product and Process in Computer-Mediated Groups. *Journal of Creative Behavior*.

II.   Kristensson, P. & Norlander, T. (2003). The Creative Process and Product in Virtual Environments. *Creativity and Innovation Management*, 12 (1): 32-40.

III. Kristensson, P., & Magnusson, P. R. & Matthing, J. (2002). Users as a Hidden Resource for Creativity: Findings from an Experimental Study on User Involvement. *Creativity and Innovation Management*, 11 (1): 55-61.

IV.   Kristensson, P., Gustafsson, A. & Archer, T. (In press). Harnessing the Creative Potential among Users. *Journal of Product Innovation Management*.

The present investigation reveals that interacting with users may facilitate the derivation of creative products. The main reason for this is that it increases the possibility of combining different sets of information. An academic dissertation may be viewed as a creative product – an innovation in the sense of presenting new and valuable results to an identified knowledge gap – it thus seems logical to acknowledge the people who have provided me with the valuable information which has made this dissertation possible.

First of all, I would like to mention my committee, consisting of Professor Trevor Archer, Associate Professor Torsten Norlander and Associate Professor Anders Gustafsson. I would like to thank you all for sharing your scientific experience, your knowledge of creativity and innovation, and for providing me with inspiration and encouragement.

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I would also like to thank my colleagues taking part in the project *Customer Driven IT development* (CuDIT), Doctoral Candidate Jonas Matthing and Dr. Peter R Magnusson. Indeed, the CuDIT project was an accomplishment entailing implications not only for the various academic fields, but also for trade and industry. Furthermore, I thank Professor Per Norling and Dr Markus Fellesson for their cooperation during

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Introduction

All innovation begins with creative ideas (Amabile, Conti, Coon, Lazenby & Herron, 1996). The development of successful products and services, the implementation of new processes, the design of new products and their introduction onto the market all depend on a person or team coming up with a good idea and developing this idea beyond its initial state. Launching a novel product, based on an original and potentially valuable idea, in the field is likely to increase satisfaction and loyalty among customers and thus implies a major financial opportunity. One critical phase of new product and service development is the early idea phase. Operations undertaken during the early, creative, phase of innovation will dictate all further activity.

The present investigation considers the problem of generating creative ideas that may be further developed during an innovation activity. More specifically, the embryo of innovation – creativity – is studied in light of the need for applied enterprises to develop and field new products.

This treatise starts with a brief description of the research context – the need for creativity within the framework of innovative enterprise. Three sections then follow which provide the theoretical framework for the present thesis. The subsequent section gives a summary of four empirical studies underpinning the present thesis. Finally, a general discussion of the results is provided.

The research context – the need for creativity in innovative enterprise

The over-reaching goal of all business activity is to create value for its customers (Woodruff, 1997; Norman & Ramirez, 1994). According to research, the most important means of achieving this is to develop new products; new products that better than before provide a person (i.e. the customer) with unique benefits (Brown & Eisenhardt, 1995). Unfortunately, it has proven difficult to conceive the value of a future product for potential customers. For that reason, members of companies need to interact and communicate with customers in order to derive new and valuable ideas for how personal needs and requirements may be fulfilled by a future product.

A background to the new product development literature – and the role of creativity

In a well-cited review article that examines the empirical literature on product development, Brown and Eisenhardt (1995) note that research into product development is viewed with increasing importance. According to them, the reason for this is two-fold. The first reason deals with the situation that new product development constitutes an important means of attaining and keeping market share. Put simply, new products are becoming the very heart of competition (Fitzsimmons & Fitzsimmons, 2000). In all kinds of corporate organizations, firms that develop exciting and memorable products that people are anxious to buy are likely to keep and, possibly, increase their market share. The second reason deals with the situation that product develop-

ment is an expensive, time-consuming and difficult matter to achieve. This is due to the difficulty of conceiving whether or not a new product will create the kind of value that makes potential customers interested in buying.

For these reasons, product development stands out as an area with high improvement potential. As a result of this, a need for management knowledge has emerged which has generated a palpable scientific approach that endeavours to identify the most important factors contributing to innovation success (e.g. Cooper & Kleinschmidt, 1987, 1993; Cooper, 1995; Henard & Szymanski, 2001). Since, in the eyes of the customer, the created value is what will largely determine success or failure, having a unique idea for a future product has been advanced as one of the most important criterions yielding success in new product development (e.g. Booz, Allen & Hamilton, 1982; Cooper, 1993 and 1999; Henard & Szymanski, 2001). The unique product idea, then, should provide a novel answer as regards how a company can create value, providing real benefits to its customers by offering that particular new product (Cooper, 1993; 1995). By 'unique' is implied that no one else has come up with the same idea, thus giving the inventing company an apparent advantage vis-à-vis its competitors. This notion, with the emphasis on novelty and value, is in line with the view of ideas held by the creativity literature (cf. Sternberg & Lubart, 1999). By creativity, the ability to derive an idea that is new and valuable, in relation to a given problem, is intended (Mayer, 1999; Sternberg & Lubart, 1999). It follows, therefore, that creativity studies ought to serve product development's need for increased efficacy.

Despite the situation that the ability to derive new and valuable ideas appears to be of significance for innovation, there are only a few studies that aim to understand how creativity can increase product development performance. A literature search using Academic Search Elite and Business Source Elite presents only eleven studies published in peer reviewed journals between 1990 and 2000, using 'creativity and product development' as search words.[1] Between 2000 and 2003, there is a slight increase, with nine additional articles. According to Easingwood (1986), the starting point for innovation – an idea that represents a new and valuable way on how to respond to hitherto unsatisfied customer needs – is quite surprisingly often taken for granted by business organizations. The ignorance reported by Easingwood forms a stark contrast to the emphasis researchers attribute to creative performance. According to Khurana and Rosenthal (1998), most projects do not fail at the end, they fail at the beginning. They state that the most significant benefit (for product development) can be achieved through improvements in the performance of front-end activities, e.g. opportunity identification and idea generation. The same is reported by Stevens, Burley and Divine (1999) who show that most significant differences between successful and unsuccessful products lie in the quality of execution of the first few stages of new product development, i.e. during the creative phase. Alam and Perry (2002) report empirical data that demonstrates idea generation as the most important phase of new

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[1] Carried out in April 2003. The BSE database provides full text articles, indexing and abstracts in more than 1,750 academic journals while the ASE database covers 3,250 journals (note: several of the covered journals appear in both databases).

service development. Scheuing & Johnson (1989) propose that a creative idea should initiate service development. Sethi, Smith and Park (2001) claim that the next step of product development research should provide underlying explanations of the factors affecting innovativeness. In a meta-analysis of the new product performance literature, Henard and Szymanski (2001) found that product advantage and predevelopment task proficiency have a significant impact on new product performance. Taking these studies together, it seems likely that increased knowledge of how new and valuable ideas evolve, in terms of the mental processes of individuals or the interaction between individuals and their environment, would provide valuable insights into product development performance.

While observing that knowledge of creativity may contribute to the understanding of how product development can be managed, one may nevertheless hear arguments reflecting the opposite view: i.e. that creativity may complicate innovation (e.g. Levitt, 2002). This consideration pertains to situations wherein original ideas may cause organizational problems because of the likelihood that they are not aligned with the 'business strategy'. Nevertheless, this consideration only serves to illustrate the need for knowledge of creativity and how it may be harnessed. Creativity does not solely encompass originality – which is the common misconception directing these types of assertions – but also includes a value dimension (cf. Mayer, 1999). Primarily ideas consisting of these elements (i.e. originality *and* value) may provide the effective driving force for successful innovation.

In conclusion, several estimates indicate that a greater understanding of creativity may increase the performance of new product development. While recognizing this, it should also be noted that, when speaking of product development, the development of new services is generally also implied. By the concept of 'product' is meant both physical goods and services (e.g. ISO 9004, 1991). However, since there is often an implicit association with goods when speaking of products, there is a need to consider some aspects that may be specific to service development, in relation to creativity, as well.

Creating value – an important notion in service development

In the academic literature (e.g. Zeithaml & Bitner, 2000), services have traditionally been distinguished from goods articles by certain commonly maintained features. Accordingly, services are often said to be intangible, heterogeneous, perishable, and produced and consumed simultaneously (Grönroos, 2000, Norman, 2000). Additionally, in service management, the emphasis on 'value', and how to create this, is significant. After all, the philosophical notion of a service is one of doing someone a favor (Sundbo, 1998). How to create value thus stands out as critical.

The characteristics of services are important in order to understand the management of them (Johne & Storey, 1998). For example, the management implication of dealing with 'heterogeneity' relates to the impact that people, staff and customers have on the final service offering. A service to one customer is seldom not exactly identical to the "same" service when provided to another customer (Grönroos, 2001). If nothing else, the social relationship in the two situations is likely to differ. There-

fore, in order for services to add as much value as possible, it is important to incorporate information, from all the parties involved, as regards how a potential service may be personalized in order to meet individual needs. The principles of collecting and integrating information in order to produce personalized offerings are important to the successful development of new and valuable services.

The management implication of 'intangibility' causes the situation where service development does not need as large investment in production facilities as in goods development. As a consequence, 'intangibility' renders ease of imitation of a successful new service, as compared to traditional goods development (Zeithaml & Bitner, 2000) This creates the need for a greater understanding of how new and valuable (i.e. creative) ideas evolve more apparently in service development than in product development. Another circumstance of services, in the same direction, pertains to the complexity of patenting a new service; a new service concept may thus be imitated by competitors much more easily than would a newly-invented good (Zeithaml & Bitner, 2000). The bottom line of this is that service companies – compared with industrial companies – are heavily dependent on the ability to develop new ideas for future services (Edvardsson, Haglund & Mattsson, 1995). Not enough, since the core of a service often essentially consists but of the very idea (of how to create value) that it is composed of, again, knowledge of how new and valuable ideas evolve has a great magnitude for service companies. The core of a financial service, for example, is basically only build up of the *idea* of how value is created (for a user), and does barely depend on any tangible entity (cf. Alam, 2002). In fact, in the development of a new service, the idea itself stands out as such a vital aspect of the final service that speaking of it only in terms of a 'sequence' in the development process, as researchers within the field sometimes do, may play down on its importance. In consequence, creativity stands out as an important subject for service management and development.

The distinction between goods and services provokes the observation that the differences between the two entities may be considerable. However, the current (and rising) view among researchers within the field suggests that this hardly need be the case and that this distinction is not of such great consequence any longer (Gummesson, 1995). Rather, one argues from a the standpoint that all products, whether goods or services, should be viewed as customer offerings. For example, Rust (1998) argues that all products are really services, and "most goods businesses now view themselves primarily as services, with the offered good being an important part of the service (rather than the service being an augmentation of the physical good)" (p. 107). In a similar vein, Bitner, Brown and Meuter (2000) emphasize the fact that virtually all firms compete on the basis of customer service and service offerings. The message implicit in these notions is that customers do not buy a good or service in the traditional sense, rather they buy an offering which renders them a service which, in turn, creates value for the individual (Gummesson, 1996). The consideration that all businesses are now in the service sector thus appears to have some justification. This implies that the principles of service management will now attain greater importance as it will not just be service companies that are striving to create value for their customers (Sundbo, 1998).

The notion that customer value is of great importance entails certain consequences. Firstly, it moves the focus from the question of how the development of goods and services differ to the question of how customer value may be created. The importance of customer value implies that the communication and interaction processes between customer and company will become the focal aspects of product development (Foxall & Johnston, 1987). In order to understand what 'creates' value for individuals, companies will have to organize strategies for communicating and interacting with their users (Olson & Bakke, 2001). The successful development of new products, 'that serve an individual', is dependent upon insights into underlying human needs and living environment and such insights may only be illuminated if company-customer relations become closer. Interaction and communication are important because they are the means by which companies derive new and valuable ideas for new products. Systematic opportunities for this type of communication and interaction with users may be achieved using modern information and communication technology and user involvement procedures. Therefore, any studies into how new and valuable product ideas evolve should start out from the effects that different types of user interaction may have on creativity. Secondly, following this line of reasoning, the necessity for interacting with individuals in order to understand their basic needs indicates that a psychological approach is required.[2] Likewise, because ideas are the result of cognitive and social psychological processes within or between individuals and their environmental conditions, there is a demand for a psychological framework and operationalization of creativity.

Creativity: theory and research

For the purposes of scientific inference, the term creativity was first coined by Guilford in his presidential address to the American Psychological Association in 1950. At this time, the concept seems to have been something of a combination of the two words *create* and *activity*. Guilford (1967a) did not provide a formal definition of creativity since he found that the diverse ramifications of such a concept *"cannot be boiled down into one simple statement"* (p. 420). In spite of this, the concept received great attention since it captured the essence in activities such as producing, designing, composing and inventing, to name but a few. Since all these abilities are much sought after, and given great importance, Taylor, already in 1959, was able to extract more than one hundred definitions. Instead of elucidating the meaning of the concept, Guil-

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[2] One further consequence is that, although what would traditionally be conceptualized as services is implied in this treatise, the concept of 'product' will be used henceforth. This is because services are included in the concept of 'product', and because research articles dealing with service development interchangeably refer to this as product or service development. From the reference management standpoint, this seems to be the simplest. Also, research into the development of new services contributes to the understanding of goods development (and vice versa). For instance, with regard to the development of either, a novel and valuable idea will increase the likelihood of achieving success.

ford emphasized the important content of creative activity, namely divergent thinking. By divergent thinking a flexible and somewhat unstructured problem-solving process is intended. In the divergent thinking process, the introduction of a new element facilitates the evolution of new alternatives which are combined with, in general, already established principles.

Divergent thinking

The problem of defining creativity brings into focus the difficulties haunting psychological definitions and explanations of the scientific concept and prerequisites of intelligence. Focusing on the mental ability to cognitively perform some activity, creativity has also been compared and understood as related to intelligence. Nevertheless, creativity differs from intelligence by way of divergent thinking, which can be compared to convergent thinking, commonly associated with general intelligence (Runco, 1999).

