Requisite variety of expertise within a group in idea generation

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Abstract: Ability to innovate is the means for organizations to maintain their competitiveness; yet for those innovations to emerge calls for generating plenty of ideas. Therefore, this paper aims to find the impacts of the requisite variety of expertise within a group in the idea generation. The conceptual part of the paper deals with the concepts of creativity, innovation, idea generation in innovation process, requisite variety and diversity, together with expertise. Then the empiric test evidence result of case study with four groups is presented. It is suggested that the requisite variety of expertise within a group enhances both the quantity and the quality of the generated ideas. It is also suggested that working together in pairs generates more ideas than when the same people work as individuals.

Keywords: Creativity; Innovation; Innovation process; Requisite variety; Requisite diversity; Expertise; Idea generation; Group;

1 Introduction

Creativity is a characteristic of an individual human being that includes various creative thinking skills, task motivation and expertise. Previously there has been found a connection between individual's creativity and organizational innovation. The work environment impacts the individual creativity, whereas creativity feeds organizational innovation. [3].

The future of organizations is dependent on their ability to innovate. In an organization, one of the enablers discovered fostering individual's creativity, and thus innovation, is requisite variety or diversity, i.e. the combination of different skills and expertise of people in an organization [12, 20, 21, 29]. In innovation process, idea generation is the first phase [8]. Without any ideas no innovations will emerge. Therefore, nurturing the idea generation is virtually indispensable for organizations. In a group, people with various set of expertise see things from many angles, and therefore generate totally different types of ideas. Therefore the group's collective idea generation capability should be encouraged.

Thus, this paper deals with the impacts of the requisite variety of expertise in the idea generation within a group. The main research question of this paper is *"What is the role of requisite variety of expertise, one of the three components of individual creativity, in idea generation of a group in innovation process?"*

Therefore, this paper aims to find out the influence of the expertise to the quantity of the generated ideas; additionally, the effect of expertise to the quality of the generated ideas. Also the paper attempts to compare individual idea generation versus idea generation in pairs, i.e. do people generate more ideas while working individually or with pairs.

In answering the question the following discussion first describes the concepts of creativity, innovation and individual creativity's connection with innovation. Then the discussion deals with the idea generation as a phase of innovation process, requisite variety, expertise and creative tension. Due to the need to attain a better understanding of requisite variety of expertise in idea generation within a group, results of an empirical study conducted in four groups both with students and experienced project managers are described in detail.

2 Creativity, innovation and their connection

Creativity

As Linus Pauling put it: "*The best way to have a good idea is to have lots of ideas…"* All creative ideas originate from the human mind [14]; in order for the ideas to develop, they need a systematic, yet human touch [5].

Creativity is easily associated with arts and considered as the reflection of highly original ideas, yet deep down, it is just the production of new, relevant ideas of human activity in any of its fields [2]. The two defining characteristics that the formal definitions of creativity generally include are novelty and appropriateness [16]; the novelty of the ideas is the key, but the ideas should be at least reasonable solutions to the given problem or opportunity [3]. For Csikszentmihalyi [10] in order to hold its significance, creativity

has to imply a process, which results in an idea or product acknowledged and adopted by others; creativity he determines as a "phenomenon that is constructed through an interaction between producer and audience" [10, p. 314]. Individual creativity is a crucial component of organizational creativity [30]. In organizations creativity is often thought to nest only in marketing and R&D, as the sprouts of innovation are especially found at the customer surface. Unfortunately often creativity is banned in functions that include systematic processes or legal regulations, thus causing managers to have a narrow approach to it. Yet creativity can benefit all the organizational functions and innovativeness should be everyone's responsibility. [2, 3]

