

Does the emergence of distributed innovation call for new innovation process theories?

By Jarle Hildrum

**Centre for Technology, Innovation and Culture
University of Oslo**

Abstract: This paper explores the concept of distributed innovation. The purpose is to put forward empirically based propositions about the specific nature of this kind of innovation process, and mark out avenues of future research through which these propositions can be examined more thoroughly. To accomplish this, the paper systematically compares and contrasts one widely recognised ‘generic’ innovation process model – the Minnesota Innovation Research Program (MIRP) model - with a longitudinal case study of an internationally distributed software development project. The case study findings correspond closely with most of the process characteristics of the MIRP model as well as with a number of previous studies of innovation processes. The paper thus offers little support for the argument that current distributed innovation represents something entirely new, and offers no justification for treating existing theories of innovation as irrelevant in analyses of distributed innovation. However, the analysis gives some justification for highlighting specific political aspects of distributed innovation, suggesting that distributed innovation ventures stand out from other innovation ventures in the sense that they entail a higher degree of detachment and autonomy from the organizational environment. One important aspect of this autonomy is external stakeholders tend to refrain from intervening directly in innovation groups to help tackling emerging technical problems and power struggles. The high geographical distribution of innovation group members, and their strong dependence on remote communication, makes it more challenging to tackle complex technical problems and intra-project power struggles efficiently.

1. INTRODUCTION

Distributed innovation - understood as the successful implementation of a new or improved product or process by a geographically distributed, multi-firm innovation group - has attracted widespread attention in the last few years (Sawhney and Prandelli 2000; Kogut and Metiu 2001; Acha and Cusmano 2005; Hildrum 2007). The rising frequency by which firms choose to undertake such innovation processes, the increasingly complex divisions of labour involved and the extensive use of the internet to facilitate interaction are - according to some authors - novel trends that started to expand rapidly around the turn of the millennium. For instance, in a recent survey of managers in over 100 major corporations based in the US, Europe and Asia, Eppinger and Chitkara (2006) describe a fast advancing trend of global product development whereby internationally and organizationally dispersed engineering teams utilize a fully digital collaborative product development process. Some authors also put forward the argument that current distributed innovation processes represents something entirely new that differs substantially from previous ways of creating innovations. For instance, in a recent book, three-times Pulitzer winner Thomas Friedman (2006, pp. 6-7) portrays the emergence of distributed innovation in the following way:

‘What happened over the last (few) years is that there was a massive investment in technology (...) when hundreds of millions of dollars were invested in putting broadband connectivity around the world, undersea cables, all those things At the same time (...), computers became cheaper and dispersed all over the world, and there was an explosion in software (...) that can chop up any piece of work and send one part to Boston, one part to Bangalore, and one part to Beijing, making it easy for anyone to do remote development. When all those things suddenly came (...) they created a platform where intellectual work, intellectual capital could be delivered from anywhere. It could be disaggregated, delivered, distributed, produced and put back together again – and this gave a whole new degree of freedom to the way we do work.’

In spite of the increasing attention to distributed innovation, the lion’s share of existing innovation research focuses on processes taking place within the boundaries of single firms, local networks and regions. Most of the literature that exists on distributed forms of innovation is

preoccupied with the globalization of formal R&D by multinational corporations, directing less attention to innovation collaborations involving several geographically distributed independent firms. Taking this lop-sidedness of innovation research as a starting point, the paper poses the following questions:

- (i) Do distributed innovation processes differ significantly from other, non-distributed innovation processes?
- (ii) Is there justification for regarding earlier innovation process theories of limited relevance in analyses of distributed innovation?
- (iii) How should future research in this field proceed in order to extend our knowledge about distributed innovation processes?

The present paper addresses these questions by systematically comparing and contrasting one widely recognised ‘generic’ process model of innovation developed by the Minnesota Innovation Research Project (MIRP), with an in-depth longitudinal case study of a recent distributed innovation project.¹ The MIRP model was developed during the 1980s on the basis of 14 longitudinal case studies of innovations, out of which most were carried out locally within in the state of Minnesota. According to its creators, the model incorporates a generic pattern of process characteristics which is common to all innovations of some novelty and size irrespective of the organizational and geographical settings in which these occur (Van de Ven et al. 1999). An important implication is that this pattern of process characteristics should be observable in contemporary distributed innovations as well. In the present study, we use the MIRP model as a rough baseline model of non-distributed innovation against which we compare an internationally distributed software innovation project. We interpret any significant deviations between the process model and the case study as tentative suggestions that distributed innovation processes differ from other innovation processes. We also use such deviations as directions to promising avenues of future research on distributed innovation.

¹ The MIRP model was created on the basis of 14 longitudinal case studies of innovation processes taking place the US during the 1980s, and focuses on explaining the temporal order and sequence of steps and cycles that unfold as an innovative idea is transformed and implemented into a concrete reality (Van de Ven and Poole 1990).

Before moving further, it is necessary to state up front some important methodological weaknesses associated with this approach. First, the single case study presented in this paper is obviously not representative of all current distributed innovation processes. Distributed innovations occur in a great variety of different geographical, organizational, institutional and technological settings that differ substantially from the one reported here. Second there is no proof verifying the generic nature of the MIRP model, or its usefulness as a baseline model of non-distributed innovations. Indeed, as we demonstrate in section three of this paper, there are alternative process models with different interpretations. This means that observed deviations between the case study and the MIRP model does not necessarily imply that distributed innovation processes differ from other innovation processes. They might for instance be indications that the MIRP model fails to capture important traits of many types of innovations, not only distributed ones. Conversely, similarities found between the model and the case study might be an indication that the model's process characteristics are representative of both distributed and non-distributed innovation processes. Although the analysis can not give conclusive answers to the research questions, the paper is still justified in the sense that it marks out some themes from which we may begin to examine the nature of distributed innovation processes more thoroughly.

The rest of the paper is organised as follows: Section two offers a conceptual discussion of the term distributed innovation, examining how the concept of has been delineated in previous research and specifying what is meant by the term in the present paper. This section also gives a brief review of previous research on distributed innovation. Section three presents existing innovation process models, directing specific attention the MIRP model. Sections four and five systematically compare and contrast the model with a longitudinal case study of an international software innovation project. The final section presents a concluding discussion, proposing tentative answers to the research questions and some implications for future research.