- *Divergent thinking* is the intellectual ability to think of many original, diverse, and elaborate ideas. Divergent thinking relates to the production of new information and knowledge.
- *Convergent thinking* is the intellectual ability to logically evaluate, critically analyze and choose the correct alternative from a selection of alternatives. Also, to infer from given and existing information, synthesizing it and drawing conclusions. Convergent thinking relates to the consumption of information.

According to Guilford (1967b), divergent thinking constitutes the core characteristic of creativity. However, some criticism has been raised towards the assumption that only divergent thinking would represent creativity, meaning that also convergent thinking is required for creative performance (cf. Norlander, 1997). Divergent thinking is essential to the novelty of creative products, whereas convergent thinking is fundamental to their appropriateness. Thus, any general definition of creativity must account for the process of recognition or discovery of novel and appropriate ideas and solutions.

Making new and valuable connections

Although creativity may be understood in terms of divergent thinking, it does not provide an explanation of the underlying processes occurring during creative thinking. According to Mednick (1962), creative thinking involves the formation of associative elements into new combinations which are in some way useful. Although Mednick (1962) and Guilford (1967b) appeared to be in opposition to each other, the associational processes described by Mednick appear to be very compatible with Guilford's concept of divergent thinking (Baer, 1993; Paulus, 2000). According to Baer (1993), Mednick's theory of associative thinking can be thought of as a theory that explains the mechanisms underlying divergent thinking. Whether applying asso-

ciational theory or divergent thinking, the focus is on how the connection of at least two previously unrelated matrices of thought create insight and invention. In explaining the mechanisms that cause innovation, Ekvall (1997) has described the mental processes involved in creative action as conceived of as the combination of "principles and elements of knowledge and insights that have not been connected before" (p. 195).

Mednick's associative hierarchy (1962) is central to the explanation of how the 'making of new and valuable connections' is brought about. The associative hierarchy refers to how an individual's associations are organized. Important in this regard is the pattern of the relative strengths of the various associations a person has with a certain, given, concept (Baer, 1993). Among less creative people, the associative hierarchy is steep, implying that only a few ideas have the probability of being generated. These ideas will in turn be conceptually closely related to each other (see Figure 1). A steep associative gradient of narrow width along existing paths usually leads to high levels of detail and accuracy in convergent thinking problem-solving tasks (Scott, 1999). For example, if the problem-solver has been exposed to advanced electronic equipment recently, the ideas generated in order to solve the problem are likely to center on electronic solutions. To provide an another example of this; during a continuous word association task, with a steep associative hierarchy the most likely response to the stimulus *paper clip* – would be staple, thumbtack, glue, tape, folder or something similar. The associations follow a predictable and logical pattern. Among creative people, the associative hierarchy will be flatter, increasing the probability of making 'less common' associations between concepts. During the same continuous word association task mentioned above, an illustrative response pattern to the stimulus *paper clip* – would be staple, thumbtack, hairpin, bookmark, fingerpost, skeleton key, rock-'n'-roll tool and victory (cf. Martindale, 1999). In this latter case, the problem solution may incorporate elements which initially appear to be rather disparate.

According to Mendelsohn (1976), the focus of attention may account for different associational hierarchies. In order to become aware of a creative idea, one must have all the elements to be combined in the focus of attention at the same time. If one can only attend to two things at the same time, only one possible analogy can be discovered at that time; if one could attend to four things at once, six possible analogies could be discovered. The greater the attentional capacity, the more likely the combinatorial leap (Martindale, 1999).

High

Associative Response Strength

Low

Steep hierarchy

most likely | next most likely | next most likely | next most likely | next most likely | next most likely

High

Associative Response Strength

Low

Flat hierarchy

most likely | next most likely | next most likely | next most likely | next most likely | next most likely
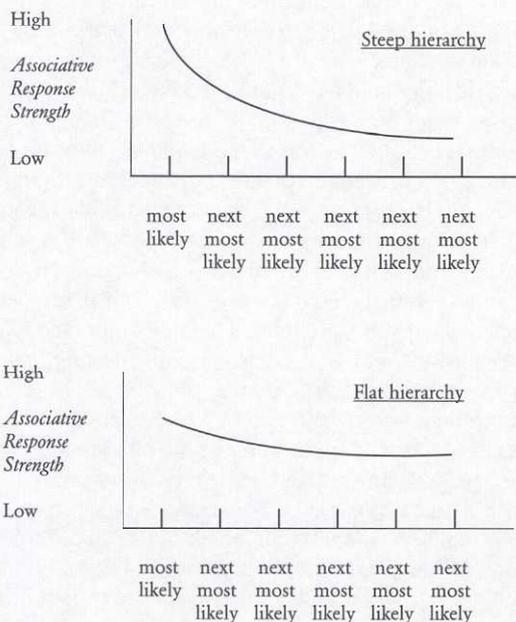
Figure 1. Steep and flat associative hierarchies (Mednick, 1962).

Inferring from the discussion on how previously separate concepts merge into new and useful ideas, it appears to be possible to understand and explain creative performance. In conclusion, the key to creative thought appears to be the combination and reorganization of information and knowledge in order to advance new understanding and, subsequent to this, the generation of ideas (Mumford, 2000). The larger the set of skills, information and knowledge at hand - the more numerous the alternatives available for producing something new. In other words, viable solutions to novel problems do not arise in a vacuum.

However, besides considering the possibility of connecting information elements, it is also of interest to note how the different informational elements are organized between, and within, conceptual categories and hierarchies (Weisberg, 1999). When people solve problems, they tend to generate ideas within certain conceptual categories. However, the further apart the considered elements are at the outset, the more creative the new configuration has the potential to be. Members of a group who are exposed to ideas within a particular category will tend to stimulate more ideas within the given category since associations commonly follow the rule of similarity. Thus, to generate a creative solution, the difficulty lies in breaking free (i.e. diverging) from one line of thinking (within a category) and connecting information ele-

ments which are initially mutually remote (i.e. belonging to different conceptual categories). Newell and Simon (1972) have poetically described this, the dynamics of the creative thinking process, as the: *"network of possible wanderings"* (p. 82). In terms of Mednick, the connection of two elements within different categories which are conceptually distal to each other will be cognitively obstructed by a steep associative hierarchy. One of the marks of creativity, as implied by the foregoing discussion, is the ability to break out of conventional thinking (i.e. convergent) and engage in divergent thinking. In part, this means being able to apply concepts or propositions from one domain to another unrelated one in a manner that produces a new insight (Chi, 1997).

Recognizing that creative thinking is a matter of making new and valuable information connections, it has to be realized that this does not provide any clear-cut definition of the concept of creativity. The problem of finding a unitary definition continues. One definition (Welsch, 1980), proposed on the basis of a review of agreements and disagreements among researchers, states that: *"Creativity is the process of generating unique products by transformation of existing products. These products, tangible and intangible, must be unique only to the creator, and must meet the criteria of purpose and value established by the author"* (p. 97). Unfortunately, because creativity is a multifaceted phenomenon, and is of interest from many theoretical perspectives, not everyone agreed with this attempted definition (Isaksen, 1987). However, in a recent literature overview of creativity research, several of the most renowned researchers within the field show consensus regarding the defining features of creativity (Mayer, 1999). The only exception to this is that they use slightly differing vocabulary, see Table 1.

Table 1: Two defining features of creativity. Adapted and extended from Mayer (1999). The names marked with an asterisk have been added to Mayer's original table.

Name of researcher (-s)	Feature 1:	Feature 2:
Gruber & Wallace (1999)	Novelty	Value
Martindale (1999)	Original	Appropriate
Lumsden (1999)	New	Significant
Lubart (1999)	Novel	Appropriate
Boden (1999)	Novel	Valuable
Nickerson (1999)	Novelty	Utility
Amabile (1996)*	Novelty	Appropriateness
Ekvall (1997)*	Originality	Value
Besemer & O'Quin (1986)*	Novelty	Resolution
MacKinnon (1968)*	Originality	Adaptiveness

While some researchers (e.g. Besemer & O'Quin, 1999; MacKinnon, 1968) have added further features to creativity, a common notion among laymen is the fail-

ure to recognize the second feature, thus missing the importance of having a novel idea that meets a need (cf. Sternberg, 1985). Regarding the company's opportunities for successful product development, Levitt (2002), one of the most influential researchers in market research, warns against the risk of an unrestricted focus on the originality dimension. He implies that creativity, in the form of original ideas, may play an inhibitory role as regards the innovative ability of a business organization. Unfortunately, Levitt fails to consider the point which makes creativity both important and difficult to achieve; i.e. that a creative idea consists of both originality and value.

Group theories regarding creativity

The associative theory presented above deals with how a novel and valuable idea occurs to an individual. On the other hand, some research is directed towards a better understanding of the ability of groups to generate new ideas. Group creativity research has to a great extent been influenced by 'brainstorming' as a technique for producing better ideas. The basis of the theory itself is precisely the same as above, i.e. that a novel and valuable idea consists of combined and reorganized concepts and knowledge elements (Mumford & Gustafson, 1988). Despite the situation that individuals generally share the early assumption of Osborn (1957), i.e. that several people think better than one, research shows in fact that groups are not always as effective as one might intuitively believe.

One common method of examining and understanding the creativity of groups has been to compare their performance with that of a so-called 'nominal' group. A nominal group consists of individuals who work singly but whose production is retrospectively combined with the redundant ideas (in general) removed. Studies wherein groups have been compared with nominal groups have shown that the confidence bestowed on the group's capacity is exaggerated. One important reason for overestimating groups pertains to expectations regarding a number of process "gains" without properly taking into account the number of process "losses" that affect group performance negatively. Pinsonneault, Barki, Gallupe and Hoppen (1999) have identified a number of 'process gains' and 'process losses' which contribute towards explaining the capability of groups for creative problem solving. More specifically, process gains and losses refer to the ability of a group, most often in an idea generation situation, to produce as many original ideas as possible. Factors that increase and enhance the groups' creative performance are referred to as process gains. They facilitate the synthesis of new and valuable connections. A factor that decreases and inhibits the creative performance of groups or individuals is process loss (Pinsonneault et al, 1999). Process losses undermine a group's opportunities for divergent thinking. The conceptual framework capturing these studies postulates that idea generation in a group interaction could be either enhanced or reduced with respect to quality and quantity (however, only the latter is usually examined). On the positive side, group interaction may stimulate motivation among members which will increase the groups' idea generation productivity (i.e. a process gain) – and on the negative side it may lead to evaluation apprehension which will inhibit the same (i.e. a process loss) (Dennis &

Valacich, 1993). The most commonly-mentioned process gains and losses are listed in Table 2 (see below).

Table 2. Process gains and losses in group creativity (abridged after Pinsonneault et al., 1999).

Process	Explanation	Outcome
Procedural mechanisms	Decomposition of tasks	Process loss (in groups)
Cognitive stimulation	Information from one member elicits new ideas from other members	Process gain
Social recognition	Contribution recognized by others will increase performance	Process gain
Task orientation	Performance is improved when discussions are not socially-oriented	Process loss
Motivational/Arousal	Presence of others stimulates the performance of members	Process gain
Production blocking	Productivity impaired because other members interfere with ones internal idea generation	Process loss
Effort redundancy	Ideas are duplicate	Process loss
Cognitive inertia	Individuals embark on a single train of thought	Process gain
Evaluation apprehension	Fear of expressing ideas	Process loss
Productivity matching	Comparison and adjustment of individual productivity to baseline	Process loss (may also be a gain)
Conformity pressure	Social pressure to 'think' in accordance with the group	Process loss
Free riding	Withdrawal of effort	Process loss

Two notions of particular importance ensue from the presented process gains and losses above. One relates to how research results are contrary to people's everyday notions about group ability, in general, and with regard to creativity, in particular. What appears to be logically reasonable and strongly recommended by the consensus of management consulting agencies, scientific study has shown to be illusory. The second notion is that computer-mediated communication might provide a remedy for the identified shortcomings of group creativity. For example, using virtual or electronic communication, group members can generate ideas in parallel, reducing the effects of production blocking. Furthermore, because computer-mediated interaction permits individuals to attend to other members' ideas, cognitive inertia (as in the case of individual brainstorming) is likely to be reduced. Thus, on the theoretical level, electronic brainstorming offers advantages going beyond both traditional face-to-face

groups and nominal groups. Electronic interaction is currently becoming more and more popular within organizations, e.g. as instruments for communication within the company and/or with the customer. The study of computer-mediated communication is therefore interesting, from both the theoretical and empirical perspectives.

The four P model: A framework for the scientific study of creativity

An approach that has been used quite extensively, and that took its base from the difficulties of finding a unitary definition to creativity, was introduced by Rhodes 1961. According to him, creativity may be understood and organized in the context of four "Ps". Instead of stating an explicit sentence that captured creativity, Rhodes identified four avenues intertwined with each other. The four Ps include research concerning the creative 'person', the creative 'process', the creative 'product' and the creative 'place'. Each of these four Ps operates as the identifier of key components in the concept of creativity. In conclusion, Rhodes (1961) did not provide any formal definition of creativity either, rather he outlined a frame of reference which came to serve as a broad categorization, making it possible to bring structure among the different theoretical approaches. Furthermore, Rhodes' general framework had the advantage of non-exclusivity, unlike previous attempts that specified a single definition.

In the following section, the four Ps of creativity are further explored as they shed light on the present investigation.

The creative product

According to MacKinnon, the bedrock of all creativity studies should be an analysis of creative products (1978). In line with this, Amabile (1996) claims that a product-centered approach is *"ultimately the most useful for creativity research"* (p. 22). From the product development and innovation point of view, the product definition approach to creativity also stands out as useful. The product definition approach captures the link between creativity and innovation, where innovation is viewed as the concrete application and implementation of a creative product.

Although the noun 'product' may lead one's thoughts to a tangible good, the implication (in this context) is more liberally applied. More precisely, a product may imply an idea as well as an observable outcome (such as a concrete product). This means that a creative product could refer to an idea for a new golf club or 'a new golf club', a new mobile phone service or an idea for this, and so on. Recognizing this, the question which then becomes interesting is what constitutes a product, whether an idea or a tangible outcome, that is perceived as creative and what constitutes a product that is judged to be more mundane?

