

TOWARDS A META-THEORETICAL FRAMEWORK FOR INNOVATION AND INFORMATION SYSTEMS RESEARCH

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Abstract

The importance of theory to the IS discipline is the subject of ongoing debate and there have been recent calls for novel conceptualizations to stimulate research. In the area of innovation, one of the main conclusions of the influential Minnesota studies was the need to develop a metatheory. This paper examines the role of theory in the development of the research agenda for the emerging composite area of innovation and information systems. Our approach is to build on the seminal work of the Minnesota studies and on the innovation perspectives of Carl Slappendel. The result of the study is a proposition that Ecological Systems Theory (EST) addresses many of the gaps that emerged from the analysis of the literature. Consequently the paper makes a contribution by developing a meta-theoretical framework for the study of innovation and information systems derived from the EST schemata.

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Introduction

The importance and nature of theory continue to be the subject of lively debate in the information systems literature (Gregor 2006; Markus and Saunders 2007; Weber 2003). In the area of innovation, one of the main conclusions of the seminal Minnesota studies was the need to develop a metatheory. The central thesis of this paper is that a novel theoretical framework is required to enable information systems researchers to successfully navigate the challenging terrain of innovation. The framework that we propose is that of ecological systems theory (EST) which provided a new perspective for research in human development when it was introduced by Urie Bronfenbrenner (1979). Our motivation is to apply some theoretical glue (Whetten 1989) to the “fragmented corpus” of innovation literature (Adams et al. 2006), in order to lay the groundwork for an IS research impetus in this increasingly important area. In a review of the prolific growth in innovation publications, Wolfe (1994) concluded that it had made little contribution to the understanding of innovative behavior in organizations and the results presented were largely “inconclusive, inconsistent and characterized by low levels of explanation”. Slappendel’s subsequent (1996) mapping of the literature on innovation in organizations in terms of three theoretical regions: the individualist perspective, the structuralist perspective and the interactive process perspective is highly regarded. Recently, there has been some noteworthy attempts to provide a more holistic appreciation of the innovation landscape such as the compilations by Fagerberg et al. (2005) and by Shavinina (2003). However, Fagerberg’s (2005) conclusion that “our understanding of how knowledge-and innovation-operates at the organizational level remains fragmentary” and “that further conceptual and applied research is needed” indicates a scarcity of progress in the intervening period. Moving closer to home, Avgerou (2002) comes to the surprising conclusion that “the term innovation is not actually widely used” in the information systems literature. Swanson (1994; 1997; 2004), who has been notable among the IS research community in addressing the subject, argues that the innovative deployment of information technology is “increasingly crucial to competitive survival and success”. Consequently, we propose to take a fresh look at the composite area of *innovation and information systems* using Urie Bronfenbrenner’s ecological systems theory which has been very influential on the research approach of psychologists and social scientists in the area of human development. Our study will incorporate the traditional focus of IS on the organizational milieu (Bacon and Fitzgerald 2001; Crowston and Myers 2004) but will argue that this view must be expanded to engage with the total context of the person interacting with the wider environment. The approach also builds on the contention that the recent interest in innovation as an interactive process perspective provides “opportunity for developing new conceptualizations” and “generating new insights into complex organizational phenomena”(Slappendel 1996).

The paper will be organized as follows. The first section will summarize the challenges faced in exploring the expansive area of innovation and immediately ground the work in the influential Minnesota studies. We will then provide an overview of the theoretical perspectives of organizational innovation proposed by Carol Slappendel. This is followed by discussing one of the main conclusions of the Minnesota Studies: that a metatheory needs to be developed to assist the study of innovation. The next section introduces the ecological systems theory of Urie Bronfenbrenner and argues that it provides a rich framework to organize the innovation literature, and to examine the role of information systems. Finally we discuss the implications of our analysis for the IS community and summarize the general conclusions of our study. Future work is proposed to further examine the application of the metatheory to the area of innovation and information systems.

Background

This section will initially provide a brief overview of the concept of innovation mainly derived from the Minnesota studies. Then we will present an overview of innovation as it relates to the IS literature and consequently argue that the subject is ripe for a new theoretical examination to progress research in the area.

What is Innovation?

Many scholars trace the introduction of innovation into the realm of economic and social change to Joseph Schumpeter's seminal work on the "Theory of Economic Development" (Schumpeter 1934). In this work he classified innovation into five categories: new products (or goods), new methods of production (or processes), new sources of supply (or half-manufactured goods), the exploitation of new markets, and new ways to organize business. In Schumpeter's original schema, innovation is accomplished by "entrepreneurs" who developed new combinations of existing resources (Swedberg 1991). However, in his later works, he came to regard the large corporation as the innovative engine driving the development of leading economies (Lazonick 2005). Fagerberg (2005) makes the fundamental distinction between invention and innovation where the former is regarded as the "first occurrence" while the latter is the "first attempt to carry it out into practice". This is in line with Van de Ven's (1986) assertion that "an invention or creative idea does not become an innovation until it is implemented or institutionalized".

