OPAALS PROJECT

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WP11: Bridging Digital Ecosystems Research to Regional Development and Innovation in the Knowledge Economy

D11.7 – Interim Report on The Role of Social Informatics and Social Media in Organising Large-scale Social Innovation

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Short Description: The deliverable provides theoretical framework for understanding the dialectical tension of a large, participative, innovation network in participatory mode of development. In this process it explores autopoietic, associative principles in a digital ecosystem, by offering an array of theoretical and empirical discussions of core concepts from a social science perspective.

Author: Jayanta Chatterjee (IITK), Debashis Pattanaik (IITK) and Paolo Dini (LSE)

Partners contributed: None

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Quality check

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Dependences:

Achievements*	We have examined a number of theories that have relevance for understanding self-organizing principles in a digital ecosystem. We have examined the relvance of autopoiesis (social), normative rule systems and cross pollination effect in knowledge sharing culture of Digital Ecosystem Community. We are able to propose a new framework, which can be considered as a preliminary framework for understanding circularity of communication and autopoieis in an emergent Digital Ecosystems theory.
Work Packages	What exactly were the contributions to other WP and what effect they have had on the work in these other WPs (max 2 pages) This is an interim report; some of our tools are in testing phase and are deployed recently. Therefore it is too early to say anything about its contributions to other WP. What exactly are the future contributions to other work packages (max 2 pages) We assume that this deliverable can have impacts on: 1. D12.10, in further elaborating the social autopoiesis principles. 2. WP11of phase 3 in the conceptualisation and operationalisation of knowledge networks, OKS and Digital Ecosystem. 3. Task 11.5, in DE design
Partners	T6, LSE
Domains	Social Science (major orientation), Biological Science (minor orientation) Computer Science (minor orientation).
Targets	Domain researchers and scientific communities on specific domains.
Publications*	Paper 1 - has been published in the Proceedings of the IEEE-DEST 2009 International Conference, Istanbul, Turkey (Best paper in the category). Paper 2 - has been submitted to the ACM MEDES 2009 International Conference France: Lyon.
PhD Students*	None

Outstanding features*	Specify the outstanding features of the work being done (incremental change in the state of art, improving significantly the state of art, or going beyond) and if anyone outside the OPAALS Consortium has taken notice of this work. Provides an innovative blending of theoretical and empirical insights from a social science perspective towards a multidisciplinary theoretical framework for digital ecosystems. We believe that this report represents an incremental improvement in the state of the art towards an integrated theory of digital ecosystems. Some of the work presented here has been highlighted by GTZ-Knowledge System in Rural Areas and Web 2 for DEV Conference sponsored by CGIAR and FAO.
Disciplinary domains of authors*	Specify the names of the authors and their disciplinary affiliation(s) **Social Science**: Jayanta Chatterjee (IITK), Debashis Pattanaik (IITK) **Social Science, Computer Science and Biology**: Paolo Dini (LSE)

The information marked with an asterisk (*) is provided in order to address Recommendation n. 4 from the Year 2 review report

Contents

Abstracts

Paper - 1
Socio-technical Innovation and the Role of Conversation in a Digital Ecosystem for Agricultural Extension Services in India

Large and complex socio-technical systems like the agricultural extension services of (the multi-lingual, multicultural and heterogeneous societies in) India, pose many challenges for creating an innovation system. The challenges stem from the multiplicity of social learning systems needed as well as due to the deep rooted heritage of age old 'successful' technical systems that now need to embrace new practices arising from new research and due to emergence of new seeds, new pests and diseases, new scarcities and new competition. Social science and particularly the sociological understanding of social change can and must integrate with information system theories to address the complex challenge of innovation in Indian agricultural system. This paper analyses the challenges and presents a compilation of action reports from the implementation of the Digital Ecosystem for Agriculture and Rural Livelihood (DEAL) project that was initiated in northern India. In this process this paper explores how the emerging digital technologies can support collaborative knowledge creation and sharing and discuss the social landscape of socio-technical innovation and community networks.

(Paper 1 - has been published in the in Proceedings of the 3rd IEEE DEST 2009 International Conference, Turkey: Istanbul. The paper has received best paper award in the category of Collaborative Systems and Sustainability of Digital Ecosystems – Relevance, Impact and Applications at the DEST conference. An expanded version of the paper wil be published on the forthcoming IEEE Transactions on Industrial Informatics (Special Issue on Digital Ecosystems)

Paper - 2
Dynamism of Organic Assemblage in Digital Ecosystem-Learning and Innovation in DEAL

Indian agriculture that engages more than 60% of India's population, needs infusion and diffusion of knowledge-driven innovation across the entire value chain to secure food for all its citizens. Knowledge creation and sharing, together mediated through digital technologies, can play a big role in rejuvenating Indian agriculture. The first step in this direction requires identification of the different elements in the Agricultural Knowledge and Information System and redesign of this system in a way that is better aligned with the improvements achievable by learning systems. This study focuses on the Digital Ecosystem approach to agriculture in Indian scenario. We assume that experiment shows that successful learning happens when people engage in participatory and collaborative conversational activities. And such properties are out comes of organic interaction among various acctors in network relationships. The organic formation in a DE shows similar biological propeties as of a living being.

(Paper 2 - has been submitted to the ACM MEDES 2009 International Conference France: Lyon.)

Background to the Deliverable

The Dialectics in a Digital Ecosystem for Knowledge and Role of Social Informatics in Organising Large-scale Social Innovation

Introduction

This deliverable focuses on:

- The role of social informatics and social media in organising large-scale social innovation.

This submission is an interim report on Task 11.5 interlinking D11.7 i.e. Knowledge sharing behaviour of actors involved in a DEK. The context of the study is innovation and its deployment in the agricultural domain for socioal innovation and economic development of North Indian regions (D 11.7).

Antecedents of Innovation Diffusion

Central to the study of innovation diffusion is the understanding of diffusion as a process of social change entailing alterations to a socio-technical system in terms of its structures and functions through communication (Rogers, 1995; Burkhardt, 1994).

Key aspects of the 'diffusion of innovation' processes are thus the 'dialectic' interaction among the 'innovation itself', the 'social system' in which the innovation is introduced and the 'communication channels' through which the social system 'members' learn about the innovation and the 'timing' of the processes.

The Current Research Focus

In the studies submited (D7.3 in Phase I and D11.6) it was observed that successful implementation of a Digital Ecosystem approach for knowledge diffusion and social innovation requires that conflicting social situations/interests are taken into consideration and that research out-put/policy agendas are based on debated and often transient consensus. A useful framework for analyzing this kind of situation where many conflicting processes are involved is offered by the Dialectic Inquiry (DI) system (Churchman 1971). This approach places special emphasis on the importance of multiplicity of view points and actors involved in an innovation and its adoption process. It argues that the new direction in research policy will only have practical results if (1) multiple view points and conflicting social situations are taken into consideration, and (2) actors with appropriate capabilities are adequately represented in the research process and are willing to take part in the process of innovation and diffusion. Thus in the second phase we have expanded the involvement of village level agricultural scientists, extension employees and other service providers to the farmers as well as engage with the farmers themselves by creating horizontal communication networks.

From our longitudinal observations it appears that Indian Agricultural Extension Services (IAES) also depicts the challenge of social innovation and adult learning through two dialectically related modes of grasping experience – apprehension (concrete experience of farmers and agri-scientists in the village centres) and comprehension (abstract conceptualisation by agri-scientists in universities and laboratories) and two dialectically complementary modes of transforming experience - intention (reflective observation) and extension (active experimentation).

In a way we saw the problems in IAES emanating from insufficient integration of the four learning styles emerging from those dialectical relationships, namely – diverging, assimilating, converging and accomodating proposed by Kolb and others (Kolb 1984, Sternberg and Zhang 2000). The synthesis approach to the learning process provides a good framework for designing the socio-digital space within in a DEK (Digital Ecosystem for Knowledge).

- The IAES scientists desire that farmers relate new ideas and concepts explained to them to previous knowledge and experience and develop new integrated concepts. The scientists, as 'teacher experts' desire that 'farmers as learners' understand underlying principles, look for new patterns and relate new ideas to new practices .
- But the audience of farmers have often explained that the facts and procedures presented by the scientists often differ from their groud realities (eg. The model farms attached to the agricultural science centres often enjoy near ideal conditions). Thus farmers often treat facts and new procedures handed down to them as static knowledge (Source: Conversations with farmers and scientists at Unnao, recorded in 2006).

In the papers that we have compiled as an interim report (D11.7) on Task 11.4, we depict a managed process of diverging and converging, enfolding and unfolding. Our continuing ethnographic studies of the actors in this process hopefully will lead us to generalisable designs and processes of DEK. These studies should validate conversational learning as a co-designing format for large scale social innovation.

The Appendix at the end of this section provides an over view of the dialectical inquiry system that has been adopted in Phase II as a research methodology that we caryy forward to our research in Phase III. Clarifications have also been provided in the Appendix regarding some key concepts used for our conversations with the focus groups and for our own debates.

The papers compiled here depict how different actors and different stake holders use different format of digital interface and the best process designs for social innovation and adult learning.