Research concerning ideas (i.e. creative products) that are perceived as being creative reveals that they elicit a distinct set of aesthetic responses from observers, for example, surprise, satisfaction, stimulation and savoring (Amabile, 1996). Findings from early researchers within the field (e.g. Guilford, 1950; Barron, 1955) concluded that originality was an important dimension of creative thinking, in general, and

within a creative product, in particular. Although much emphasis has been placed on the need for a creative product to be novel, the aspects of appropriateness and value constitute an equally important dimension of creativity. As Briskman (1980) points out: *...the novelty of a product is clearly only a necessary condition of its creativity, not a sufficient condition: for the madman who [...] believes himself to be a poached egg may very well be uttering a novel thought, but few of us, I imagine, would want to say that he was producing a creative one* (p. 95).

Answering MacKinnon's (1975) call for a better understanding of creative products, Besemer and O'Quin (1987; O'Quin & Besemer, 1999) have developed a judging instrument that facilitates creative product analysis. According to them, and in line with the above, the dimensions that capture creative production or creativity in general are commonly characterized by novelty and usefulness (see also Table 1). By the dimension novelty, the degree of originality is implied (O'Quin & Besemer, 1999). In the literature (e.g. Isaksen, 1987), novelty is commonly and often referred to as the most obvious attribute of creativity in products. This is in line with Guilford's and Barron's early assumptions. The premise that originality is a central element of a creative product agrees well with the identified factor for successful new product development, product uniqueness. Furthermore, Runco and Sakamoto (1999) hold originality as the most respected trait in the creativity complex. Nevertheless, as implied in the previous section, the element of newness is not enough to make a product unique; it must also contain the aspect of value and be appropriate in a specific situation. Finke, Ward and Smith (1992) note that, in many creativity studies, people are simply concerned with, and trained for, the generation of a variety of novel ideas without regard for real creative achievement (Perkins, 1981). In order for creativity to provide meaning and be as valuable as individuals hope, originality must be combined with usefulness. In line with this, Besemer and O'Quin (1987) empirically found indications that practical usefulness, the value, is a central dimension of creative products. By usefulness, they are concerned to what extent the product responds to or solve the problem which initiated, and was the purpose of, the creating activity.

To sum up, creativity results in the production of some novel output that is satisfying and represents a real leap forward from the current state of the art (Stein, 1974). The creativity of a product is expressed by its uncommonness, or rarity, in a particular situation and its applicability vis-à-vis solving a given problem. These distinguishing qualities of the creative product are typically referred to as dimensions (Amabile, 1996; Besemer & O'Quin, 1987; O'Quin & Besemer, 1999). Dimensions are defined as criteria, facets, which together provide important perspectives on the quality of a creative outcome, e.g. an idea or an already existing product.

Besides originality and value, further dimensions have been suggested: one dimension that appears useful from the product development and innovation perspective is realization, suggested by MacKinnon (1968). Such a dimension captures the capability and facility of evolving an idea into a commercial product. The dimension of realization focuses on the application of creativity into innovation, thus representing the degree of innovativeness of a creative idea. While the dimension of realization has been applied in the present thesis, there are further dimensions which are sug-

gested to be central to any creative product. One example is provided by aesthetic dimensions that provide the attractiveness of a creative product.

During his work of analyzing creative products, MacKinnon (1968) argued for the importance of employing dimensions when assessing creativity and the creative product. According to him, the usage of dimensions was important, not only for research purposes but also in real-life situations. For example, in a product development situation, a less haphazard attitude would be beneficial for an R&D department which needs to extract the new product idea with the most promise for future development and market launch. By using dimensions, a more systematic way of determining the future potential of an idea is obtained. As such a line of thought seems rational, MacKinnon noticed that the explicit and accurate determination of the qualities of an idea is often neglected because people often simply assume they know what is creative merely by 'looking'. Montoya-Weiss and O'Driscoll (2000) applied dimensions in an idea-screening project and, correspondingly, their main objective was to minimize the likelihood of random and haphazard selection when choosing between many ideas with a varied, and difficult to judge, future potential.

In conclusion, whether using the dimensions suggested by Besemer and O'Quin (1987) and MacKinnon (1968) (i.e. originality, value and realization), or adding further dimensions, the purpose of employing dimensions is to receive a template by which to judge the overall merit of one or more creative products.

The creative person

Even if the dimensions, the intrinsic elements, of a creative product currently appear to be most interesting with regard to creativity, that part of creativity research only contributes with one perspective on the subject. The study of a creative product redirects, for example, the focus away from the performing subject to the result of the subject's performance (i.e. the object or product). In the initial phase of creativity research, during the 1950s, the primary focus was directed towards persons known to be creative (Isaksen, 1987). Typical areas of research relate to the identification and scale measurement of the creative personality, biographical inventories and studies of creative ability in terms of divergent thinking (King & Anderson, 1995). Some often-mentioned personality characteristics of the creative individual concern a tolerance of ambiguity and a disposition toward originality (Plucker & Rentzulli, 1999; Barron, 1955).

One important reason why Guilford (1950) began to study individuals' creativity was that he had earlier researched the construction and validity of intelligence tests. During the Second World War, the Anglo-American forces were in need of tests that distinguished suitable persons for difficult piloting assignments. Guilford noted that there were dimensions of analogical thinking that were not covered by these tests. In his Presidential address to the American Psychological Association (APA), he thus wanted to focus upon the necessity for studying divergent thinking in parallel with the convergent thinking that the tests measured (Michael, Comrey & Fruchter, 1963). Later, Guilford, at about the same time as Mednick (1962) and Torrance (1965), began developing tests designed to measure creativity in terms of divergent production.

Divergent thinking is a concept that covers the mental processes, cognitive styles of thinking, underlying the induction of a creative product. Through examining individuals' creative ability, an indirect understanding/knowledge of possibilities or limitations for the derivation of future creative products is maintained. Guilford used different dimensions to understand the ability to assess creative actions in terms of divergent thinking within a person. According to him, fluency and flexibility make up the elements of divergent thinking and are essential to the ability to generate creative products. Fluency represents the quantity of ideational responses provided for a certain problem. Flexibility is the number of separate categories to which a response belongs. Through the application of these two quantitative dimensions, which are assumed to reflect an individual's mental processes, one retains a measure of a person's capability for divergent production. Also originality and elaboration may be exploited as important dimensions characterizing a person's capability for divergent production. Within the creative person, originality concerns the statistical rarity of a response or novelty and the remoteness of a response. In this regard, the content of originality construes a dimension of divergent production and corresponds to the content of originality as a dimension for a creative product. Elaboration, which is also a more qualitative dimension of the creative person (i.e. divergent production), relates to the development or filling out of ideas.

In order to illustrate this, suppose that an individual is given the problem of developing improved services at the university (cf. Cropley, 1999), the following responses to the problem may be generated: "improve administration by providing information on an Intranet for the students", "use more interactive and problem-based teaching strategies" and "electronic information for students going by bus to the university". This set of responses would yield three points for fluency (there are three responses), and two for flexibility (one for the category of IT and one for the category of improving the teaching). Finally, it would yield a rather low score for originality (Intranet for students and improving teaching are commonplace, only the electronic information for students using the regular bus service to the university appears novel). A high score on the four dimensions suggested by Guilford indicates an ability to think divergently and is essential for the production of ideas (Baer, 1993).

The dimensions that provide and characterize the capability for divergent production have been developed further by Torrance (1965).

The creative process

The scientific concept of incubation pertains to the unconscious and involuntary mental activity that takes place during an act of complex problem-solving. The concept can be traced back to Wallas in 1926, who outlined a model for creative thought. Considering that Wallas presented his model nearly three-quarters of a century ago, it is astonishing that the different stages of his model are still, by researchers in the field, being described in his terms (Koski-Jännes, 1995; Norlander, 1997) or regarded as consistent with more recent models (Runco, 1994).

In Wallas's (1926) work, the creative process is viewed as a sequential process. He describes the background to his work as follows: *"… take a single achievement of*

thought – the making of a new generalization or invention, or the poetical expression of a new idea – and ask how it was brought about. We can then roughly dissect out a continuous process, with a beginning and a middle and an end of its own." (p. 79). Wallas's model of the creative process contains four phases: preparation, incubation, illumination and verification.

The first stage of the creative process thus involves preparation. The preparation phase contains, as interpreted by Guilford (1971), the motivation and energy to overcome obstacles and problems, in order to start assembling information and achieving competence. It seems reasonable that the more intensively one prepares to solve a problem; the better the chances become of achieving good results. According to Amabile (1996), convergent thinking is an important ingredient during this phase. The next step involves incubation. As previously mentioned, incubation occurs in forms that are to a certain extent unconscious. During the incubation phase, the individual does not focus on any specific problems. Instead, Wallas (1926) describes this phase as a maturing one where the individual dwells, simmers and ripens with regard to a series of different unconscious and involuntary mental activities. According to Wallas, the individual can pursue completely different activities, other than the present ones, during incubation. Thus, the incubation phase does not imply any explicit thought efforts, although appearing to be the engine of the creative thought process. During the third phase, that of illumination, the result of the incubations occurs in the form of an "instantaneous flash" (p. 95). Thus, Wallas illustrates illumination by describing it using the well-known metaphor of creativity – the sudden flash, or click – as the culmination of a successful train of thought associations. In conclusion then, when the unconscious processes during incubation have matured, solutions emerge during the illumination phase. The final phase, verification, resembles the first one, preparation, inasmuch as they are both fully conscious and operations occur in accordance with logical, i.e. convergent, thinking (Amabile, 1996). The verification phase implies that there should be a creative solution that is tested and elaborated in some way (Guilford, 1971).

Patrick (1935, 1937 and 1938) offers a systematic attempt to confirm Wallas's proposals regarding distinct and definable stages during the creative process. Through asking people involved in creative writing, drawing, and scientific problem-solving to describe their thoughts during work, she observed the creative process as directly as possible. Her notions thus represent a landmark attempt to carry out psychological experiments on the creative process (Rothenberg & Hausman, 1976). In an elegant manner, the scientific work of Patrick makes it possible to investigate the creative process in individuals and/or groups. According to Patrick (e.g. 1938), the preparation phase is indicated by assertions and thought changes. In her operationalization of the creative process, an assertion is indicated by a statement like: "this is a difficult task", or: "we seem to be trapped here". A thought change is operationalized as the initial addressing of an idea: "the idea of providing students with electronic information about buses to the university is really one way of attacking the problem." Incubations are indicated when the person(s) returns to a previously presented idea with varying degrees of modification. In order to count as an incubation, the idea must have recurred in some way; this means that the subject(s) has been discussing another topic,

or been silent, prior to the recurrence of the idea. An example of this could be a statement like: "I'd like to add, to my previous idea of implementing information, electronic signboards in the center..." When a final plan has been formulated, this is an indication of the third phase of Wallas, illumination. The formulation of the plan should be distinct, separating it from incubations (Norlander & Gustafson, 1996). The seminal work of Patrick has later been validated by, for example, Norlander (cf. 1997; Norlander & Gustafson, 1996; Norlander, 1999) and her approach is also used in the present investigation.

Research into the creative process is by far the least common strategy for assessing and investigating creativity (Dodds, Smith & Ward, 2002; King & Anderson, 1995; Kay, 1994; Nemiro, 2002). However, one area given great attention within creativity is idea elicitation techniques. Basically, these techniques deal with teaching people how to think in a divergent manner. One of the first in this respect was Osborn, an advertising consultant, who developed the technique of brainstorming based on his experiences, (1957). The brainstorming technique has subsequently been subjected to careful scientific investigation (e.g. Richards, 1999). Developing management tools that serve as a wonder medicine for deriving great ideas has entailed considerable commercial success. Perhaps one of the foremost proponents of this approach is de Bono, with his techniques like "PMI" and "six thinking hats" (e.g. 1992). One problem with this approach is that the people developing these techniques (i.e. de Bono) have primarily been concerned with facilitating creative processes but only to a smaller extent with understanding it, and almost not at all with testing the validity of their ideas concerning it (Sternberg & Lubart, 1999).

The creative place

The creative place refers to the relationship between individuals and their environments. This avenue of creativity research involves the study of social climates conducive or inhibitive to the manifestation of creative thought, differences in perception and sensory inputs from varying environments, and the various reactions to certain types of situations (Isaksen, 1987). Thus, the environment and the forces it brings to bear on the individual are in focus (Rhodes, 1961).

The emphasis of this research has been to identify the factors, in certain groups and in organizations, which enhance or stifle creative performance. Even though groups and organizations do have significant creative potential, environmental factors may hinder them from attaining this. For example, groups and organizations are often shaped in such a way that a similarity of values and interest or purposes is achieved (Paulus, 1999). Individuals whose words or deeds conflict with the general group consensus are likely to elicit negative reactions from other groups members, who may try to move the deviant member back into the group mainstream. Such behavior will, however, risk inhibiting the communication and elaboration of ideas and may thus be considered negative with regard to creativity flourishing. On the contrary, if communication is supported, utterances by other members in an organization or group may contain task-related stimuli so that cognitive stimulation leads to the elicitation of new ideas (Pinsonneault et al., 1999).

One area of research that is given great attention and that may be sorted within the creative place is the intrinsic motivation hypothesis of Amabile (1996; Plucker & Renzulli, 1999). In her componential model for creativity, Amabile outlines a theoretical framework that emphasizes how intrinsic motivation affects creativity in a positive way. Although 'intrinsic motivation' may lead one's thoughts toward the creative person, it is emphasized that the social environment is in focus and exerts an influence. The common characteristic of systems approaches, like Amabile's, is the emphasis on the environment in which creativity occurs (Plucker & Rentzulli, 1999). The social environment primarily affects the degree of intrinsic and extrinsic motivation and may also influence other important components of creativity. The intrinsic motivation hypothesis states, more specifically, that the intrinsically motivated state will be conducive to creativity, whereas the extrinsically motivated state will be detrimental. Although her model focuses on how social-psychological aspects affect task motivation, she integrates research from the creative process and the creative product into her componential model. The creative product constitutes the focus of interest of Amabile's research seeing that the outcome is always what is sought after, irrespective of whether the creativity environment or the creative person are being studied.