2. DISTRIBUTED INNOVATION PROCESSES

Innovation processes are characterised by the exploration of opportunities for new and improved products, processes and services, based either on an advance in technical practice or a change in market demand, or a combination of the two (Pavitt (2005, p. 88)).² On a general level, it is possible to argue that most such processes are distributed. Indeed, there are debatably few innovation processes that do not entail the intersection of people from different disciplines, different teams, departments and also different locations and organizations. However, there are several ways of delineating distributed from non-distributed innovation processes, and these differ according to the specific aspect of distribution in question. For instance, some authors, such as Consoli and Patrucci (2007) and Coombs et al (2003) emphasise organizational aspects, referring to distributed innovation as novel development processes that involve the collective efforts and the interaction of heterogeneous organisations. This definition encompasses a wide range of innovation collaborations, excluding only those that take place within the boundaries of a single firm (and between independent individuals).

The innovation literature offers several comparable concepts. For instance, Chesbrough's (2003) widely recognised concept of *open innovation* refers to R&D collaborations between organizations that may or may not be co-located. More specifically, open innovation concerns a trend in which more and more firms find that they cannot anymore afford to rely entirely on their own in-house research, and therefore start buying externally developed technology, opening their R&D laboratories and partnering up with other companies.³ Focusing primarily on the inter-organizational dimensions of distribution while disregarding the geographical dimension, the above conceptualisations of distributed innovation are difficult to separate from previous concepts about which there is a large amount of research such as inter-firm cooperation (Richardson 1972), networks (Grahber 1993), clusters (Porter 1990) and regional innovation systems (Asheim and Gertler 2005).

² Such processes typically involve groups of entrepreneurs who, with support from upper managers or investors create and transform a new idea into an implemented reality (Van de Ven et al. 1999, p.3).

³ Another related concept is Von Hippel's (2006) *democratized innovation*, which refers to innovative collaborations between users and producers. This concept encompasses inter-firm collaborations, collaborations between firms and independent individual users and collaborations between individuals. The interacting agents may be co-located, such as is the case with collaborations between users and producers of technology in learning regions (Gertler 1995), or they may be internationally distributed, like in the case of open source software communities (Bonaccorsi and Rossi 2003).

Other authors put more emphasis on the geographical aspect of distribution, while directing less attention to the cross-organizational aspect. For instance, the Initiative for Distributed Innovation (IDI) group at the Massachusetts Institute of Technology (2005) defines distributed innovation as the successful implementation of creative ideas, tasks, or procedures by employees in different geographic locations. This definition differs from the former in the sense that it excludes innovations taking place in co-located teams, networks and clusters, and includes innovation that take place within single organizations and across the borders of several organizations. This approach reflects the view that internal relations, for example, between business units that compete for central resources, can be just as important in shaping distributed innovation as collaborative relations between several independent organizations. There is a considerable amount of existing research on this latter type of distributed innovation. An important example is innovation collaborations among dispersed subsidiaries and departments of multinational corporations (Ghosal and Bartlett 1988, Nohria and Eccles 1994; Ridderstråle 1997; Hansen 1999; Sölvell and Zander 2000, 2004).⁴

The position taken in the present paper is that both dimensions – cross-organizational and geographical distribution - are important features of distributed innovation processes. For this reason, we refer to distributed innovation in the following as the successful implementation of a new product, process or service by two or more organizations that are located in two or more regions. Important examples are international multi-firm innovation projects (Blakeborough and Oliver 1998; Hildrum 2007), and innovation ventures between independent companies within the context of global production networks (Ernst and Kim 2002; Ernst 2004).⁵ It is obvious that distributed innovation collaborations within single firms and regions are also important. However, directing attention to collaborations between independent organisations that are positioned in different regions is justified for two reasons: The first reason is that such processes are, according to several authors, becoming an increasingly important part of firms' innovative

⁴ Indeed, as Ghosal and Bartlett (1988) argue, in some well-established MNCs, the geographically dispersed network of subsidiaries and alliance partners functions as an efficient arena knowledge integration and innovation.

⁵ A global production network (GPN hereafter) is an internationally dispersed network of organizations contributing in a coordinated way to the value chain activities of a network flagship company, which is typically a large multinational corporation (Ernst and Kim 2002, p. 1420).

activities (Huston and Sakkab 2006; Eppinger and Chitkara 2006). Second (and most importantly) there is relatively little existing research about this kind of innovation. Innovation studies have a long tradition of treating the single firm and the single region as the main units of analysis. What literature there is has so far been mainly preoccupied with the globalisation of R&D within the boundaries of multinational corporations (Narula 2003). In contrast, internationally distributed multi-firm innovation processes have so far been much less studied (Coombs et al 2003).

2.1. Previous studies on distributed innovation

The relatively scarce body of previous research on distributed innovation processes has tended to focus on specific challenges associated with such processes (Torre and Rallet 2000; Bengtsson and Söderholm 2002; Hildrum 2007). One example is offered by Blakeborough and Oliver (1998) who conclude that complex innovation processes are more difficult to manage in projects with internationally distributed partners as opposed to projects with geographically concentrated partners. An important reason for this is the need for face-to-face interaction in the solution of complex joint tasks and technical problems. According to these authors, less complex, stand-alone or modularised, innovation processes are easier to conduct in internationally distributed settings. Another example is provided by Bengtsson and Söderholm (2002) who point out that there are specific impediments to exchanging knowledge within distributed innovation projects. According to these authors, geographical distance carry with it communication and coordination difficulties, while organizational and technological distances carry with them difficulties of translating between different technological communities. Moreover, Chesbrough and Teece (1996), Chesbrough (2003) demonstrate that coordination between agents in distributed innovation ventures is often challenging because the agents involved often pursue different and diverging goals. As Chesbrough and Teece (1996) put it: 'Each party to joint development activity necessarily acts in its own self-interest. Over time, innovation can generate unforeseen surprises that work to the advantage of some parties and to the disadvantage of others. The result: Once-friendly partners may be unwilling or unable to align strategically, and coordinated development activity falters. In contrast, integrated, centralised companies (...) have established processes for settling conflicts and coordinating all the processes needed for innovation'

(Chesbrough and Teece 1996, p. 66).⁶ In a study of a large multi-firm industrial project, Dahlgren and Söderlund (2001) describes similar coordination problems, suggesting that a solution might be found in processes of *spacing*, meaning inter-organizational coordination of activities, and *matching hierarchies*, meaning the establishment of joint decision making on the partner organizations' top management level.

While the above studies unveil some important features of distributed innovation, they do not examine the specific ways in which such processes progress over time from initiation until completion, and whether or not the specific challenges and opportunities in distributed innovation processes differ from the ones encountered in other innovation processes. In the following section, we address this topic by reviewing existing process models of innovation and systematically comparing one – the MIRP model – with a longitudinal case study of a distributed software development project.