Work in Progress

The compilation of papers in this folio, as an interim deliverable against Task 11.5 and our research direction regardingthe role of social informatics and social media in organising large scale social innovation connecting the social autopoiesis process (D11.6) with the dialectical process of socio-cultural and socio-economic change. At this point, we hypothesise that while the self catlysis and autopoiesis in a socio-technical system exhibits 'living system' characterstics through recursive, intense, coversational loops, the germination of that autopoietic process happens due to the inherent dialectical urge for change and renewal lying within the socio-cultural system itself. The designing of a creative, germinating, nuturing socio-digital space of a DEK therefore should be inspired byMaturana, Varela, Luhmann (D11.6) as well as by Hegel, Durkheim and Sorokin.

The papers in this complation focus on the Deliverable D11.7, ie. Role of social informatics on large scale social innovation and adult learning. The field experiments are based on the hypothesis that greater the anticipated reciprocal relationships are, the more favourbale will be the knowledge sharing attitude. Rather than extrinsic rewards our system deployment relied on encouraging the sense of self-worth through knowledge sharing behaviour.

The expertimental DEAL architecture is based on an assumption that conversation is a 'meaning making' process where understanding is achieved through interplay of opposites and contradictions. Following Parker Palmer, in this ongoing experiment, one has thus assumed that socio-technical innovation and learnng follows a process of being involved in 'an eternal conversation about things that matter', conducted with passion and discipline. The innovation here is not in the conclusions so much as in the process of the conversation itself, (Palmer 1990).

Initially, it seems that interdisciplinary or inter KVK boundaries inhibit or block conversation and exchange across boundaries is often difficult. However soon the space created by the boundaries host conversations that explore dialectical continua. The following papers, as an interim report on Task 11.4 (of Phase II and III) therefore should be read not as boundaries of exploration but rather 'shape givers'. That will shape our final exploration into the DEK as a model of 'how adult practitioners and experts learn'. Our field work will be based on our continuing engagement with the Indian Agricultural Sector but will hopefully provide insights into generic socio-economic innovation processes that can be applied across multiple sectors.

Links Between the Papers here and Deliverable Description

The research output from this Work Package were two investigative papers. All the papers have been presented to and accepted for publication in the proceedings of two International Conferences/Journals after several reviews.

Appendix to Research Outline

The Dialectical Inquiry Approach

The DI approach to social system innovation research stems from a scheme suggested by Churchman's (1966, 1971) interpretation of Hegelian dialectics. Mason (1969) proposed the DI system as a new problem solving approach to planning and policy development. Essentially, DI involves a process utilizing a confrontation of thesis (plan) and antithesis (counter plan) in a structured debate and a synthesis (integrated plan) of the opposing views. The synthesis constitutes a new conception of the world, or '*Weltanschauung',* that is, a higher level understanding of the problems, issues, premises, and assumptions involved in the planning process. Constructive debate - explicit statement and examination of the underlying assumptions of two polarized opposites (plan vs. counter plan) - is hypothesized to improve the planning process by creating an awareness of the complexity and interdependence of the issues involved.

There are two schools of thought, philosophical (supported by the writings and research of I. Mitroff, R. Mason, and their associates) and empirical (advocated by R. Cosier, C. Schwenk, and their group), involved in a dialectical conflict over the application of DI to planning.

The proponents of the philosophical school support their claims regarding the advantages of the DI approach in decision making with a number of field studies, dealing with a variety of real world problems in diversified settings (Emshoff and Finnel 1978, Laurenco and Glidewell 1975, Mitroff, Barbara, and Kilmann 1977). These field studies used no control groups or alternative planning methods; moreover, statistical results were not reported. The participants' and researchers' perceptions of the effectiveness of DI and their satisfaction with the decision making process were utilized as a measure of DI success. Supporters of the empirical school in contrast advocates for objective

measurement and control over experimentation, data validity and reliability in DI (Cosier 1978, 1980, 1981, Cosier, Ruble, and Aplin 1978, Schwenk 1982a, 1984, Schwenk and Cosier 1980).

The supporters of the philosophical school of thought suggested that DI is most appropriate when the problem in question is ill-structured (Mitroff 1982a, 1982b; Mitroff and Mason 1981). Against this researchers such as Cosier (1982) and Schwenk (1982b) expressed a strong belief in the necessity of conducting rigorous research under controlled conditions for DI. However observations from field and laboratory studies of DI do not provide any conclusive evidence supporting one or the other school of thought.

Philosophical Foundations of Dialectical Inquiry System

DI system is based on Hegelian dialectics, a philosophical system known since the nineteenth century as dialectical idealism. Built on the theoretical foundations of Hegelian philosophy, DI has inherited many of the advantages and disadvantages of dialectical idealism. Dialectical idealism represents a very insightful and comprehensive view of the universe as being interconnected and constantly changing. Hegel called the process of change 'dialectics' (Churchman 1971). According to Mulej (1978), the ideas in Hegelian dialectics: (1) are changeable and develop out themselves; (2) are interrelated and interdependent; (3) tend to be adverse to each other.

Conceptual and Operational Modes in Dialectical Inquiry System

A philosophical system, including Hegelian philosophy, consists of ontology - a theory about the fundamental nature of the world and being; epistemology - a theory of knowledge that deals with nature, application, presuppositions, basis, and the general reliability of claims to knowledge; and method - a set of principles and techniques used to obtain knowledge (Mitroff and Mason 1982). Furthermore inquiry is a purposeful human activity designed to produce systematic knowledge. Mitroff, Mason, and their colleagues view DI from a broad philosophical perspective based on the Hegelian doctrine. They suggest that: (1) more general and qualitative knowledge (e.g., improved learning) can follow - from purposeful human inquiry; (2) more specific and data-based knowledge can be derived by using specific problem-solving technology.

Dialectical Inquiry System as Methodological Tool for Field Studies

Mitroff and Mason point out that 'true dialectic entails two or more groups (possibly the same group at different points in time) actively participating in the examination and formulation from markedly different points of view' (1981, p. 649). Dialectic is a longitudinal and process-oriented phenomenon. Therefore longitudinal studies ranging from several months to several years are most appropriate timeframe to conduct DI.

DI system places special importance on the role of structured debate in inquiry. The structured debate, designed to be the forum in which proponents present and argue the pros and cons of the plan and counter plan and underlying assumptions with the forcefulness different interpretations of the same data bank (1982a, p. 208). Field based DI system follows a silent and introspective mechanism to study the pros and cons of the plan and counter plan. It is in the structured debate that the implicit and explicit assumptions are exposed and a new understanding of the problem, with corresponding new assumptions, is achieved.

Materialistic Dialectics for Socio-Cultural Change

One major, but frequently overlooked, source of change is related to the universal tendency for opposition between the individual and the social order. A basic factor endemic in social evolution is the human condition that generates a continuous potential for change. In the simplified language of analysis, human personality structure consists of two parts, one part being in the service of the unique, biological individual, the other in the service of the normative, standardized social order embedded in material culture. These two parts often oppose each other, and the dynamics of the dialectical struggle may traverse beyond the individual to the social and cultural order as well.

Although the theme of the existential struggle between the individual and material culture is not new, it is largely underdeveloped within the contemporary social sciences. Some of the best statements on this subject are still found in the works of three classical theorists: Emile Durkheim, Sigmund Freud and Georg Simmel. Durkheim's clearest assessment of this struggle is in his essay, *The Dualism of Human Nature and Its Social Conditions*, where he explicitly argues that man is essentially divided against himself.

As Durkheim sees it, the pursuit of moral (social) goals necessarily subtracts from the instinctual side of human nature, and, conversely, instinctual expression tends to be at the expense of our material and social sensibilities. Durkheim places specific importance on order and normative regulation. Freud, on the other places more emphasis on the value of biological expression. One of Freud's best general statements on this internalized struggle between the individual and society is in his *Civilization and Its Discontents.* Strongly reminiscent of Durkheim's statement, he observes that: ' . . . in every individual the two trends, one toward personal happiness and the other toward unity with the rest of humanity, must contend with each other; so must the two processes of individual and of cultural development oppose each other and dispute the ground against each other' (Freud 1958, 99). Freud believes culture grows and increases in complexity at the expense of the individual, and that the demands of contemporary civilization are becoming so excessive that the individual can only meet them at a tenable personal cost - if at all. Simmel like Freud is also concerned with the problem of increasing cultural dominance. He sees the basic antinomy as being between spirit and form. Spirit represents human creativity; form represents the products of this creativity. Although man creates his own cultural forms, he paradoxically must stand eventually in opposition to them. (A view shared by Weber as well).

Information and inputs for socio-technical innovation, once created, follow an immanent logic of their own (Simmel 1968, 39-40). They unfold and expand in directions that may have little or no relationship to the needs that first created them. At the same time they arc not completely irrelevant to the individual, since they are internalized and place demands on him. Knowledge repositories become stultifying as they move further and further from their creative base. The need eventually arises to discard the old forms and to create new ones (Simmel 1968, 44).

Thus socio-cultural change follows a dialectical mode of operation where succeeding stage represents a higher form than the previous. For example P.A. Sorokin's illustration of the decline and devitalization of cultural systems, is a best expression of such socio-cultural transformation.