One of the main challenges of a review of innovation is the range of definitions from a wide body of literature. In their analysis of the terms "innovation" and "innovativeness" from 21 empirical studies in the new product development (NPD) literature, Garcia et al. (2002) discovered that "no less than fifteen constructs and at least 51 distinct scale items" were used leading to a great deal of ambiguity. In the course of his work, McInerney (2004) assembled over thirty author-centric definitions of innovation from publications since 1960. These were based on antecedent work by (Rahmanseresht 1988) and that of (Zain 1993). Faced with this rather daunting background, we will now seek the assistance of one of the most comprehensive academic studies of innovation in order to provide a definition of innovation for this paper.

The Minnesota Studies

The work of Andrew Van de Ven has made a significant contribution to innovation scholarship since the early 1980s. This pioneering work was carried out during the Minnesota Innovation Research Program (MIRP) and its publications are generally known as the Minnesota studies (Van de Ven et al. 2000). A testimony to the enduring quality and wide-regard of these seminal studies is the fact that, though the book was originally published in 1989 and subsequently taken out of print, it was re-printed in the year 2000. The MIRP program was carried out by approximately 40 researchers, now scattered among faculty across the globe, who conducted longitudinal studies of 14 innovations during the 1980s. Significantly, Van de Ven and his team "returned to the library" in the 1990s as they considered that if it took 10 years to gather the data, then they "deserved at least ten years to analyze and make sense of the data" (Van de Ven et al. 2000). In this section of the paper we are attempting to find some shared understanding of the term *innovation* so it is worth pausing and reflecting on Van de Ven's definition of the phenomenon (1986).

Innovation is defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context.

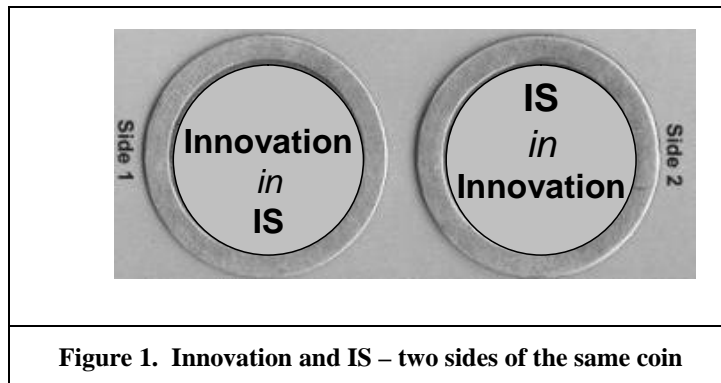
Four basic factors are implicit in the definition: new ideas, people, transactions and institutional context. Having briefly introduced the term innovation and the Minnesota studies; we will now focus specifically on innovation vis-à-vis the information systems literature.

Innovation and Information Systems: an overview

In this section we make a basic distinction which we believe is essential to clarity when approaching the topic "innovation and information systems". The first one we term "innovation in IS"¹ and the second as "IS in innovation". The former we develop from Swanson's (1994) generic definition of a process innovation as "any new

¹ We will follow Swanson (1994, p1072) by including computing, IT and ICT as subsets of IS

way of developing, implementing and maintaining IS". The latter we express as "the role of IS in supporting innovation". These related concepts are shown in figure 1 as being two sides of the same coin.



In connection with "innovation in IS", Swanson (1994) argued that current innovation theory had done little to explain IS innovation and where it stood within the general debate on organizational innovation. To address this situation he posited the following three types of IS innovations to provide a new theoretical impetus:

- Type I : innovations confined to the IS task
- Type II: innovations supporting administration of the business
- Type III : innovations imbedded in the core technology of the business