3. INNOVATION PROCESS MODELS

Innovation process models are characterised by the fact that they devise a temporal progression of steps and cycles through which any given innovation is likely to pass through from inception until completion. Existing, well-known process models of innovation can be roughly subdivided into two categories; (1) Linear stage-wise models, and (2) non-linear cyclical models. In the following, I do not offer an exhaustive review, but some important and well-known examples belonging to each of the two categories. Models belonging to the first category describe innovation as a sequential process progressing through a series of well-defined stages. These stages are believed to follow each other in a predictable manner, and activities within each stage are expected to settle down to a stable equilibrium. Stability is achieved through a process of trial and error learning, that is; people do more of what leads to positive outcomes and less of what produces negative outcomes (Van de Ven et al. 1999, p. 3.). One example is the so-called 'linear model of innovation', which is often associated with economic justifications for investments in

⁶ Von Hippel (2006) spots a similar challenge in distributed collaborations between manufacturers and users of technology, suggesting that innovation development tasks should be sharply modularised and partitioned into need-related tasks for users and solution related tasks for manufacturers.

scientific research. This model which is now largely discredited portrays innovation as applied science and predicts that innovations pass through a clear cut sequence of stages involving research, development, production and marketing (Fagerberg 2005, p. 8).

The category of non-linear cyclical models emerged as a critique of the linear model. For instance, in an influential book, Kline and Rosenberg (1986) criticise the linear model on the basis that it misrepresents the complex nature and direction of the causal factors at work in innovation. Taking this critique as a starting point, Kline and Rosenberg offer an alternative model - the chain-linked model – which describes innovation processes as a complex and non-linear change process taking place along multiple interdependent paths, such as market environment, production facilities, research and the social context of the innovation organization. In contrast to the linear model, the chain-linked model describes innovation as a continuous cyclic process with multiple closures centred on different temporary versions of the technology in question. Scholars associated with the Social Construction of Technology (SCOT) approach (Bijker and Pinch 1989; Bijker 1989, 1995) also describe innovation as a continuous cyclic process with multiple closures. However, while Kline and Rosenberg focus on intrinsic constraints in technology and the market as forces determining the progress of innovation ventures, the SCOT approach focuses instead on negotiations and power struggles among social groups as the key determining factor. According to this latter model, technological innovations are gradually constructed and reconstructed through time in a continuous process of negotiations between and within relevant social interest groups with different needs and agendas associated with the technology in question (Bijker 1995).

One of the most detailed and most widely recognised process models of innovation to date was developed by the Minnesota Innovation Research Program (MIRP) during the 1980s. (Van de Ven et al. 1989; Van de Ven et al. 1999). The MIRP model is similar to the two previous models in the sense that it criticises the linear stage-wise model, describing 'nonlinear cycles of divergent and convergent activities that may repeat over time and at different organizational levels if resources are obtained to renew the cycle' (Van de Ven et al. 1999, p. 16). However, we choose to direct specific attention to this model in the following because it puts forward a detailed temporal pattern of process characteristics that, according to its creators, is the same in all

innovation processes of certain novelty and size. This proposed general applicability makes the model well suited as a basis against which distributed innovation processes can be compared and contrasted.

3.1. The MIRP model

Between 1983 and 1993, MIRP, which involved over 30 faculty members and doctoral students at the University of Minnesota, conducted exceptionally detailed, longitudinal case studies of 14 technological and administrative innovations with the objective of developing an empirically grounded process theory of innovation (Glaser and Strauss 1967). To reach this objective, the researchers developed a sample of innovation ventures with intrinsic differences between them involving various technological fields such as agriculture, industry, electronics, health care, education, nuclear power, and covering many different organizational arrangements, such as private business, government, public-private sector partnerships and inter-firm collaborations (Van de Ven and Poole 1990; Van de Ven et al. 1989, 1999). By systematically comparing and contrasting the 14 case studies findings, the MIRP researchers discovered a common set of patterns and characteristics across the innovations, which provided a basis for what they refer to as a ‘generic’ process model of innovation (Van de Ven et al. 1989, 1999). The MIRP model explains the temporal order and sequence of core characteristics that are reflected as an innovative idea is transformed and implemented into a concrete reality. Each cycle comprises three successive temporal periods: an initiation period, a development period and an implementation period, and each of these periods are described and distinguished from each other on the basis of specific process characteristics (see table 1). It is important to note that there are no clear-cut boundaries between these three periods. In many cases there are overlaps between the development period and the implementation period since many innovations are developed through interaction between innovation teams and the market.

Table 1: Key characteristics of an innovation process cycle

	Initiation	Development	Implementation
<i>Generic innovation process characteristics</i>	1. Gestation 2. Resource acquirement 3. Shocks	4. Proliferation 5. Setbacks 6. Diverging and changing success criteria 7. Fluid participation of personnel 8. Involvement of investors and top managers 9. Relationship building 10. Creation of social infrastructure to support innovation	11. Integrating the new with the old 12. Attributions about innovation success and failure.

According to MIRP, innovations are largely organizational phenomena, which are prepared by large groups of people during a prolonged *initiation period*. This period, which may last for several years, involves three core process characteristics: 1) gestation, 2) resource acquirement and 3) shocks. *Gestation* refers to a phase in which the innovative effort is prepared by groups of entrepreneurs who meet, get inspired by each-other's knowledge and start developing novel ideas. At a certain point, these people decide to make a concentrated effort to *acquire resources* needed to convert their ideas into an innovation. Because it is generally difficult to convince resource controllers to fund innovation projects, plans often take the shape as sales vehicles with unrealistic accounts of the potential innovative outputs of the future project. The initiation period also involves one or several internal or external *shocks* that induce resource controllers to provide funding for the innovation venture.

After the entrepreneurs have acquired funding to implement their ideas, the innovation development period begins. In an early stage of this period, the original innovative idea *proliferates* into multiple ideas and initiatives that make the project more complex to manage. Later, as original plans go turn out inadequate or unexpected events occur, parts of the innovation process runs into a series of *setbacks*. When not attended to, these setbacks produce vicious circles of over-expenditure and project-wide setbacks. This complexity is compounded by the fact that stakeholders' innovation performance expectations often change and diverge during the innovation venture. This often leads to power struggles between project insiders (such as innovation managers) and outsiders (like top managers and resource controllers). While such power struggles can be negative in the sense that they produce delays and setbacks in projects with tight budgets and schedules, they might also be a valuable resource to the extent that they unleash creativity and new ideas. Another core characteristic of the development period is that *investors and top managers intervene* and help solving problems, and sometimes exert different and often contradictory pressure on the strategic and technical direction of the innovation

venture. To acquire the resources necessary to solve problems in the development period, innovation personnel engage in *relationship building* in networks of organizations with complementary resources. The development period is characterised by attempts on part of the innovation personnel to create an *institutional and social infrastructure* that is conducive to the innovations that they are developing.