According to Sorokin, if not disrupted by outside forces, cultural systems that make up part of the larger, do follow an immanent logic of their own. Every culture contains a multitude of systems. The movement of all these systems is from periods of creativity and vigor to periods of sterility and exhaustion. Unlike

the decline of biological entities, many systems can and do have periods of renewed vigor in which their decline is temporarily reversed. All cultural systems, though varying in size, duration, and periods of renewal, hold two features in common: (1) they generate change from within themselves, and, (2) if allowed to run their course, they are ultimately responsible for their own demise. Sorokin has labeled this first universal characteristic the ‘principle of immanent change of socio-cultural systems’; and the second is the ‘principle of limits’ (Sorokin 1947, 696, 699). In Sorokin’s own words: This inherent deterioration explains the extinction of most of the defunct systems and of most cases of the temporary decline of various systems and super-systems. Each of them contains the seeds of its own degeneration (Sorokin 1947, 711). He argues skillfully that cultural systems do indeed move from periods of relevance and vigor to periods of inanity and decline but does not provide a satisfying explanation why such changes do in fact occur. One plausible explanation to this lies in the dialectic nature of human action and his existence as species being. The early, vigorous, creative period in the development of cultural systems described by Sorokin, corresponds to that moment in the dialectic when new cultural forms have been established but are still in the service of the majority of the members of the culture. Because the system meshes significantly with the inner states of individuals, it stands a good chance of being perpetuated. Once perpetuation is under way, however, the ‘principle of immanent change of socio-cultural systems’ comes into play; that is, the cultural system is developed along lines that eventually become antithetical to human needs. When this internal development has gone far enough, the system becomes so far removed from relevance for most of its subscribers that it may be described as devitalized, sterile, exhausted or the like (Sorokin 1947, 705). It is at this moment in the dialectic that the ‘principle of limits’ becomes important. The system can no longer perpetuate itself because a significant number of the individuals who participate in it will no longer tolerate it. It must either be revitalized or replaced, so the process begins a new.

Paper 1

Socio-technical Innovation and the Role of Conversation in a Digital Ecosystem for Agricultural Extension Services in India

Debashis Pattanaik **Jayanta Chatterjee**

1.1. Introduction

There is wide agreement that we are witnessing an information technology 'revolution', or a change of 'socio-technical paradigm' based on Information and Communication Technologies (ICTs) (Castells 1996). The study of such changes - sociology of technology - is a heterogeneous field. With the dawn of the information age (knowledge society), we have harnessed a technology that moves at the speed of light. Now, knowledge could be produced, transferred, and distributed to thousands in ways that never happened before. ICT tools are used not only to coordinate data flow, but they also provide meeting spaces for the kinds of knowledge that should be shared between different stakeholders in a community (Figallo and Rhine 2002). Knowledge is growing faster than anything that humans now produce. Since the work of Peter Drucker in the 1990s, knowledge has come to be recognised as the primary driver of socio-technical innovation and change. Drucker, among others, argued that in the emerging society, knowledge is the primary resource for individuals and for the community overall; land, labour, and capital (Drucker 1999). Thus managing knowledge has become an important aspect for socio-technical innovation in the present era. Over the past few years, various ICT supported knowledge management tools has become a crucial means to connect people not only to digital knowledge repositories but also to other people, in order to share knowledge and create new forms of knowledge networks[1] and communities (Ichijo and Nonaka 2007).

This new emergent collaboration of different knowledge nuggets helps people to improve their lives more rapidly and effectively. It empowers individuals. It is a potent means for tackling poverty, ignorance and disempowerment. It enables people to dip more freely into the well of human knowledge and select the things of most value, relevance or interest to them (Cribb and Hartomo 2002). However for the true 'socio-technical innovation' to happen there must be a cultural change within technology itself. In addition the practitioners of socio-technical innovation should acknowledge that; 'lay knowledge' and 'scientific knowledge' are equal and necessary partners in the innovation and adoption process; and that true communication is not about sharing information, but about sharing meaning and achieving a common understanding (Cribb and Hartomo 2002).

1.2. Technology and Society – The Interplay

It is argued that all successful technological innovation involves the construction of durable links between humans and nonhuman entities-'actors' (Latour 2005). This implies that any socio-technical change involves two interrelated phenomena. The first is the way the 'physical' aspects of technology

[1] A knowledge network is an integrated platform for conversation and managed content. It is used as a space for group process as well as for individual research. It requires people skilled in both discussion facilitation and online content editing.

are influenced by the demands of its 'social' user. The second aspect relates to transformations that bring about changes in the patterns of social relationships due to introduction of a new technology[2] (Mackenzie and Wajcman 1985). In general much of social theory conceives social relations as simply unmediated relationships between human beings, rather than being made possible and stable by artefacts and technologies. There are possibilities that society can exist without artefacts and technologies, but such societies; for example of primates are small and rare today. Thus artefacts and technologies make larger and more complex societies possible.

Largely technological change follows persistent patterns, such as; the increasing mechanization of manual operations, the growing miniaturization of microelectronic components, and the increasing speed of computer calculations. Some of these patterns are indeed so precise as to take regular quantitative form (Mackenzie 1996). For example, 'Moore's Law' concerning the annual doubling of the number of components on state-of the-art microchips, formulated in 1964, has held remarkably from the first planar-process transistor in 1959 to the present day (Noyce 1977).

'Normal' technical change maintains a momentum of its own which defines the broad orientation of the innovative activities. Once a path has been selected and established, it shows a momentum of its own. In contrast persistent patterns of technological changes though possess momentum, but needs intervention (Mackenzie 1996, Latour 1987). One form of intervention to persistent pattern of technological change is 'self-fulfilling prophecy' (Merton 1968). The other possible intervention to persistent pattern of technological change is communication loops of ongoing conversations particularly if the object of orientation is ICT.

Users' expectations of the technological future are part of what make a particular future. These expectations evolve through communicative interactions among users groups. Thus technological trajectory is like an institution. Like any institution, it is sustained not through any internal logic or through intrinsic superiority, but because of the interests that develop in its continuance and the belief that it will continue (Mackenzie 1996). Its continuance becomes embedded in actors' frameworks of communication and routine behaviour, which are actualized by many communication loops that users of a particular technology constructs through everyday practices. It continues because it is embedded.

A socio-technical system in principle is a '*de novo* construct'. According to Pfaffenberger 'people are engaged in the active technological elaboration, appropriation, and modification of artifacts as the means of coming to know themselves and of coordinating labor to sustain their lives' (Pfaffenberger 1992). Thus socio-technical systems refer to the complex systems of social and technical components intertwined in mutually influencing relationships (Deborah and Wetmore 2008). In general the socio-technical system refers to the interaction between society's complex infrastructures and human behaviour (Wikipedia 2009).

1.2.1. Socio-technical Change and Innovation: Constructivist Paradigm

All social organization of scientific or technological change assumes a community structure, as Kuhn and others (such as; Price, Merton and Knorr-Cetina) have suggested (Kuhn 1970, Price 1963, Merton 1973, Knorr-Cetina 1999). For example Crane has suggested that the development of communication networks since the seventies has expanded the domain of exchange and sharing of ideas beyond local

[2] This involves tacit and explicit sharing of knowledge using new technology.

boundaries, and that become possible through ongoing interaction of people in a community like structure (Crane 1972). This suggests that evolution of a new technology depends on relevant social groups' involvement, use and interpretation of particular technology. Importance of user involvement in successful socio-technical innovation has been suggested by Mumford in his participatory design approach. Participatory design focuses on the active engagement of the end user in all the phases of design (Mumford 1993). Applied to information systems it suggests that successful design of information systems depends on repeated discussions with various groups of users, and integration of the multiple system perspectives into a composite information strategy that can later be implemented using a wide range of system engineering tools (Sjoberg and Timpka 1998).

The user interpretation of particular technology as successful means for socio-technical innovation has been highlighted by Pinch and Bijker in their social constructivist approach to evolution of new technology. According to them different social groups have different interests in the development of a technical artefact[3]. In the early stages of the evolution of an artefact, alternative designs are produced aimed to solve different problems and fulfil different needs. In later stages, because of social, technical, economic and political constraints, there is an increasing degree of stabilization through a competition for survival, as a result a few of them survive and become successful. Thus the evolution of a technical artefact denotes institutions and organizations as well as organized or unorganized groups of individuals who share a set of meanings constructed through communication loops in relation to an artefact (Pinch and Bijker 1987).

Pinch and Bijker use the evolution of the air tyre in bicycle technology to illustrate further. Pinch and Bijker note: 'when, for the first time, the tyre was used at the racing track, its entry was hailed with derisive laughter. This was however, quickly silenced by the high speed achieved, and there was only astonishment left when it outpaced all rivals' (Pinch and Bijker 1987). From a social constructivist point of view demonstration/conversation and its ongoing self production are two guiding elements towards any understanding of technological innovation and their diffusion.

A dominant paradigm in this direction is suggested by Rogers through his socio-technical innovation approach to rural adoption of new technology, popularly known as 'diffusion of innovations'. According to Rogers key aspects of diffusion of innovations are communication and their operation in facilitating dissemination of innovation through 'word of mouth' within local communities. He suggests that communication effects, especially the ability of media messages and opinion leaders to create knowledge of new practices and ideas persuade the target to adopt the exogenously introduced innovations (Rogers 1969). The necessary route for this change is 'word of mouth' which creates a path for acceptance of new ideas from sources external to the social system (Rogers 1969, Fjes 1976). In Roger's view word of mouth is the catalyst for innovation diffusion. Thus communication and conversations are central links through which new/exogenous ideas enter local communities.