A proposed reorganization of the conceptualization of creativity research

A creative idea is, by necessity, complex (Mumford & Gustafson, 1988). It is influenced by a host of variables, ranging from divergent thinking abilities and general mental processes like memory and perception to personality, perceived rewards, group processes and environmental conditions. A scientific approach towards understanding the origins of a novel and valuable idea thus demands the interaction of theoretical standpoints. For example, one type of study that has utilized a mix of theories, involves computer-mediated communication as a means of problem-solving. Within this area of research, theories from three of the Ps may be applied with the purpose of understanding how the product P is generated. Communicating electronically provides new conditions for creative performance since it represents a new setting (Place) which has not previously involved problem-solving. Research in this area has concentrated on identifying different kinds of processes that occur as a reaction to the new environment (e.g. Connolly, Jessup & Valacich, 1990; Pinsonneault et al., 1999). To examine how these creative processes are influenced, a common procedure is applied regarding the measurement of individuals' capability for divergent production. Studies like these are typified by their motivation being couched in terms of improving the innovative capacity of organizations, which implicates the focus on the creative product. To conclude then, it appears as though one measures productivity in order to capture processes, in new places, in order to understand how the generation of new and valuable products may be facilitated or obstructed.

From the above observation, it is clear that, despite the the 4 P model of creativity appearing to be elegant and comprehensive, certain questions regarding how creativity should be conceptualized may be put forward based on a perusal of the research. One reflection is that the 4 P model appears to have served as an *ad hoc* sorting mechanism of research carried out rather than being a navigational compass for

directing ongoing research. If functioning in accordance with the notions of Rhodes (1961) (see also Mooney, 1963), research ought probably to have been more systematically directed. Even if Rhodes (1961), and later Isaksen (1987) and Richards (1999), indicates that the four Ps are interwoven and overlapping, it ought to be possible to distinguish each area's unique identity since the purpose was to provide a frame of reference for the study of creativity. This is not the case currently since it is difficult to differentiate between the different Ps. For example, divergent production may be given interchangeably as a dimension of a creative product (e.g. Finke, Ward & Smith, 1992; Connolly et al., 1990) as well as a dimension of the creative person (Amabile, 1996; King & Anderson, 1995). To illustrate this, with regard to the evaluation of creative <u>products,</u> Finke et al (1992) state: *"one can also measure the productivity of creative ideas, in terms of the number of ideas generated"* (p. 39) while Amabile (1996) concludes that: *"four criterion components of creativity (derived mainly from Guilford's theory): (1) fluency..."* (p. 24) have guided the research within the creative <u>person</u>.

In the case of the product and the person, this is not necessarily a problematic intermix since both entities are quite intimately connected with each other and may partly overlap. After all, divergent production leads to creative products, and, in several studies, one is provided with significant relationships between fluency and originality as arguments for this intimate connection (e.g. Paulus, 2000; Rickards, 1999). However, it becomes somewhat more diffuse when divergent production is also accounted for in terms of the creative process, as in Plucker & Rentzulli (1999): *"Fluency [...] is a key component of creative <u>processes</u>"* (p. 39, underlining added). Nevertheless, their arguments appear solid as they claim that creative thinking differs from convergent thinking in terms of its (differing) cognitive processes. To sum up, the situation that it is fairly easy to argue for the inclusion of a certain theory into three of the four Ps appears unorthodox. In no single case does this pose a problem, but from a global perspective it is relatively diffuse. The four Ps do not appear, from this perspective, to provide creativity research with a sufficiently stable structure.

At the same time, a further problem resulting from the above, concerns the situation that one P today appears to be overriding the others. The study of creative products appears to be a pattern, even when studying the creative person, the creative process and the creative place. This is distinct, for example in Amabile's (1996) research into how environments (i.e. Place) influence the individuals' creativity. The product (i.e. output in the form of an idea that is novel and useful) is then used as the dependent variable. Even in studies of creative processes, product definitions have been employed (e.g. Amabile, 1996; Getzels & Csikszentmihalyi, 1976) and the same arguments are also postulated in studies of the creative person (e.g. Amabile, 1996; Hocevar & Bachelor, 1989). One important reason why the creative product seems to have achieved a more central role than the other Ps may be due to notions similar to those presented by MacKinnon (1978): *"In a very real sense... the study of creative products is the basis upon which all research on creativity rests and, until this foundation is more solidly built than it is at present, all creativity research will leave something to be desired"* (p. 187).

As MacKinnon implies, the rules and structure that a conceptual framework can offer creativity research may ultimately be provided by a product definition based on novelty and usefulness (or its synonymous concepts as given in Table 1). For example, already in 1953 Stein concluded that creativity is "that process which results in a novel work that is accepted as tenable or useful or satisfying…" (cited in Amabile, 1996, pp 37-38), confirming that creative processes are the ones that result in creative products. Similarly, creative people are the ones who bring creative products into existence. The creative place, is one which fosters and makes creative products possible. This summing up, inspired by MacKinnon (1978), conveys a frame of reference that promotes the creative product as the central *gestalt* of creativity studies. To continue, if one investigated which people made up the most creative popular music writers of the last century, one would have to investigate not *only* the personality traits that the different musicians possess, but also their songs – i.e. their products. The creative product always seems to be an element of creativity studies that is important to consider. Thus, there is reciprocity between the Ps and the Product P appears to take a central position.

Inferring from this discussion, instead of conceptualizing creativity research in terms of a prism (as Rhodes suggested), a more viewable definition of the study of creativity emerges from the cited literature (see Figure 2).
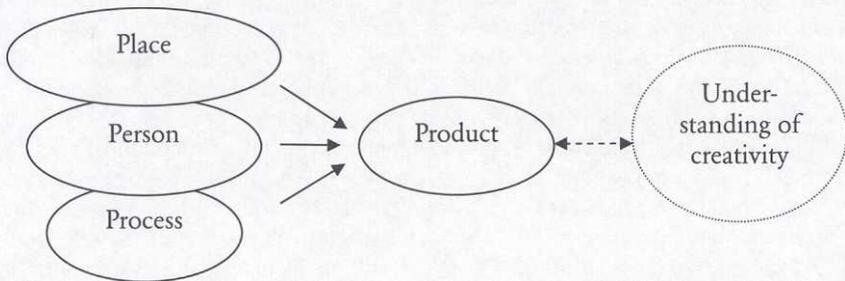
Figure 2. A proposed reorganization of the conceptualization of the 4 P model.

This figure seems to provide a better fit with the development of creativity research since it offers an illustration of how Process, Place and Person lead to a Product. The figure aims to illustrate the research field in accordance with earlier descriptions. Process, person and place may be described as influencing variables to the extent that they include research into what leads to a creative product. Place is the study of environment and climate factors, often at the organizational and group level. Person is located under place since people remain in and are affected by environments. Lowest is process, which in turn ought to be a characteristic of person. Finally, these three variables are related to each other and jointly to the creative product. If one wants to study the creative product, this may be done directly by studying the dimensions of the creative product or indirectly by applying one of the theories in the other

Ps affecting how creative products will be construed in the future. One can see each of the first three variables in the light of, or together with, product, with whose help we may today understand creativity and creative performance.

A last comment on the structure suggested above is that it brings opportunities, on the conceptual level, to design studies wherein the different measures of the different Ps fulfill validatory functions in creativity studies. For example, measurements of the creative process may be employed with measurements of divergent production (the creative person) with the purpose of understanding the possibilities and limitations of obtaining future creative products. Despite its reinforcing nature for convergent validity in creativity research, this step is uncommon.

The scientific study of creativity

The scientific study of creativity has historically hinged upon, on the one hand, creativity tests that measures the personality characteristics associated with creative and inventive behavior, and on the other hand, expert methods of assessment that measure the creativity in products and processes (Plucker & Renzulli, 1999). A significant difference between these two approaches lies in the former methodology having been dominant in studies of the creative person and the creative place, while the latter is applied when focusing on the creative product and the creative process. Amabile's (1996) consensual assessment technique is an example of a methodological technique aimed at measuring the creativity in products. The consensual technique is applied in the present thesis and further described below. Subsequent to this, an overview of the methodological approach of the present investigation is given.

Measuring creativity – the consensual assessment technique

Although Rhodes's (1961) four facets of creativity may imply a possible way of understanding and classifying creativity research, it does not convey any implications on how to undertake a scientific study of it. Transforming the creative product, or the creative person, into dimensions and the creative process into its indicators, implies an important first step toward operationalization. However, just how the operationalized product and process will yield measurable results has not yet been answered.

Amabile (1996) has presented a solution to this, i.e. the consensual assessment technique (CAT). The CAT is a technique whereby expert judges assess and measure the merit of a creative performance. The rationale of the CAT is that two or more persons, with presumed expertise within a given domain, are to judge the creative value and merit of a certain contribution. Judges should make their assessments on their own, independently of each other. Afterwards the judges' assessments are compared; if there is consensus regarding the creative merit of a product, the judges' estimations would then appear to be a reliable and valid verdict, this assumption being based on the fact that the judges were experts within the specific domain.

Amabile's (1996) definition derives from social-psychologically oriented research where she has empirically investigated how different work environments affect

and correlate with creative performance. There are several procedural requirements for using the CAT (Amabile, 1996; Hennessey & Amabile, 1999):

- Judges should have experience of the domain in question.
- Judges should make their assessments independently.
- Judges should rate the products in relation to each other (rather than against an absolute standard).
- Judges should assess the products in a different random order (so that high levels of agreement do not reflect methodological artifacts).

The CAT, then, is highly dependent on the premise that the judges assess the product in concordance with each other. Amabile (1996) describes the essence of her technique thus: *"The essence of the consensual definition is that experts in a domain can recognize creativity when they see it, and that they can agree with one another in this assessment. If experts say (reliably) that something is highly creative, we must accept it as such. The integrity of the assessment technique depends on agreement being achieved without attempts by the experimenter to assert particular criteria or attempts by the judges to influence each other. Thus, the judges should not be trained by the experimenter to agree with one another, they should not be given specific criteria for judging creativity, and they should not have the opportunity to confer while making their assessments"* (p. 42).

Using expert judges to analyze the merits of creative outcome is now recognized as by far the most common method of conducting creativity research (Plucker & Renzulli, 1999). When relying on expert ratings, researchers occasionally provide judges with rating categories, not unlike those mentioned in Table 1. These categories serve as guides for the judges as they evaluate creative products (Plucker & Renzulli, 1999). Norlander (1997; 1999) employed this procedure when he investigating the effects of alcohol on creativity (cf. Norlander & Gustafson, 1996). In contrast to this, other researchers have used experts to rate the creativity of products providing them with little or no additional information. Amabile's consensual definition advocates, as is explicit in the citation above, no specific criteria being provided. By using an amorphous definition, it is assumed that experts know creativity when they see it. In the present investigation, the CAT is jointly applied with the procedure described by Plucker and Renzulli (1999). The dimensions of the creative product and the stages of the creative process have served as rating categories.

In the present investigation, Amabile's consensual assessment technique has been used by means of expert judges assessing, independently of each other, creativity on a scale of 1 to 10. More specifically, judges have been asked to rate a dimension or indicator in the creative product, process or person. In terms of the creative product, this means that the judges have maintained a direction in their judgments through having been instructed to rate the ideas from, for example, the originality point of view. Dimensions of the creative product or the creative person, or indicators of the process, have been used as the guiding principle (see Plucker & Renzulli, 1999). Furthermore, in the judging procedure used in the present investigation, the judges rate all the products in relation to each other and are told to rate at least one

product at each step, with the best idea being given the highest score. During rating, all products are rendered unidentifiable and shuffled into a randomized order. None of the judges were employed to judge more than one dimension, in order to avoid methodological artifacts. After the ratings had been carried out, a Pearson product-moment correlation, or similar statistical computation, is conducted in order to assess interjudge reliability.

Regarding interjudge reliability, an interesting discussion concerns whether or not to exclude the subsequent analysis of data if there is a low level of agreement between one or more pairs of judges. Clearly, as evident from previous discussions, creativity is a concept that is difficult to define, and, as a consequence, may be even more difficult to measure (Hennessey & Amabile, 1999). However, whether to exclude data from further analysis or not is a question that does not enjoy a precise answer. For example, there are 'shifting' directions for which correlation indices that may be considered acceptable or not Hennessey and Amabile provide recommendations between 0.6 and 0.7)[3] and in an experimental study examining consensus and accuracy in judgment, Blackman and Funder (1998) describe notably lower correlations as sufficient. One difficulty in making recommendations regarding correlational values originates from the situation that different types of statistical analyses are employed which do not necessarily express the same comparative outcome. Further, different researchers provide, to greater or lesser degrees, different types of information, which influences the agreement (Plucker & Rentzulli, 1999). Additionally, different numbers of judges are used in different studies, which in turn entails consequences for the statistical analysis. For example, the value computed in Cronbach's alpha grows bigger as a function of the number of judges. Thus, by increasing the number of judges, one obtains higher alpha values even if the actual interrater agreement remains constant (see Cronbach, 1955).

Given the difficulties of finding directives about acceptable levels of consensus, it appears adequate to consider what high and low consensus levels may depend upon. Previous research reveals some studies that explain how congruity between judges arises. For example, Christiaans (2002) found that the level of agreement between judges was explained by the level of heterogeneity between them. Thus, pairs of judges who share the same cultural background and learning experiences are likely to produce similar assessments. In line with this, Blackman and Funder (1998) describe empirical support for the position that consensus and accuracy are dependent upon how long a period the judges have at their disposal to make judgements. When given more time, judges are more able to digest the material and unite their notions, thus becoming more homogenous. Amabile (1996; Hennessey & Amabile, 1999) have also shed light on this subject. Her emphasis on 'expert knowledge within the given domain' implies that the amount of information that judges have acquired is related to accuracy of assessment in a positive way. Being an expert ought to mean that one bestrides knowledge of an amount of information allowing the experts, independently of each other, to reach similar judgments (i.e. consensus will be achieved).

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[3] Amabile, T & Moneta, G, personal communication, April 23, 2002.

