The Sources of Novelty: A Cultural and Systemic View of Distributed Creativity

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This article discusses the limitations of the first generation of creativity-management technologies based on the psychological theories of intelligence and problem solving. The turn into a cultural and systemic conceptions in the psychology of creativity is analysed. It is argued that this psychology converges with the ideas developed in the sociology of knowledge, the history of technological systems, and activity theory as well as in innovation studies. All of them underline the significance of artefact-mediated communities, domains or practices. They agree on the importance of combining heterogeneous cultural resources and knowledge by horizontal networking across the boundaries of knowledge and activity domains. The internet-mediated new communities are discussed as emerging forms of distributed creation. A challenge for the management of creativity is to study and learn from the emerging problems, means and patterns of conduct of these communities.

Introduction

Innovation became a central part of science and technology policy making and rhetoric in the 1980s and 1990s. The emergence of creativity as an issue of management evidently has the same origins. New knowledge and new technologies have become a key factor in the global economic competition of the so-called knowledge society.

A prologue to this turn can be found in the history of the psychological studies of creativity. In 1950 J. P. Guilford, when accepting the presidency of the American Psychological Association, gave an inauguration speech on the need for the study and development of creativity (Guilford, 1950). He stated that the significance of creativity for industry and society has enormously increased. Both industry and public administration need leaders with vision and talent. Guilford set two tasks for creativity studies. One was that it is necessary to recognize the creative talents of individuals and the second was to develop them. The first task was to be achieved by developing tests that measured the creative traits of individuals, and the latter by developing technologies of creative thinking and decision making. By the end of the 1950s several creativity tests and problem-solving technologies had been developed with support from the US Defense Department, and creativity courses became an important branch of the business of commercial training (Getselz, 1987). Brainstorming and synectics designed by the 'creativity movement' of the decade are standard parts of university curriculums even today.

This first generation of creativity technology was based on the differential psychology developed in the 1930s and 1940s to measure intelligence and IQ. Its individualistic and positivistic conception of creativity and personality was subsequently heavily criticized by psychologists (Oeche, 1990; Weisberg, 1993), sociologists (Branningan, 1981) and philosophers (Feyerabend, 1987).

Today, the potential theoretical sources for the understanding and management of creativity come from different disciplines and research traditions, such as psychology, sociology of science and technology, economic and sociological studies of innovations and history of technology. Furthermore, important converging developments can be discovered in these traditions. These developments suggest that a common ground for understanding creativity might be gradually achieved. The first evident feature of these developments is the

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transition from an individualistic into a systemic, contextual or sociocultural view of creativity. Different concepts and ways of making sense of various cultural and social determinants of creativity and innovation have been suggested (Csikszentmihalyi, 1977 and 1999). The second feature is the turn from cognitive processes to the analysis of human practices and material culture. This latter turn has recently been called a practice turn in social theory (Schatzki, Knorr-Cetina & von Savigny, 2001).

Creativity and innovativeness are such complex phenomena that a simple model of them cannot be formulated. Instead, I will suggest that the accumulation of insights by these aforementioned disciplines can together constitute a non-unitary and non-trivial basis for understanding conditions of creativity (Miettinen, 1996, 2000). In addition, to aid in the understanding of these phenomena, rich, domain-specific and historical accounts of cases of creative enterprises and achievements are needed (Wartofsky, 1980). It may turn out that a deep understanding of certain technologies and practices together with active networking would supply a more important basis for the management of creativity than any single theory of creativity or set of social technologies.

From Individual Psychology to a Cultural and Systemic View of Creativity

Traditional psychology of creativity regarded creativity as a gift or property of an individual. Humanistic psychology (Maslow, 1959), psychoanalysis (Kris, 1952) and differential psychology (Guilford, 1950) were used to make sense of this gift. These disciplines were also embodied in creativity training as well as in guides and popular books about creativity. An important step toward a systemic or contextual approach in creativity studies was Howard Gruber's (1981, 1989) path-breaking studies on the dynamics of the creative work of Charles Darwin. Gruber conceptualized creativity as a long-standing, heterogeneous *work* instead of analysing it as a quality of personality or as a special cognitive process (Gruber, 1981). His approach uncovered the complex dynamics of creative work that are organized into a network of enterprises and that use diverse cultural resources through collaboration with others.