1.2.2. Conversations, Self-production and Autopoiesis

The key point about conversation lies in its self-production. The term self-production has biological roots. It refers to systems where the components of the system participate in the processes of production that produce those same components that themselves constitute the system (Varela 1981, Maturana 1981). Self-producing systems have a circular organization where the outputs of the system are its own

[3] The term 'technical artifact' refers to a set of concepts, products and services bundled together.

inputs (Mingers 1995). Self-production in social context has a very specific meaning. One of the approaches to self-production in a social system comes from Luhmann's understanding of communication as a mode of circular organization proposed in his theory of autopoiesis (Luhmann 1990). Luhmann does not claim social systems as living systems, rather he suggests that if 'we abstract from life and define autopoiesis as a general form of system building using self-referential closure, we would have to admit different modes of autopoietic reproduction and that there are general principles of autopoietic organization that materialize as life, but also in other modes of circularity and self-reproduction' (Luhmann 1990). According to him communication exists as a unity constituted by three elements: information, utterance and understanding (Luhmann 1995). These elements exist in a mutual interactive field as they are co-created within the process of communication (Luhmann 1990).

Although Luhmann's conceptualization of communication refers to a higher level than 'conversation', yet conversation occupies a central position in his frame work. A significant aspect of Luhmann's conceptualization of social systems, and within that organization, is the notion of expectation and its relationship to the way the system is structured and decisions form. As such, self-referential social systems structure themselves through conversations and expectations of actions (Luhmann 1995). This framework combined with a social constructivist perspective provides valuable theoretical support to the development of Digital Ecosystem for Knowledge (DEK) that dynamically enhances 'self production' balances 'knowledge stocks' and 'knowledge flows' in socio-technical systems.

1.3. Multiple Media and ICT mediated Architecture for Socio-technical Innovation

An ICT intervention provides the community both wider and richer access to information. It infuses information into social networks with greater speed and density. The use of ICT shapes the social structure through recursive loops it constructs by organizing actors in the network into language communities. The internal propensity of this community continually organizes and reorganizes by networked communication channels produced through an autopioetic mode of communicative action while maintaining its boundary.[4]

The networked communication of the language community depends on the nature of trust, induced by the socio-technical system. Trust is a willingness to act on the basis of reliance. It has been suggested that a thick kind of trust, in which members have high degree of confidence in others role expectations is found mostly in stable and structured communities, such as village or agricultural communities. Such communities have been known as *Gemeinschaft* since the time of Tonnies (Toennies 1957). Opposite to it a thin trust with goal oriented behaviour exists in communities which Toennies called *Gesellschaft* (Toennies 1957, Adler and Heckscher, 2006). For socio-technical systems and knowledge networks which are like Gemeinschaft we have to enhance evolutionary growth conditions for trust based relation enhancing systems. In this context ICT helps us to propagate 'words of mouth' and enhances the trust based relationship through circularity of communication and expands the reach and thickness of network provided we focus on 'trust' and relation building and make it person oriented rather than technology oriented.

It has been observed that when knowledge structure is fluid or random face to face (F2F), mobile nets, audio blogs, interactive radio, and TV act as successful modes for generating conversations and propagating word of mouth in a trust based relationship environment. In contrast when the nature of

[4] Section also appears in P.27.

knowledge is explicit conversation depends on dynamic mode of knowledge sharing (Fig. 1.1). Key aspects of the 'diffusion of innovation' processes are thus the dialectic interaction among the 'innovation itself', the 'social system' in which the innovation is introduced and the 'communication channels' through which the social system 'members' learn about the innovation and the 'timing' of the processes. The communication is maintained through circularity, organization and reproduction.[5] This requires interoperability of the information (interoperability provides potential for automation and systemic self-management) and digitization of the information in various forms for easy use created by many stakeholders in the domain.

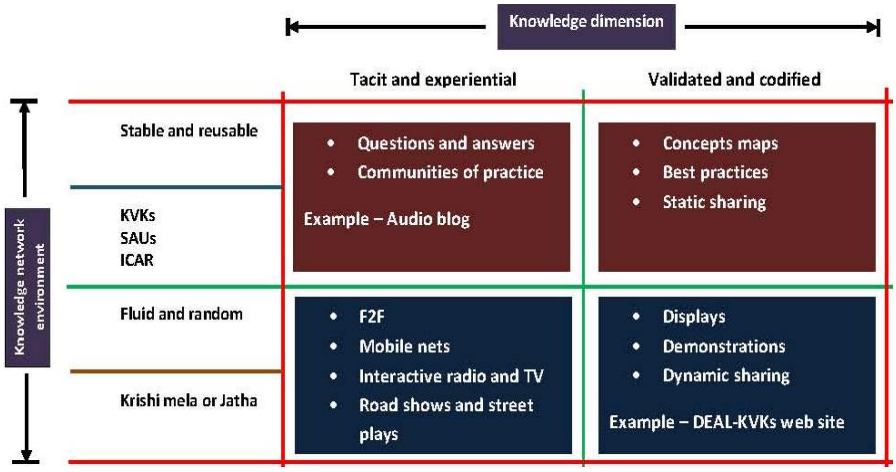

Figure 1.1 - Knowledge Network Environment and Knowledge Dimension

The goal framework of the DEAL - Digital Ecosystem for Agriculture and Rural Livelihood, [www.dealindia.org] project focused on interoperability of the information. The goal was to facilitate communication through context sensitive query processing over heterogeneous information sources. The agenda was to build an action oriented network supported with multiple ICT tools and technologies, whose interaction e.g. KVK (Krishi Vigyan Kendra = Farm Science Centre) scientists and farmers create new knowledge based relationships in a trust based framework (Chatterjee and Pattanaik 2009).

1.4. Socio-techinal System for Agricultural Extension Services

The concept of ICT for rural development has always attracted media and corporate attention and therefore many multilaterally funded projects on this theme have been initiated over the last ten years across many developing countries. Most of these projects focused on establishing info-kiosks in villages and grappled with the initial problems of connectivity, power and other infrastructural issues. Some of them were oriented towards electronically delivered Government to Citizen Services; some were focused on trade and some on a range of consumer oriented services. Our initial study across North Indian locations during 2002-2004 of many such projects led us to believe that to ignite the agricultural and rural livelihood innovation process with knowledge flow, these rural ICT kiosks not only needed network connectivity and electrical power but also the power of appropriate content and applications.

[5] Section also appears in P.27-28.

Our research hypothesis was that the process of creating a self propagating content/knowledge network and self managed knowledge repository can be enhanced by efficient networking of many conversations to build action oriented network (digitally enabled) communities. This can then create a digital ecosystem and a dynamic grass root innovation system sustained by many feedback loops (Chatterjee et al. 2008). The DEAL perspective starts from the assumption that ICTs can play an important role in catalyzing development. In this statement we immediately recognize different possibilities of interpretation. If we focus on the technological aspects, we might expect efficiency improvements in those processes that can most easily be automated, such as information storage and retrieval or any of the other processes that support the business and economic life of the users of DEAL. Development in this case tends to be interpreted in terms of quantifiable economic measures. If, on the other hand, we focus on the communication processes enabled by the technology, we are led to inquire into the nature of the link between the social processes supported by ICTs and the different kind of possible social interactions and exchanges. These two perspectives reflect a dichotomy at the heart of research on ICTs that corresponds to the main epistemological viewpoints in the current OPAALS-DEAL project (Rivera Leon and Dini 2008).

1.5. Research Methodology

Field deployment of the DEAL project was between December 2006 and June 2007. Some further deployment work has been done under the OPAALS project (www.opaals.org) during 2008. We have been conducting studies among participating KVKs, October 2007 onwards. The data used in this paper are taken from the data collected during our field visits at two different time intervals during July-August 2008. The data was collected from five participating KVKs, involving a sample size of 32 in number. The data was collected through qualitative techniques and semi- structured questionnaire.

1.6. Conversation in Extension Services among Agriculture Scientists – Pre DEAL Scenario

It is observed that, in the absence of proper channels to facilitate communicative action most of the scientists of the KVKs operate in isolation and hardly have any opportunity to gain the information and knowledge about other scientists working in her/his area in another district even at the local level. In their respective KVK the scientists also have sparse networks for knowledge exchange. For example in one of the studied KVK (located at Dhaura) all the scientists maintained reciprocal relationships with the SMS (subject Matter Specialist - Agriculture Scientist) of horticulture as he was the administrative head of the particular KVK, whereas in terms of actual information sharing hardly they have any reciprocal relation with another scientist (Figure 1.2).

Our study shows a low network density (for communicative action) among the KVK scientists in pre DEAL scenario. The network density for communicative action in pre DEAL scenario is .1199[6]. In pre DEAL scenario SMSs of animal husbandry and home science are most isolated actors in the network space of knowledge exchange, where as SMSs of agronomy, plant protection (plant pathology), farm management and soil science have unitary mode of networked conversation. These forms of networked conversation hardly meet the rising need of the information resources of the scientists in the present context of the rapid changes that occurs in agricultural technology.[7]

[6] The network density has been calculated by proportion of ties in the network relative to the total number possible (sparse versus dense networks). Connection weights are ignored and connections are undirected.
[7] Section also appears in P.28-29.