One interesting question that Amabile does not touch upon concerns the situation that experts might differ in their perceptions of what is conceived as valuable vis-à-vis non-experts (i.e. ordinary people). Value is an important dimension of the creative product and a conceptualization of creativity that Amabile uses. This distinction is important in the context of product development as the experts may not be recipients of the future innovation which creative production can lead to. The expert's method of thinking is probably more similar to that of the people producing the creative product, than the people who are to be the recipients of it. It therefore seems more logical that the people who are the recipients (i.e. non-experts in terms of real users) should best be able to decide the utility factor. From the innovation perspective, a risk of relying on a consensus decision made by experts thus occurs, supporting the position that even non-experts should contribute to judging, at least in the value dimension. This risk should not be a problem if the creative product is an artwork, but only if one refers to judgments about creative products from the perspective of innovation and their future sales potential in the marketplace.

The experimental method and the input-process-output paradigm

Osborn (1957), recognized as the father of group brainstorming, has illustrated the all-importance of creativity in a simple taxonomy of human mental capacities (p. 1):

1. *Absorptive* – the ability to observe, and to apply attention.
2. *Retentive* – the ability to memorize and to recall
3. *Reasoning* – the ability to analyze and to judge
4. *Creative* – the ability to visualize, to foresee, and to generate ideas.

As illustrated by Osborn's taxonomy (1957), creativity is among the most complex of human behaviors. It seems to be influenced by a wide array of social, environmental and cognitive processes, and it manifests itself in a variety of domains (Mumford & Gustafson, 1988). Theories of creativity have, as previously stated, recognized the complexity inherent in creativity as a multifaceted concept. Indeed, the many nuances of creativity entail consequences for its scientific study.

The complex nature of creativity suggests that meaningful research must take multiple influences and diverse forms into account (Runco & Sakamoto, 1999). Experimental research into creativity is useful for precisely this reason. Experimental methods utilize various controls to reduce complexity to a manageable level. By manipulating one or more independent variables, controlling and thereby minimizing the effects of confounding or nuisance variables, experimental methods can detect and measure changes in the dependent variable (Runco & Sakamoto, 1999). While the manipulated and controlled independent variable concerns the social, environmental and cognitive influences, the dependent variable is constituted by the creativity in focus.

In the present investigation, an experimental approach is taken which studies the effects on creativity of several independent variables. The independent variables

are extracted from research within the field of innovation. The approach is consistent with the input-process-output paradigm (e.g. Connolly et al., 1990; McGrath, 1984; Pinsonneault et al., 1999; Taggar, 2001). The input is the composition of the group or the environmental situation that individuals perform within, the process is conditioned by the creativity-stifling and creativity-enhancing forces that are present, and the output in question is the creative performance of the group. Employing such a methodological framework makes it possible to predict, evaluate and design experiments examining the effects of environmental situations or group compositions on creativity. Figure 3 graphically illustrates the methodological approach undertaken during the experiments.

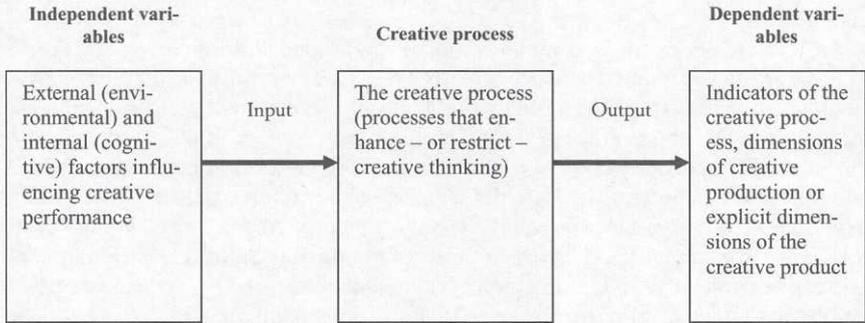| Independent variables		Creative process		Dependent variables
External (environmental) and internal (cognitive) factors influencing creative performance	Input	The creative process (processes that enhance – or restrict – creative thinking)	Output	Indicators of the creative process, dimensions of creative production or explicit dimensions of the creative product

Figure 3. Outline of the input-process-output model applied to the four experimental studies in the present thesis.

While the choice of experimental design carries with it increased possibilities for control, it also means reduced possibilities with regard to generalization. The trade-off between external and internal validity is inevitable and an important consideration in psychological research (Cook & Campbell, 1979). In this dissertation, the choice of the experimental method accompanies a prioritization of internal validity taken from the above-described reasoning that creativity is influenced by a "host of variables" (Mumford & Gustafson, 1988). Further, since the main purpose is to study the causality between two or more variables, the priority of internal validity is reasonable. While this is confirmed by Cook and Campbell (1979), who state that "the priority ordering for many applied researchers is first internal validity, [then] external validity, construct validity…" (p. 83), there is a need to reflect over how this 'trade-off' influences the external validity. One such aspect that contributes to the reduction of external validity concerns the motivation of the participants in the studies. Amabile (1996) has shown the importance of intrinsic motivation for creative performance which is dependent on variables in the environment. Neither the laboratory environment nor the controlled field-setting can, with certainty, offer the intrinsically motivation that Amabile found to be critical for creative performance. This implies that generalizations regarding other situations and populations, and 'reality', must be made

with care. From an internal validity viewpoint, it does not appear as problematic since it is reasonable to assume (in a true experiment) that different levels of motivation are randomly distributed between participants.

Summary

Previous theory and research dealing with creativity has been reviewed. The starting point for any theoretical foundation of creativity is provided by Guilford (1950). Guilford (1967b) introduced divergent thinking as a distinct element of creativity. Although researchers have had considerable difficulty agreeing on a definition, it is now widely acknowledged that creativity involves the evolution of a new and valuable idea.

Creativity research is commonly organized around the framework of the four "Ps". According to this framework, creativity can be viewed as a product, process, person or place. Creativity as a product involves understanding the features of a creative output, whether in terms of a tangible product or an intangible concept, in the light of its distinguishing qualities. Besemer and O'Quin (1987) have, by developing a judging instrument, extracted the dimensions of the creative product. According to them, the creative product is marked by originality and value. Among others, MacKinnon has emphasized the importance of the dimension of realization in allowing creativity to evolve into innovation. The mental abilities marking creative production within the person concern fluency, flexibility, originality and elaboration, as postulated by Guilford (1967b). The process of creativity is described sequentially as consisting of preparation, incubation, illumination and verification (Wallas, 1926). Patrick (1935, 1937 and 1938) has contributed an operationalized model for Wallas's (1926) creative process. The creative place concerns research into how environmental factors facilitate or restrict creativity and creative performance. In order to examine creativity, for example from the point of view of innovation, the creative place, person and process need to be considered in the light of their reciprocal influences on the creative product.

According to psychological, business and management-oriented research (Clark & Wheelright, 1994; Rogers, 1995; Sternberg & Lubart, 1999), creativity represents the first part, the starting-point, of innovation. Norlander (1997) claims that it is the creative problem-solving that undergoes application and evolves into innovation. In line with this, Amabile (1996) states that creativity is the seed of innovation. The ability to create a stream of valuable new products represents competitive advantage for enterprising companies. As breakthrough innovations involve unexpected leaps in creative performance and insight, the study of creativity appears to be a necessity, if the aim is to contribute to product and service development. In order to understand how such valuable creative ideas are evolved, studies of mental abilities and processes are required. Such examination should be carried out in the close-up of a situation where interaction and communication are apparent. Communication and interaction, with customers as well as members of the company, are important strategies for innovative enterprise since they are likely to increase the knowledge of the important

needs that will serve the purpose of creating value for the user. Therefore, studies of how information and communication technology, and user involvement, affect creativity appear to be justified Such studies need to take advantage of research into the creative process, person and place in order to receive a full understanding of the creative product.

Amabile (1996) has launched a technique that makes it possible to undertake studies of the creative product, even though the actual investigation pertains to studies of the social environment, for example. Her consensual assessment technique (CAT) makes it possible to assess and measure the creative performance of a group or an individual. This assessment technique involves the presence of expert judges who independently assess the creative merit of a certain contribution.

The complex nature of creativity suggests that meaningful research must take multiple influences and diverse forms of expression into account (Runco & Sakamoto, 1999). Experimental research into creativity is useful for precisely this reason. Experimental methods utilize various controls to reduce complexity to a manageable level. By manipulating one or more independent variables, the effect of confounding or nuisance variables is minimized and changes in the dependent variable may be interpreted as a result of treatment (Runco & Sakamoto, 1999). While the manipulated and controlled independent variable concerns social, environmental and cognitive influences, the dependent variable is constituted by the creativity performance brought into focus.

In the next section, the aims and problems of the empirical studies will be outlined and a summary of each of the four empirical studies underpinning the present thesis will be given. Finally, the conclusions and some managerial implications will be suggested.

The present investigation

Brown and Eisenhardt (1995) have reviewed and critically examined research into product development over recent decades. They identify three areas, referred to as 'streams', as the vital future research directions needed in order to gain knowledge of how to manage new product development. The three streams deal with questions such as (1) how to develop a unique product, (2) how external and internal communication may embellish the development process and (3) how disciplined problem-solving may be facilitated.

The first stream focuses on product development as a 'rational plan' and involves research into a broad range of determinants that may influence the future market success of a product. The research emphasizes that successful product development is principally the result of a product that delivers unique benefits (thereby differentiating it from other competitive offerings) to a user. The intrinsic value of a product, which includes the core benefits to users, high quality and innovative features, has proved to be a critical success factor suggested by several researchers (e.g. Brown & Eisenhardt, 1995; Cooper & Kleinschmidt, 1987 and 1993; Montoya-Weiss and Calantone, 1995; Griffin & Page, 1996). These conclusions are further supported in a recent meta-analysis of the determinants of new product success carried out by Henard and Szymanski (2001). Although the research done within this stream has been quite successful in indicating the important determinants of success, it also shows a lack of well-defined constructs and methodologies that permit casual inference. According to Brown and Eisenhardt (1995): "*the research results are likely to suffer from a host of attributional and other biases, memory lapses, and myopia, which are associated with subjective, retrospective sense-making tasks*" (p. 353). The conclusion is that the next step of research should provide a deeper understanding of what constitutes a 'better' product and how the effective execution of developing such a product is accomplished and understood (Brown & Eisenhardt, 1995). In line with this account, Henard and Szymanski (2001), calling for directions for future research, state that *"few attempts have been made to model how firms generate ideas for new products"* and that a response toward these deficiencies would provide managers and academic researcher with valuable insights (p. 374). Furthermore, regarding future research approaches, a more solid methodology should be employed. For example, using an experimental design, casual inference regarding the underlying processes that yield innovation should be permissible. Such an approach would avoid repeating the same mistakes that Brown and Eisenhardt have reported.

The second stream emphasizes that communication between project team members and users[4] will stimulate the performance of development teams (Brown & Eisenhardt, 1995). More specifically, communication is important for the ability to develop high-quality 'customer offerings'. As stated in the introduction to this treatise, products, whether goods, articles or services, are increasingly being viewed as cus-

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[4] By *user*, customer is usually implied, but not always. In this treatise, no emphasis has been placed on dealing with the distinction between these two closely-linked concepts.

tomer offerings. In order for customer offerings to evolve, a number of value-creating activities must be performed in the interaction between the user (customer) and the service provider (service company) (Grönroos, 2000). Thus, interaction, which involves communication, between the user and the company, or between members of the company, is important in order for a company to understand which offerings to create. The better the connections between the members of a team and the potential users, the better the information they will be relying on, and the more successful the development process will be presumed to be. Therefore, studies in this stream highlight the importance of external and internal communication. Since problem-solving largely depends on the possibility of combining different sets of knowledge, which may often be distributed multidirectionally within the organization, the development of mechanisms for communication across different interfaces is critical to innovation success (Tidd, Bessant & Pavitt, 2001). In consequence, situations where people have to communicate and interact, in order to obtain information, are today increasingly being mediated electronically using computers (e.g. Kraemer & King, 1988; Nunamaker, Dennis, Valacich, Vogel & George, 1991; Walthers, 1996). For example, information and communication technology may play an important role when a company attempts to connect information from customers with information about financial opportunities, technological requirements and the strategy of senior management.

Although Brown and Eisenhardt (1995) do not state this, there are important links between the first and second stream. For example, research into how different forms of communication and interaction with external sources (i.e. users) affect the performance of the early phases of new product development, provides both the first and second streams with knowledge. Consequently, in terms of this study, it is hypothesized that investigating how different forms of user interaction affects creativity will serve the purpose of providing knowledge into both the first and second research stream. Thus, in the following studies, how communication and interaction affects the ability among users to come up with novel and valuable ideas emerges as a central theme in order to bring impetus to innovation efforts within service oriented companies.

The situation that user interaction affects the quality of a potential, but undeveloped, product has been discussed in previous research. In the large-scale generalist study of new product development, SAPPHO, Rothwell, Freeman, Horlsey, Jervis, Robertson and Townsend (1974) came to the following conclusion:

> User needs must be precisely determined and met, and it is important that these needs are monitored throughout the course of the innovation since they very rarely remain completely static. Many successful firms achieve this *deep and imaginative understanding of user needs through interaction with a representative sample of potential customers* (p. 289, italics added).

In a more recent study, Gruner and Homburg (2000) report both theoretical and empirical justification of the management of information exchange and cooperation between suppliers/providers and users. According to them, customer interaction, during the early and late stages of the new product development process, will increase

the likelihood of success for a new product. The same contention is made in a study by Alam (2002). Alam states that a firm must acquire an in-depth understanding of user needs, which requires collaboration with users during the development process. Seminal studies by von Hippel have found that users may very well play a dominant role, if given the opportunity, in several industrial product development projects (1978). In addition, von Hippel has been innovative in proposing techniques that can be used to obtain user input into product development projects (e.g. 2001). Thus, user interaction, whether it be in terms of communication or active involvement, seems to provide the firm with important knowledge about how it may create value for potential users by developing a new product.

