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TOWARDS A MECH-ORGANIC PERSPECTIVE FOR KNOWLEDGE SHARING NETWORKS IN ORGANIZATIONS

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Abstract.

We suggest that the development and sustainability of Knowledge Sharing (KS) networks requires an understanding of the interplay between Organizational structure (OS), communications network and KS practices in organizations. We suggest that the application of a fundamental social theory (e.g., The Elementary Theory of Social Structure) is a useful paradigm for understanding the development and management of KS networks from both a theoretical and an applied perspective. We argue that organizations need to design and manage legitimate network (i.e., formal) structure so that it can promote both the development and sustainability of shadow network (i.e., informal and "tacit") structure. A Mech-Organic Perspective (MOP) based on an understanding of the mechanical (i.e., theoretical and/or applied) and organic (i.e., conceptual and/or subjective) components of communications network is introduced. Implications of MOP for the study, design, and management of learning organizations are discussed.

Keywords: Knowledge Sharing, Social Networks, Shadow Networks, Mech-Organic, Elementary Theory, Synthetical

1.0 Introduction and Background

With the advent of new technology, the management of organization is increasingly becoming more complex. Managers at all levels of the organization must have a deeper understanding of interactions between the individual, group, and organizational level. This has been caused by a climate within and between organizations that has become more competitive as a result of increased accessibility to information (Drucker, 1993). This has created a need for the managers to become

better at identifying valuable information and managing the social capital via which it is both produced and shared. We propose that these changes in the competitive environment require a more eclectic approach to the management of social capital and social networks within organizations that is potentially more *co-adaptive* (Grisogono, 2006). This approach separates itself from others in that it requires managers to have skills common to both *academicians and practitioners*.

Recent developments suggest that a sustainable competitive and so *co-adaptive* advantage requires a more "organic" perspective as opposed to a traditional "mechanistic" perspective on general management strategy (Farjoun, 2002). The mechanistic perspective is rooted in "Newtonian mechanistic logic" and applies to a stable, relatively static, and predictable world while the organic perspective is rooted in the social and natural sciences and applies to a changing, fluid, and potentially unpredictable world (Farjoun, 2002). The critical difference between these two perspectives is in their core assumptions about time, flow, and how to integrate theoretical and conceptual models. In terms of time, the mechanistic perspective focuses on single occurrences and related variables at a fixed point in time. Conversely, the organic perspective views relationships as part of a continuous and iterative process. In terms of flow, the mechanistic perspective views events as linear and deterministic. Conversely, the organic perspective views flow as more of an interactive, co-adaptive and reciprocal process.

We consider the term *mechatronics* as originally *coined* in the late 1960s by the Yaskawa Electric Company (Japan) and derived from the *synergy* achieved in *adapting* and integrating mechanical and electronic technologies (Harashima, 1996; Kyura, 1996). Grimheden and Hanson (2001), suggest *mechatronics* as the '*synergistic* combination of precision mechanical engineering, electronic control and *systems* thinking in the *design* of products and manufacturing processes' (Comerford, 1994). We posit *Mech-organics* or *Mechorganics* similarly in terms of 'the *synergistic* combination of *civil* mechanical *systems* engineering, social network dynamics, ICT and the management of *interconnected* knowledge, information (and data) *infrastructures* in the *designing* and *composing* of *adaptive* (resilient and sustainable) organizations'. After Dahlgren (1995) and Grimheden & Hanson (2001), we consider *Mechorganics* to be an *emerging* academic subject already taught

separately (not as whole) and which 1) has a thematic *systems* identity (defined by its *networked* disciplines) and 2) could be given a *functional* education and taught formally.

Below, a Mech-Organic Perspective (MOP) on KS systems is introduced. MOP allows for a co-adaptive advantage to be gained through a more economic allocation of managerial resources. MOP requires one to be able to develop (1) theory built from tangible, clear, and validated assumptions (i.e., be an "academic") and (2) concepts and a tacit understanding built from practical experience (i.e., be a "practitioner"). It is suggested that a minimal amount of attention should be allocated to those behaviors that can be reasonably predicted (i.e., given relatively "static", but valid, assumptions) and a maximum amount of attention should be allocated to behavior that cannot be reasonably predicted (i.e., given relatively "fluid" and ad hoc assumptions). MOP is based on the premise that *theory* is solely based on *validated* assumptions. Properly developed theory can then be used to predict – albeit with limited certainty and application to – behavior within organizations. Therefore, it is to be concluded that the mechanistic component of MOP is built on and defined by theory, whereas the organic component of MOP is built on and defined by that which theory does not directly address, but can be approached with some "certainty" given practical experience.