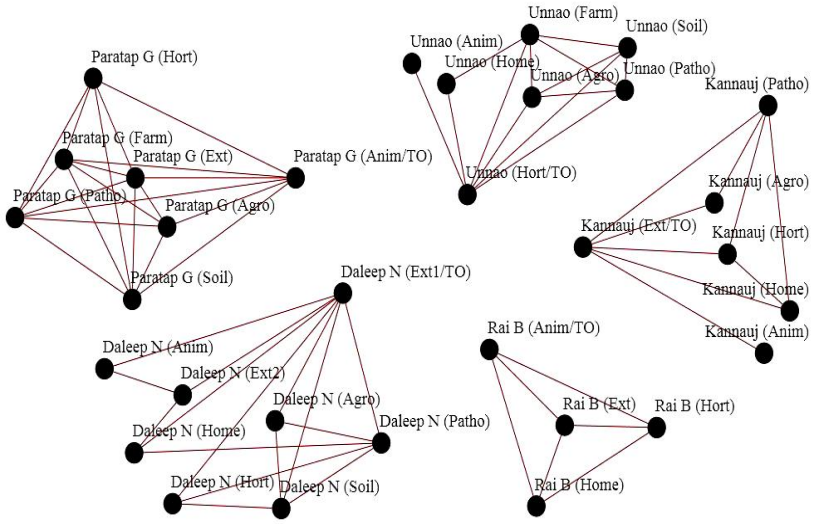

Figure 1.2 - Networked Conversation in Pre DEAL

1.7. Conversation in Extension Services among Agricultural Scientists - Post DEAL Scenario

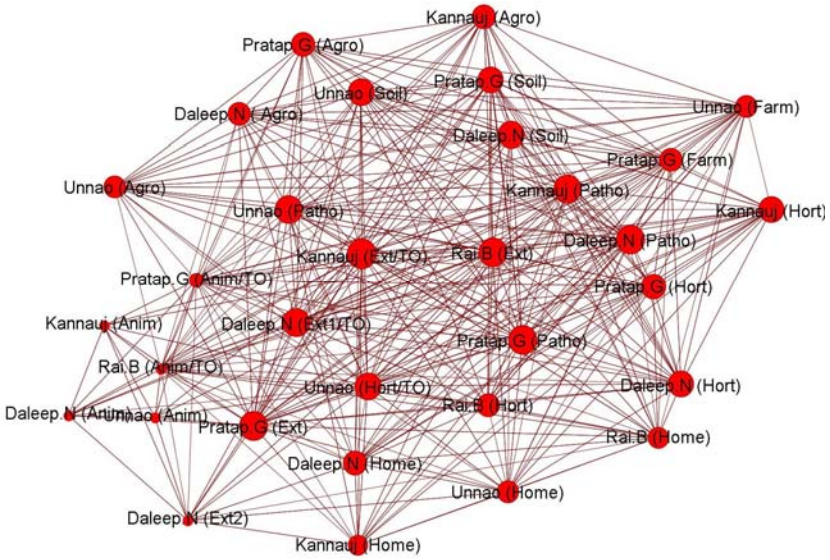

Figure 1.3 - Networked Conversation in Post DEAL

Studies in network architectures suggest that centralized networks are ineffective modes of interaction for information sharing (Fahey and Prusak 1998, Markus 2001). In contrast a participatory bottom-up approach allows information sharing and communication more effectively. This is where the DEAL has played a crucial role.[8]

[8] Section also appears in P.29.

The DEAL aimed to create many conversions through an autopoietic mode of network among different SMSs of KVKs by linking each of them to other through digitally facilitated knowledge architecture. The DEK design of the system places special emphasis on voluntary participation, and as more members access the network the number of ties increases, and these ties are mutual, trust based and voluntary (Pattanaik, Chatterjee and Sarkar 2008). Figure 1.3 shows the network developed among various scientists in a post DEAL scenario. The network density at post DEAL scenario is .6279. Literature in knowledge management and communities of practices suggest that normally people in a structured Communities of Practice (CoP) come from background having shared knowledge or shared belief system. In these kinds of structural arrangements often people learns through the facility that is available through structural resources and positions (Baalen, Bloemhof-Ruwaard and Heck 2005).[9] In contrast information and communication builds a different kind of network i.e., an Action Oriented Network of Practice (AONoP) by challenging the established social structure through communication interaction of different language communities (Pattanaik and Chatterjee 2008).

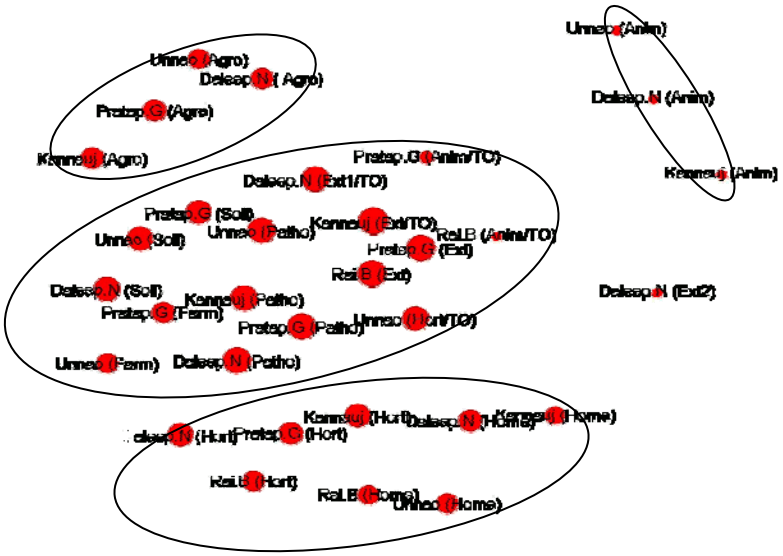

Figure 1.4 - Networked Conversation in Language Communities

Language communities are structured around some form of similarities among participating agents in an AONoP. A kind of hemophiliac quest and satisfaction designs patterns interaction of language communities in an AONoP (Monge and Contractor 2005). In our case this hemophiliac quest is structured around subject expertise of agricultural experts (Figure 1.4).This hemophile also acts as a source of trust among the actors in a language community. A knowledge portal such as DEAL under these conditions facilitates the process of socio-technical innovation through recurrent language reproduction of AONoP in a trust-relationship based framework (Figure 1.5). A sucessful DEK implementation depends on only on the technology but the way people participtates in it. People participate beacue they fell taht their is a need to sahre their experience and ideas with other andsuch facilities are available to them.Once people satrts to participate they reorganise themselves into structured entities based on some similarity of traits (we have refered to them as language communities-in DEAL knowledge structure/domian expertise configured the structed entities in the network). Their

[9] Section also appears in P. 30.

interaction and organic growth are then designed by the amount of trust induced to the network. This eventually leads to the emergence of and participatroy, collaborative, active and bottom up network (referred as AONoP). The emergence of such network rebuild new rule sytems and provides feedback to the ecosystem for context specific adoptation and change.

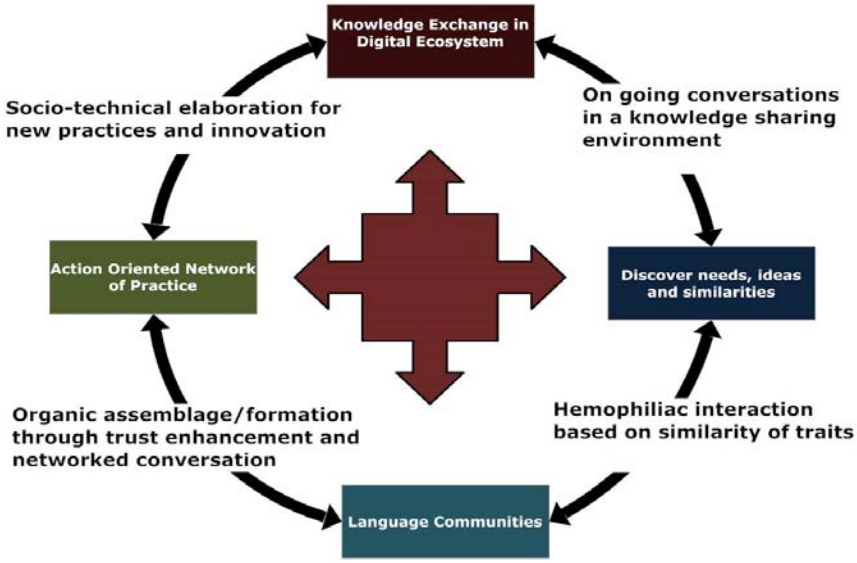

Figure 1.5 - Circularity of Networked Conversation in a Digital Ecosystem

DEAL as a socio-technical system facilitates the bottom up approach for knowledge sharing to the people from different organizations and backgrounds. A network of conversions exhibit inherent circularities and self amplifying feedback loops. The closure of the network results in – a shared system of beliefs, values and possibly praxis, a context of meaning, which is continually sustained by ongoing conversation and propagation of word of mouth.

1.8. Conclusion

The DEAL has been able to create an AONoP among various scientists for knowledge and information sharing. There is a continuous dialogue among scientists of the KVKs both at horizontal and vertical level. This has been done by creating a platform for different KVKs to share their extension experiences with each other through multiple media facilitated by ICT tools and technologies. Making new knowledge recognizable to others is one crucial principle of socio-technical innovation. The DEAL experiment shows that successful knowledge networking depends on use of a commonly understood language and trust is the cornerstone of knowledge sharing cultures. In general as people starts conversing with each other trust grow and the transfer of relevant knowledge between them becomes easier and more efficient. Learning begets more learning; people not only learn what others know, but also learn the best ways to make others share what they know.

