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The Richness of Diversity in Knowledge Creation: An Interdisciplinary Overview

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Abstract: The goal of this article is to explore some of the main reasons that sustain a distributed approach to Knowledge Management, and this will be done, first, showing how, according to very different theoretical disciplines, knowledge diversity is proposed as the very source of organizational innovation and adaptability; second providing some evidence coming from major applicative domains; third proposing some considerations on the role of technology.

Keywords: Distributed Knowledge Management, Evolutionary Theory, Theory of Complexity, Communites of Practice, Cognitivism, Constructivism, Semantic heterogeneity, Structuration Theory
Categories: A.0**,** A.1, H.1.0, H.1.1, K.4, K.6

1 Introduction

Although knowledge has been claimed as the new core asset of organizations, the managerial practice that has been proposed as a means to exploit its value (Knowledge Management) still hasn't demonstrated the expected benefits. According to a distributed approach to KM (DKM) [Bonifacio, 00], such failure is not due to technical reasons, but rather to the very assumption underlying current KM systems; that is, knowledge can and must be centralized through standardization. The most spread technological architectures, organizational models, and managerial practices in the domain of KM are consistent with this view [Bonifacio, 02b]. On the other hand DKM assumes a perspective that views knowledge as a distributed matter that should be organized accordingly. Technologies, organizational models and practices must be designed in order to allow and support "distributedness" which is seen not just as a constraint to deal with, but also as an opportunity to generate value. As a consequence organizations, when viewed through the lenses of knowledge, appear as networks of autonomous communities that are engaged in a double faced process of consolidating within, and bridging across local "knowledges". As we propose in this paper, such a view is consistent, from a theoretical perspective, with a variety of disciplines that have attempted to explain the very nature of organizational learning. From a practical perspective, it is sustained by the evidence that competitive advantage is increasingly rooted in the capacity of organizations to enable and manage, rather than reduce, heterogeneity and specialization. Finally, although technology is still perceived as a means to reach standardization and control of knowledge, technological waves –such as the internet- and trends –such as peer to peer technologies- are clearly going in the opposite direction; winning technologies are increasingly those that are based on distributed architectures and business logics.

2 Diversity in Theory

A wide range of theoretical disciplines have proposed, from different angels, the valuable role of diversity in sustaining knowledge creation. The evolutionary metaphor has been widely applied to organizational studies and, in particular, to the dynamics of organizational learning [March, 91]. Here the double faced process of variety generation and selection has been related to the learning dynamics of *exploration* and *exploitation*. Knowledge is seen as the capability of a complex system to give appropriate responses to environmental stimuli. Within a changing and turbulent environment, such capacity depends not just on traditional response improvements –same stimulus, better response-, but increasingly on the generation of alternative responses –new stimuli, new responses-. Seemingly, an organization in order to learn, must not just support the process that consolidates existing knowledge (exploitation), but also enable the generation of new and unforeseen answers; new and alternative practices, mental models, and languages are necessary in order to adapt to changing conditions. While the former process focuses on continuous adaptation and improvement, the latter on discontinuity and innovation. In this sense, the availability of different and heterogeneous “knowledges” can bee seen as a set of ready to use “alternative answers” that an organization, as an organism, can give when facing new and unforeseen environmental situations.

A similar concept can be derived by the study of complexity, and in particular by the notion of *requisite variety* in organizations [Ashby, 56]. Here an organization is seen as a system that has to manage the trade off between the need of stabilizing its “internal” processes, and the one of answering to “external” environmental complexity. An organization is seen as a “complexity selector” that has mainly the goal to filter between external stimuli which are relevant to its survival and those which are not. In fact, on the one hand higher levels of internal complexity generates losses in control, on the other is required in order to match the demands of increasingly dynamic markets. As an example, in the paradigmatic case of car industry [Rullani, 1990], until product differentiation wasn’t a key success factor such as during the Fordist Era, production processes could have been designed with a high degree of rigidity. As soon as the market became more complex and segmented, product differentiation became a critical success factor and, as a consequence, internal industrial processes had to become more flexible “incorporating” increasing levels of complexity. From this perspective it’s proposed that the more the external complexity increases, the more the organization needs to internally incorporate an increasing level of variety. In terms of knowledge, the stabilization of knowledge through standardization seems to be in direct contradiction with the evident quest of complexity posed by the current competitive environment.