To demonstrate this approach we apply MOP to the issue of how to manage Knowledge Sharing (KS) systems within organizations for an optimal return on investment in social capital. KS in organizations refers to the transfer of knowledge among individuals, groups, communities or systems (Davenport, 1998; Hansen, 2001; Alavi, 2001). Previous studies suggest that OS plays an important role in leveraging Information Technology (IT) infrastructure for facilitating knowledge sharing within different sub-units of an inter-organizational network (Pidduck, 1999). Therefore, use of organization structure (OS) or networks in helping organizations share or pool knowledge is considered vital for facilitating effective KS (Earl, 2001).The assumption here is that people exchange and share knowledge interactively, often in non-routine, personal, and unstructured ways as independent work. Encouraging socialization as a mean to KS is also seen as critical for facilitating KS in organizations (Earl, 2001; Hossain, 2002b). Consequently, nurturing and utilizing

social capital that develops from individuals interacting formally or informally is considered central to facilitating KS (Nahapiet, 1998). For example, Communities of Practice (CoPs) received a high level of success in facilitating KS activities in organizations (Brown, 1998). CoPs refer to groups of people informally bound together by shared expertise and passion for a joint enterprise (Wenger, 2000). A CoP may or may not have an explicit agenda and communicate in an informal setting or via email networks.

Below, the mechanistic component of MOP is demonstrated through the application of Network Exchange Theory (NET) and Elementary Theory of Social Structure or (ET) in order to develop an understanding of the complexity of KS in organizations. NET advanced by Markovsky, Willer and Patton (1988) provides a basis for understanding the differences in the resource accumulations of positions in interconnected groups of actors. NET is considered as an outgrowth of the ET (Willer, 1981). Understanding of the mechanics of exchange, conflict, coercive relations is central to the ET (Willer, 1987; Willer, 1981). We show how an understanding of how OS effects informal and formal communication between the members of different sub-units of an organization can aid in the development of sounder management strategies.

The complementary organic component of MOP is demonstrated through an illustration of how one might build a conceptual understanding of the types of communications network, which support explicit and tacit KS within the sub-units of an organization. Specifically, we highlight how the mechanics of ET can be applied for more effective acquisition of practical knowledge that is specific to a given organization. The power of this approach is demonstrated through case examples from companies such as the Canadian Federal Government (Bourgault, 1993), DuPont (Norling, 1996), Dow Corning (Easton, 1998), Amoco Exploration Production Technology Group, Buckman Lab (Boykin, 1998) and Nucor Steel (Gupta, 2000).

The research gap we identify may be considered against the potential end of one age – the “Computer (sometime referred to as the Digital and / or Information) Age”, during which time the emphasis has been upon automation, digitisation and “taking the human out of the loop” – and the beginning of a new age. The Kuhnian type step-

change we envisage may be one of 'intellectually violent revolution' (Kuhn, 1996), when the emphasis moves back towards knowledge sharing (KS) and properly *synthesising* the analogue with the digital; the social with the technological and the organism with the machine, see Mintzberg (1979) and Ropohl (1979). We do not see this as an "either/or" – for example 'a reversion of digital data back to an analogue form' (Bollacker, 2010) or some form of 'Golem' warned of by Wiener (1964). Instead, we see this as a *synthesis* of the two and "designing humanity back into the loop" – hence *Mechorganics*. In other fora, this has been suggested as possibly being the start of a 'new *Synthetical* Age' (Reay Atkinson, 2012).

The aim of this paper is to "consider Knowledge Sharing (KS) networks and the interplay between Organizational Structure (OS), communication networks and KS practices with regard to: (1) applying a fundamental social theory for understanding the development and management of KS networks; (2) designing, modeling and managing legitimate and shadow network structures and (3) developing a Mech-Organic Perspective".