The DEAL experience shows that organic formation and socio-technical change happens when people are given access to tools for building conversational relationships. DEAL as a digital ecosystem for knowledge, demonstrates the emergent behaviors that makes socio-technical innovations possible and self-sustaining. Most of the content at the DEAL portal has been created outside of any structured mandate and through voluntary participation. The participating community has developed it because; there was an opportunity and need for change in the contemporary approach to extension services. One

of the most fruitful out come of the DEAL experiment was the 'cross-pollination' effect of different internal cultures brought together electronically[10] (Figallo and Rhine 2002). People whose physical paths might have never intersected were able to interface and integrate in a new knowledge nexus. These different groups of people conversed with each other under a variety of contexts; as cohorts, subject experts, interest groups, domain stakeholders, practitioners and observers of the world. Knowledge sharers at the DEAL portal conversed both through the technology and as well as about the technology because they recognized together how improvements in application design and content delivery can help them discover, exchange and use information and conversation more effectively.

To expand the conversation further the DEAL has developed audio applications such as Kishan Blog for sharing knowledge. Kisan blog holds three possibilities for the upcoming web technology: it allows acquisition of tacit knowledge as a direct input, distortion of knowledge does not occur due to rendering in audio format, and it provides easy to use and easy to learn facilities to the user. Above all it ensures collaborative practices for knowledge generation and reuse through intrinsic rewards and trust based relationships. Contemporary web 2.0 has empowering effects if it is used as a tool for communication and cooperation in civil society. In this sense DEAL as a web 2.0 application has enlarged the sphere of voices and issues that other wise have remained marginal (Pattanaik and Srakar, 2008). The DEAL experience in expanding the Indian agriculture extension services knowledge network and the self catalyzing characteristics exhibited by several applications like the Kisan blog inspire new research interests regarding the role of participative digital communication as enabler for innovation in large and complex socio-technical systems.

[10] Similar observations of cross pollination effect for knowledge sharing cultures have been suggested by Figallo and Rhine.

Paper 2

Dynamism of Organic Assemblage in Digital Ecosystem-Learning and Innovation in DEAL

Debashis Pattanaik **Jayanta Chatterjee** **Paolo Dini**

2.1. Introduction

Ensuring a thriving agricultural economy is critical for India's global competitiveness to be inclusive of as many economic sectors as possible. A global competitive Indian economy must be based on a knowledge-driven transformation of Indian agriculture because agriculture, which engages more than 60% of India's population, has already reached the physical limits of land and water. The large and complex Indian agriculture system however has started to languish and needs infusion and diffusion of knowledge-driven innovation across the entire value chain. This study focuses on the Indian Agricultural Extension System as a knowledge-learning network, and on the impact of infusion of digital and communication technologies on that complex socio-technical system to enable the next stage of adaptive innovation through new forms of learning systems.

India's first green revolution was a spectacular success. Volume of production went up by orders of magnitude for most crops, particularly for basic food grains like wheat, rice and pulses through higher acreage under cultivation, and vast areas were brought under pump irrigation. New seed varieties like dwarf wheat and dwarf rice were successfully introduced, which significantly enhanced yield per hectare. Yield also improved due to the widespread usage of chemical pesticides and fertilizers. India became a net exporter of many types of agricultural produce and the national buffer stock for basic grains ensured India's food security. Forty years later the situation has changed. The mismatch between supply and demand has again started widening. The increasing standards of living in India's bustling cities, higher demand of food grains at home and around the world can not be adequately served by declining agricultural productivity in India's country-side. This has initiated a complex downward spiral. More and more land is needed for industrial expansion. Water resources are constrained. And, to complicate the situation, over-tillage, over-irrigation, and excessive or wrong usage of chemicals, fertilizers, and many other adverse effects of earlier technological approaches have severely impaired India's productivity across the most fertile and irrigated states (Chatterjee et al., 2008).

It has been pointed out that information asymmetry and lack of rapid knowledge diffusion has created stagnation in Indian agriculture (Kaushik and Singh, 2004). Knowledge creation and sharing, together mediated through digital technologies, can play a big role in rejuvenating Indian agriculture. Innovation in Indian Agriculture at every stage of the value chain, from seed to food processing, is a national priority. But borrowed science will often not work anymore. Associative Open Innovation is needed at grass-root level (Chatterjee et al., 2008).

This goal of knowledge-driven agriculture to increase production, reduce costs, and enhance agricultural profitability, to make Indian agriculture globally competitive, also needs new programmes to reduce rural poverty and inequality and to protect the environment by reversing the degradation of natural resources (like land and water). New programmes are needed towards innovating new forms of rural

enterprises that will effectively manage the shift of labour forces, stem the migration to urban slums, and broaden the base of economic growth potential of rural citizens (Chatterjee and Pattanaik, 2008).

To make good decisions, both extension workers and farmers need information from different sources and often need help to integrate the information. Due to its sole dependency on State Agricultural Universities (SAU) and to some extent on Indian Council for Agricultural Research (ICAR) institutes, the present extension agents only learn about the knowledge and technologies generated by these research stations. However the current agricultural scenarios demand an increasing role of international knowledge sources as well as better visibility of local solutions developed by innovative farmers. Thus the extension needs to expand its role from technology transfer to include roles such as (self-catalyzed) problem-solving, education, and human development (Chatterjee et al., 2008). The first step in this direction requires identification of the different elements in the Agricultural Knowledge and Information System and redesign of this system in a way that is better aligned with the improvements achievable by learning systems (Hall et al., 2002). Our work indicates that communication networks supported by multiple media tools and interaction platforms that allow reflexive learning exchanges were needed to facilitate knowledge-driven change in centuries-old agricultural practices.

2.2. Multiple Media Tools and DE for Agricultual Extension System

The first official extension system had its origin in the Potato blight in Europe in 1845. The idea was to improve potato cultivation and grow other nutrients crops in the region. Contemporary extension systems broadly aim to enhance the process of learning through linking researchers (and other innovations) with potential users of research results. The system had its origin in the US Land-Grant University system. The US system was exported to India in the second half of the twentieth century. Following it India adopted the “training and visit” (T&V) approach to the extension system supported by the United Nations. T&V had attempted to streamline the traditional extension system through three kinds of mechanisms: (1) concentration on a few “contact farmers” in a service area, (2) concentrating on agricultural matters exclusively; and (3) concentrating on a few practices during each regular visit of village extension workers (Colle, 2008).

A dominant assumption of the extension service system is that individuals will learn about new practices and technology “if only they understand what is advocated and know how to carry it out” (Andreasen, 1995). Thus the contemporary extension service ignores farmers’ perception of their needs and mismatches those presumed by the researchers, whose interpretation of reality counts. The fundamental assumption in the current extension is that no matter where they operate the method will work. The role of the extension agent and farmer is to learn “best practices” from the experts and to put their dictates into practice. Thus the knowledge that is developed through farmers’ trials and errors never becomes part of the learning system.

A well-designed extension service must not only be multidimensional and sophisticated but must also be able to address diverse settings from the different vantage points. The ability to accomplish such a complicated task successfully cannot be mandated by top-down edicts. To produce best practicing agriculturists with the disposition to become agents of their own development and the social good, extension agents and farmers need a communicator and participatory bottom approach to learning system (Pattanaik and Chatterjee, 2009).

We assume that planned and systematic use of multiple media tools built upon a Digital Ecosystem (DE)[11] approach can enhance the pedagogical and communication capabilities of the agents. It can build a Glocalized Learning Environment (GLE)[12] for the agents to converse more effectively and interactively with different audiences sustained by many feedback loops.

2.3. A Digital Ecosystem Approach to Knowledge in a Glocalized Learning Environment

Literature in knowledge management, complexity sciences (Holland, 1995; Gell-Mann, 1994; Kauffman, 1995; Juarrero, 1999; Hall, 2005), and organizational learning (Argyris and Schon, 1974; Argyris, 1993; Senge, 1990) suggests that systems that are characterized by distributed continuous learning, self-organizing, and problem-solving produced by dynamic processes of interacting autonomous agents are non-deterministic in character. Such learning systems depend on social, geo-physical, economic, and cultural conditions, and also social network effects (Firestone and McElroy, 2003). Learning processes are part of a sequence of cognitive operations that have been described in the literature in varying terms, e.g. the organizational learning cycle (Ackoff, 1970), the experiential learning cycle (Kolb and Fry, 1975; Kolb, 1984), the adaptive loop (Haeckel, 1999) and others. In this paper we refer to them as glocalized learning environments.

The learning process is a part of actions, and actions – activities – are the stuff that social processes and social networks are made of. Existing knowledge is always the immediate precursor to action. In a conventional learning environment new knowledge is generated about specific conditions and situations by using preexisting knowledge routinely. This type of learning is widely known as single-loop learning (Argyris and Schon, 1974) and it is linear in nature. In this type of learning old information is replaced by new as soon as this appears. In contrast, glocalized learning environments play a key role in initiating and performing non-linear[13] types of learning. Argyris and Schon call this double-loop learning (Argyris and Schon, 1974). This type of learning is media-centric and reflects the nature of continuous dialogues. It does not replace old information but keeps it for future use along with the accumulated new information (Snow, 1959).

The DE approach to Knowledge follows the latter principle. The DE in this context aims at opening up continuous conversations among different members of Glocalized Learning Communities (GLC).[14] This in turn helps the members of the learning communities (agents) to gain new knowledge through the realization of activities and practice. It represents the working practices of continuous dialogues in GLC by means of multiple media- and DE-specific operations. It has been suggested that media-specific operations about learning processes involve three mechanisms: (a) *Transcription* - a medium-dependent

[11] The digital ecosystem is the pervasive soft support infrastructure populated by components or digital species able to evolve and to adopt local conditions and to mediate services and knowledge (Dini and Nachira, 2007).