A more recent systemic framework was proponed by Mihaly Csikszentmihalyi, David Feldman and Howard Gardner (Feldman, Csikszentmihalyi & Gardner, 1994). They call it the DIFI (Domain Individual Field Interaction) framework. The DIFI framework underlines the domain specificity of creativity and regards it as a result of interaction between a person, a cultural domain and a social field (Csikszentmihalyi, 1997) 'Edison's and Einstein's discoveries would be inconceivable without the prior knowledge, without the intellectual and social network that stimulated their thinking, and without the social mechanisms that recognized and spread their innovations' (1997, p. 7). The recognition of the need for interdisciplinarity has been an aspect of the systemic turn in creativity studies (e.g. Gardner, 1994; Holmes, 1989).[1]

Sociological theory of cultural maturation (Merton, 1961) and theory of attribution (Brannigan, 1981) are compatible with and complementary to the systems framework of psychology. Merton (1961) developed the theory of cultural maturation to explain the phenomenon of multiple, relatively simultaneous discoveries. He thought that the study of 'multiples' would reorient the study of scientific work from an individualistic and localist account to the social and cultural environment in which the scientists live, one which is larger than their local milieu and local interpersonal relations. According to Merton (1973), joint problems, joint scientific theories and joint instruments are the essential ingredients of cultural maturation and, at the same time, preconditions of an invention. Merton, therefore, regarded invention as basically a cultural phenomenon, one based on the use and transformation of cultural resources.

The representatives of the constructivist sociology of science criticized the theory of cultural maturation for its universalistic and deterministic bias. According to them, two issues should be considered. The very quality of originality or inventiveness is attributed to a product by communities of specialists or users – in many cases after the construction actually has been established (Brannigan, 1981; Schaffer, 1996). Discovery is a retrospective label attributed to a candidate event by research communities – a technique for marking technical practices that are prized by the community (Schaffer, 1986, p. 387). According to this view, the attribution or the social construction of the status of invention to any product is the central phenomenon in studying creativity.

The sociological theories characterized above elaborated two complementary aspects of the creative interaction between individuals and cultural contexts that are both recognized by the DIFI framework. First, the foundation and the starting point for creativity are the existing cultural resources (knowledge, instruments, practices, problems) of a domain. Second, the field recognizes, selects and retains the new variants or the contributions of a domain.

Contradictions and Functional Failures of Practices as a Driving Force of Creation

System-oriented historians and economists of technology as well as sociologists have studied the sources of change in socio-technical practices. Hughes (1978) and Constant (1984) regard the critical problems of socio-technical systems as central in explaining technological change. They call them 'functional failures' (Constant, 1984, p. 31) or 'reverse salients' (Hughes, 1987, p. 80) in the use and development of technology. Critical problems can be defined as problems retarding technological or industrial change and as problems likely, in the opinion of the inventor, to be solved by invention (Hughes, 1978, p. 172). Hughes understands that critical problems constitute a bridge between the imbalances of current technology use and inventive activity. The formulation of a critical problem already implies the possibility and direction of the solution. Drawing evidence from empirical studies of technical inventions, Hughes (1978) delineates a model of invention. It is based on finding a reverse salient of a socio-technical system and on the definition of a critical problem.

The idea that a crisis or failure of a practice is a source of both change and the emergence of novelty is suggested by various philosophical and psychological research traditions, among them Dewey's pragmatism and cultural historical activity theory. For Dewey, the formation of habits is a central mechanism of learning and the transmission of know-how and cultural tradition (Dewey, 1938/1991). In a changing world, habits often do not work or confront serious difficulties. In such a situation, according to Dewey, conscious reflection on the conditions of activity is needed, which leads to the formation of a working hypotheses for the reconstruction of the situation.