The need to preserve heterogeneity is more valuable if we consider the constructive nature of the environment proposed by the phenomenological-cognitivist school of thought in organizational studies, and in particular with the notion of “enactement” [Weick, 79]. Here the availability of “alternative interpretations of the world" is not merely seen as a constraint to deal with in order to adapt to a changing environment; rather is proposed as an opportunity to "create" (or enact) new possible worlds in which, ex-post, such interpretations can be defined as "true". This perspective assumes that a clear and well defined world "out there" doesn't exist. Continuously organizations face markets that are to be actively "created" rather than passively described. An example which became increasingly relevant during the last decades, is given by those technologies whose success depends on critical mass factors. Home video, computers, operating systems, communication protocols, security standards and so on, are all examples of technologies whose success depends on adoption rates rather than technical performance. The well known success stories of Microsoft's operating system versus Linux, or VHS versus Betamax, all underline the same conclusion: "a good technology is the one that is adopted" instead of "adopted technologies are good ones". Rather than assuming as an explanation some form of consumer's ignorance or irrationality, it seems more reasonable to consider that users valuate the parameter of "social adoption" more than the one of "technical superiority". Adoption means a wide set of positive externalities such as interoperability, the availability of services and related products, and social certification of usability. These situations are better explained assuming a constructivist view of the business environment. Designing a valuable product is not a matter of describing correctly an external market; rather is a question of enacting the right market. From this perspective, partnerships, agreements, cooperation, and alliances are seen as attempts of an organization to establish, rather than accomplish, the right environment. Alternative "knowledges" are then proposed as the cognitive source that can ideate such possible realities.

While constructivism has inspired the notion of enactment, the work on language of the philosopher Wittgenstein has inspired the idea that an organization is a constellation of linguistic communities continuously engaged in "language games" [Boland, 95]. Here knowledge creation is again proposed as a double faced process: one the one hand the intra-community process of *perspective making* views communication as non-problematic, and existing knowledge is consolidated through the refinement of local interpretative repertoires. On the other hand, the inter-community process of *perspective taking* views the attempt to exchange knowledge across different "interpretations of the world" owned by different communities; communication becomes problematic since dialogue must take into account the exploitation of heterogeneous interpretative assumptions. From an organizational perspective, while the former process has been related to the notion of "continuous improvement", the latter has been defined as the basic source for "innovation". According to this perspective, protecting linguistic heterogeneity is a need the more knowledge improvement is required, while the enablement of linguistic interoperability (and not standardization) is a need the more the focus is on knowledge innovation. A growing attention to the latter process seems quite consistent to the trend, started during the '80s, to foster product and process innovation through the introduction of a wide set of new organizational metaphors such as team working, brainstorming, inter-functional cooperation, process oriented reengineering, and project management. All this organizational interaction and design practices are proposed, more or less explicitly, as means to generate discontinuities in the way people interpret the business environment. Open *dialogue* across different *mental models* [Senge, 90], and reasoning on current consolidated *theories of action* through *double loop learning* [Argyris, 78], are cornerstones of managerial methodologies focused on fostering innovation within increasingly turbulent and complex business environments.

A similar famous argument is proposed from a social perspective by the ethnometodologist school [Mead, 34], and in particular by those researchers that focused on the more recent idea of *communities of practice*. Starting from the American pragmatist philosopher Dewey, knowledge is seen as practice which is intuitively defined as the actual, embodied, practical way of “doing things”. A business reading of such theme has interpreted this concept as the base of a distinction between formal -or explicit- and informal -or implicit- knowledge, whereby the latter can be transformed into the former [Nonaka, 95]. A more precise analysis shows a quite different angle: knowledge is always a practice, and what we call formal or scientific knowledge is a particular practice rooted into the myths of science (management) and the identities of scientists (managers) [Brown, 91][Lave, 90]. A major consequence is similar to the one proposed by the previous authors; the evolution of organizational knowledge is given by an interplay between the consolidation of local practices within the boundaries of communities, and the establishment of “boundary practices” [Wenger, 98] able to bridge (and not standardize) meanings across communities through negotiation. Again, Brown and Duguid define boundary encounters between different communities as the origin of organizational innovation.