To explain the concept, Swanson graphically presented this typology as a tri-core model of IS innovation with the innovation core sandwiched in a swiss-roll arrangement between the inner technical core and the outer administration core. A subsequent empirical testing of the model resulted in "cautious optimism" but suggested a need for further theoretical work to refine, elaborate and extend the system (Grover et al. 1997). Recently, Costello and Donnellan (2007) have argued that the considerable growth of self-service technology and business extends the traditional boundaries of the customer service function and needs to be incorporated into Swanson's tri-core innovation typology. In a subsequent influential paper, Swanson and Ramiller (2004) start by defining IT innovation as the process by which "IT comes to be applied in novel ways" and conclude that the literature on bandwagon phenomena indicate that much supposedly innovative behavior is actually "me too" activities. This leads them to propose the application of the concepts of "mindfulness" and "mindlessness" to IT innovation theory. Their call for an enlarging of the IS academic research to "investigate the cognitive processes of organizations" and to engage with the *psychological* as well as the organizational literature has relevance for the present study. Fichman (2004) takes the concept of "mindfulness" with six others (innovation configurations, social contagion, management fashion, technological destiny, quality of innovation and performance impacts) and presents them as emerging perspectives that can take IT innovation research beyond its present "dominant paradigm" which he believes is showing signs of exhaustion. He defines the "dominant paradigm", derived from economic-rationalistic models, as positing that an organization with the greater quantity of "Right Stuff" will demonstrate a greater quantity of innovation. Recently, a comprehensive analysis of an extensive body of research, based on Fichman's description of the "dominant paradigm" resulted in a revised depiction of the model that differentiated between individual and organizational characteristics and prescribed the best predictors of IT adoption for each characteristic (Jeyaraj et al. 2006). This study concluded with a counter argument that the dominant IT paradigm was alive and well and continues to make significant progress.

Other scholars, albeit a minority, have taken a different approach when viewing innovation and information systems. In this case they have explored the role, both positively and negatively, of what we term "IS in innovation". For example, the work of Tarafdar et al. (2005) examines how a firm's information technology (IT) capabilities affect its ability to innovate. They explain that the IT capability of the firm has five dimensions: IT Infrastructure, IT Human Resources, IT-related Intangible Resources, IT Coordination and IT governance. Donnellan's (2004) empirical study describes how companies such as Analog Devices Inc. (ADI) are using IT systems to support and promote innovation. On a more general level, Pavitt (2005) argues that ICT can support innovation by reducing "costs of search and selection" it has "created opportunities for increasingly complex systems made possible by the

digitalization of data". Elsewhere Whelan (2007) investigates the relationship between the structural properties of electronic networks of practice and the successful diffusion of innovative knowledge. While the work on both perspectives of information systems and innovation has been commendable in addressing specific topics within the innovation landscape, we propose that the topic is now ripe for a more holistic approach.

The purpose of the opening section of the review was to demonstrate that, despite the volume of innovation literature, its sense-making and progress is severely hampered by the absence of theoretical frameworks. Another objective was to provide evidence that the study of innovation in the information systems literature is under-developed and not without ambiguities. We will address the issue of the lack of innovation theoretical frameworks in the next section.

Innovation Theory

Recently, there has been a renewed call for "good concepts and theories" to stimulate research and counteract a perceived "ambivalent attitude towards theory" in our field (Markus and Saunders 2007). This section will begin with a presentation of Slappendel's taxonomy of innovation theories which has been utilized in the analysis of software process improvement (SPI) innovations by IS researchers (Kautz and Nielsen 2004). Following this we will present a major conclusion of the Minnesota Studies, on which the argument of this paper is based, that a metatheory of innovation is required.

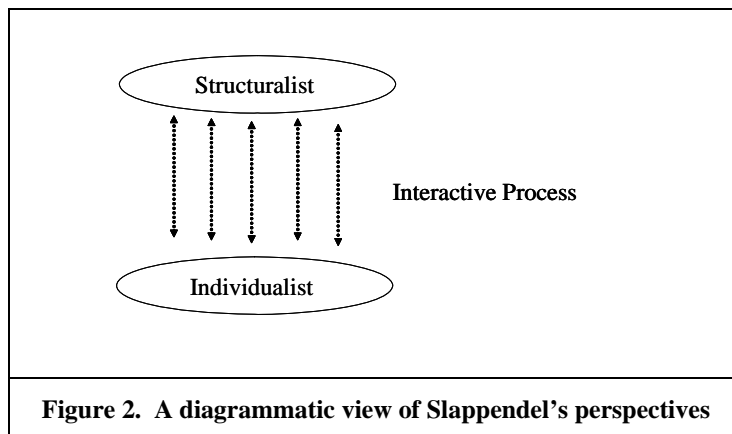
The Perspectives of Carol Slappendel

We will now discuss Carol Slappendel's (1996) classification of the innovation literature in terms of three theoretical perspectives based on the antecedent work of Pierce and Delbecq (1977). These three theoretical approaches: the individualist perspective, the structuralist perspective and the interactive process perspective are presented in the sequence that reflects their historical development. She argued that the increasing growth in innovation publications necessitates that both researchers and students "establish mental models of the domain", which is one of the main objectives of our study. The first category in her cognitive map is that of the individualist perspective which is characterized by the basic assumption that individuals cause innovation. Researchers holding this view propose that certain individuals have personal qualities or "traits" which "predispose them to innovative behavior" and that they make rational decisions based on the economic concept of "utility". Studies of this type use concepts such as "age, sex, education level, values, personality, goals, creativity and cognitive style" to examine innovation. While there is general acceptance of the importance of individual roles such as champions, leaders and entrepreneurs in the innovation process, this perspective has been firstly criticized for its unreasonable assumption that innovative decisions are made by autonomous agents, and secondly due to evidence that suggests individual characteristics can be subsumed by organizational roles and positions. She quoted studies, by among others Saren (1987) and Van de Ven (1986), which argued that the complex, non-routine and often irrational characteristics of the innovation process require the assistance of other individuals in an organizational context. The former author also made the salient point that it is just as important to understand why some people resist innovative activity as why some people support innovation.