Cultural historical activity theory is based on the concept of cultural mediation: the relationship between subject and her environment is mediated by signs and tools (Vygotsky, 1979). Correspondingly, the central mechanism of learning is *remediation*, the finding and creation of new means. The unit of analysis in studying human mediated activity is an activity system, a community of actors who have a common object of activity with a division of labour and by rules (Engeström, Miettinen & Punamäki, 1999; Leontjev 1978). Activity theory regards the historically developed contradictions of an activity system as a source of change. Engeström charaterized several kinds of developmental contradictions (Engeström, 1987, pp. 82–91).

In the development of artefacts, the contradiction between use value and exchange value is expressed, for instance, as an unceasing struggle for resolution between the demands of functionality and price. Contradictions also arise between the elements of the activity system, for instance, between the established tools or division of labor and the changing object or the projected new outcome of the activity. These developing contradictions first express themselves as errors, disturbances and as indeterminate discontent, which can be called a need state. Transforming them into a recognized problem requires conscious reflection by the participants and a call for remediation and innovative solutions. A clarifying example can be presented from a study on the labour protection inspection work in Finland (Virkkunen & Kuutti, 2000). The enforcement of labour-protection legislation in Finland is the responsibility of eleven district authorities, the Occupational Safety and Health Inspectorates. In these authorities, each inspector used to be responsible for a fixed number of work places and was supposed to inspect them regularly by using a unified checklist developed by the National Board of Labour Protection. The list was designed to standardize the inspection procedure. When the number and intricacy of the technological problems found in work places substantially increased in the 1970s as a result of a new legislation, this division of labour and the means of inspecting became highly unsatisfactory. It was also widely acknowledged that the causes of the health and safety problems remained uncovered. This is an example of a contradiction between the division of labour and long-established tools, and the changed object of the work.

The health inspectorate of Uusimaa developed an alternative model of organizing the inspection work with corresponding new means. Teams of inspectors were established to analyse the risks and safety problems of one industrial area (such as the construction industry) within their jurisprudence. A new set of tools called the *System for Depicting the Field of Activity* (SDFA) was developed and tested. It included a database that served as a common memory for the inspection teams. Instead of only inspecting separate workplaces, industry-wide measures, such as new regulations for scaffolding rental companies, were taken as a result of the analyses (Miettinen & Virkkunen, 2005). A simultaneous re-organization and re-tooling took place as a solution to the dysfunctionality that developed within the inspection system.

This conception of the sources of change and novelty resembles the ideas of the theory of development of technological systems by the historians of technology as well as the pragmatist conception of a reconstruction of habits. All of them find re-tooling (or invention, innovation) as a reaction to the contradiction or imbalance in a system of practice. On the other hand, the concept of artefact-mediation also implies that the development of new tools and instrumentalities (such as information technology), makes the creation of new kind of objects and products possible and calls for, or even demands the re-organization of work.

Distributed Creation and the Networks of Innovation

The ideas of the combining and hybridization of diverse cultural resources or the adoption of knowledge or instruments from foreign practices encountered in novel contexts have been elaborated by psychology of creativity (Koestler's biassociation theory 1978), sociology of science (Ben-David, 1960) and innovation studies. Innovation studies have adopted Schumpeter's idea of a novel combination of elements as a source of radical innovation. During the last few decades, sociology of science (Latour, 1987), sociology of economic institutions (Powell, 1990) as well as innovation studies (Freeman, 1991; Rothwell, 1992) have discovered network interaction as a social mechanism of such a hybridization. The focus on the significance of users (Von Hippel, 1988, 2005) as well as a producer-user relationship as a source of innovativeness (Lundvall, 1988) constitutes a special case of networking. Recently, open-source software development has been regarded as a paradigmatic example both of distributed creation or innovation (Boyle, 2003; Von Hippel, 2005) and of a network form of organization (Weber, 2004).