It should be noted, however, that other researchers have suggested that user interaction may be detrimental to new product success (e.g. Christensen, 1997). These conclusions are based on findings suggesting that users are incapable of communicating innovative ideas. According to these researchers, innovations that meet customer needs stem from the strenuous work done in a company's R&D department (i.e. a technology push strategy). Apparently, listening to the voice of the customer is not so much of a clear-cut question as it would seem. To make it even more confusing, Cooper (1999) asserts that, despite 25 years of research into why new products fail, product developers have not yet learned their lesson and continue to make the same mistakes. One important mistake is that the voice of the customer is too seldom taken into account. Clearly, this dispute provokes the question of whether users are capable of contributing ideas that can be used in the development of successful products.

In a recent article, Alam and Perry (2002) show empirical data that confirms idea generation as the most important stage of a new service development process. Thus, if users were capable of providing input, this input would have its greatest impact during the early, introductory, phases of product development. At this stage, then, users should provide companies with ideas regarding the future products that they want to use. Such a product would be likely, if developed and launched, to solve a problem considered important by the user.

Thus, an important reason to study how user interaction, in terms of the different modes of communication and involvement, affects creativity concerns the importance of deriving high quality, in the eyes of the user, ideas in new product development. More precisely, two questions emerge as central as regards how user interaction affects creativity. The first concerns how different modes of communication affect creative performance *while* the second concerns whether or not users are capable of coming up with creative ideas that can readily be turned into innovations. As may be seen, these two questions touch upon the first and second research streams identified by Brown and Eisenhardt (1995) as important areas of future research.

Four studies of user interaction

In the present investigation, four experimental studies of creativity were carried out. The studies aimed to provide further understanding and knowledge where previous research into product development was identified as being inconclusive or methodologically weak. The psychology of creativity serves as a theoretical framework in

all of the studies. Viewed on the broader level, the four studies primarily focus on internal and external communication from the perspective of the early phases of innovation.

Derived from the foregoing discussion, the following model may conceptualize the research undertaken.
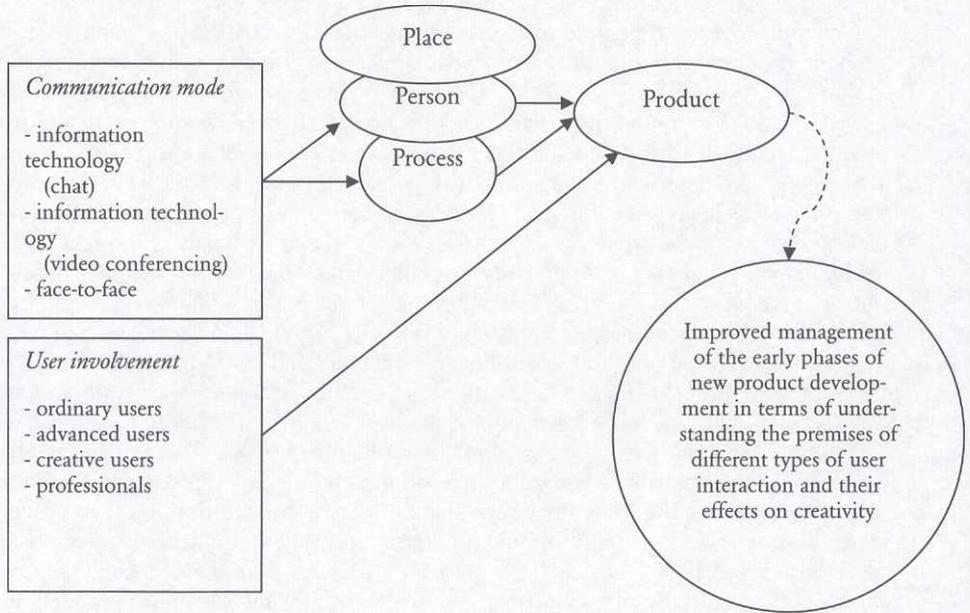
Figure 4. Conceptual framework of the dissertation.

The aim of the present thesis, thus, was to create an understanding of how external and internal communication may affect innovation in terms of facilitating or stifling problem-solving and the development of creative products (within the 'rational plan' approach). As implied by Figure 4, the four studies pursued the aim of providing knowledge pertinent to the previously identified areas of research within each stream. Such scientifically derived research is in turn assumed to entail the improved management of product development. In the present thesis, two independent variables are studied. The first set of independent variables is directed towards internal and/or external communication. The second set of independent variables is directed toward external communication, and has implications for the understanding of how users may initiate innovation by providing creative input. The first independent variable concerns the usage of information technology in order to enhance and facilitate communication and information-sharing. How computer-mediated communication can affect creativity is examined in Studies I and II. The second independent

variable concerns external communication in terms of customer involvement. How customer involvement can yield unique ideas for future products and which qualities mark a creative product are examined in Studies III and IV. Below, additional background information regarding the two independent variables is presented.

Study I and Study II

In order to reduce uncertainty and ambiguity, and meet customer needs, both of which are considered to be major obstacles to innovation, organizations need to process information (Daft & Lengel, 1986). Information is processed in order to coordinate diverse activities and to interpret the external environment. One distinguishing feature of information processing is communication (Zhang & Doll, 2001). Today, information technology is proliferating as a means of facilitating communication and thus enhancing the processes that may lead to product development success. A Group Communication Support System (GCSS) may play an important role when a company attempts to connect information from customers with information about financial opportunities, technological requirements and the strategy of senior management (Nunamaker, Dennis, Valacich & George, 1991; Cairncross, 1998). A GCSS is a form of technology whose functionality provides or modifies intra-group communication (Hollingshead, 2001). A GCSS may ease the cognitive load of a team working in concert toward a mutual goal. It is designed to provide an arena for focusing and enhancing the communications, deliberations and decision-making of groups (Nunamaker, 1997). However, while information technology is diffused as a tool for facilitating what has been identified as important in product development – external and internal communication – inconclusive gains are made regarding how communicating electronically affects many aspects of work, with creative performance being one (e.g. Pinsonneault et al., 1999; Straus & McGrath, 1994, Straus, 1997). In the present investigation, Studies I and II are carried out to examine the effects of computer-mediated communication on the creative process and the creative product.

On the managerial level, Studies I and II shed light on situations where a company communicates internally with regard to a problem, and situations where a company communicates externally (i.e. with users) with regard to its needs, values, behavior, and how to meet these.

Study III and Study IV

In order to manage product development successfully, new products must accurately respond to user needs and requirements. Consequently, external communication with users is essential. User involvement, which implies external communication in its purest form, is being advanced as an important means of creating successful products. This type of external communication is important because it allows the exploitation of customer skills and knowledge. In particular, user involvement has been reported as being essential since, from the supplier's perspective, it has proven difficult to perceive 'user value' pertaining to a future product. Therefore, users receive suggestions to use their own competencies to develop ideas for new products that

anticipate the wants and needs of tomorrow. The difficulty of capturing need-related information motivates active user involvement for the purposes of finding unique product ideas during the product development process. However, as appealing as this managerial strategy may sound, no studies are known of which have undertaken to empirically examine whether or not the ideas of users are more creative (new and valuable) than the ideas of an R&D department of a company (Alam, 2002; Gruner & Homburg, 2000). Neither does there exist any underlying explanation of which cognitive processes account for the creative performance of users. As mentioned previously, since product uniqueness has shown itself to be an important success criterion for innovative enterprise, researchers have demanded theoretical explanations of how to create this and also of the determinants of the distinguishing elements of such a unique product (Brown and Eisenhardt, 1995, Henard & Szymanski, 2001; Cooper, 1995). In the present thesis, two studies are presented which examine the effects of external communication, in terms of user involvement, on the creative product.

On the managerial level, Studies III and IV shed light on if, why and how user involvement may be used as a management strategy in order to derive ideas for future products.

Summary of the empirical studies

In the present studies creativity has been studied in a way that may be illustrated by the logic of the previously presented 4P model of creativity. When studying how computer-mediated modes of communication (Studies I and II) affect creative performance, it has been considered important to understand how peoples' styles of thought, mental processes, are influenced in this environment. One way of approaching this is via the stages of the creative process, which is usually neglected in studies of this type (cf. Dodds, Smith and Ward, 2002). The study of the creative process gives information about how new ideas may be facilitated and limited during the different phases of idea development. Another approach is to study how individuals' divergent production, and thus indirectly the creative product, is influenced. In Studies I and II, divergent production is described in terms of the creative product. However, 'product' refers, in this case, to outcome in terms of cognitive processes which in turn foster the occurrence of creative products. In Studies I and II, the creative product was studied both by measuring the capability for divergent thinking among individuals and by measuring specific product dimensions. One important reason for choosing to study divergent thinking processes is that the environment (in this case computer-mediated communication and interaction) influences peoples' mental processes, entailing consequences for the creative product. In Studies I and II, and to a certain extent in Study IV as well, studies of indicators of the creative process, dimensions for divergent thinking, and dimensions for the creative product represent different levels of knowledge, all of which are aimed at increasing knowledge of creativity from an innovation perspective.

To summarize, in order to uncover the embryo of innovation in applied enterprises, external and internal forms of communication, in terms of user involvement

and communication mode, were used as independent variables to examine the effects on creativity. Four experiments were conducted and in each experiment participants were given the task of solving a problem that resembled a situation of life-like product development.

Study I: Kristensson, P., & Norlander, T. (In press). The creative product and the creative process in computer-mediated groups. *Journal of Creative Behavior.*

The quality of a new product or service is largely dependent on the creative performance of individuals working in groups. Today, information and knowledge from members of firms are synthesized with various customer needs by networking innovation teams that use information and communication technology to combine their efforts into new products.

Unfortunately, contrary to what one might expect, creativity research during recent decades has indicated that the creative efforts of groups are not always as successful as suggested or imagined (e.g. Diehl & Stroebe, 1987; Dugosh, Paulus, Roland & Yang, 2000; Stroebe & Diehl, 1994). Psychological processes such as evaluation apprehension, free riding and production blocking provide, to a certain extent, explanations for these discrepancies. Interestingly, research indicates that these weaknesses, termed process losses, might be transformed into process gains by the use of information technology, e.g. a Group Communication Support System (GCSS) (Hollingshead, 2001). A GCSS is a form of technology whose functionality provides or modifies intra-group communication (Hollingshead, 2001). Since the use of these information technologies is increasing in organizations today, advances need to be made concerning how communicating electronically affects various creative activities, for example brainstorming (e.g. Pinsonneault et al., 1999).

Previous research into computer-mediated communication has only focused on creativity in terms of quantity. Thus, important aspects of the creative product, e.g. originality, are commonly omitted. Furthermore, other aspects of creative performance, e.g. the creative process itself, are not, typically, considered. However, as communication is a process, it seems justified to deploy measurement of the creative process as well. Because empirical findings regarding how the creative process and product are influenced by a GCSS are weak, Study I addresses this issue. In doing so, the paper draws on the literature on creativity to find theoretical and operational concepts that can be used to assess the effects that computer-mediated communication might have on the creative performance of a small group.

Furthermore, in addition to the inconclusive findings regarding the effects of GCSSs, the question of how user beliefs – concerning the possibilities of using information technology as a means of communicating – may affect performance was addressed. According to research, there ought to be a relation between user beliefs concerning the potential of information technology and the level of success upon which these users manage them (Davis, 1989; 1993). The objective of this research

question was to examine the relationship between creative performance in groups and the perceived usefulness of information technology as a communication tool.

A 3 X 2 between groups design was used in Study I. The independent variables were, firstly, types of mediated communication where the conditions of two GCSSs were compared to each other and to a Face-to-face condition; secondly, the participant's positively or negatively perceived usefulness of an information technology support system as a means of communication (see Figure 5).

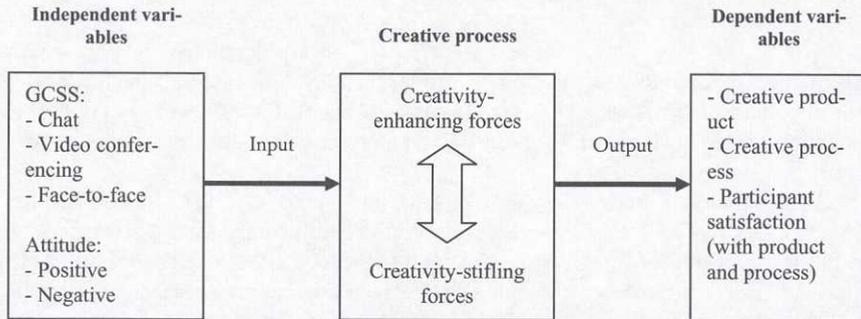| Independent variables		Creative process		Dependent variables
GCSS: - Chat - Video conferencing - Face-to-face Attitude: - Positive - Negative	Input →	Creativity-enhancing forces ⇕ Creativity-stifling forces	Output →	- Creative product - Creative process - Participant satisfaction (with product and process)

Figure 5. The input-process-output model employed in Study I.

The study was conducted at the Cyber/IT Research Laboratory situated just outside Karlstad University. One hundred and twenty-six men and women were randomly assigned to one of the three communication conditions. The participants were also evenly and randomly assigned to a group (consisting of three participants) with a positive or a negative attitude across these conditions.

The experimental session was composed of three phases consisting of two meetings, an original and final meeting, with a deliberation period in between (c.f. Norlander, 1997). On arrival at the laboratory for the original meeting, the participants were instructed to fill out a questionnaire concerning background information, a test measuring life orientation (Scheier & Carver, 1985). Each participant then received a complex problem to work with. All the participants had a 48-hour intermission between the original and final meetings. During this time, the participants were instructed to report notions of concern regarding the problem in a notebook. During this second phase, all participants worked individually. At the final meeting, the third phase, the participants were instructed to outline in detail a plan, considered optimum, to solve the problem given at the original meeting. Also, at the final meeting, data concerning participant-satisfaction was collected. The aim of the experimental procedure was to try to emulate a typical project sequence during product or service development. In order to make the experimental setting more realistic, all participants were informed that the three best ideas would be rewarded with a cash price of SEK 1,000.