Such a vision that privileges diversity rather than standardization, and envisions the exchange of knowledge as a process of “mapping across diversities” rather than establishing a common language, is well rooted also in philosophy of science, linguistics, cognitive sciences and AI. In particular we underline that one of the main debates around the philosophy of science has proposed that knowledge evolution is rooted in the interplay of dynamics within and across paradigms [Kuhn, 70], or that every knowledge, such as “natural sciences” or “management sciences”, is a “tradition” that competes and judges other traditions [Feyerabend, 78]. Similar arguments are proposed in cognitive sciences and linguistics when dealing with role of mental models [Johnoson-Laird, 92], mental spaces [Fauconnier, 85], conceptual spaces [Gardenfors, 00], in meaning formation; in the domain of AI such a view is clearly defined in the theory of contexts and local models semantics [Giunchiglia, 00].

3 Diversity in Practice

The fact that heterogeneity is an opportunity instead of a limit, is not only a theoretical claim as shown in the previous section, but also a practical evidence. This is easily observable by analysing business processes, structures and models in several application domains. In this section we will discuss some real business cases in which the authors are directly involved both in terms of organizational analysis and systems design. In such cases, the request to manage differences and diversities is not only due to a mere need to solve contingent problems or get to established goals and results, but rather a mean to support innovation and knowledge creation processes.

The first case comes from the public sector and, in particular, from the healthcare domain [Molani, 02]. Here different actors, like hospital doctors, home doctors, nurses, technical and administrative staff and patients themselves, have to cooperate in order to achieve the main goal of healthcare organizations, that is, having patients well treated. It is quite evident that such cooperation is an answer not only to a mere quantitative demand -the amount of time needed to reach the goal would be too much expensive for just one actor- but also to a qualitative one: different competencies, distributed over a set of experts and specialists, have to be collected in order to have patients well treated. This is true also for the wide set of artefacts that have to be involved, such as the clinical reports produced by each ward dealing with a patient careflow, public guidelines and hospital protocols, the most updated scientific studies, lab and legal data, and administrative information. These resources show both an “objective“ heterogeneity, such as different formats, different geographical locations and different languages, and a more “subjective” one, dealing with the different reasons why several actors access the same resource. Consider for example the case of an administrative staff member who, in order to compute patient expenses, needs information on a lab test result and, at the same time, a surgeon needs the same data in order to set the right therapy. Even if data are exactly the same, meaning, interpretation, and data organization strongly depends on the actor who accesses it. In such cases, heterogeneity is not supported by specific tools: all the data are collected in just one folder, which is the patient clinical record, that could then be accessed by the actor that needs them. The collection doesn’t follow any particular logic, neither the administration’s nor the surgeon’s one, but just a very general and common parameter which is the chronological entry of data. Obviously, the time and the efforts needed by each actor to find out the right data in such a wide and unorganized folder, which doesn’t provide any logical help, is definitely a lot, and often too much in order to get the work done in time. A very interesting and practical solution to this problem is being experimenting by a ward of the Hospital of Udine (Italy): for each new patient, a brief and specific Clinical Record is produced by a specialized nurse who first extracts from the big folder only the data relevant for the surgery operation and then reports them in a record specifically designed according to the surgery needs. In other words, the nurse translates the neutral clinical record in a resource which is meaningful just from the surgery’s point of view. Following this idea, the hospital Chief Knowledge Officer is thinking about a solution in which the neutral and general clinical report is completely substituted by local ward reports where data are organized according to each ward’s perspective. The coordination among each ward would be guaranteed by some translating rules (like the ones created and followed by the nurse we mentioned above) which map the same data onto different local reports[1].