The *implementation period* begins when an alpha version of the innovation has been created and concentrated efforts are made to diffuse and implement it in various internal and external environments, and ends when resources run out or when the innovation has been implemented.⁷ This period reflects two process characteristics: 11) efforts to *link and integrate* the innovations with existing technology in the local organizational environment, and 12) *attributions of innovation success or failure*; top managers and resource controllers make different judgements regarding the performance of the innovation venture. These judgements often have serious implications for the careers of innovation participants (Van de Ven et al. 1999, p. 23-24). According to MIRP researchers, the process characteristics described above are common to all innovation processes of a certain novelty and size, regardless of the specific organizational, institutional or technological settings in which these occur. Where there are variations, it is argued, these will be in degree and not in substance (Van de Ven et al. 1989, 1999). As these authors put it; ‘the innovation journey entails many of the same core processes, irrespective of organizational settings (...) variations on the core process themes can be attributed to the different organizational settings; however, these are variations in degree not in substantive characteristics’ (Van de Ven et al. 1999, p. 17).

The following section explores these propositions empirically by comparing and contrasting the MIRP model with a longitudinal case study of a distributed innovation project in the European software industry. As noted above, we interpret significant deviations between the MIRP model and the case study project as a suggestion that distributed innovation processes differ from other non-distributed processes and as a justification for exploring promising avenues of future research on distributed innovation.

⁷ In many cases there are overlaps between the development period and the implementation period since many innovations are developed through interaction between innovation teams and the market.

4. CASE STUDY - A DISTRIBUTED INNOVATION PROJECT IN THE EUROPEAN SOFTWARE INDUSTRY

This section presents the *LinCo* project, a joint venture by a group of three Norwegian, one German and one Greek organization to develop a new software system. The project's main objective was to implement the new system in operative units of the partner organizations during project operation and to launch it in the European software market after project-termination. *LinCo* is a pseudonym and since the project partner organizations requested anonymity, I do not disclose their real names but refer to these in the following as *Alpha*, *Beta*, *Charlie*, *Delta* and *Echo*. The innovation venture lasted for five years beginning with the establishment of a project consortium in August 1998, involving the three Norwegian organizations (*Alpha*, *Beta* and *Charlie*) and the German organization (*Delta*). In October 1999, the Greek organization (*Echo*) entered the consortium as the 5th partner. The project was formally launched in January 2000, after the consortium had gained funding from the EU's 5th Framework programme for research, and discontinued as funding ran out in July 2003.

4.1. Methods

The project was purposely selected as a case study because it involved multiple contributing partner organizations that are located in several different countries. Our observation of *LinCo* started in December 2000, after the joint venture had been formally in operation 30 months, and continued for 32 months until the project was concluded in August 2003. The collection of empirical material included participant observation at a three day project workshop in April 2001 and 28 in-depth interviews with project managers and key personnel from all partner organizations. Company annual reports, internal project reports, technical industry publications provided additional information. The interviews lasted between one and two hours each, and

inquired about the progress of innovation development, the continuous formation and reformation of project strategy, changing innovation performance expectations, and experiences associated with collaborating over distances.

4.2. The LinCo project

The LinCo consortium was highly diverse in terms of size and area of business (see table 2). Alpha is a diversified multinational corporation offering industrial and maritime risk management products and services in global markets. Charlie and Delta are among Europe’s largest R&D organisations. The two remaining two partners SMEs, focusing on specific software products and ICT consultancy.

Table 2: LinCo’s partner organizations (2003)

Partner	Area of business	Staff	Location
Alpha	Industrial and maritime risk management services and products.	5500	Norway
Beta	Software development	136	Norway
Charlie	Contract R&D organization	2200	Norway
Delta	Contract R&D organization	11000	Germany
Echo	ICT consultancy	45	Greece

The project sought to develop and implement a new software product for extended enterprise (EE) planning and operation. EE are organizations that traverse geographical and organizational boundaries while EE-software systems support EE-employees in collaborating efficiently over distances. The project’s new product is based on *enterprise architecture software*, which enables large groups of collaborators to co-create and computerized representations of organizations, operations and tasks using powerful graphical modeling languages. In crude technical terms, LinCo’s system consists of two main constituent parts: 1) Four stand-alone software systems with complementary functionalities. 2) A shared system architecture merging these four systems into a larger system. The system architecture is a complex structure of interfaces through which the four

component software can communicate with one another, comprising mutual data exchange formats and computer languages, and a web server system allowing users to access the integrated system using a computer connected to the Internet. The innovative value of the system was that it integrated four complementary software systems that had up to the time of the project only been commercially accessible as stand-alone systems.

At project termination in July 2003 the project group had developed a product prototype instead of the commercial product it originally planned for. Even though the project failed its objective of launching the technology in the market, it generated new ideas and technology that served as key inputs in a spin-off company and the development of a new product in one of the partner organisations.⁸ The following section compares and contrasts the innovation process of the LinCo project with the predictions of the MIRP model.

5. CASE STUDY FINDINGS

Reflecting the basic structure of the MIRP model, the LinCo innovation process can be subdivided into three temporal periods: (1) an initiation period, in which various activities and events set the stage for innovation development; (2) a development period, in which a concentrated effort was made to transform innovative ideas into a new software product; and (3) an implementation or termination period in which efforts were made to implement the innovation in various organizational settings.

5.1. The initiation period

⁸ Our observation of LinCo started in December 2000, after the joint venture had been formally in operation 30 months, and continued for 32 months until the project was concluded in August 2003. The data collection included participant observation at several project workshops - among these a three day workshop in Patras, Greece - and 28 in-depth interviews with project managers and key personnel from all partner organizations. In addition, a questionnaire survey was distributed and collected among all project participants in November 2001, March 2002 and December 2002. Company annual reports, internal project reports, technical industry publications provided additional information.

According to MIRP few innovations are created on the spur of the moment by single entrepreneurs. On the contrary, innovations are usually prepared by large groups of people over prolonged initiation periods, which reflect three specific process characteristics; a *gestation*, *resource acquirement* and one or several *shocks*.