Actor network theorists (Callon, 1986; Latour, 1987) started to study innovation as a simultaneous and interactive evolution of an artefact and the network of actors connected to it. They focused on the innovators' capability of mobilizing other actors and translating their interests into making their participation necessary. As a result of this focus, the cultural content of the actors' contributions and interactions tended to remain marginal (Miettinen, 1999). Cultural-historical activity theory in turn has focused on the cultural content and learning in the study of networks (Engeström & Escalante, 1995; Miettinen 1999). This theory regards innovation as a process of the shared construction of an object, a mobilization of the necessary and complementary cultural resources as well as a process of mutual learning. Focusing on different aspects of network formation, the points of view of the two theory are complementary. Both of them also focus, as does symbolic interactionism in science and technology studies, on the material objects that mediate the relationships between actors. Boundary objects (Star & Greisemer, 1989), standards (Fujimura, 1992), platforms (Keating & Cambrosio, 2003), databases, computer-based design kits (von Hippel, 2005) and other kind of artefacts and tools make the crossing of boundaries between different cultural domains possible.

In sociology of economic institutions, networks were introduced in the 1990s as an alternative form of economic activity to hierarchy and market (Adler, 2001; Powell, 1990). In their early phases, innovations are composed of open, hypothetical and emerging knowledge that is hard to define in terms of price or well-established routines. In the market, price is a simplifying mechanism, which makes it difficult for the market to exchange novel technological know-how or enhance learning. Nor is hierarchical organization optimal for the purpose. Open, more informal interaction is needed:

> Networks, then, are especially useful for the exchange of commodities whose value is not easily measured. Such qualitative matters as know-how, technological capability, a particular approach or style of production, or a philosophy of zero defects are very hard to place a price tag on . . . The open-ended, relational features of networks . . . greatly enhance the ability to transmit and learn new knowledge and skills. (Powell, 1990, p. 304)

According to this logic, Powell and his colleagues have proposed that the locus of innovation lies ever more in inter-organizational relationships, which they call networks of learning (Powell, Koput & Smith, 1996, p. 119). These relationships are not based on written contracts but rather on the norm of reciprocity, based on the complementarity of the knowledge, resources and interests of the actors.

Noteboom's theory of innovation finds a source of novelty in the transition of ideas and artifacts through several contexts:

> Before we can replace any practice, of theory, technology or organization, we first need to pursue its potential, in a range of

> applications in a variety of contexts. We need to do this in order to build up a motive for change, to discover the limits of validity, and to other indications as to how to change it and what elements to preserve it, and how in a novel practice. (2001, p. 177)

Because the boundary or a gap (the division of labour within organizations) between designer-producer and user prevails (Suchman, 2001), boundary crossing through horizontal networking between people from different contexts or practices is needed.

The most distinctive example of a new network-based model of distributed creation is the open development model in software production (Boyle, 2003; Weber, 2004). It is seen as a paradigmatic case of a network organization or mode of distributed innovation called for by the knowledge-based economy (Castells, 2000) or the information technology revolution (Freeman & Louçã, 2002). In the model the source code of the software is kept freely available. According to licences based on the copyleft principle, users can use, modify and further distribute code and are invited to develop the code further. Linux kernel development is the best-known example of this model. The core of the community comprises Linus Torvalds and 121 maintainers who are responsible for the modules of Linux. In addition, several thousand user-developers participated in the reporting of bugs and in the writing of new pieces of code (Lee & Cole, 2003).[2] This kind of distributed creation is not controlled by an innovator: developers in the periphery select the problems and improvements they want to work with.