Another interesting business case regards the B2B sector and, in particular, digital marketplaces and e-procurement [Bonifacio, 03]. In order to coordinate different procurement and supply processes, marketplace participants need to share heterogeneous information such as products and services catalogues. To overcome this barrier, they are thus asked to map their own information structures onto standard conceptualizations such as universal products and services catalogues (to map product

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[1] A first experimentation of a technological system which supports the collaboration among different healthcare professional communities is being done by the EDAMOK project [EDAMOK] at the Hospital of Udine (Italy). The solution will provide each community with an automatic system able to discover and record the mappings among the different perspectives through which data is used and organized by different actors.

and services descriptions) and process definition schemas (to map information needed in order to execute transactions). Typically, marketplaces are intermediaries that have the goal to facilitate such standardization process. Although during the eBusiness hype marketplaces have been proposed as the optimal solution to foster efficiency and dynamic business integration, reality have shown something different. The assumption that standard catalogues can substitute local ones has been neglected by the simple evidence that on similar business domains, different competing standards are available [Ding, 02]. Moreover, company buyers have difficulties in adopting classification standards that are too complex and generic if compared to their simple and task specific ones. This is true the more we consider that local conceptualizations are not just the mere result of cultural/historical differences, but rather the consequence of different, substantial, valuable ways of doing things. An alternative solution to the problem of integrating catalogues is to support a direct matching among local ones, without using any external standard. This is allowed, for example, by using matching techniques able to find mappings between different structures. One of these techniques is a matching algorithm developed within the EDAMOK project [EDAMOK] and tested by a well-known world wide telecommunication company. The situation, very frequent in the eBusiness environment, involves a company business unit that was asked, by the headquarters, to buy products and services using the catalogue adopted within the firm wide eProcurement platform. The unit's catalogue was different from the platform's one, mainly for task oriented reasons. The business case scenario assumed that, instead of adopting the centralized catalogue, the unit should have rather mapped its own catalogue onto the standard one. As a consequence, buyers of the unit could have continued to use their own catalogue when purchasing products and services. The successful result of the experimentation[2] suggests a scenario in which heterogeneous actors that need to buy products and services on-line, instead of adopting huge, generic, and hard to maintain standard catalogues, could benefit from solutions in which local, specialized, and flexible catalogues are mapped (even automatically) one to each other. Here, through the use of matching techniques that automatically discover the correspondences between different catalogues, a distributed marketplace allows to maintain and support the different "knowledges" that underlie the heterogeneous needs and offerings of buyers and sellers.

A third business case deals with inter-organizational cooperation and, in particular, refers to the Balearic Island Tourism system Here the problem is how to support the collaboration among a set of public and private entities, all involved in promoting a sustainable development of tourism. Planning sustainable development means taking into account different information that belong to different domains such as economy, socio-politics, and ecology. Information is produced by different entities involved in the Balearic touristic system such as the University of Balearic Islands, the local government, the Balearic Institute of Tourism, and the Foundation of the Balearic Islands for the Innovation of Technology. Obviously in order to get to a common view and approach on what is a sustainable development for tourism, and on how to promote it, they need to share information and work together even if each has

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[2] In particular, 70% of the item was rightly classified, 22% hadn't been classified, and only the 8% was wrongly classified [Bonifacio, 03].

its own goal and task to achieve. A way to provide a solution is to use a typical knowledge repository, like an extranet portal, where all the relevant information are stored and organized in an easily accessible way. But this solution has immediately showed a set of limits: questions arose on how to design a repository categorization model able to represent and satisfy the different needs; how to have a system flexible enough to allow new partners (like the School of Hotel and Catering management, or the department of the Higher Diploma in Tourism) to join later without re-designing the whole portal; how to manage in a flexible way the fact that a user may want to share some project resources with her own organization and some others with members of other organizations, without dealing with more then one technological environment.

An alternative solution is the one proposed by the SWAP project [SWAP], and is based on the possibility for users to keep on using their local environments, repositories, categorization structures and technologies, and to support knowledge exchange and coordination processes enabling semantic interoperability across different ontologies, and the creation of trust networks by using peer to peer technologies[3].