[12] The term refers to learning environments that are global in nature but are produced by many interactional effects of local communities. Here in this paper the interactional effect refers to conversational relationships among different actors.

[13] It is common in the social science literature that studies complex-adaptive systems not to define precisely terms that have a mathematical origin, but to rely on an intuitive (and ultimately socially constructed) semantics arising from context and use. In this case, 'non-linear' connotes the presence of knowledge feedbacks and interdependencies between the various actors or agents.

[14] The term refers to learning communities who shares knowledge with each other in a virtual global space but are located at local level. In simple terms they are global in nature but local in existence.

operation to make mediated collections more readable, (b) *Localization*[15] - an operation to transform global media into local practices and forms and (c) *Addressing* - an operation that stabilizes and optimizes the accessibility to channels of communication (Jager & Stanitzek, 2002; Fohrmann & Schuttpelz, 2004, cited in Spaniol, Klamma and Cao, 2009).

In the following, we synthesize the Glocalized Learning Processes (GLP) from the perspectives of media theory proposed by Spaniol, Klamma and Cao (2009). We supplement it with our own approach to a DE. Our proposed model thus elaborates the GLP in a DE.

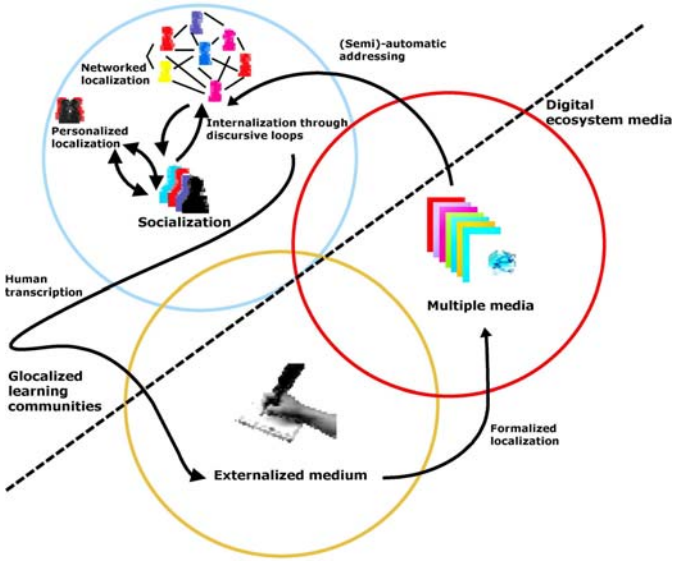

Figure 2.1 - Glocalized Learning Process in Digital Ecosystem[16]

In the upper section (Figure 2.1) we focus on actions performed by humans. Starting with some people who have internalized some specific knowledge, there are two ways to communicate with others. They can present this information to others either through human-human interaction – *personalized localization* – or can perform a *human transcription* of the knowledge. Human transcription generates new knowledge/media artifacts. This brings us to our next section where the transcribed knowledge is processed. In a DE this involves digitization of the knowledge. In occasions when knowledge is tacit or source is personalized, localization, human transcription, and digitization occurs simultaneously. For example, in the case of a rare book, it is scanned; image files are created and transferred to a personal computer. In case of oral traditions and fluid knowledge they are digital recorded and stored on a personal computer. This makes available knowledge in a localized community an externalized artifact. This then takes us to the next section where the externalized artifacts of an individual are further processed by the information system and transmitted. This is done by *formalized localization* of the externalized knowledge/media artifacts. Externalized artifacts are refined so that they become easily

[15] There are three types of localization *formalized localization* within information systems [here in digital ecosystem], *personalized localization* [in glocalized learning communities in physical space] among humans, and *networked localization* [in glocalized learning communities in virtual space] among humans.

[16] The basic design for the figure has been taken from Spaniol, Klamma and Cao (2009). We have modified it for our purposes.

accessible, addressed by multiple media, easily transmittable and interoperable. Finally they are put in to air and passed down to different localized communities across regions.

2.4. Multiple Media and DE Architecture for Learning Systems

In our estimation multiple media and ICT intervention provide the community both wider and richer access to knowledge. Greater infusion of knowledge (more practically information) into social networks depends heavily on communication technologies. The use of ICT does shape the social structure by organizing actors in the network. The network structure in DEs depends on the knowledge dimension, the learning network environment, and associated media tools and technologies.

We have observed that when the knowledge structure is fluid or random face-to-face (F2F), mobile nets, interactive radio and TVs act as successful modes for generating conversations among different stakeholders in a network. In contrast, when the nature of knowledge is explicit dialogues depend on dynamic modes of knowledge sharing (Figure 2.2).

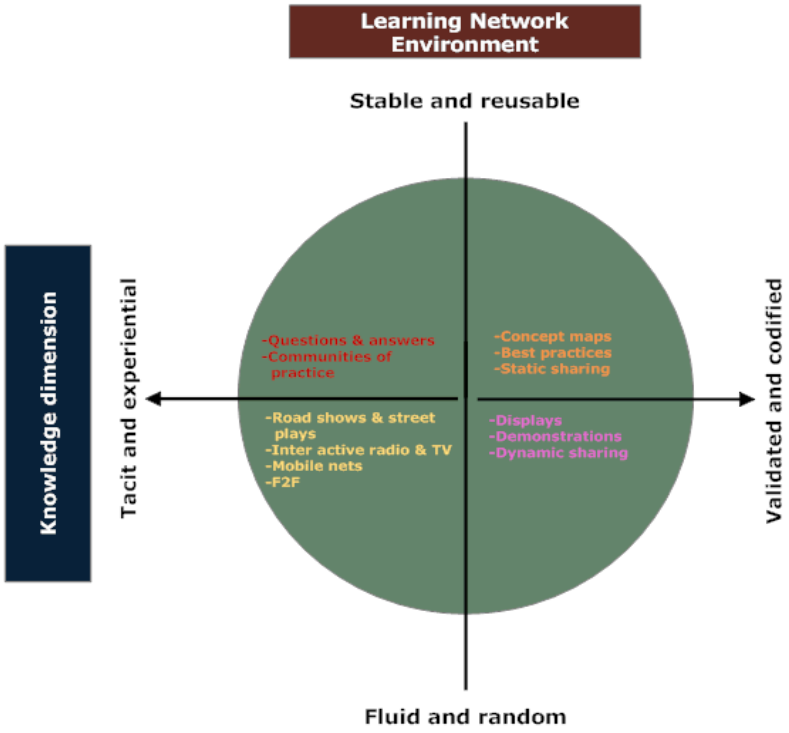

Figure 2.2 - Knowledge Sharing and Learning in Digital Ecosystem for Learning Systems[17]

Key aspects of the 'learning systems' are thus the 'dialectic interaction among the 'learning object itself', the 'social system' in which the learning object is introduced, and the 'conversation channels' through which the social system 'members' learn about the object or idea and the 'timing' of the processes. The conversation is maintained through circularity, organization and reproduction. This necessitates a need for interoperability of the information. Interoperability provides potential for

[17] Adopted from Pattanaik, D. and J. Chatterjee "Introductory Paper - Digital Ecosystem for Knowledge – An Perspectives and Observations form the DEAL Project, In *D11.6*.OPAALS Network of Excellence.

automation and systemic self-management.[18] In the following we will discuss the GLP in a DE architecture developed for knowledge sharing and learning in the Agriculture domain. The DE architecture named as the Digital Ecosystem for Agriculture and Rural Livelihood (DEAL-www.dealindia.org) project focused on semantic interoperability. The goal was to create a glocalized learning environments over heterogeneous knowledge sources. The agenda was to build an action-oriented network of practice, whose interactions, e.g. among Krishi Vigyan Kendra (KVK) scientists and farmers, create new learning environments and vice versa.

2.5. Research Methodology

Field deployment of the DEAL project was between December 2006 and June 2007. Further deployment work has been done under the OPAALS project (www.opaals.org) during 2008-09. We have been conducting studies among participating KVKs, October 2007 onwards. The data used in this paper are taken from the data collected during our field visits at different time intervals.

2.6. Learning and Innovation in Personalized Localization – The Extension System

We find that in the absence of proper conversation channels a majority of the scientists do not have conversational interactions. They operate in isolation and hardly have any opportunity to learn new things that are generated in another station or in the field. This also applies to intra-organizational learning within a KVK. For example, in one of the studied KVKs (located at Dhaura) we found that the scientists shared reciprocal conversational relationships with the horticulture scientist (as he was the administrative head of the organization). But in terms of actual learning they hardly had any conversational relations with other scientists of the same organization (Figure 2.3). It is noteworthy to point out that network density for personalized localization is 0.1199. .