Process characteristic 1: Gestation

Innovations are initiated by extended gestation periods, lasting several years in which seemingly coincidental events occurs that precedes and sets the stage for the initiation of innovations. (Van de Ven et al 1999, p. 23)

The two-year phase that led up to the establishment of the LinCo consortium matches this description. In this phase, researchers in Alpha, Beta, Charlie and Delta who were engaged in simultaneous and complementary technological search activities, met, got inspired by potential novel combinations of each-others knowledge and, and created the project idea. More specifically, prior to the establishment of the consortium in 1998, a group of researchers in Alpha's R&D department were exploring software systems for organizational planning, project simulation and workflow management. The aim of this research was to solve a long line of problems related to planning and information management tasks in Alpha's large-scale customer projects. To support the research, Alpha entered a collaborative agreement with the University of Stanford and Foxtrot, a small Stanford spin-off company, in 1997. According to the agreement, Alpha was given the source code of Foxtrot's main product *Visual*, a project simulation software system, so that this technology could be redeveloped and customised to fit Alpha's organizational environment. In return, Alpha was to communicate its experiences from using Visual back to Foxtrot and the University of Stanford. To fulfil their part of the agreement, the researchers at Alpha's R&D department started an active search for opportunities to move this research into a concrete development project.

In the same period, a team of software developers at Beta were occupied with developing a new version of the company's core product *Meta*, a software system for organization modelling. The small and idiosyncratic research community surrounding this technology was centred on Beta's vice CEO and his ideas connected to the use of computational modelling technology as a means representing complex activities and relationships in organizations. With the emergence of the

Internet, the company realised that the most promising strategy towards a broad application of the product went through modern web-based technologies. As a consequence, in 1998 Beta was actively searching for new projects in which Meta could be augmented and improved through integration with state-of-the-art web technology.

Concurrently, a team of computer scientists in a software department in Charlie's IT and telecom division were working on an early version of *Workflow*, a web-based software system for workflow management support. Contrary to the research groups in Alpha and Beta, the people in Charlie were not aiming primarily at developing software for commercial uses. Rather, their primary interest was to conduct basic research on the ways in which people use ICT in collaborative settings and to publish on that topic in scientific journals. Indeed, the workflow management software emerged as a by-product of this research.

Complementarily, but independently of the developments that were taking place in Charlie, Alpha and Beta, a group of German computer scientists in one of the German partner Delta's software development institutes were developing *Synchro*, a prototypical synchronous groupware technology that allows geographically distributed employees to collaborate on complex work tasks in real time. Like their colleagues in Charlie, the researchers in Delta were primarily interested in doing research that could be published in technical journals. Yet, the researchers had discovered a commercial potential in *Synchro*. Since Delta actively encouraged its employees to commercialise their research, the German group started searching for partners who could contribute to upgrading *Synchro* into a commercial product.

These complementary search activities were linked together in the following way: First, the research groups in Charlie, Beta and Alpha collaborated in a related research project, *ComCo*, between 1997 and 1998. In the course of the project, the researchers discovered complementarities between Meta and Workflow and that a combination of Meta, Workflow and Visual could contribute to reducing problems related to information management tasks in Alpha's large-scale international projects. As a result, the researchers in Delta, Alpha and Beta started preparing a continuation project of *ComCo*. To capitalize optimally on these complementarities, the researchers needed an extra partner with knowledge about synchronous groupware

technology. An opportunity emerged as the director of Alpha's R&D department made a visit to headquarters to Delta's headquarters in Germany in April 1998. In the course of the visit, the director met the manager of Delta's software institute and invited him to participate in a technical workshop in Oslo with people from Alpha, Beta and Charlie. In that workshop, and in a follow-up meeting in Delta's headquarters in Darmstadt, the LinCO consortium was formed and the basic ideas of the innovation were conceived of. At this point, the participants started to search for funding to launch a joint innovation project. The goal was to acquire 50% of the funding from the EU's Framework programmes for R&D, and 50% from the partner organizations. At this instance, the consortium also began searching for an additional partner organization which could provide technology testing and troubleshooting services. In late 1999, just a few months before project launch, the consortium enrolled the Greece-based IT consultancy firm Echo as the fifth partner.

Process characteristic 2: Resource acquirement

Plans are developed and submitted to resource controllers to obtain the resources needed to launch innovation development. In most cases, the plans served more as „sales vehicles“ than as realistic scenarios of innovation development (Van de Ven et al. 1999, p. 23).

The LinCo case reflects this description. Between September 1998 and October 1999, the members of the LinCo consortium invested a considerable effort in writing a comprehensive application for innovation funding from the EU commission. According to one project member, the project plans outlined in the application were exaggeratedly ambitious and the budgets were too small to cover the expenses associated with the planned development activities. Difficult issues were glossed over and potential rewards were accentuated. One project member described the project plans in this way:

The technical development plan we presented in the project application was not concrete enough, it was just too abstract. We would have needed more fine-grained level of detail to really see the problems ahead and to know whether we were able to undertake all of the projects ambitions in practice.

Yet this was not a result of a purely opportunistic strategy by the group to “sell” a project to the EU and the partner organizations. The application was written in this way because the consortium faced a two-sided challenge of having to adhere to the EU commission’s detailed format for project applications and accommodate the partner organizations’ different goals and aspirations regarding the technical content of the project. To keep all stakeholders happy, it was easier to make a very ambitious and slightly unrealistic project plan, than a realistic and parsimonious one.

More specifically, to qualify as applicants to the EU Framework programme, the LinCo partners had to present detailed accounts of their project’s future innovative contributions, the division of labour among the project participants, a project plan conveying milestones and deliverables, and a detailed market exploitation plan. To meet the requirements, the committee members engaged in an intensive phase of interaction in which the innovative ideas from the gestation period were codified and elaborated upon. The fact that the committee members came from different scientific and organizational backgrounds had the dual effect of inducing novel combinations of knowledge processes on the one hand, while leaving a set of unresolved conceptual issues for the subsequent technical development period on the other. One participant illustrated this state of affairs with the following example:

“In the project application period, A had an important role in our discussions, because he threw in visions and metaphors. It was up to us to sort these out, combine them with our existing knowledge and bring them further. This has certainly helped us to formulate some of our ideas. However, I am still not quite sure what he means when he is talking about these things.”

Process characteristic 3: Shocks

Concentrated efforts to initiate innovations are triggered by „shocks“ from sources internal or external to the organization.