The paper is divided into four sections. In the first section, a review of the literature on organizational design is presented. Then, we provide a description of the literature on communications network and discuss the direct relationship between organizational design and communications network that form within organizations. Thirdly, we introduce ET and discuss its potential application to an organizational setting. Finally, we provide a critical examination of MOP by (1) demonstrating how one might apply ET to an organizational setting in order to validate and/or build theory (i.e., a mechanical approach) and (2) showing how one might complement the mechanics of theory building by using what is learned to guide the acquisition of practical knowledge specific to the management of shadow networks (i.e., an organic approach).

2.0 The Organisation of Knowledge Sharing

Understanding how knowledge is captured, stored and shared requires an understanding of the organization of knowledge sharing. In this section, we first discuss the different perspectives of organization and its forms. Secondly, we explore the relationships between organization, its structure and communications network for

KS. Thirdly, we highlight the need for understanding the distinction between legitimate (e.g. formal) and shadow (e.g. informal) for the development of KS in organization and conclude that Elementary Theory of Social Structure is a useful paradigm for understanding the design of a KS in organizations.

Communication network structure serves as a basis for understanding KS in an organizational setting (Hossain, 2002b). Previous studies suggest that communication network structure provides insight about the communication patterns of individuals working in an organization (Wigand, 1988) and therefore, needs to be viewed as an essential part of the design of KS systems in organizations. Therefore, the design of the KS structure should be based on the study of the existing communication structure. Communication networks may suggest how individuals, groups, communities or systems interact in an organization and can be used as a basis for KS process of an organization (Davenport, 1998; Hansen, 2001; Alavi, 2001).

We suggested earlier that an organization can be viewed as a person or a group of people united for some purpose. Mintzberg (1979) suggests that OS has both the formal and informal structure. Formal OS is usually represented by the organization chart and widely accessible by the internal and external members. It is also suggested in the organization science literature that every organization is a network of people (Cyert, 1963; Mueller, 1996; Charan, 1991; Nohria, 1992; Stacey, 1996). Therefore, communication networks are increasingly seen as a useful mechanism for understanding of the informal OS for knowledge sharing (Hossain, 2002b). For example, Granovetter's *theory of strengths of weak ties* suggests that informal or casual acquaintances may provide useful insights or new ideas for the organization, which promotes organizational learning (Granovetter, 1973). An analysis of the communication network can help us in understanding the information exchange, patterns, coalition and power of the individual members in an organization (Wigand, 1988; Bonacich, 2000).

A differentiation between formal and informal OS can be drawn by looking at the types of interactions, or links, among individuals or agents in an organization where the legitimate network refers to formal structure and the shadow network refers to the informal structure of an organization (Stacey, 1996). In the legitimate network,

interactions or links are either (i) formally and intentionally established by the powerful members of the organization or (ii) established well-understood, implicit guiding principles, which are accepted by the members of the organization (Stacey, 1996). On the other hand, the shadow network consists of links that are spontaneously and informally established by the individuals among themselves during the interaction process in the legitimate system (Stacey, 1996). We argue that the KS system needs to be designed by conducting a thorough requirements analysis of both the legitimate and shadow network. This is important as a legitimate network may provide a normative view of how individuals should share knowledge while communication network analysis of shadow networks will assist KS system designers in understanding the functional and empirical-descriptive view of individual agents' communication patterns.

Polany (1975), Nonoka and Takeuchi (1995) suggest two broad categories of knowledge--explicit and tacit. Knowledge that is expressed in words and numbers and shared in the form of data, scientific formula, specifications, manuals, and the like is referred to as explicit knowledge (Hossain, 2002b). On the other hand, knowledge that is highly personal, hard to formalize, and difficult to communicate or share with others is referred to as tacit knowledge (Hossain, 2002b). Subjective insights, intuitions, and hunches fall into this category of knowledge. Tacit knowledge is deeply rooted in an individual's actions and experience, as well as in ideals, values, or emotions he or she embraces.