The second category; that of the structuralist perspective, proposes that innovation is determined by the structural characteristics of the organization. The proponents are from a number of different theoretical schools which according to Astley and Van de Ven (1983) "share a common deterministic orientation by which organizational behavior is seen to be shaped by a series of impersonal mechanisms that acts as external constraints on actors". The shift to this perspective coincided, according to Slappendel, with the increased promotion of "positivist epistemology in business research" and the availability of increasing computing power for "quantitative data analysis". However the main criticism of the approach is the organizational features such as technology and strategy, tend to be "reified" and treated as objective realities *per se*. Interestingly for our thesis concerning the need to take into account the multi-level influences on innovative behavior, Slappendel suggests that the widespread one-dimensional use of "cross-sectional questionnaire surveys" fail to capture socio-political influencers such as government policy. For example, many studies agree that the uncertainty generated by rapid environmental change actually stimulates innovation and that innovation is facilitated where an organization has extensive communication channels with actors in its environment. She concluded that the individualist and structuralist perspectives tend to facilitate research projects that focus on identifying chief determinants of innovation and which employ cross-sectional surveys. Another interesting point was that many researchers seemed to gravitate to either of these

perspectives more for pragmatic reasons, such as restricting the scope of the research project, than from any ideological conviction of their incompatibility. In the final analysis, adopting either of these “monistic” approaches will “inevitably lead to simplistic theorizing of complex phenomena” which is an important point underlying our thesis.

The development of the third approach: the interactive process perspective resulted from a reaction by scholars to the linear “stage-to-stage” notion of the innovation process and from calls that researchers view innovation as a dynamic process in a continuously changing environment. This evolution in thinking requires that any attempt at the generation of theory should address “the complex, and paradoxical relationship, between action and structure” over time. It also needs to endeavor reconciling both individual and structuralist consideration by analyzing their interconnection. One study of particular interest to our work is that by Walton (1987), who proposed a framework that emphasized the interaction of the factors which take into consideration individual, organizational and environmental features. Walton acknowledges his debt to the work of Pettigrew (1987) who argued that change should be analyzed in terms of the dynamic interplay between context, content, and process with the preferred research approach of “a historical method involving longitudinal case studies”. Pettigrew’s work, while primarily focusing on strategic change, has informed and influenced research on “strategic innovation”. Slappendel’s analysis of these studies illustrates the following important aspects of the third perspective: the rejection of the “rational economic model of decision making” with the associated attention to the political context; the emphasis on “understanding the dynamic nature of the innovation process”; the belief that innovations may be transformed by the process itself; and finally the methodological implications which resulted in the prevalence of longitudinal case studies with a focus on induction and in some situations the use of grounded theory. She agrees with the researchers who have rejected the “conceptualization of innovations as insulated, static objects or practices” and that have argued for the “analysis of complex innovation configurations and changes of innovation features over time”. This opportunity for “developing new conceptualizations” is an important motivation for our study. However a number of theoretical and methodological challenges face those who undertake researching the interconnectivities of innovation. These include the tendency to lapse back into the “description of uni-directional models”; the lack of training and knowledge about the approach; the cognitive limitations of a researcher to process the large amount of information coming from a fast changing environment; and finally the linguistic constraints of the words used to describe the research. One proposal to deal with some of these challenges is to involve “pairs or teams of researchers”. The suitability of case-study research to generate “new insights into complex organizational phenomena” suggests a strong methodological compatibility with the interactive process perspective notwithstanding the ongoing debate on generalization (Yin 1994) and the time-consuming nature of the approach. We have attempted to capture Slappendel’s perspectives in a diagrammatic form in figure 2.