Creativity is more than inventive or creative thinking, which is usually connected to creativity. According to Amabile [2], the creativity of an individual or a small team is an activity, consisting of three elements: expertise, creative-thinking skills and motivation described in the "Componential Theory of Creativity" (CTC). Creativity is a compound of three major elements, all essential for creativity in any given domain and the occurrence is most likely when people's skills overlap with their strongest intrinsic interests, their profound passions. The higher the level of each component, the higher the level of creativity will be. [3] The CTC -model presumes that all individuals with normal capacities are capable of producing reasonable creative work in some domain at some time. Additionally, the social environment, i.e. the work environment, can have an effect on both the level and the frequency of creative behaviour [3]. *Creativity skills*, i.e. creative thinking depends to some extent on personal characteristics related to e.g. independence, self-discipline, orientation toward risk taking, tolerance of ambiguity, perseverance in the face of frustration, and a relative lack of concern for social approval. Creative thinking is a capacity to put existing ideas together in new combinations. Those skills can be enhanced by the learning and practice of techniques to improve cognitive flexibility and intellectual independence. [3] *Expertise* is the basis for all creative work, containing memory for factual knowledge, technical competence and work domain-related special talents [3] and it can be influenced with training and education [26, 32]. Whereas expertise and creative thinking are the natural resources of an individual, motivation is the determining factor of what people will actually do. Extrinsic motivation comes from outside a person, when people are expected to be evaluated, under surveillance, competing with peers, dictated by superiors or they have been promised rewards; *intrinsic task motivation* is the motivation to work on something because it is interesting, involving, exciting, satisfying, or personally challenging. To some degree intrinsic motivation lies in a person's personality; some people are more driven than others. Yet the individual's social environment also may affect the level of intrinsic motivation. Of the three components of creativity, it is the motivation component the work environment can influence most immediately. [2] Even small changes in an organization's environment can increase intrinsic motivation significantly. [2, 3]

Innovation

Creativity and innovation are frequently thought of as exchangeable terms, yet innovation is the process of transforming an idea or invention into action within the organization [20]. Moreover, for creative ideas that originate within an organization, innovation also depends on ideas that originate elsewhere as in technology transfer [4]. The OECD [22] defines innovation as "...the implementation of a new or significantly improved product (goods or services), or process, a new marketing method, or a new organisational method

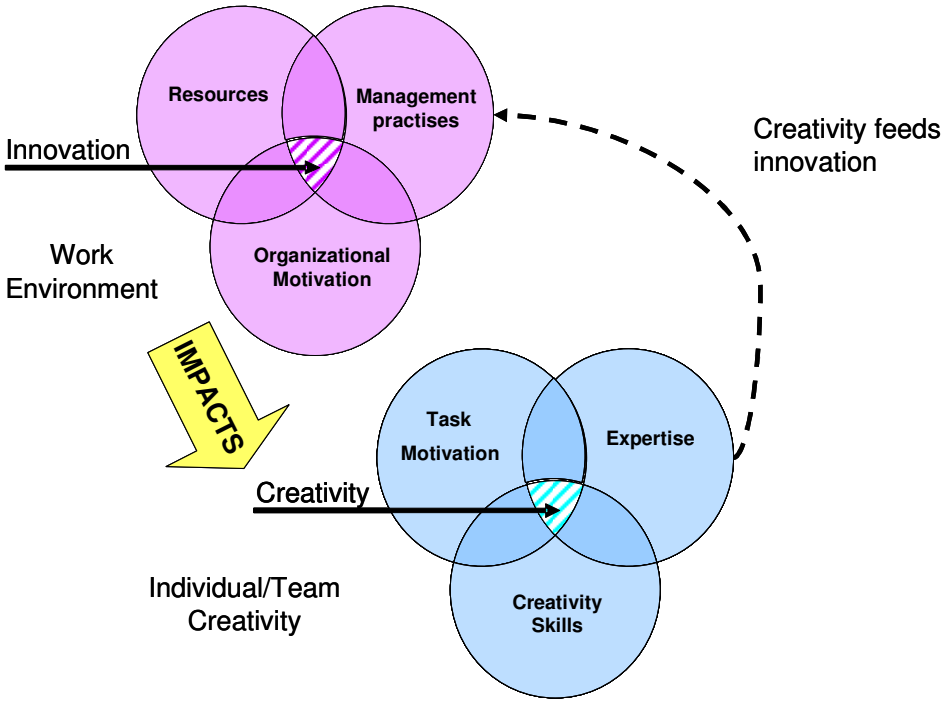
in business practices, workplace organisation or external relations." Therefore the minimum requirements for an innovation are its novelty and the implementation. The novelty or significant improvement to the firm includes product, processes and methods that firms have developed themselves or adopted from other firms or organisations. The implementation signifies the introduction of a new or improved product to the market or new processes, marketing methods or organisational methods brought into actual use in the firm's operations. [22]

Tidd et al. [28] have introduced a division of innovations into four types: namely (1) product innovation i.e. changes in the things (product/services) which an organization offers, (2) process innovation i.e. changes in the way products/services are created and delivered, (3) position innovation i.e. changes in the context in which the product/services are introduced and (4) paradigm innovation i.e. changes in the underlying mental models which frame the organization.