Organizational networks for KS need to be looked at from both a macro and micro perspective. From a macro level, organizational networks can be divided into two (Mueller, 1996)broad categories--legitimate and shadow network structure (Stacey, 1996). The distinction between the two macro level network structures can be seen from the generic definition of formal and informal organizations (see Mintzberg (1979)). Organization network structure from a micro level can be classified as--content, situational, and work flow (Norling, 1996). A DuPont case study by Norling (Norling, 1996) highlights that interest or focus on a common area of knowledge provides the bonding among people for the content network. For example, different individuals may form a network to discuss and share information about corporate policy, about privacy issues for financial records.

Situational networks can also be referred to as common-role or common-condition networks. Situational network is a common situation—an interest in discussing issues related to that situation (Norling, 1996). For example, individuals may form a network when they have a common ethnic background, are members of a particular professional society, or share very similar job responsibilities. Work flow network deals with the individuals responsible for running a work process. For example, the function of hiring new people, purchasing, carry out various human resources activities fall under this category. It is also highlighted in studies that development of an effective social ecology is crucial for ensuring effective knowledge sharing activities in an organization (Gupta, 2000). Here, social ecology in its broadest term can be referred to as the social system in which people operate (Gupta, 2000). It drives an organization's formal and informal expectations of individuals. It further defines the types of people who will fit into the organization, shapes individuals' freedom to pursue actions without prior approval, and affects how people interact with others both inside and outside of the organization (Gupta, 2000).

Studies suggest that tacit knowledge is deeply rooted in an individual's actions and experience and therefore understanding how individuals act and their relationships with other actors within the social relation is vital for the sharing of tacit knowledge (Polanyi, 1975; Nonoka, 1995; Hossain, 2002b). It is argued here that the legitimate system network of an organization is more effective in facilitating the sharing of explicit knowledge and the shadow system network can be used as a basis to understand the flow of tacit knowledge. Therefore, we apply Network Exchange Theory (NET) and Elementary Theory of Social Structure or (ET) to develop an understanding of the complexity of KS in organizations. NET advanced by Markovsky, Willer and Patton (1988) provide a basis for understanding the differences in the resource accumulations of positions in interconnected groups of actors. NET is considered as an outgrowth of the ET (Willer, 1981). Understanding of the mechanics of exchange, conflict, coercive relations is central to the ET (Willer, 1987; Willer, 1981).

3.0 Maintaining a Co-Adaptive Advantage by Finding a Balance between Legitimate and Shadow Networks

The application of ET to KS allows for deeper insight into the issue of organizational design (OD). At the heart of the problem of appropriate OD lies the dichotomy of legitimate and shadow networks described above. Legitimate, or formal, networks are often designed by organization heads and/or influenced over time by established behaviors and culture (Stacey, 1996). Their critical functions are often on multiple levels ranging from research and development to administration and operations (Krackhardt, 1997; Mintzberg, 1994). It also serves as a framework for guiding individuals to act. Furthermore, KM literature suggests that there is a direct relationship between the formal or legitimate structure and knowledge legitimation (Gumport, 2002). Knowledge legitimation refers to testing of new knowledge. Research by Manheim (1936), Kuhn (1996) and Mulkay (1979) on the dynamics of knowledge legitimation demonstrated that knowledge has social origins. This is deeply rooted in the information structure of an organization and can be referred to as a shadow system network. Krackhardt and Hanson (1997) further added that the formal organization (e.g., legitimate structure) is the skeleton of an organization, where the informal network (e. g., shadow structure) is the central nervous system that drives the collective thought processes, actions, and reactions. Several research studies on formalized strategy for OD further suggest that formal structure is required to facilitate day to day or standard operation, and informal structure evolves from the formal structure for supporting unexpected problems (Krackhardt, 1997; Hossain, 2002a; Hossain, 2001).

Shadow networks are informally formed within the context of legitimate networks (Stacey, 1996). We suggest that their primary function is to support the flow of tacit knowledge through the organization (Hossain, 2002b). The value of tacit knowledge is well established within the literature on knowledge management (Nonoka, 1995; Gupta, 2000). Although knowledge is generally stored in the brains/minds of individuals, many organizations have hoped to store and spread the knowledge of experts in order to (1) increase organizational “memory”, (2) increase the organization’s ability to learn, and (3) reduce the risk of having a relatively fluid and changing employee base (Smith, 2000). This has resulted in numerous IT initiates aimed at “capturing” tacit knowledge. A study by Orlikowski and Yates (1994)

suggests that people can use collaborative technologies routinely in ways leading to share meanings being associated with particular forms of technology-enabled interactions. Many of these initiatives resulted in failure because they overlooked critical social dimensions of KS (Hossain, 2002b). Specifically, attempts to build IT infrastructure for the capturing of tacit knowledge often overlook the roles that individual agents and informal networks play in the storage, flow, and creation of knowledge (Hossain, 2002b).