While we agree with Slappendel’s important analysis of innovation, especially her contention that due to the increasing level of organization change the interactive process perspective will become more established, we believe that a number of factors call for an enhanced theoretical framework. The first point concerns the importance of the environment on the innovation process which was raised in her reference to Walton’s work above but is not discussed in her paper. Recent studies such as that by Crowston and Myers (2004) have proposed a broadening of IS research from its present focus on individual and organizational aspects to industry level that should include “an economic perspective, an institutional perspective, and a socio-cultural perspective”. The second point is that

Slappendel's perspectives do not take into account the multi-level discontinuities driven by the rapid advances of information and communication technology (ICT) which have taken place since the publication of her paper; chiefly through the development of the internet. These paradigmatic shifts have caused fragmentation of organizational boundaries: resulting on a move towards open and user-lead innovation (Chesbrough 2003; von Hippel 2005) and the development of social networking and networks of practice (Whelan 2007). In the next section will propose a novel theoretical framework which, we argue both builds on the perspectives of Slappendel and addresses the developments in innovation research since the publication of her important paper. Now we will move from our discussion of the innovation theory to the main thesis of this study: the need for a meta-theoretical framework.

Meta-theory: The Unfinished Business of the Minnesota Studies

Previously we introduced the Minnesota Innovation Research Program (MIRP) which is regarded as one of the most significant studies on how organizations initiate, develop and implement innovative products and services. The MIRP involved a large number of researchers carrying out longitudinal studies of diverse innovations; over an extended period of time; across a number of disparate organizations. One of the most important results that emerged was the need for a metatheory which is the main inspiration for our present work. In this section we will firstly describe their conception of a metatheory and its general requirements. The "desiderata" and basic structure for a metatheory are then presented. This will provide the basis for our later arguments that ecological systems theory provides a match for their specifications.

Poole and Van de Ven (2000) set the scene by reminding readers that the previous nineteen chapters of their compilation have "illustrated the diversity and complexity of innovation processes". Variation occurred along multiple dimensions such as the type of product, process or service being developed; the maturity of the industrial sector; and the nature of the organization. Their solution, faced with the discrepancy between the MIRP findings and current theory, is to propose the development of a metatheory: a theory of theories. Antecedent research, they argued, had produced a plethora of theories whose validity was confined to the scope conditions. The conclusion, important for our work, was that "no overarching theory has yet emerged, nor are prospects bright in the near future".

They proposed that a satisfactory metatheory must meet the following conditions:

1. incorporate models of both global (macro and long-run) and local (micro and short run) development
2. precisely specified the motor driving development at both levels
3. spell out inter-level relationships

The ideal metatheory should provide "a conceptual map" in order to explain how innovations "develop, grow, and terminate over time". One major flaw identified in existing theoretical frameworks was the lack of connection between local phenomena and the wider global context of innovation processes. Their following description will be quoted in full as it is extremely pertinent to our work:

Consideration of local and global models leads one to examine the relations between innovation processes at different levels of analysis, such as how individuals relate to project teams, teams to organizations, organizations to a larger industry community.

The importance of the metatheory being able to accommodate the dynamic nature of the innovation process is stressed. Furthermore, any proposed solution should provide guidance on conditions for switching between subsidiary theories and models. Their statement that "previous work has largely ignored this global/local distinction" is very direct. Poole and Van de Ven then describe in more detail what they mean by the term global and local in this context. Global models take into account innovation characteristics "such as economic trends, social needs, the legal system, cultural norms, and the long-term institutional arrangements". On the other hand local models deal with more immediate factors such as "motivation level and group interaction processes, as well as direct macro influences such as organization structure, resource control, and competition". They summarize this conceptualization using an analogy.

[The] worldview in global models tends to be that of an astronaut in orbit, while it is that of the person-on-the-street in local models.

Furthermore they attribute the lack of global/local connection to the immaturity of developmental theories which should resonate later in our description of the human developmental model. They then go on to argue for the central

place of the individual in any general theory of innovation. A main finding of the MIRP studies is that it would be erroneous to consider the role of the individual as a rather mechanistic output of the process of innovation and other “impersonal factors”. However the important role of key individuals did not emerge in isolation but as intimately associated with the organizational context. Successful innovation is “premised on building an organization that can nurture the idea, garner resources, overcome obstacles, and orchestrate development”. In addition the development of innovations was found to be influenced by “key external resource controllers” and “the institutional context” was, in some cases, crucial. However, the relationship between the innovation and its environment should not be considered only as a one-way-street. One Minnesota case-study described how a revolutionary medical device innovation; a cochlear transplant, had spawned a new industrial sector. Poole and Van de Ven went on to outline in more detail their tentative formulation of a nascent metatheory. Their justification was based on the conclusion that a “single theory cannot encompass the complexity and diversity of process patterns observed across the MIRP innovation studies”. Furthermore they predicted that a “truly general typology and theory of innovation will be a long time coming” but hoped that their paper would “stimulate new patterns of reasoning that may promote further developments in building theories of theories”. Twenty five years later we are still inspired by their challenge to propose a theoretical framework which we will describe in the next section.