Connection between individual creativity and organizational innovation

Creativity is the prerequisite for innovation [18]. Amabile [3] has discovered connection between individual creativity and organizational innovation and in the Componential Theory of Organizational Creativity and Innovation (CTOCI), which presents how individual's creativity can be integrated into the organizational work environment (Figure 1).

Figure 1 Component model of creativity for the individual and team (adapted from Amabile [3, p. 43]).



For innovations to emerge the primary source of innovation within the organization is the creativity that individuals and teams produce, a combination of expertise, task motivation and creativity skills; managers can influence these components through workplace practices and conditions [2]. The social, i.e. work environment influences those individual components. Though the environment can impact all of the components, the most significant impact is the immediate and direct affect on task motivation. The three components of the work environment are organizational motivation, resource and management practices. *Organizational motivation* constitutes the organization's basic orientation toward innovation and support for both creativity and innovation. *Resources* contain all the elements that organizations possess that help work in the domain targeted for innovation. *Management practices* comprise management at all organizational levels, especially departmental and project management. [3]

From the management and leadership point of view, the immediate connection between individual creativity and organizational innovation is a crucial finding as the notion that the work environment impacts the individual's creativity is decisive. Additionally, the fact that all three organizational components have a joint impact means that even with one part missing the impact is not an entity. Unfortunately the negative effect strikes individual motivation as the first element of creativity by weakening it. Therefore in organizations it should understood, that individual creativity is the main source of innovation, which calls for innovation-orientation with adequate resources together with suitable management practices in the organization.

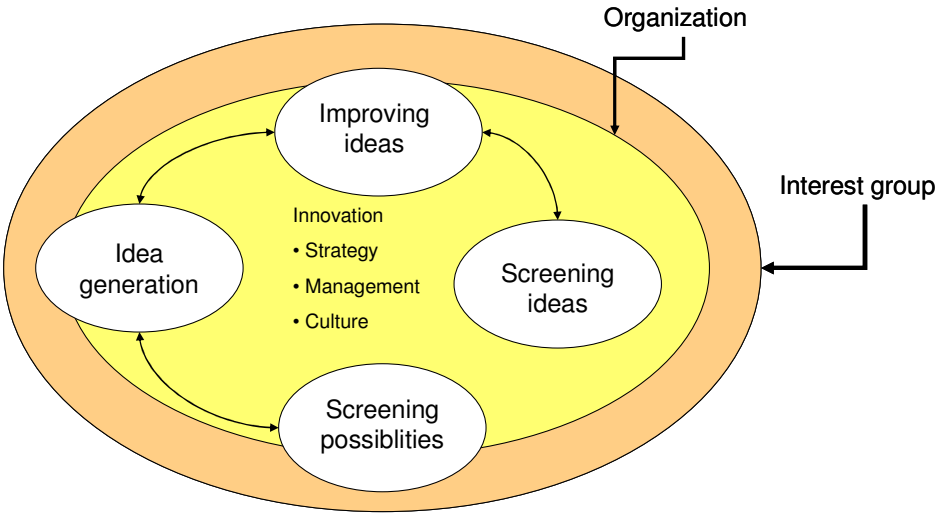
Smith [25] has detailed the interrelationships of creativity and innovation from other perspective. Innovation starts with a realized demand for change, culminating in its productive implementation. The key stages of this process are idea generation, progress of the most promising ideas and their acceptance by the relevant parties. Problem solving is an inherent part of innovation since idea generation and implementation of change never occur without complexity. Yet problem solving is not innovative at all times; problems can be solved with tried-and-true solutions. Invention, or the generation and development of novel ideas, occurs in the early stages of the innovation process and also involve problem solving, particularly if the ideas can be patented. Furthermore, design work involves thinking and problem solving, being the development and devising of complex things. However, not all design is invention e.g. architects designing houses. In most stages of problem solving events, the mental production of prospects or alternatives, i.e. idea generation, occurs. A person's ability and performance of idea generation represents that person's level of creativity. [25]