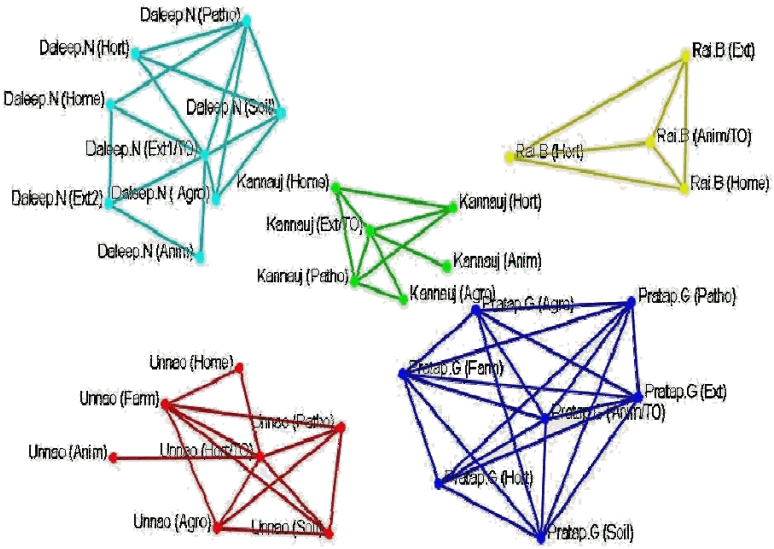

Figure 2.3 - Learning and Innovation in Personalized Localization

Further observation highlights that the animal husbandry and home science scientists are most isolated people in the personalized local network/community in the interactional space of learning, where as scientists of agronomy, plant protection (plant pathology), farm management and soil science have

[18] Section also appears in P.16-17 of the document.

unitary mode of learning relations (Figure 2.3). These forms of conversational relationships and learning systems hardly meet the rising need of the knowledge resources of the scientists in the present context of the rapid changes that occurs in agricultural technology. The lack of conversational relationships among scientists of different KVKs reflects the predominantly centralized and top-down approach to learning and innovation in the Indian agricultural extension system.[19]

2.7. Learning and Innovation in GLE –The DEAL

Studies in network architectures suggest that centralized networks are ineffective modes for learning through knowledge sharing and conversational relationship (Fahey and Prusak, 1998; Markus, 2001). In contrast to it a participatory bottom-up approach allows better knowledge flow and thus a better learning system and a more effective conversation environment. This is where the DE plays a crucial role.[20]

A DE for knowledge tries filling the gap by providing knowledge over multiple media addressed through (semi) automatic tools and techniques. It aims to develops a network among different people of the localized communities by linking each of them to others through a digitally facilitated knowledge architecture

The Digital Ecosystem (DE) design of the system thus places special emphasis on voluntary participation. As more members access the network the number of ties increases, and these ties are mutual and voluntary (Chatterjee, Pattanaik, and Sarkar, 2008). Figure 2.4 shows the conversational relations developed among various scientists in GLE. The GLE is an offshoot of the DEAL project. The network density for GLE/DEAL scenario is 0.6279.

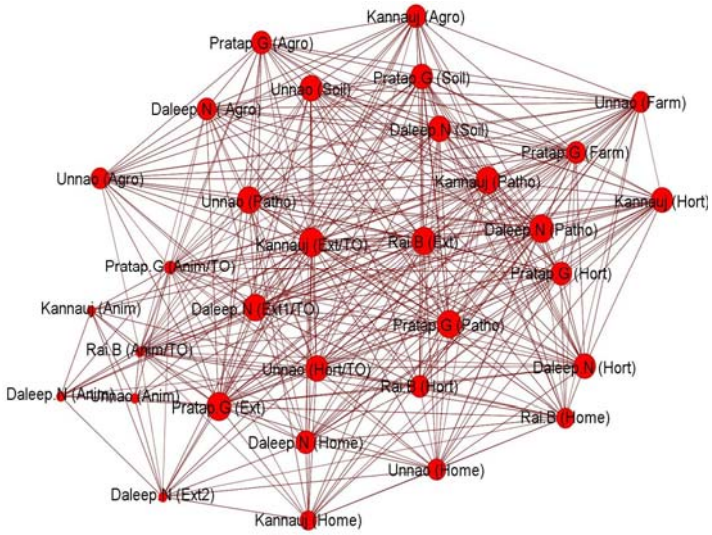

Figure 2.4 - Learning and Innovation in a Glocalized Learning Environment.

Literature in knowledge management and communities of practice suggests that normally people in a structured Community of Practice (CoP) come from backgrounds having shared knowledge or a shared

[19] Section also appears in P.18.
[20] Section also appears in P.19.

belief system. In these kinds of structural arrangements often people benefit from the ease with which structured resources and positions can be accessed (Baalen, Bloemhof-Ruwaard, and Heck, 2005).[21] This facilitates quicker and easier learning systems in CoPs. In contrast, the DE builds a different kind of learning network, i.e. a network that is located at a local level physically but exists at global level virtually – Glocalized Learning Community – by reconfiguring and reorganizing the normative systems through self-amplifying conversational loops.

The self-amplifying conversational loops are outcomes of the GLE and of interactional effects that are configured by the DE architecture. A GLC community configures and reconfigures in some kind of frame of reference. In the case of the DEAL project it was subject expertise of agricultural scientists. Scientists bonded with one another in systems of homophily. This homophily also provides a sense of belonging and increases people's trust in bonding together in reciprocal relationships (Figure.2.5).

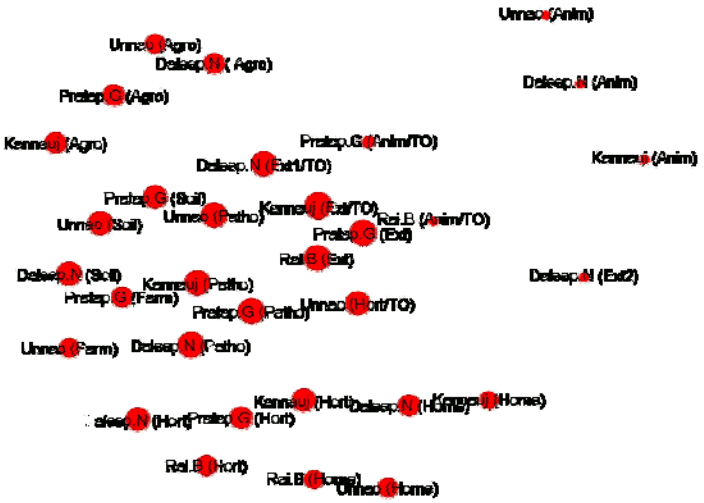

Figure 2.5 - Reconfiguration of Glocalized Learning Communities

Our research showed that a DE for knowledge portal such as DEAL nurtures conversational relationships across time and space. This promotes learning and creates new learning systems for localized communities located in different regions. In the process it generates new knowledge and promotes innovation through GLEs. A network of conversations exhibits inherent circularities and self-amplifying feedback loops. The closure of the network results in a shared system of beliefs, values and possibly praxis.

2.8. Conclusion

The DEAL as an active DE phenomenon has created an emerging GLE of various scientists for knowledge sharing and learning. There is a continuous conversation among scientists of different KVKs. Making new knowledge recognizable to others is one crucial principle of learning supported by new media and communication technology. The DEAL experiment shows that successful learning happens when people engage in participatory and collaborative conversational activities. In general as people start conversing the transfer of relevant knowledge between them becomes easier and more efficient.

[21] Section also appers in P.20.

Learning begets more learning; people not only learn what others know, but also learn the best ways to make others share what they know.

The DEAL experience shows that organic formation and learning happens when people are given access to tools for building conversational relationships. DEAL as a DE for knowledge demonstrates the emergent behaviours that make learning easier and self-propagating. Most of the content on the DEAL portal was created outside of any structured mandate and through voluntary participation. The participating community has developed it because there was an opportunity and call for change in the existing approach to learning in the extension services.

However DEAL as an open system of learning environment also represents the dynamism of complexity in an evolving society. There are perhaps many underlying phenomena subject to ever-changing patterns of unpredictability that have made this dynamism possible in the DE. Here in this paper we have attempted to explore a few aspects of such complexities in a DE. Further, human societies are part of the living world and therefore also the product of evolution. We know from biology that groups are made up of individuals, individuals are built from cells, cells contain chromosomes, which in turn have genes. Selection is known to occur at any or all of these levels. However the higher-level entities reproduce as a unit and function as an integrated one, even if they continue to be made up of parts that, in the evolutionary past, were once independently reproducing entities (Jablonka and Lamb, 2005).

Growth of complexities transforms a DE from a lower-level organic assemblage to a higher-level unit, it then reproduces as a unit and functions as an integrated unit. The learning process in a DE for knowledge follows principles that biologists call adaptive radiation (Guttman, 2005). One original localized population radiates out in several different directions in the virtual space. A general way of life to which a species adopted is called an adaptive zone (Guttman, 2005). In our case there are three adoptive zones: the zones of networking, externalization of knowledge and zones of multiple media. Each of these zones as in biological systems has its own special functions (but the three zones are interrelated). Their overall aim is system maintenance and system reproduction. It is noteworthy to mention that there might be drifts in the system when new species develop within the DE for knowledge. Drift may also change some form of internal dynamics of the system. WE are living in a society where what sociologists called solidarity has undergone a fundamental transformation. We have evolved from organic solidarity (Durkheim 1984 [1933]) to a type of solidarity which is “segmented”. Today separate, autonomous social segments connect with each other not only out of necessity and mutual dependency but also on the basis of individual choice (Komter, 2005). A DE as an open and collaborative platform supports the individual choice to adapt to the conditions individuals prefer.

To expand the conversation and learning systems further the DEAL has developed web 2.0 based applications such as Kisan Blog and Krishi Katha for sharing knowledge (Pattanaik and Chatterjee, 2009). The DEAL experience in expanding the Indian agriculture extension services learning system and the self-catalyzing/producing characteristics exhibited by several applications like the Kisan blog and Krishi Katha inspire new research interests regarding the role of participative digital communication and multimedia tools as enablers of learning and knowledge sharing in large complex adaptive systems.

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