Overall, the experiment produced three main results:
1. The Face-to-face group generally evoked more creative results indicating the importance of the interaction possibilities when there is a need to produce a lot of ideas. The more life-like the conditions were - the better the fluency of ideas was.
2. Regarding the creative process, the Video conferencing group experienced significantly less incubations than the other CMC group (i.e. the Chat group).
3. The participants of the Face-to-face group were more satisfied with their product and process than was the case in the computer-mediated groups.

The creative product, here in terms of the number of ideas, benefited from face-to-face communication; the other dimensions remained unaffected. The creative process was inhibited in the Video conferencing condition. The Media Richness Theory (Dennis, Kinney & Hung, 1999) was used to explain the results of the creative product as well as the subjective measurement of satisfaction. However, the Media Richness Theory could not support the findings regarding Video conferencing. It was suggested that this type of media was the kind people are most unaccustomed with, and thus needs more practice if it is to be managed efficiently.

Study II: Kristensson, P. & Norlander, T. (2003). The Creative Process and Product in Virtual Environments. *Creativity and Innovation Management*, 12 (1): 32-40.

The development process of new products and services has proven to be a complex and iterative process and is often performed by groups of people. This makes communication between the parties involved crucial to success. According to researchers (e.g. Tidd, Bessant & Pavitt, 2001) many problems in the innovation processes occur due to failures in communication. Since problem-solving largely depends on the possibility of combining different sets of knowledge, which may often be distributed multidirectionally (up, down and laterally) within the organization, developing mechanisms for communication across different interfaces stands out as critical to innovation success. As a consequence, the use of GCSSs is proliferating in organizations. A GCSS is an information technology software tool whose functionality provides or modifies intra-group communication (Hollingshead, 2001). Among other things the GCSS has become a widely recommended tool for companies attempting to develop new products or services. For example, a GCSS may play an important role when a company attempts to connect information from customers with information about financial opportunities, technological requirements and the strategy of senior management.

The research approach in Study II is consistent with the one taken in Study I. In addition, the question of how groups differ from individuals regarding creative performance is also addressed. In his influential book, Osborn (1957) claimed that if the principles behind brainstorming were adhered to: *"the average person can think of twice as many ideas when working in a group than when working alone"* (p. 229).

There is still a common belief among academics as well as business leaders that groups are viewed as an asset and a valuable resource useful when generating innovative and creative ideas (Ilgen, Major, Hollenbeck & Sego, 1993; Paulus, Dzindolet, Poletes & Camacho, 1993). However, according to recent research (Dennis & Valacich, 1993) many of the benefits claimed by Osborn (1957), the father of 'group brainstorming', have remained illusory. Deriving from research emphasizing the importance of idea generation in new product development (Clark & Wheelwright, 1994), Study II was designed to examine the effects of information technology on creativity when comparing small groups with individuals.

The methodology of Study II is consistent with the input-process-output paradigm (e.g. Connolly, Jessup and Valacich, 1990; Pinsonneault et al., 1999; Taggar, 2001); the input is the creative composition of the group, the process is indicated by group creativity-stifling and creativity-enhancing behavior, and the output in question is the creative performance of the group (see Figure 6). This framework makes it possible to predict, evaluate and design experiments investigating the effects of GCSSs on creativity.

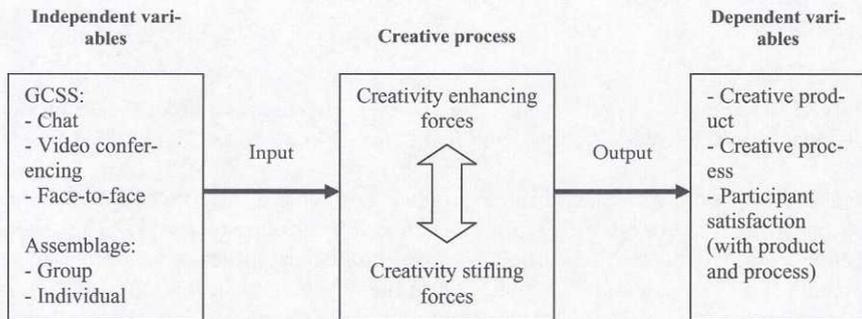| Independent variables		Creative process		Dependent variables
GCSS: - Chat - Video conferencing - Face-to-face Assemblage: - Group - Individual	Input →	Creativity enhancing forces ⇕ Creativity stifling forces	Output →	- Creative product - Creative process - Participant satisfaction (with product and process)

Figure 6. The input-process-output model employed in Study II.

A 3 X 2 between groups design was used in Study II. The independent variables were types of mediated communication where the conditions of two GCSSs were compared to each other and to a Face-to-face condition. Besides these variables, group versus individual creative performance was also examined within the three conditions of communication.

The study was conducted at the Cyber/IT Research Laboratory situated just outside Karlstad University. Ninety-six men and women were randomly assigned to one of the three communication conditions. The participants were also evenly and randomly assigned to a group (consisting of three participants) or individual across these conditions. In the nominal condition, the individuals communicated their ideas to a computer, to a person listening via video conferencing, or to a person face-to-face. In this condition, there was thus only one-way communication. It was deemed

important to include a nominal condition that corresponded to each group condition since several theories (e.g. Connolly et al., 1990; Pinsonneault et al., 1999) imply that interpersonal processes influence the quality of the ideas. The extent to which one presents an idea in written or oral form is thus important to control.

The experimental session was composed of three phases consisting of two meetings, an original and a final meeting, with a deliberation period in between (cf. Norlander & Gustafson, 1996). On arrival at the laboratory for the original meeting, the participants were instructed to fill out a questionnaire concerning background information, a test measuring life orientation (Scheier & Carver, 1985), and a test measuring the attitude to creativity with respect to change and stability, the FS-test (Holmqvist, 1986). Each participant, group or individual then received a complex problem to work with. Whether working individually or group-wise, all participants had a 48-hour intermission between the original and final meetings. The participants were instructed to report in a notebook notions of concern regarding the presented problem,. Thus, during the second phase, all participants worked individually. At the final meeting, the third phase, the participants were instructed, group-wise or individually, to outline in detail a plan, considered optimum, to solve the problem given at the original meeting. Also, at the final meeting, data concerning participant-satisfaction was collected. The aim of the experimental procedure was to try to emulate a typical project sequence during product or service development. In accordance with this, all participants received notice that the three best ideas would be rewarded with SEK 1,000.

Overall, the experiment produced the following results:
1.   Regarding the creative production, small groups showed a higher level of flexibility, implying that groups are able to produce a greater variety of ideas than individuals.
2.   Regarding the creative process, the Face-to-face group showed significantly better preparation. The small groups produced significantly more incubations than the individuals.
3.   Subjective measures regarding participant-satisfaction showed that participants communicating Face-to-face perceived their process to be more satisfying than did the computer-mediated groups.

On the whole, it is suggested that the face-to-face condition has an advantage over the computer-mediated conditions. Although the results indicate no difference regarding the creative product, the face-to-face condition showed a better preparation phase during the creative process. Subjective measurement validate this suggestion. Furthermore, in accordance with what Osborn (1957) suggests, groups turned out to generate more flexible solutions. Groups also turned out to have significantly more incubations, one explanation for this concerning the ability to make new 'connections'. The concept of 'connection' refers to the opportunity to break free from cognitive sets by merging two or more objects that appear to be separate One significant benefit of problem-solving in groups is, thus, the increased probability that the group will come across categories of ideas that would not have been thought of single-handedly (Paulus, 2000).

External communication is an important means by which companies can enhance their processes leading to product development success (Brown & Eisenhardt, 1995). Product development success is dependent on the advantages that a new product will bring to its customers. Because of this, both scholars and practitioners have placed an emphasis on the importance of finding unique ideas for future products (Cooper & Kleinschmidt, 1987). On the basis on these findings, normative research has emphasized the involvement of customers in the development of new products and, primarily, new services. The logic behind this notion is that if the customers are the ones who can decide whether a product idea is unique or not, then they should be considered a hidden source for initiating profitable ideas. Thus, this strategy for accomplishing external communication is believed to result in new ideas for future products.

However, the assumption – i.e. whether or not customers are able to contribute more creative ideas than the company itself – has not been empirically confirmed. There are indications that users are the real source of many innovations (von Hippel, 1988), but, in general, research investigating how user involvement is carried out, and the implications for new products that it may have, is weak. The purpose of Study III is to report the empirical findings from a study of user involvement in service innovation. The paper focuses on the users' contributions to the originality of the generated ideas.

In the CuDIT (Customer Driven IT development) project, a quasi-experimental method was chosen (Cook & Campbell, 1979). The basic idea was to design a study that compared new services generated by professional service developers working at a company to services generated by users. In doing so, conclusions could be drawn regarding the actual value of user involvement by means of their contribution in an experimental setting. An important feature of the research was simulating a situation of user involvement as realistically as possible. In other words, the research design itself should constitute a realistic way of organizing user involvement.

The first was a control group consisting of 12 professionals in service development, i.e. this group did not have any user involvement. The other two groups consisted of 19 ordinary users, represented by students on non-technical study programmes, e.g. social science, teacher training, business administration, etc, and 17 users, represented by the same category of students, who had received training in creativity techniques (henceforth called creative users). The independent variable was the user involvement strategy (type of user) and the dependent variable was the originality of service idea (see Figure 7).

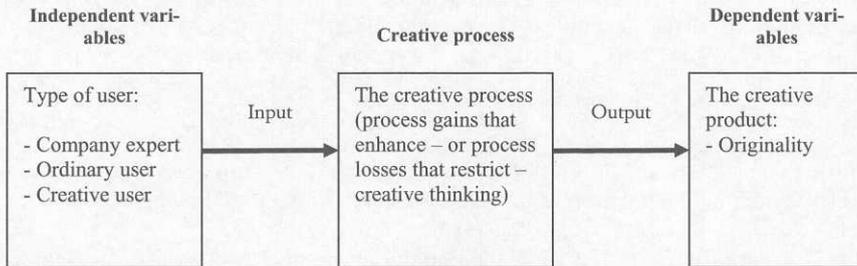| Independent variables		Creative process		Dependent variables
Type of user: - Company expert - Ordinary user - Creative user	→ Input →	The creative process (process gains that enhance – or process losses that restrict – creative thinking)	→ Output →	The creative product: - Originality

Figure 7. The input-process-output model employed in Study III.

The actual experiment consisted of four stages; initiation, idea generation, termination, and evaluation. At the initiation meeting, the users were gathered and the scope of the study was outlined. The application platform for mobile telephony was demonstrated to the participants. The task and instructions were handed out, in both oral and written formats. All participants, with the exception of the professional service developers, were given the task of creating service ideas that they perceived to be valuable vis-à-vis themselves. The experts, on the other hand, were instructed to design a service that they thought would bring value added to the students at Karlstad University. By carrying out these different formulations, all the groups were actually trying to satisfy the same target group, namely the students at Karlstad University. Consequently, it was possible to compare the ideas for new services. The participants were instructed to document the idea generation process in a diary that was handed out to them. The participating users were also equipped with mobile phones containing a special account, since they were to come up with service ideas for this type of equipment. During the second phase, the idea generation phase, the participants were to create service ideas and log them in their diaries. An estimate of the amount of time spent on idea generation was established, on average, as half an hour a day. After twelve days, the idea generation period was terminated and the participants transformed their ideas into a service description. After all the trials had been concluded and the service descriptions had been collected, the evaluation phase then followed. In order to evaluate the service ideas, two panels were set up. One panel consisted of experts within the given domain (Amabile, 1996), i.e. mobile services, while the other panel consisted of potential users of the services, i.e. university students. The assessment method was based on the Consensual Assessment Technique (CAT) (Amabile, 1996).

Overall, the experiment produced two main results:
1. Customers generate ideas that are more original than the ones generated by the company.
2. Customers generally assess innovative ideas differently to the company.

Taken together, Study III indicates that user involvement in service innovation may contribute to the creativity produced in the service ideas. The empirical data indicated that the company experts did not think outside of the current technology. It was hypothesized that technology knowledge stimulated convergent thinking at the expense of divergent, thus explaining the lower scores in originality.

Study IV: Kristensson, P., Gustafsson, A. & Archer, T. (In press). Harnessing the creative potential among users. *Journal of Product Innovation Management.*

The early idea phase is a critical one during product and service development. In fact, research indicates that most projects do not fail at the end, generally they fail at the beginning (Khurana & Rosenthal, 1998). Nevertheless, as it provides sustainable competitive advantage for organizations, the management of creativity is one of the least understood aspects of innovative enterprises (Cooper, 1993; Kristensson, Magnusson & Matthing, 2002). The starting point for innovation, an idea that represents a new and valuable way of responding to hitherto unsatisfied customer needs, is quite surprisingly often taken for granted (Easingwood, 1986). How such unique ideas are developed, and what they contain, is an important question for research to address (Brown & Eisenhardt, 1995).

The perception of what real value is arises within the user, i.e. what it is made up of, the unique benefit of a certain offering. Unfortunately, it has proven difficult, from the supplier perspective, to perceive in advance the unique value of a future product for potential users. The difficulty of understanding customer needs is becoming evermore manifest as many product and service offerings are acquiring an incrementally greater technological complexity (Parasuraman, 2000). Moreover, traditional market research techniques only manage to skim the surface as regards the users' needs and desires. With this scenario at hand, researchers have started to emphasize the involvement of users in new product and service development. More specifically, a customer is thought of as a co-producer and an idea generator of new products and services (Prahalad & Ramaswamy, 2000; von Hippel, Thomke & Sonnack, 1999; Tyre & von Hippel, 1997; Wikström, 1995). The reasoning behind this perception is that if users are the ones who decide whether a product idea is unique or not, then customers should be thought of as a valuable source when it comes to initiating exploitable ideas.

The subject in focus is important to organizations due to the situation that new products – and services to an even greater degree – must accurately respond to user needs if they are to succeed. Since it has proven a costly, difficult and time-consuming matter to understand user needs, user involvement is suggested as a means of collecting such information. It is reasonable to expect user involvement, being so emphatically recommended, to be grounded in theory and substantiated by data (Ives & Olson, 1984). However, as this is not the case, the aim of Study IV is to provide a theoretical framework and examine empirical data regarding the creative contribution of user involvement.