The open development model is said to offer advantages over closed, in-house development as a model of the organization of development work (Moon & Sproul, 2002). This has been explained by referring to the quantity and heterogeneity of the programmers and users involved in development. The maxim 'Given enough eyeballs, all bugs are shallow', dubbed 'Linus's Law' by Raymond (1999, p. 41), refers to a quantitative explanation. Raymond also presents a complementary qualitative explanation, the utilization of localized variety or the Delphi effect: 'Because adding more users adds more different ways of stressing the program. . . . Each one approaches the task of bug characterizing with a lightly different perceptual set and analytical toolkit, a different angle to the problem' (1999, p. 43). The variety of skills, the uses for the software and the working environments of the volunteers add extra value to the quality of code (Von Hippel, 2005).

The open source model has been regarded both as a new community-based model of knowledge creation and as a recent example of distributed creation that has long been characteristic of open science, law and education (Boyle, 2003). In his recent book *Democratizing Innovation*, Von Hippel (2005) suggests that open source development anticipates and expresses an ongoing development towards user-community based innovation. The emergence of the Internet and new tools based on information technology such as computer-aided design (CAD), databases and platforms have made this development possible. The heterogeneous needs and capabilities of users can be mobilized to contribute to the design of new products. According to von Hippel, firms will increasingly externalize the development of ideas and prototypes to user communities and appropriate the results in their business without owning them. Red Hat, the vendor of Linux distributions, is a successful example of this business model.

Contingency: The Unanticipated Intertwining of Chains of Events and the Potential Multi-Usability of Artefacts

The theory of serendipity or accidents has persisted in engineering literature and in the folklore tradition of chemistry (Roth-Bernstein, 1994). Royston has argued that 'most of the important discoveries in organic chemistry have been made by accident' (1989, p. xiii). The protagonists of the model have concluded that creative science-making cannot be planned (Merton & Barber, 2004). What, then, are the sources of contingency in a contextual and cultural conception of creativity? The first one is related to the impossibility of predicting the various historical developments that may turn out to be significant for the emergence of an innovation. The second is the basic difficulty of predicting the development of a technical artefact and its future uses (Rosenberg, 1995). Technological and cultural artefacts potentially have multiple uses in diverse activities or domains that are difficult to anticipate (Noteboom, 2001).[3] In the following, examples of both sources of contingency are presented.

An example of the difficulty of anticipating potential uses of a technological system is the emergence of the text message. The development of the specifications for a European GMS telephone system started in 1982. In 1983 Finnish engineers suggested in a meeting that the possibility of sending short text messages via the control line of mobile phones should be included in the specifications (Juurus, 2002). It was only one of the dozens of features included and remained unnoticed and unused for a decade. In the mid-1990s the first cellular phones with the capability for two-way text communication came onto the market. At the turn of the millennium, text messages grew into a major business for operators and constituted a part of daily life for the young. Text messages showed their value and strength during the week after the tsunami catastrophe of the 26 December 2004. It was instrumental in connecting the people in the catastrophe area with their relatives in Europe when other channels of communication were not available. The engineers who suggested adding the 'feature' to the specifications, nor anybody else, could ever have dreamt of such uses for the text-message transmission.

Attempts to formulate a model of creativity or innovation face a basic problem of defining a logic of something that by definition does not yet exist. In innovation studies there is a long tradition of suggesting the critical success factors of innovations (Rothwell, 1992). Although they make sense, they are a limited means of orienting to the future. A distinguished example in innovation studies is Freeman's (1987) attempts to discover the institutional and economic factors of Japanese society that would explain Japan's superior technological and economical development compared with other industrial countries in the 1970s. While the institutional arrangements found were novel and impressive, they did not enable Japan to maintain its competitive edge in the 1990s.

In dealing with the sources of the systemic unpredictability of human affairs, MacIntyre analyses the limits of the idea of organizational effectiveness based on predictability (1984, pp. 106–107). He considers that the inadequacy of this idea is most evident in the case of innovative adaptation. According to Bhaskar (1987), there is an asymmetry between explanation and prediction in the social sciences. What explanatory analysis can do is not predict, but only 'inform our understanding of the present and illuminate projects and strategies for the future' (Bhaskar, 1987, p. 219).