We propose that critical to successful OD is an organization's capacity to design and support legitimate networks that maximize the potential for "spontaneous" development of shadow networks. This view is also consistent with the views gathered from prior research such as Krackhardt and Hanson's (1997) study on informal networks, Pan and Scarbrough's (1999) study of KS practices at Buckman Laboratories, Easton and Parbhoo's (Easton, 1998) study on how clubs promote R&D interaction at Dow Corning, and Provan and Sebastian's (1998) study networks within networks. Further, explicit attempts to "design" a shadow network have a high potential for failure because the newly motivated network will not have the distinct characteristics—or identity—of either a legitimate or shadow network. This will filter down to individual agents and potentially lead to a lack of motivation (e.g., diminish a sense of empowerment, eliminate the chance for pure individual accomplishment, etc.) of key members of the networks and stifle effective KS.

The requirement of identity is applied directly from Wenger's (2000) model of a CoP. Wenger describes a CoP as a "constituent element" of a larger framework for learning. The process of learning includes four components that interact to produce an environment for learning at the individual, group, and organizational level—meaning, practice, community, and identity. Meaning is defined here as an individual's or group's ability to discuss and share experiences in a valued way. Practice is defined as the vehicles used in conveying meaning (e.g., shared historical events, frameworks, perspectives). Community relates to the social context within which experiences are recognized as "worth pursuing" or individuals are perceived as competent. As used above, identity relates to how one is defined within the context of the community. The informal nature of CoPs is what often allows for free and creative exchanges as the network develops. Identity is formed through the negotiation of

one's role in the CoP. An association with a legitimate network could potentially leave key members feeling less empowered and, thus, reduce the potential effectiveness of the network. Similar to the challenge of how to motivate the development of shadow networks discussed above, organizations hoping to promote KS through CoPs have to find methods for developing informal social networks albeit through formal channels.

Shadow networks have additional characteristics that are often prescribed to CoPs. For example, Wenger (2000) argues that CoPs differ from legitimate networks, or "institutional entities", along the following three dimensions: (1) they negotiate their own enterprise, (2) they develop/evolve according to their own learning processes, and (3) they shape their own boundaries. This is similar to Stacey's (1996) requirement in that shadow networks consist of links that are spontaneously and informally established by individuals imbedded within the environment of legitimate networks. Additionally, Wenger (2000) partially defines a CoP by its continuously changing internal and external "boundaries", or relationships. Moreover, this is similar to Stacey's requirement that a shadow system have porous boundaries and multiple routes for interaction between individual agents in an organization or in an inter-organizational network (Stacey, 1996).

The importance of shadow networks and CoPs to the function and overall *co-adaptiveness* of an organization is starting to become more recognized by both academics and practitioners. For example, Cross and Prusak (2002) recently analyzed shadow networks and CoPs across 50 organizations and suggest that Social Network Analyses (SNA) aimed at identifying shadow networks is a legitimate management tool. Most obvious was the existence of individuals who were "often invisible" to senior management, but held strong power positions within the organization. Most pertinent to our argument, is that their findings were consistent with ET. That is, the power of these agents was defined by (1) their individual beliefs and the "resources" they held and (2) their relative position within the social network.

Cross (1972) identified four important power players whose function was critical to any organization—central connectors, boundary spanners, information brokers, and peripheral specialists. Central connectors are generally not the formal leaders of an

organization, but act to link most of the agents within their immediate network by connecting the appropriate people at the appropriate time. Boundary spanners cross organizational boundaries by acting as a conduit through which knowledge from external networks and sources of knowledge flows. Like boundary spanners, information brokers act to link networks that otherwise would not have been connected, but they tend to link networks internal to the organization. Like central connectors, boundary connectors tie a large number of people together, but they tend to have more indirect than direct connections. Lastly, peripheral specialists remain on the fringe of most networks, but offer the specialized knowledge critical to success.