The partner organizations’ decisions to launch the project did not occur as a result of one or a few clearly identifiable shocks. Rather, it occurred as a result of several parallel progressions of events that induced resource controllers to sponsor the project. LinCo represented a sizeable investment to the partner organizations, but there were specific conditions in each partner

company that made the project seem a good investment to resource controllers. In Alpha, top managers were supportive of LinCo because the technical content of the joint venture was at the time closely related to some of the corporations' core research issues. In Charlie and Delta, resource controllers looked at LinCo as a way to build competencies, to publish in technical journals and as references that could be used as a means of selling projects to clients. Finally, resource controllers in Beta saw LinCo as an important arena in which new and considerably improved versions of the company's core product, Beta, could be developed and tested. More specifically, Beta found the project promising because it offered an opportunity to augment Meta with complementary web-technology from the other partner organizations. Echo saw the project as an important arena in which to develop new technology testing and troubleshooting competencies, and thereby, improved capacity to sell consultancy services in the future.

A more general reason why the resource controllers in all the partner organizations were supportive of launching an innovation project was that the idea of LinCo emerged at the height of the "Internet bubble economy" in 1998 and 1999 when, as one project member put it; 'most top managers were interested in anything web-based and fancy'. Since Internet based technology was generally regarded a highly promising technological field at the time, it was relatively easy for the participants to acquire resources from internal sources. After the consortium committee submitted application to the EU commission in August 1999, the consortium remained inactive until the project application was accepted in October 1999. The LinCo project was initiated in January 2000 and was in operation until June 2003. I describe this period in the following section.

5.2. The development period

After project launch, the group members began converting their ideas about a new software system into a concrete product. The consortium's activities became more complex and considerably more difficult to manage in this period. Following the work-plan prepared in the initiation period, the project set up 9 different teams, responsible for technical development, technical testing, marketing and project coordination. An important source of complexity was that the nine teams operated in parallel. The teams had overlapping tasks and overlapping

membership, which occasionally made it difficult to get an overview of who were responsible for what tasks.

Process characteristic 4: Proliferation

When developmental activities begin, the initial innovative idea soon proliferates into numerous ideas and activities that proceed in divergent, parallel and convergent paths of development. (Van de Ven et al. 1999, p. 23)

This trait corresponds with the development period of LinCo. Shortly after the project was initiated, the initial ideas described in the project application proliferated into numerous different ideas and initiatives. For instance, one of the original ideas associated with the effort to integrate the four software systems was to install a very simple web server that enabled uploading and downloading of data files from each system. As the project proceeded, some participants came up with the new ideas that the database and the user interface should entail the possibility of freezing files and the possibility to have entry restrictions on these files. The introduction of these new ideas induced long discussions in the project group that delayed the progress of the technical development activities.

Process characteristic 5: Setbacks

Setbacks and mistakes are frequently encountered because plans go awry or unanticipated environmental events significantly alter the ground assumptions of the innovation. Unattended problems and setbacks often snowball into vicious circles. (Van de Ven et al. 1999, pp. 23-24)

From early on in the development period, the project experienced a series of setbacks. One of the setbacks concerned the integration of a common data exchange format in the partner organizations' four component software systems. This task turned out to be more difficult than the participants had expected. During the first four months of the project, the technical teams were mainly preoccupied with defining this format through a series of meetings. This involved agreeing on what concepts the format should encompass, what attributes should be connected to the concepts and what relationships should be between the concepts. When a final design was agreed upon in June 2000, it was up to the individual partner organizations to return to their organizational sites and integrate it into software components they contributed to the project. In

the period that followed, the participants experienced serious difficulties with this task, thus seriously postponing the first version of the integrated system. These difficulties were partly caused by unresolved issues from the resource acquirement period. As one participant noted:

We continuously found that there had been misunderstandings regarding the data exchange format, that our specifications had not been clear enough and so on...

The negative effects associated with these difficulties were compounded by the fact that the four component software systems were tightly integrated: a local change made in one component system required that all other systems be updated accordingly. For this reason, single problems encountered in one software component frequently proliferated into multiple interdependent problems that paralysed the whole project, sometimes for days and weeks. These problems were compounded by the geographical distribution of the technical teams, which made it difficult for the participants to resolve misunderstandings and report changes and problems in an efficient manner (in spite of the fact that they had access to state of the art communication technology). The project's few plenary, face-to-face sessions proved a valuable opportunity for the group to resolve conceptual ambiguities and resetting project goals. In spite of the palliative effect of these meetings, the project members tended to forget or disregard what they had agreed on after each meeting was over and as they returned to their distributed sites. As one project member put it:

The problem is that, in work like this, small details emerge all the time. Suddenly something doesn't work, a mail is sent, time passes and then there is a meeting and people decide to do things in a different manner. Two months later there is a different meeting in which people find out that they misunderstood each other in the former meeting. This just goes on and on. There is an incredible barrier to efficiency in this.

Process characteristic 6: Diverging and shifting innovation performance criteria

Stakeholders' criteria of innovation success and failure often change and diverge over time, triggering power struggles between project insiders and outsiders. (Van de Ven et al, 1999, p. 24).

Stakeholders' innovation success criteria changed in diverging directions during the project development period, causing intensive negotiations and power struggle about project strategy.

However, and in contrast to the propositions of MIRP, the main conflict line in these power struggles did not run between project insiders (such as project managers) and outsiders (like corporate top-managers). The main stakeholders involved in these power struggles were all project group members. This does not mean that these stakeholders were not engaged in shaping the strategy of the project. For instance, several top managers sought to influence the project strategy indirectly by directing and offering support to project members from their own organizations. The important point is that external stakeholders did not intervene directly in these negotiations to manage and control project strategy.

In the course of the project initiation period, the project group agreed about a mutual set of project goals and innovation performance criteria. However, as the project progressed through the development period, and as the partner organizations' altered their R&D strategies, the project members' innovation performance criteria changed in divergent directions. For instance, Beta changed its R&D strategy after a Norwegian software consultancy firm bought the company a few months into the project development period. At the time of the purchase, the acquiring SME was working on refining a prototype web-based EE system which was similar to the LinCo project's system. The most important difference between the two systems was that they were based on different types of web-server software, making them difficult to integrate. Thus, as a result of the acquisition, Beta faced the dilemma of having to develop two fairly similar but incompatible software products competing for the same resources. In dealing with this problem, Beta's project members started campaigning intensively for a decision to discard the web-server specified in the project plans and adopt Beta's server instead (and thereby turning LinCo into a test-bed for the prototype EE system).