Ecological Systems Theory

In this section will introduce ecological systems theory and argue that it provides a suitable framework for researchers to approach the topic of innovation and to examine its relationship with information systems. The argument builds on the antecedent perspectives of Slappendel (1996) and takes into account important developments in innovation and information systems since the publication of her work.

An introduction to ecological systems theory

Urie Bronfenbrenner spent most of his professional career as Professor of Human Development, Family Studies and Psychology at Cornell University. His development of Ecological Systems Theory (Bronfenbrenner 1979) is regarded as having revolutionized studies in these areas by shattering barriers and building bridges among the social science disciplines. Previous to Bronfenbrenner’s work, the study of human development was compartmentalized among psychology, sociology, anthropology, economics and political science. However, through the concept of the ecology of human development, these disparate environments were integrated into a holistic conceptual framework of interdependent nested systems where human development was viewed as a continuum (Lang 2005). Bronfenbrenner viewed a “child’s development within the context of the system of relationships that form his or her environment” with each complex “layer” influencing the development (Paquette and Ryan 2001). His own conception of the theory was as “a set of nested structures, each inside the next, like a set of Russian dolls”(Bronfenbrenner 1979). He acknowledges the debt he owes to the theories of Kurt Lewin who expressed behavior as a function “of the interplay between person and environment” in the form of a classic equation:

$$\mathbf{B} = f(\mathbf{PE})$$

Bronfenbrenner argued that Lewin’s formulation did not included a time dimension and proposed his own version of the equation for the area of human development that includes the missing dimension.

$$\mathbf{D} = f(\mathbf{PE})$$

Bronfenbrenner theory is shown diagrammatically in Figure 3.

Lewin’s work has had a significant influence on the IS community in another area: the recognition that action research had largely developed from his work and that of his associates (Coghlan and Brannick 2005).

In this paper we will propose that innovation is essentially a behavior that results from the complex interaction between a person and their environment. This we suggest can be expressed by modifying both Lewin’s and Bronfenbrenner equations and that explicit included the time dimension:

$$\mathbf{I}_{(t)} = f(\mathbf{P}_{(t)} \mathbf{E}_{(t)})$$

This contention also follows Bessant’s (2003) conclusion that in dealing with the challenges of innovation the “key management task lies in creating and reinforcing patterns of behavior”.

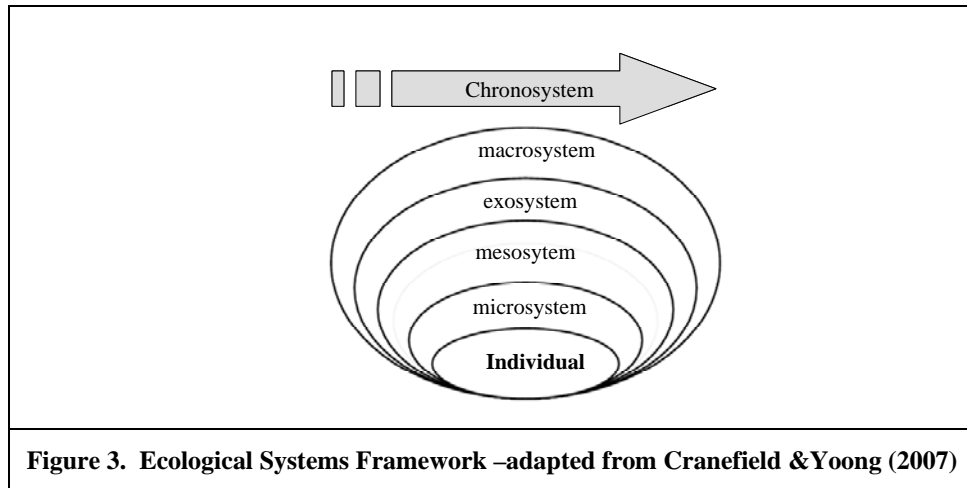


Figure 3. Ecological Systems Framework –adapted from Cranefield &Yoong (2007)

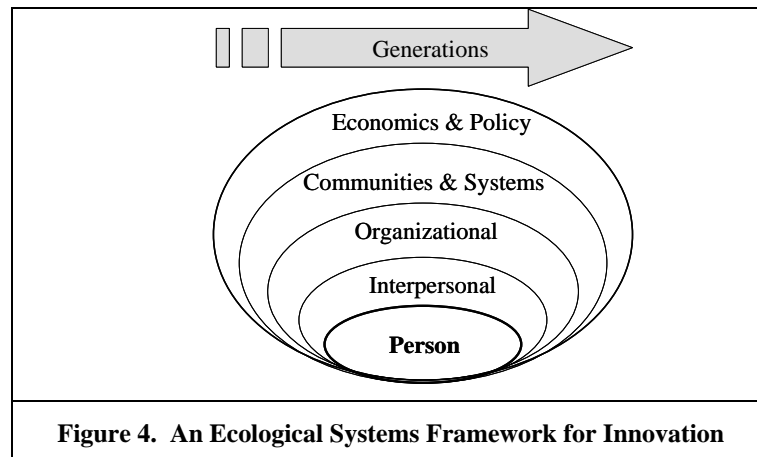
Cranefield and Yoong (2007), building on the work of McLeroy et al.(1988), have argued that ecological systems theory can contribute to debate on “relevance” by delivering an “enriched understanding of the domain of IS practice”. Following these authors, we will firstly describe each nested layer of the modified Bronfenbrenner model where the “patterned behavior” is determined by the following:

1. Individual level: Intrapersonal factors-characteristics such as knowledge, attitudes, behavior, self-concept, skills etc. It also included the developmental history of the person.
2. Microsystem: interpersonal processes and primary groups –formal and informal social network and social support systems, including the family, work group and friendship networks.
3. Mesosystem: institutional factors –social institutions with organizational characteristics, with formal (and informal) rules and regulations for operation.
4. Exosystem: community factors-relationships among organizations, institutions, and informal networks within defined boundaries.
5. Macrosystem: public policy – local, state and national laws and policies.
6. Chronosystem: This was a later addition by Bronfenbrenner (2004) and was not taken into account by McLeroy et al. This concept “encompasses change or consistency over time not only in the characteristics of the person but also of the environment in which that person lives” (Marentette 2007).

Having presented the ecological systems theory, we argue that it should not simply to be viewed as an isolated attempt to impose a novel framework on the area of innovation but builds on and extends, the theoretical perspectives proposed by Carol Slappendel that we referred to earlier. Furthermore, we propose that using Bronfenbrenner’s theory also responds to Swanson’s (2004) call for IS researchers to engage with the psychological literature due to the cognitive nature of the innovation process.

An Ecological Systems Framework for Innovation

Based on the foregoing analysis, we will now present our framework to analyze innovation based on Bronfenbrenner’s theory. The structure is based on the implicit assumption that innovation originates from the human “person” but is significantly influenced by interaction and interconnection with the five other layers. The framework is illustrated in figure 3.



The revised innovation framework is now described and a small number of references are included for the purpose of illustration.

1. **Personal Dimension:** this layer includes the intrapersonal characteristics that assist or inhibit innovativeness. Development of knowledge, skills and competencies through education and training to support innovation both in terms of creative invention and of implementation are relevant here (Amabile et al. 2003). For philosophical reasons we have replaced the term “individual” as we believe that the origin of innovation is the “acting person”.
2. **Interpersonal:** formally this dimension will include the ability to contribute to and direct teams or work groups. Informally it will include social networks, communities of practice and personal contacts, both inside and outside the organization. Interpersonal attributes such as empathy will also be deemed relevant in this layer (Ciborra 2002).
3. **Organizational:** the characteristics of the organization that the person is a member of will be significant for this layer. Culture, climate, and the management of innovation and change will influence the person’s tendency to innovate (Goffin and Mitchell 2005).
4. **Communities and Systems:** this layer will include relationship of the organization with peer organizations, academic institutions, state-sponsored support bodies (Etzkowitz and Leydesdorf 2000). The layer will also encompass formal and informal networks, clusters that support innovation, National Systems of Innovation (NSI) (Lundvall 1995) and the area of Inter-organizational Systems (IOS) which is having increasing influence on business to business (B2B) and business to government relationships.
5. **Economics and Policy:** this dimension will include innovation policy of local, regional, state and supra-national (for example the European Union), indicators of innovation (OECD 2005) and important economic theories of innovation (Schumpeter 1934).
6. **Chronological Generations:** Analogous to human development, “generations” can encompass a number of concepts. At a macro level it will take cognizance of the time dimension of the innovation environment which has been, for example, outlined in Rothwell’s (1994) taxonomy of innovation processes. At the organizational level this would involve assessing the innovation maturity level such as the “archetypes” of innovation proposed by Tidd et al. (2005). In the realm of information systems Ward et al. (1990) developed a three era model of IS to illustrate this concept.

In the previous sections of this paper we have presented the term innovation and discussed the concept in terms of its relation to information systems. We then proposed a new framework based on ecological systems theory that develops the previous mapping of the innovation literature by Carol Slappendel in light of recent developments in innovation models and ICT. Now we will discuss some philosophical issues associated with applying ecological systems theory to the areas of innovation.