In terms of ET, each of the four types of power players identified by Cross and Prusak (2002), (1) possess resources that are highly valued by the network and (2) exercise a high amount of power because of the relatively low probability of exclusion from the network when compared to other agents (Willer, 1999). Cross (1972) suggests that these structures can be formalized and solidified through initiatives aimed at (1) identifying shadow networks and power players through the use of SNA and (2) managing the network through the reward and recognition of power players. These topics are more thoroughly addressed in the following section that illustrates the potential application of ET to the prediction, design, and management of effective social networks within a learning organization.

4.0 The Mechanics and Organics of Organizational Design and Management

SNA can be seen as a method that allows us to analyze social structures and relational aspects of the structures that exists in a CN between individuals, teams, groups and communities (Scott, 2000; Wigand, 1988). It is important to note three groups of researchers who contributed to the advancement of the SNA. Sociometric analysts worked on small groups and contributed to technical advances with the methods of graph theory. In the 1930s, Harvard researchers explored the application of SNA to understand patterns of interpersonal relations and the formation of cliques (Scott, 2000). The Manchester anthropologists investigated the structure of community relations in tribal and village societies by building on the foundation of sociometric analysts and Harvard researchers. Methods include three general stages—defining the

types of networks to be explored, designing a survey instrument for the collection of data, and mathematical and/or graphical analysis of the data.

Absent from much of the literature on SNA is the demonstration of how to formulate precise and testable hypotheses. This potentially makes SNA more of an exploratory tool—whose potential use was demonstrated by Cross and Prusak (2002) – rather than a tool for both hypothesis and theory building. We propose that researchers can work towards the development of testable hypotheses by applying assumptions developed within the framework of ET. As discussed above, the value of ET is in its simple, clear, and experimentally validated assumptions about resources, structure, or both. Hypotheses based on the assumed resources of specific agents within a network combined with their placement within equal, weak, or strong networks can be used as a tool for building and testing theory.

Any potentially general effects of structure could then be used to validate further testing on specific networks within the organization. Again, because of the potentially applied and social context implied above, we do not expect one to be able to control for all potential confounds, account for *every* potential conduit of exchange, or, for example, immediately determine what is meant by a "high" or "low" probability of exclusion in one study. Such an approach is suggested as a "good place to start." As with any science, we would expect continued refinement of both theory and methodology by basing salient confounds, variables, and methods on both practical and theoretically sound foundations.

In sum, we wish to introduce ET as a theory that can be used to build a firmer foundation for the science of OD *and management*, in general. It should be expected that theories be a *synthesis* of validated assumptions (i.e., with definable and tangible components for discussion) and endless streams of testable hypotheses (i.e., each acting to refine, validate, or invalidate previous findings). ET is (1) open to further validation or invalidation because it is based on tangible and testable assumptions, (2) applicable to OD, and (3) based on subsequently accepted and applied theories (e.g., game theory, etc.,).

5.0 CONCLUSION

We conclude that Knowledge Sharing design is essentially a socially and functionally focused process. It is highlighted in this paper that the legitimate network structure of an organization needs to be developed in ways that support the development and sustainability of shadow networks. In particular, we conclude that continuous and co-adaptive learning and innovation occurs when an organization is able to accommodate the development of shadow networks through *synthesis* with their existing legitimate network structure.

The original contribution of this paper can be seen from three standpoints – we suggest as being the theoretical; the methodological, and the applied. From a theoretical Mech-Organic perspective (or MOP), we argue that well-established theories such as the Elementary Theory of Social Structure (ET) might serve as a basis for better understanding the complexities involved in system design, modeling and implementation of Knowledge Sharing (KS) networks in organizations. We humbly submit this study may be considered, *thematically*, under the title of *mechorganics*. From a methodological standpoint, we suggest that Social Network Analysis (SNA) might be best used in *synthesis* with ET so as to more *dynamically* guide *deductive* data collection, analysis and assessment. Lastly, we suggest that ET and SNA have practical application in the more *inductive* designs and management of learning organizations.

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