The Possibility of the Management of Creativity

In the philosophy of science the problem of creativity was dealt with by drawing a distinction between the context of justification and the context of discovery (Reichenbach, 1938). The mainstream philosophy of science worked to define the method of science, that is, a general way of defining the objectivity of scientific statements and theories. In contrast, it regarded the task of finding a logic of discovery to be hard or impossible. Philosopher Marx Wartofsky thinks that a logic of discovery cannot supply an explanatory theory of invention, but, rather, a suggestive logic: 'An account of examples, of actual exercises in judgment given specific boundary conditions, or problem situations, or a reconstruction of historical cases' (Wartofsky, 1980, p. 15). In the same vein the historian of technology, Hughes constructs this logic in analysing historical cases of inventors' activities: 'The exploration of case histories . . . that analytical interpretation does bring credible – and not simplistic – order out of a chaos of facts' (Hughes, 1978, p. 180).

The emerging cultural view of creativity delineated in this article cannot be directly applied to management. However, the ideas developed by several research traditions do have implications for the management of creativity. The domain specificity of creativity calls for the mastery of the specific knowledge and practice of a cultural domain. It requires following up on the scientific, technical and economic developments as well as on the user activities of a domain. This task has been discussed in management literature in terms of developing core competencies and absorptive capabilities (Cohen & Levinthal, 1990).

A vital question in managing creativity is related to the mobilization of heterogeneous cultural resources within domains and across the boundaries of domains. This will take place in horizontal networks that cannot be managed in the ways characteristic of the market and hierarchical organization. The development of information technology, especially the Internet, is rapidly giving rise to new forms of distributed creation and new types of communities. This development is still in its early stage, and new technologies have unprecented pontential for novel uses and organizational forms. Therefore, it is vital to learn from the organizational principles and critical problems of the open developmental model and other forms of Internet-mediated activities. The means (boundary-crossing artefacts) and rules of distributed creative work, such as the uses of the Internet, computer-based platforms, adequate forms of recognition and new types of agreements, including licences, should be understood far better than now and developed further to foster distributed creation.

Some scholars think that necessary contingency creativity implies methodological irrationality, that is, the impossibility of the planning of creative activity (see Klages, 1967;

Merton & Barber, 2004). This position does have a point: it underlines the limitations of the methods of rational planning, such as ROR (Return on Research Index), that have also been applied to research and developmental activities since the 1960s. Some of the researchers look for the solution from abduction, a logic that Charles Peirce suggested for the formulation of new hypothesis and ideas. I am, however inclined to agree with Wartofsky, McIntyre and Bhaskar about finding a set of domain-specific analyses of current and emerging developments as the central way of learning about the changing conditions of creative solutions.

Such terms as the 'information revolution', 'network societies' and the emergence of new kinds of Internet-mediated communities have been used to characterize the general direction of change in society and economic life. However, this change will assume content-specific and varied forms. The challenge for the management of creativity is to develop adequate means of studying and learning from the emerging problems, possibilities and patterns of conduct in these local activities. Instead of best practices, suggestive, potential or germ forms of new practices may be found to further the development of creativity.

Notes

1 Frederic Holmes, for instance, formulates the necessity of multidisciplinarity in the study of scientific creativity as follows: 'The study of creative scientific activity belongs to no single discipline. History of science, philosophy of science, sociology of science and cognitive psychology are all prominent among the fields to claim to provide accounts of the processes involved' (1989, p. 44).

2 Lee and Cole (2003, p. 641) estimated the number of contributors by extracting the e-mail sent messages in the years 1995–2000 that included the words 'oops' and 'patch' in the subject headings and calculating the number of senders. They concluded that there were 1,562 bug reporters and 2,605 developers in the periphery of the community during that time.

3 Historian of technology Edward Constants states: 'Except for the most trivial . . . of sense, technology of itself is both indeterminant and indeterminate. Neither its consequences nor its future development can be reliably predicted only from its prior development. Nor can any finite list of ex ante circumstances predict its future course' (1989, p. 455).

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