3 Idea generation as part of innovation process

The innovation process is more than just a process of research and development [6]. Ahmed [1] sees that the innovation process has three somewhat obvious phases: *idea generation*, *structured methodology* and *commercialization*. However, though these phases are often seen as sequential, they are actually more iterative and simultaneous in nature [1]. Boeddrich [8] divides the innovation process into four phases: *concept finding, development of innovation elements, achievement of readiness for marketing and market launch*. Essential for the innovation process' overall success is the importance of methodical, systematic and structured procedures.

Furthermore, Apilo & Taskinen [6] have considered the idea generation phase. They see this phase as when the possibilities are identified, improved and eventually the final solutions screened (Figure 2). If an idea is thought to be worth further development, it proceeds via conceptualization, definition and design to either process development or product solution. Additionally, there are sources of innovation both inside and outside the organization. [6]

Figure 2 The idea generation phase of an innovation process (adapted from Apilo & Taskinen [6, p. 43]).



4 Requisite variety or diversity

In 1956 Ashby introduced *The law of Requisite Variety*, the idea of the complex law in short is that the internal complexity of a system should correspond to the multiplicity and complexity of the environment; otherwise the system will not function effectively enough in its environment [7].

In an organization, one of the enablers discovered fostering knowledge creation by Nonaka & Takeuchi is requisite variety [21]. As one of the five enabling conditions for the knowledge spiral, [21] have acknowledged requisite variety to enhance the member's ability to manage many incidental events. Requisite variety can be added to by combining information differently, flexibly and quickly and by allowing equal access throughout the organization as otherwise the search for different interpretations of new information may be hindered. [21] Martins & Terblanche [20] also see that aside from personality traits, a value like diversity is extremely important when recruiting and appointing people as diverse backgrounds lead to richer ideas and processes. Trott [29] sees the diverse range of skills, i.e. combination of specialization and diversity of knowledge and skills, as one of the organizational characteristics that facilitate the innovation process. The diverse range of skills assists the cross-fertilization of the specialist knowledge. Additionally, the organization should have individuals of a hybrid nature, capable of comprehending various technical subjects and assisting the knowledge transfer within the company. This

applies to managers also; the ability to manage diversity of knowledge and skills is hybrid management [29]. Regarding team diversity, Farr et al. [12] suggest that demographic diversity is most relevant to idea generation; for both idea generation and evaluation, diversity in knowledge and skills is relevant; and in the application and implementation of the ideas, diversity in personality and attitudes is most relevant. Farr et al. [12] believe optimal levels of requisite diversity exist, which leads to effective creativity and innovation implementation.

According to Florida [13], diversity is not just a nice thing, it is a necessity. The three things in common for the most creative organizations are: openness, diversity and tolerance. Tolerance is not only about accepting different people, but proactively including them in the work community [13]. Diversity needs to be managed but more importantly all levels of staff need to be involved in leveraging diversity [17]. For an individual, leveraging diversity is a competence, i.e. capability in which people believe in others [9] and see diversity as an opportunity [15].

To sum it up, leveraging diversity is seeing differences as richness and being able to benefit from different viewpoints and opinions. Leveraging diversity promotes multi-disciplinary thinking, for example, where marketing people together with research and development try to come up with solutions that benefit both sides. Requisite variety or requisite diversity in the organizational environment can be summarized as signifying the employment of a range of people with different backgrounds and skills. In addition to the diversity of the people, demographic, cultural, educational, intellectual, etc., diversity should be regarded as richness of the organization. Furthermore, the different skills of people should be put to use across organization in various departments or groups.

5 Expertise, self-development and creative tension

Professional and technical expertise

Thinking imaginatively is just one part of three components of creativity - another is knowledge [3]. Expertise is vital, since knowledge is the basic requirement in order something new in a specific domain to be created [2, 12, 27]. Expertise includes the mastery of job-related knowledge: technical, professional, or managerial; and additionally the motivation to use, develop, and share work-related knowledge with others [26]. The motivation and commitment to develop expertise and lifelong learning can also be examined as the individual's ability of self-development [32]. Expertise is in this case understood as whether or not one has the knowledge required in performing the job and the readiness to give and receive help when necessary.