Discussion

Gregor (2006) contends that “thinking clearly about the nature of theory in information systems” has importance for both research and practice and that leading journals in our field expect papers to have a strong theoretical foundation. In the same essay she classified metatheory as having “a very high level of abstraction” and that it facilitates “thinking about other theories, possibly across disciplines”. The decision by the editorial board of MISQ to “emphasize the criticality of conceptualization and theory development” in IS through the opening of a specialized Theory and Review Department provides further evidence of its fundamental importance to healthy research (Markus and Saunders 2007). Earlier we argued that the development of an innovation metatheory was the unfinished business of the Minnesota studies and we presented Poole and Van de Ven’s vision of a multi-level architecture built on the rock of the individual actor cemented in an organizational context. Vanhaverbeke & Cloodt (2006) propose, in their contribution to the relatively new research area of *open innovation*, that value constellations are interesting from a theoretical viewpoint as they require a number of perspectives to be synthesized in order to understand the phenomenon. Furthermore, they suggest that these emerging forms of value networks must be examined at the level of different nested layers. These diverse layers span the spectrum from the individual; to firms-organizations; through Dyads; onto inter-organizational networks and ultimately reaching to national/regional innovation systems. In the specific area of innovation applied to IS, Swanson’s original tri-core conceptualization also incorporates this idea of interweaving layers which have recently been expanded due to the major technological advances since 1994 (Costello and Donnellan 2007; Rose and Lyytinen 2001). In addition Crowston and Myers (2004) have called for a general broadening of research perspectives within our discipline. Building on this antecedent body of literature, we will now summarize our argument for the adoption of ecological systems theory in information systems research by means of the following proposition:

Ecological System Theory provides a meta-theoretical framework for the study of *innovation and information systems*. Innovation is to be understood as a dynamic behavior of an acting person within a community of interpersonal relationships; contextualized by an overarching topology of micro-, meso-, exo-, macro- and chrono-system characteristics.

Furthermore, we claim that this paper makes a contribution by addressing the following criteria proposed by Webster & Watson (2002):

- “*What’s new*” - ecological systems theory has not been applied previously to the areas of innovation or information systems. Furthermore this paper has argued for the need for metatheory – a concept that has not been debated significantly in the IS literature. It has also responded in a novel way to Swanson’s suggestion to engage with the psychological literature to bring fresh perspectives to the study of innovation in relation to IS.
- “*So What*” - The paper has the potential to make an impact in the field by addressing the increasing focus on innovation and the dearth of IS studies in the area. It directly builds its argument on the seminal Minnesota Studies with its call for the continued quest for a metatheory of innovation. It also aims to address Swedberg’s (2007) lament that despite the avalanche of writing on entrepreneurship, an important subset of innovation, “there has been little substantive theoretical progress”.
- “*Why so*” - Ecological systems theory has a proven academic track record and the underlying logic can address the calls for a more inter-disciplinary and cross-functional approach to the study of innovation (Fagerberg 2005; Leavy and Jacobson 1999; Slappendel 1996).

Finally we believe that it is incumbent on us to provide a short discussion of our research approach. The thesis of this paper has resulted primarily from a review of literature on: theory, , innovation *per se* and innovation *vis-à-vis* information systems. However, the genesis of the paper emerged in the course a number of longitudinal studies based in multinational subsidiaries located in the West of Ireland. These investigations included organizations in the electronics, manufacturing and software development sectors. The result, we hope, will provide further evidence of the wisdom of Urie Bronfenbrenner who reversed the classic maxim of his mentor Kurt Lewin that “nothing is so practical as a good theory” to: “there is nothing like the practical to build a good theory” (Bronfenbrenner 2004).

The work is limited in that it does not specifically address the categories within the nested layers or examine the sub-layer theoretical relationships. A thorough investigation of the philosophical challenges presented by each sub-layer will require a significant academic investment. Furthermore, Bronfenbrenner devoted a lifetime of distinguished scholarship on refining the definitions and principles to guide EST research in his own field. Our main

objective has been to make a modest contribution in response to the call by Van de Ven and his collaborators that the pursuit of a metatheory must be continually subjected to novel patterns of thinking.

Conclusions

The importance of theory to our discipline is the subject of ongoing lively debate (Gregor 2006; Weber 2003) and there have been recent calls for novel conceptualizations and theories to stimulate research (Markus and Saunders 2007). In this paper we have examined the role of theory in the development of the research agenda for the emerging composite area of *innovation and information systems*. Our approach was to build on the seminal work of the Minnesota studies and on the theoretical innovation taxonomy of Carl Slappendel. We then argued that the Ecological Systems Theory (EST) of Urie Bronfenbrenner addressed many of the gaps that emerged from our analysis. Consequently we developed a meta-theoretical framework for the study of *innovation and information systems* derived from the original EST schemata. Finally we argued that our proposition makes a novel contribution to a critical area of the IS discipline which is presently hampered by a paucity of theoretical guidance. Future work was proposed to further develop and test the thesis of the paper.

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