The research context consisted of participants who were equipped with GSM mobile phones. All the participants were assigned the task of creating value adding mobile phone services. The present research utilizes a quasi-experimental three-group (type of user) design (Cook & Campbell, 1979). The dependent variable in the present study is represented by the ideas generated by the participants and the independent variable by the type of user involved (see Figure 8).

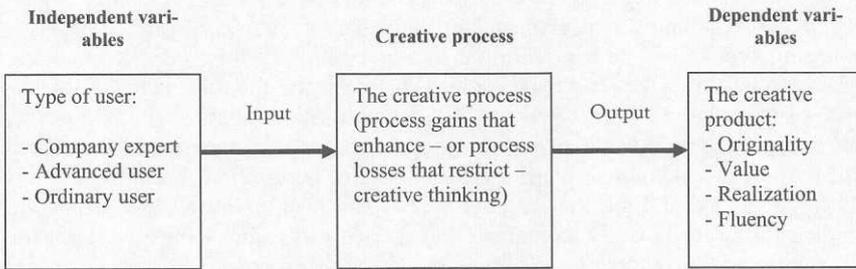| Independent variables		Creative process		Dependent variables
Type of user: - Company expert - Advanced user - Ordinary user	Input →	The creative process (process gains that enhance – or process losses that restrict – creative thinking)	Output →	The creative product: - Originality - Value - Realization - Fluency

Figure 8. The input-process-output model employed in study IV.

Since the research question concerned the creative performance of users versus professionals, different kinds of participants constitute the independent variable. The first group consisted of advanced users. According to previous notions (von Hippel, 2001), advanced users are individuals who develop needs for not yet existing or developed goods and services, ahead of the rest of the market. Since advanced users possess strong and unmet needs, these users awaken to, and sometimes to a certain degree start to develop, ideas regarding how to solve their immediate needs. In this study, sixteen Computer Science students participated as advanced users. These students possessed advanced knowledge of mobile phone technology and of the computer programming language that enables mobile services in a GSM system. Thus, these students were skilled enough to create and implement their own mobile services. The second group consisted of nineteen ordinary users. These were university students mainly with a major in Business Administration or Social Sciences. Unlike the advanced users, these participants had not mastered programming a new mobile phone service. The third group consisted of twelve professional service developers with the leading telephone operator in Sweden, Telia Mobile. As these participants were professional developers, rather than users, they functioned as a control group in such a way that the ideas produced by them made it possible to assess the value of the user-driven ideas.

The actual experiment consisted of four stages; initiation, idea generation, termination, and evaluation. At the initiation meeting, the users were gathered and the scope of the study was outlined. The application platform for mobile telephony was demonstrated to the participants. The task and instructions were distributed, in both oral and written formats. All the participants, with the exception of the professional

service developers, were assigned the task of creating service ideas that they perceived to be valuable vis-à-vis themselves. The experts, on the other hand, were instructed to design a service that they thought would bring value added to the students at Karlstad University. By carrying out these different formulations, all the groups were in fact assigned with satisfying the same target group, namely the students at Karlstad University. Consequently, it was possible to compare the ideas for new services. The participants were instructed to document the idea generation process in a diary that was handed out to them. The participating users were also equipped with mobile phones containing a special account, since they were to come up with service ideas for this type of equipment. During the second phase, the idea generation phase, the participants were asked to create service ideas and log them in their diaries. An estimate of the amount of time spent on idea generation was established, on average, as half an hour a day. After twelve days, the idea generation period was terminated and the participants submitted their ideas into a service description. After all the trials had been concluded and the service descriptions had been collected, the evaluation phase then followed. In order to evaluate the service ideas, four panels were set up. Two panels, containing three people each, consisted of experts within the given domain (Amabile, 1996), one was made up of experts from the telephone company while the other was made up of consultants within mobile telephony but from outside the company. The third panel consisted of six potential users of the services, i.e. university students. Finally, the fourth panel consisted of marketers from the telephone company. The assessment method was based on the Consensual Assessment Technique (CAT) (Amabile, 1996).

Overall, the experiment produced three main results:
1. Ordinary users produced more original new service ideas indicating a more divergent style of thinking.
2. Professional developers produced the most realizable ideas followed by advanced users, indicating that the more expert knowledge there is within a given domain - the more realizable will be the ideas produced.
3. Ordinary users produced significantly more valuable ideas on an aggregate level.

Taken together, the overall findings from Study IV support the notion that users are able to create unique ideas in terms of the ideas' original and valuable merit. As creative actions consist of the derivation of new and valuable connections, the empirical data from this study suggests that ordinary users have a greater propensity for attaining this. Accordingly, an explanation of the user's creative performance concerns the increased possibility of connecting different information elements with each other (e.g. Ekvall, 1997).

Conclusions

Introduction

Overall, the primary aim of this thesis was to investigate how creativity may be affected by internal and external communication and interaction opportunities during the early phases of product development. From the management perspective, the early phases of innovation are perceived as uncertain and difficult to manage (e.g. Zhang & Doll, 2001). However, creative performance, which concerns the ability to produce new and valuable ideas, may be an important contributor to new product development success and needs to be managed. The thesis was motivated by previous research that maintained a need for research into creativity in relation to new product and service development (e.g. Brown & Eisenhardt, 1995; Zeithaml & Bitner, 2000; Henard & Szymanski, 2001). Innovation research has highlighted interaction opportunities as essential to enhanced product development processes. By employing the psychology of creativity, the effects of internal and external communication on the early phases of innovation, primarily in terms of the creative product, were examined. In this final section, the main results will be discussed, along with managerial implications.

General conclusions

In Study I, an experiment was designed in order to understand how a Group Communication Support System, an information technology tool, would affect the creative performance of small groups. In doing so, it was possible to understand how a communication web would facilitate or restrict the problem-solving ability of a small group of people (e.g. a product development team). Previous research was extended with the inclusion of additional measurement such as the creative product and the creative process. The results indicated that the opportunity to engage in rich and smooth communication, i.e. in face-to-face interaction, increases the prospect to divergent thinking. It was of special interest to note that the Video conferencing condition, which is communication-rich, experienced significantly less incubations during the creative process. The probable explanation for this was that the Video conferencing involved more tedious and technically-demanding interaction, which restricted the flexible exchange of information. In addition, the face-to-face group turned out to perceive their process and product more satisfactorily, thus giving some support to the previous findings.

In Study II, the experimental design regarding the effects of computer-mediated communication on creativity was reiterated. The results showed that flexible and smooth communication, as provided in face-to-face interaction, established a solid foundation in terms of preparations for creative performance. This finding was supported, as in Study I, by the situation that the face-to-face condition perceived its process to be more satisfying than the computer-mediated groups. In Study II, as opposed to study I, no effects were found regarding the creative product, a circumstance that was confirmed by the participants' perception of the product.

Study I also aimed to examine how the perceived usefulness of electronic communication would affect creative performance under computer-mediated conditions. This research question did not yield any significant effects. However, the significant difference as regards the creative process in both studies and the creative product in Study I, gives rise to the hypothesis that the perception of usefulness ought to have some implication, if not with regard to the short term, as in the present study, then at least with regard to usage in a longer term perspective.

In Study II, it was also investigated whether or not groups would differ from individuals concerning their creative performance in virtual environments. The results indicated that the group condition incubated significantly more than the individuals. The greater ease to incubate was also confirmed by the results from the creative product, where groups showed a higher level of flexibility. A theoretical explanation of these results relates to the increased opportunity, for groups, to make connections between and within different information categories. Since this was not the case for the individuals, this finding not only verified the theory but also suggested that the availability of communication and information is important whenever creative performance is needed, as during the new product development process.

Taking Studies I and II together, it appears that interaction and communication by means of virtual environments do not make a contribution from a creativity standpoint, compared with face-to-face interaction. Conversely, in both studies, it emerges that indications, in terms of divergent thinking, creative processes and participant satisfaction, regarding ordinary face-to-face group interactions, optimize creativity to a greater degree.

Concerning the development of new, value-adding products, one managerial implication of Studies I and II concerns the potential of using new communication technology, not as a surrogate for the physical meeting, but as a substitute for canceling a meeting due to restraints of time and distance. Instead of the members of a project team being prevented from collaborative work, information and communication tools can provide a common platform for collaborative work efforts, stimulating the exchange and development of ideas. By distributing information on a virtual arena, members of a team or an organization may receive valuable input that stimulates incubation by facilitating a break of cognitive set; something that an individual on his/her own is unlikely to accomplish. Furthermore, from Study II, it is inferred that the initial problem has to be carefully prepared, preferably under face-to-face conditions, if computer-mediated communication is to work as well as possible as an arena for exchanging and developing ideas. Viewed on the broader level, the findings from Studies I and II stress the importance of information-processing and exchange to facilitating the making of new and valuable connections.

In Studies III and IV, the main aim was to examine the effects of external communication in terms of user involvement. In these studies, the participants interacted face-to-face and the task concerned the development of new technology-intensive services. In Studies III and IV, different types of users generated ideas for future mobile phone services.

By applying creativity research, it was possible to provide a theoretical framework suitable for understanding the inherent qualities of a unique product. Further-

more, Studies III and IV also provided an answer to the addressed need of understanding how a unique product, which meets customer needs, may be developed (cf. Brown & Eisenhardt, 1995).

In Study III, the originality of an idea was theoretically operationalized as the distinguishing feature product that delivers unique benefits. The results showed that creative users surpassed company experts as regards the ability to evolve using original ideas for future services. It was argued that a deep understanding of technology might inhibit professional developers from thinking outside the current capabilities of the technology in focus.

In Study IV, the ability to think either divergent or convergent was further explored. Deriving from theory, the distinguishing signs of a unique product were further operationalized to involve original, valuable and realizable merits. In Study IV, theoretical developments (von Hippel, 2001) pointed toward the significance of using advanced users in product development, and hence, advanced users were used as one independent variable along with ordinary users and professional developers. The results of the study showed that ordinary users produced significantly more original and valuable ideas than both advanced users and professional developers. It was argued that divergent thinking was facilitated, thus accounting for the performance of the ordinary users. As expected from Study III, non-professional users have a better opportunity to combine the different information elements that appear separate at the outset. The idea generation of new and valuable connections was facilitated by the situation that non-professional users were able to couple personal needs with the functionality of mobile phones.

Viewed on a broader level, the findings from Studies III and IV suggest that users may contribute original and valuable ideas in situations where products offering customer value are being sought. Regarding managerial implications, one advantage of user involvement is the proactive attitude that companies can employ, responding to customer needs instead of competitors when developing new products. According to Studies III and IV, external communication in terms of user involvement may yield unique and valuable ideas for future products, possibly with the trade-off of a more costly and time-consuming production process. A further implication of involving users in taking the initiative for new products concerns the situation that it is not just possible to understand the user needs of tomorrow but also to conceive and anticipate products that would seem unthinkable in advance. Especially in this latter case, the theoretical foundation of creativity can play an important role in contributing to the understanding of how ideas for new and valuable products are evolved – an important issue for the management of innovation. An impressive finding from Study IV is that even when professional developers assessed the coded ideas for future mobile phone services, they perceived the ideas of the users to be more original. If customer involvement is put into practice in applied settings, further implications are likely to concern an accelerated development process and an intensified relationship with the customers in question. Both implications are important since time-to-market and loyalty are held to be important competitive means.

Final remarks

In summary, the development of new products and services may become increasingly dependent on the ability to manage creative performance as a means of facilitating innovation success. The present thesis has placed an emphasis on some of the psychological processes underpinning the creative performance of individuals aiming for innovation success. Perhaps the most apparent finding of the present research pertains to the emphasis on the possibility to connect information elements that appear separate at the outset. According to the studies undertaken, this may be facilitated by extending communication opportunities, either by involving users or by enabling information exchange in virtual environments. If the management of creativity is to be successful, it will need to provide for communication, and thus, connection opportunities. Different information elements – for example with regard to the latent root needs of users and what is technically feasible to produce – may then be combined into new and valuable ideas for a new product that solves a problem appropriate to a segment of customers.

From the management perspective, the early phases of innovation are perceived to be uncertain and difficult to manage (e.g. Rogers, 1995; Zhang & Doll, 2001). Whereas the later parts of the development process of new products and services often follow predictable paths of implementation, the early front end of innovation involves unexpected leaps of creativity and insights. Although such original thinking manifests itself in various directions, it has to be realized that creativity does just not happen; it can and needs to be managed. In fact, the results from Studies III and IV highlight the fact that customers should be considered a valuable resource for innovative enterprise. Unfortunately, empirical findings by other researchers indicate that this is a neglected and often underused source of innovation (e.g. Martin & Horne, 1995). One important way to involve customers in the development process is by using new communications technology to establish virtual relationships with this group. Although the findings from Studies I and II suggest some limitations, further advances in communications technology bringing about improvements will serve the purpose of reducing distances and may offer a means of sharing ideas to customers. While some studies emphasize the importance of customer orientation (e.g. Woodruff, 1997), other studies report failings in establishing external communication (e.g. Martin & Horne, 1995), in such cases, electronic communication stands out as a valuable alternative.

Interaction and communication with users stands out as important since it may result in creative ideas. However, even ideas from users that are evaluated as not being creative may turn out to be of value to a company. This is due to the situation that interaction and communication may lead to a better understanding and appreciation of the needs, requirements and behavior essential to a user (cf. Gruner & Homburg, 2000). It would thus seem that there is no such thing as a 'bad' idea, at least not if it is generated by a user. In respect of the cognitive processes of members within a product development team, the type of information that is incorporated into an idea may facilitate understanding of user needs. Such acquired knowledge may, in that case, be

combined with the functionality and key instruments of a company's product platform, into an original, valuable and realizable idea.

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Appendix

Study I:
Kristensson, P. & Norlander, T. (In press). The Creative Product and Process in Computer-Mediated Groups. *Journal of Creative Behavior*.

Study II:
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Study III:
Kristensson, P., & Magnusson, P. R. & Matthing, J. (2002). Users as a Hidden Resource for Creativity: Findings from an Experimental Study on User Involvement. *Creativity and Innovation Management*, 11 (1): 55-61.

Study IV:
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