In the same period, Charlie experienced a decline in demand for new IT-related products and services. As a result of this change, Charlie's top managers put less emphasis than before on developing entirely new technologies, and stronger emphasis on streamlining technological standards and procedures across Charlie's many research projects. Thus, it became increasingly important for Charlie to ensure that the technical standards used in LinCo remained compatible with technical standards in other Charlie-projects. These new priorities clashed with the attempt of Beta people to change the project's web server technology.

Moreover, at the outset of the development period, top management in Alpha decided to terminate the company's licensing agreement with Foxtrot and the simulation software *Visual*. Since the licensing agreement was not renewed beyond the duration of the project, internal research on the simulation software was discontinued. This change strongly affected Alpha's role in discussions about project strategy. Since the project had lost its status as a strategically important innovation venture, Alpha's project members became less and less eager to partake in the negotiations and left the initiative to the other partners.

As a consequence of these changing and diverging innovation performance criteria, the innovation development period involved continuous negotiations and power struggles about project strategy. Several authors in the innovation literature emphasise that such power-struggles can be beneficial in the sense that they trigger creativity and novelty (Pavitt 2005, Roome and Wijten 2006). This is true also in the context of LinCo; some of the ideas and initiatives that emerged during the negotiations were exploited by Beta and Delta after project termination. However, according to the project members, the power struggles had mostly negative effects in the sense that they were time-consuming and delayed the progress of the technical development activities. The project's tight deadlines and budgets offered no 'slack' for extended negotiations about project strategy. The fact that the project's resource controllers were distributed across five organizations and the EU's Framework programme made it difficult to re-negotiate the project plans and extend project duration. Furthermore, according to several project members the large geographical distances and the limited opportunities for plenary meetings and face-to-face contact made it severely difficult to resolve the power struggles efficiently. The whole project group was hardly ever available on-line when spontaneous plenary sessions were needed and in many instances ICT mediated communication proved insufficient for complex multi-party negotiations. One of the Norwegian participants put it like this:

I have previously been sitting in the same room as people who are developing software modules that my software module is support to interact with. Then I managed to solve problems like this, through osmosis and daily chit-chat in the hallways. Geographical distribution forces you to

work more intensively with the specification at the outset of the development phase and to abide by it afterwards.

Process characteristic 7: fluid participation of innovation personnel

Innovation personell participate in highly fluid ways. They tend to be involved on a part-time basis, having high turnover rates (Van de Ven et al 1999, p. 24).

In LinCo, participant turnover was relatively low during the initiation period and the first months of the development period. However, in June 2000, several project members from Alpha left the group as a result of the decision not to renew the licence on the Visual software. From that moment and onwards, there was a high rate of personnel turnover; people entered and left the project frequently and while they were inside, many spent very little of their total working time on the project.⁹ Previous research suggests that high levels of personnel turnover can be beneficial for innovation in the sense that it carries with it the introduction of new perspectives and mitigates lock-in effects (Eskeröd 1998). However, according to several interviewees, an important reason why the group failed to cope efficiently with technical setbacks and negotiations about project strategy was the high turnover rate. An important consequence was that the project group had to spend much time and resources on training newcomers. Moreover, many key project members – who played key roles in solving communication problems and who brokered and translated between members who misinterpreted or disagreed with one another - left the group. According to several interviewees, an important reason why the group failed to cope efficiently with the power struggles and communication problems was that there were no project-members left with the necessary multi-community experience and credibility to broker, mediate and translate between dispersed members who misinterpreted or disagreed with one another.

Process characteristic 8: Influence and intervention of top managers and resource controllers

Investors and top managers are frequently involved throughout the development process and perform contrasting roles that serve as checks and balances on one another.

⁹ Out of a total of 28 project members, only two members stayed in the project throughout its duration and five different persons occupied the project manager role at different intervals.

Top managers or resource controllers did not intervene directly in project discussions to resolve technical setbacks or to influence project strategy. The influence of the project's main resource controller, the EU commission, was the most strongly felt when the project was subject to technical reviews from EU-commission controllers. Interestingly, some participants used the EU-commission as a negotiation tool in internal discussions about the strategy of the project, holding that they knew what the EU-commission wanted the project to do. According to one interviewee, this deviation might be explained by the project's geographical and organizational distribution. The fact that project authority was dispersed across several organizations in three different countries, and the fact that none of these organizations had full control over the project, might clarify why top managers and resource controllers left it to the project members to solve complex technical problems and negotiate about project strategy.

Process characteristic 9) Relationship building

Innovation development entails developing relationships with other organizations. These relationships lock innovation units into specific courses of action that often result in unintended consequences (Van de Ven et al. 1999, p. 24)

LinCo developed relationships with two external organizations. First, the project group entered a collaborative agreement with a Norwegian consultancy firm which tested preliminary versions of the software and gave feedback about user friendliness. The project also developed a close (technical) collaborative relationship with Gamma – a spin off from Delta. In addition, Alpha terminated an important technology licensing agreement with Foxtrot. This latter event had, as we have described above, serious consequences for Alpha's involvement in and contribution to the project.

Process characteristic 10) Creation of a social infrastructure for innovation support

Innovation participants are often involved with competitors, trade associations, and government agencies to create and industry or community infrastructure to support the development and implementation of their innovations.

The project members did not make a concentrated effort in developing creating a social and institutional infrastructure to promote innovation development and implementation. According to

one interviewee, this had to do with the fact that the project partners were dispersed across three countries, and that such a concentrated effort would have been prohibitively time and resource demanding.

4.3. The implementation period

The implementation period starts when a testable version of the innovation has been created and efforts are made to diffuse and implement the innovation in various environments, such as the operating units of the innovating organization(s) and in the market. It is important to note that there may be considerable overlap between the development period and the implementation period since many innovations are developed and refined during implementation efforts. According to MIRP, this period ends either because resources run out, and the overall innovation process is terminated as a consequence, or because the innovation has been implemented in an organizational setting or in the market.

Process characteristic 11) Linking and integrating the new and the old.

Innovation adoption and implementation occurs throughout the developmental period by linking and integrating the „new“ with the „old“ or by reinventing the innovation to fit the local situation (Van de Ven et al. 1999, p. 24)

Beta and Delta's spin-off company *Gamma* made considerable efforts link and integrate partial and versions of LinCo's software system with internal product development activities (and both companies reaped important learning effects from these efforts). Attempts to link and integrate were much more limited in Alpha, Charlie and Delta.¹⁰ An important reason for this was that, in the course of the development period, LinCo's software technologies became less relevant to and less compatible with these partners' internal product development activities. This can be explained by two changes that took place during this period: First, the decision to discontinue the software licensing agreement with Foxtrot had the effect of rendering LinCo less relevant and valuable to Alpha's internal R&D. Second, the project group's decision to adopt Beta's web-server made the project's technologies considerably more difficult to integrate with internal R&D in Charlie and Delta.