Yet, expertise is interrelated with other variables too. When expertise and challenges are balanced a person can reach the optimal experience of human being, called flow [11]. The two factors effecting "Flow" have both a full range: expertise ranging from virtually no skills to expert level of knowledge, and challenge from minor challenges moving towards extreme requirements. Csikszentmihalyi [11] has elaborated four distinct combinations of these two factors. Person is outside the "Flow" either when one has low skills together with too high challenge causing anxiety, or very high skills concurrently with too low challenges causing boredom. In "Flow" person exists either when both challenges and skills are low, or when expertise and challenges are high enough. This

would indicate that managers should also take into consideration the level of challenges when thinking about developing expertise.

Self-development, personal mastery and creative tension

According to Zwell [32], self-development can be described as the desire to continually grow, learn and develop. People with a high level of self-development can accurately assess both their current skills and those they need for better success in their job. Self-development determines how vigorously a person will develop his or her expertise and prepare for future challenges.

There are different levels of self-development. At the most basic level self-development is used to sustain the current professional and technical expertise. At higher levels self-development is about extending knowledge beyond the current work tasks or current field of expertise [32].

People will only do as much as they think they are capable of doing or even less [32]. Yet, human beings are more capable than they actually believe. Human performance and behaviour are dependent on the beliefs and perceptions of the capabilities one possesses.

According to Senge [24], personal mastery is grounded in competence and skills, but it also comes from seeing life as a creative work, living from a creative point of view rather than a reactive point of view. It is about continually clarifying what is important to us and all the time learning how to see the current reality more clearly. Personal vision (what we want) acts as a desired destination that people strive to reach [24]. According to Zwell [32], vision is usually a changing state, what people want, but never achieve. The difference between a vision and a clear picture of current reality (where we are relative to what we want) generates creative tension: a force to bring them together. There are two ways to resolve creative tension: either move reality toward the vision or move the vision toward reality. If people have no creative tension, there is no need to move toward the vision. [24]

6 Research Methodology

This study is based on the findings that idea generation plays an important role in innovation process. Hypothetically it was assumed that requisite variety of expertise within a group is important phenomena in idea generation process.

Based on a conceptual analysis we have described the concepts of ‘creativity’, ‘innovation’, ‘expertise’, ‘innovation process’, ‘requisite variety’ and ‘requisite diversity’ in the conceptual part of this paper. According to Olkkonen [23], by their nature, concepts are abstract notations or symbols; they assist the solidification, structuring and illustrating both phenomena and their characteristics at a quantitative level.

The case study method [23, 31] is applied to collect data in the empirical part of the study. According to Olkkonen [23], the results obtained through the case study method are often new hypotheses or theories, explanations of change- or development processes, even normative instructions. The material and its processing are empirical, although often the material is formed of a small number of cases. Therefore, the problem of generalization is especially related to the results obtained by the case study method. Thus, it remains to be contemplated to what extent the results obtained in a limited number of

cases can be generalized applicable also to a larger group. In other words, the results have to be regarded more or less directional.

The research material based on the cases should be chosen carefully in order to help the understanding of the research problem. According to Olkkonen [23], the cases should be chosen e.g. by applying the following principles:

- Cases that can be justifiably regarded as typical with regard to the basic set
- Cases that represent examples of different types, in their typical form, in accordance with the preceding conceptual analysis and typeset
- Special cases, in case it can be assumed that they reveal interesting and useful factors with regard to the research.

The entire case population of this study is, to some extent, technically oriented students or professionals. The sample groups, varying from four to eleven persons of their size, represented four different types:

1 two groups comprised of experienced experts with higher level technical education (group 1)

2 one group of experienced experts with lower level technical education (group 2)

3 one group of less experienced young experts with higher level technical education (group 3)

4 one mixed group including both young and older experts with both higher and lower level technical education (group 4)

The case population chosen by the researchers, altogether 24 people, took part in the study. The age of the participants varied from 25 years to 60 years. For those with working experience, the average within project work field was more than 5 years, which was also regarded as minimum experience to be ranked as an experienced project expert. Those participants regarded to have a higher level technical education had degree in university of applied sciences (BSc or corresponding) or degree in university (MSc or corresponding).