4 Diversity in Technology

KM has given a major role to technology mainly because of the dramatic impact that ICTs had on the cost of communication, and on the brake down of communication barriers. Besides this obvious argument, KM technologies have been proposed as a neutral tools whose architecture doesn't impact on knowledge flows but rather on aspects such as performance and scalability of KM systems. In this sense, the selection of a centralized instead of a distributed architecture, has relevance in terms of technical rather than conceptual feasibility. The underlying assumption goes directly to a traditional "conduit" view of knowledge, which is composed by pieces of information that have to be managed efficiently [Boland, 95]. As a consequence, a centralized technology is judged as highly controllable and efficient but prone to critical points of failure. On the other hand a distributed technology is typically redundant and anarchic, but immune to brake downs. From this perspective, highly distributed technological phenomena such as the internet, are mainly to be explained by technical, rather than social, reasons.

Another perspective, that goes back to the structurationist school [Giddens, 84], has analyzed the relationship between technological architectures and social structures [Orlikowski, 91]. Here the myth of technology as a neutral vehicle of knowledge is deconstructed showing how, on the one hand, people tend to shape the use of technology according to their practices, and, on the other hand, technology embeds practices that management wishes to impose on social structures. In this direction, interesting studies have been carried examining how flexible technologies prone to social adaptation, such as Lotus Notes, have been successfully implemented when architecturally shaped in a way that was consistent to the organizations' social

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[3] A first pilot is currently in progress in collaboration with EDAMOK and adopting KEx, a peer to peer knowledge exchange platform developed by the EDAMOK project. For more details see [Bonifacio, 02a].

structure. Conversely, socially inconsistent architectures have been adopted when management was able to shape the social process imposing new interaction models. Assuming the distributed nature of knowledge, through the structurationist perspective we derive three conclusions about the use of KM technologies. First, given a technology that assumes knowledge as a centralized process, such technology will be probably not used by people that will continue to engage in the distributed process of knowledge creation through other means of communication (e-mail, coffee breaks, etc.). Such effect is confirmed by a well known trend that affects the implementation of centralized Enterprise Knowledge Portals; after a first phase in which usage is sustained by enthusiasm, people tend to desert the system that falls into a perverse cycle of no-valuable-content, no-use [Bonifacio, 00]. Second, if used, the KM technology falls into the paradox of minimizing the possibilities of creating knowledge. In fact, following our previous arguments, such a technology would have reached the goal of reshaping the distributed social process in favour of centralized one. Through diversity reduction the system would have increased standardization and control while reducing, as a side effect, adaptability and innovation. Last, these arguments shall suggest that an appropriate KM technology must support on the one hand the autonomy of knowledge communities in building and consolidating local content management practices (i.e. local category schemas, validation cycles, membership policies, etc.). On the other hand, it should support knowledge interoperability without assuming that standardization is the only form of coordination (i.e. semantic interoperability, cross-certification, application integration, etc.). Observing current technology use, while autonomy is actually managed by people through the daily use of heterogeneous and task specific local technologies (i.e. e-mail, databases, web sites, etc.), coordination is still a challenge that needs an answer. In this respect, we underline how some current research projects are trying to address this topic either from scratch, such as the EDAMOK project [Bonifacio, 02a][EDAMOK], or also as a natural evolution of a debate around the role of ontologies, such as in the case of SWAP [Fensel][SWAP]. Moreover, we underline how technology trends, such as peer to peer and distributed content management, are moving towards an approach to “distributedness” which is no longer seen as a technical feature but rather as a source of value.

5 Conclusions

In this paper we proposed some theoretical, practical, and technological arguments in favour of a distributed approach to KM (DKM). In particular we strongly sustained how knowledge diversity is a source of value and, on the other hand, we intentionally ignored the obvious value that resides in centralization for two main reasons. First, because we believe that environmental trends are evolving towards situations in which the value of discontinuity and innovation is higher than the one originated by consolidation and improvement. Second, because we observe how, besides such environmental evidence, managers, technologies, and researchers are still over committing to a view that privileges centralization. If standardization is valuable in terms of control, managers should also take into account the importance of sustaining a proper level of internal diversity as a means to foster adaptability and innovation. In this sense, we conclude proposing a perspective on KM as a managerial practice whose main goal is exactly to balance a very complex trade off between the need to control through centralization, and the one of supporting innovation enabling knowledge autonomy and coordination.

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