The main method to collect data was a repeatable test. Research instrument – 13 minutes long video – was carefully chosen by researchers in order to have a material that can be globally interpreted. The video was an introduction of the IKEA kitchen assembly [19]. In this video the different basic innovation types presented in the contextual part of this paper are clearly visible. However, noticeable is that none of the experts had any experience particularly in furniture or construction business.

The test was conducted in class room conditions, which gave the participants the most convenient environment to focus on the video screen and in further mentioned way:

Test assembly 1, the individual test

1 Group was studying basic four concepts of innovation types: product, process, position and paradigm innovations.

2 Each individual was equipped with paper and pencil.

3 Each individual was instructed to look at the video and simultaneously capture as many ideas of four innovation types as possible from the video and write them down to the form.

Test assembly 2, the pair test

1 The same group of people was divided into pairs.

2 Each individual was equipped with paper and pencil.

3 Each pair was instructed to look at the video and simultaneously capture as many ideas of four innovation types as possible from the video and write them down on the form. Discussion with the pair during the video was allowed (and encouraged).

7 Results

An individual's capability to generate ideas varied from zero (0) findings to thirty one (31) findings. On the average, an individual produced twelve (12) ideas from the video (test assembly 1). Additionally, in the second phase of the test (test assembly 2), while working in pairs the same group generated 15 % more ideas on the average from the video. Therefore, it can be concluded that people generate even more ideas while working in pairs than as individuals.

However, from individual's creativity point of view, the impact of motivation component is impossible to separate from the process. Although, task-motivation plays an important part in idea generation and is different for each individual, yet in this test the differing impact was diminished by supplying each test person the similar test environment with practically no advantages or gain to achieve, but personal pleasure of completing the task. Each test person attended the test voluntarily and nobody was informed that the results were compared with other people or groups. In practise people were competing with themselves. Thus, we can assume the creative tension of an individual drives them to generate those creative ideas.

Second finding was that the mixed age structure and variation of expertise and experience also influenced on the capability to capture the ideas from the video (group 4).

Third finding was that the lower the education level of the test group was, the less new ideas were generated (group 2); and furthermore, the higher the education was, the higher the quality of ideas was (group 1 and group 3). The quality of the generated ideas could be seen by comparing the amount of more demanding ideas generated. Position and paradigm innovations were discovered as more challenging or difficult areas on the basis of the research material. In other words people with higher education are more prone to generate more complex ideas as they are more ready to look and discover matters from various angles.

Fourth finding was that the highest number of new ideas was generated by the homogeneous group of highly educated expertise in the second phase as working in pairs (group 1). Finally, both the expertise group (group 1) and mixed group (group 4) were able to generate over 70 pieces of different ideas in two times 13 minutes sessions. This was far more than other groups.

The result of the study suggests that people of all backgrounds generate ideas, but requisite variety of expertise adds both to the quantity and quality of idea generation in a

group. Furthermore, working additionally with pairs adds considerably to the quantity of the generated ideas, which can be interpreted also as pair workings stimuli to idea generation and the contribution of learning.

8 Conclusions

The requisite variety of expertise is an important feature in idea generation within a group in the future, especially, in a project work context. For innovations to emerge requires a lot of new ideas – and especially different types of ideas.

Our claims in this article have been as follows:

First, expertise grows the quantity of the generated ideas. Second, with expertise the generated ideas are of different type, more complex, than without expertise. Third, two people working together generate greater number of ideas than two individuals accumulated singularly. Fourth, people learn from each other during the idea generation phase, when working together as pairs.

On the basis of the results, the people working in a project work context see that working in mixed groups rather than emphasizing the individual performance conducts more new ideas. Moreover, expertise is partially based on experience. For innovation processes and idea generation it is fruitful to have mixed aged groups. Furthermore, variation in individual's capability to idea generation creates a risk of failure in innovation process, whereas working in teams reduces the risk significantly.

Therefore, finally, we conclude that as people with diverse backgrounds generate different types and quantities of ideas, organizations should build up groups with people having various types of expertise and ages. Additionally, people working as pairs or within a group should be encouraged, in order the idea generation to flourish in organizations.

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