¹⁰ Echo does not have internal product development, and thus made no attempts to link and integrate.

Process characteristic 12) Attributions of success or failure

Investors or top managers make attributions about innovation success or failure. These attributions are often misdirected but significantly influence the fate of innovations and the careers of innovation participants (Van de Ven et al. 1999, p. 24).

The EU commission, the project's main 'funding agency gave the project a positive verdict, but there were different verdicts among the partners' managers. Most emphasised the fact that a testable version of the innovation had been developed and saw this as a fruitful starting point for a more implementation-oriented continuation project. Other managers claimed that the project had failed in the sense that the innovation was not properly implemented in any of the partner organizations and that it was never implemented in a market.

1. COMPARISON AND DISCUSSION

Summing up the results from the above analysis, we observe that the case study findings correspond remarkably well with most of the MIRP model's process characteristics (see table 2).

Table 2: A comparison of the MIRP model and the LinCo project

<i>Process phase</i>	MIRP process characteristics	Characteristics of the LinCo project
<i>Initiation</i>	1. Gestation Innovations are initiated by long gestation periods .	LinCo was anticipated by long-term complementary technological search activities in the partner organizations.
	2. Resource acquirement Entrepreneurs strive to obtain innovation funding. Plans involve exaggerated accounts of project progress and undersized budgets.	The entrepreneurs prepared an application for innovation funding with overly ambitious accounts of project progress, and undersized budgets.
	3. Shocks Concentrated efforts to launch innovations are triggered by “shocks” internal or external to the organization.	Resource controllers in the partner organizations were supportive of funding LinCo because the project idea emerged at a time when there was great demand for R&D on internet technology.
<i>Development</i>	4. Proliferation Initial innovative ideas proliferate into numerous ideas that often proceed in divergent paths of development.	The original innovative idea proliferated into multiple ideas and initiatives soon after the development period was launched.
	5. Setbacks Setbacks and mistakes occur frequently because plans go awry or unanticipated environmental events alter the ground assumptions of the innovation.	There were numerous technical setbacks, some of which were induced by unresolved technical issues from the initiation period. Other setbacks were associated with internal power struggles about which ideas to adopt and which to discard.
	6. Diverging performance criteria Stakeholders’ innovation performance criteria diverge over time triggering power struggles between project insiders and outsiders.	Project members’ innovation success criteria changed and diverged during the development period, triggering power struggles within the project group. Outsiders, like investors and top managers, were not directly involved.
	7. Fluid employment Innovation personnel tend to be involved on a part-time basis and have high turnover rates.	There was a high level of personnel turnover. The project manager was the only full-time employee.
	8) Involvement of outsiders Investors and top managers frequently intervene into the process and solve innovation development problems.	Investors and top managers did not intervene directly in the innovation development activities. The project group had a significant amount of freedom to control the strategic direction of the innovation process.
	9) Relationship building Innovators develop relationships with external organizations that lock innovation teams into specific courses of action.	LinCo developed collaborative relationships with two external organizations. One partner disbanded a licensing agreement with an external organization. This latter event had a strong impact on project progress.
	10) Infrastructure development Innovation participants aspire to create a social infrastructure to support the development and implementation of their innovations.	There were no concentrated efforts to develop an industry or community infrastructure to support the innovation process.
<i>Implementation</i>	11) Linking and integrating Adoption an implementation occurs as personnel link and integrate the innovation with the internal environment.	One partner organization, and a spin-off from another partner, linked and integrated the innovation with existing technologies. Linking and integrating were more limited in the other partners.
	12) Attribution of success / failure verdicts Top managers make different attributions about innovation success or failure with serious consequences for innovation adoption and project members’ careers.	The partner organizations attributed differed verdicts - some positive others less positive - to the project.

Linco’s initiation period involved an extended gestation phase and an intense effort to acquire resources. There were no clearly identifiable shocks triggering the innovation venture, but the fact that the innovative ideas were conceived of at the peak of the internet bubble economy in the

late 1990s might partly explain why internal and external resource controllers chose to launch it. As envisaged by the MIRP model, the innovation development period involved a consistently high level of personnel turnover and the original project idea proliferated into a large number of new ideas and initiatives. The project group also experienced a number of setbacks during project operation: unresolved technical issues and unanticipated problems continuously surfaced causing vicious circles of delays. Moreover, and as envisaged by the model, different stakeholders' innovation performance expectations diverged during the development period, causing internal negotiations and power struggles about project strategy. While some researchers suggest that such power struggles and tensions might be valuable in the sense that they promote creativity and new combinations of knowledge (Pavitt 2005), the effects in LinCo were – according to the interviewees - mostly negative. The high geographical distribution of LinCo made it difficult to settle negotiations about innovation strategy. The whole project group was hardly ever available for on-line communication when spontaneous plenary sessions were necessary and in many instances ICT mediated interactions proved inadequate for complex multi-party negotiations. The effect was that the innovation process was severely delayed, and there was little opportunity to put new ideas and initiatives into practice before time and funding ran out.

These latter findings are in line with existing research on the micro-politics of innovation (Bijker 1995, Pavitt 2005, Roome and Wijen 2006). For instance, Frost and Egri (1991, p. 265) view power as operating on different levels of awareness: surface and deep structure: When a proposed innovation is congruent with existing organizational structures and activities, these authors propose, political activity remains primarily on the surface, is benign or at a low level. However, an innovation which is incongruent with these structures and activities evokes the full breadth and depth of opposing political forces, strategies and tactics. As the case study shows, LinCo's innovative activities were – at different points of time – strongly incongruent with existing innovation activities in Beta, Charlie and Delta, and this might explain some of the observed power struggles and tensions.

However, and in contrast to the propositions put forward by the MIRP model, the main conflict line in these power struggles did not run between project insiders on the one hand, and outsiders on the other. Instead, the main actors directly involved were all insiders – that is - project

members from different partner organizations who were competing with one another to gain control over project strategy. While external stakeholder influenced project strategy indirectly by directing and offering support to project members from their own organizations, they did not intervene directly in project discussions to resolve technical setbacks or to settle conflicts by way of managerial decisions. This relative autonomy and detachment from organizational control structures represents the most important deviation from the MIRP model. This might be explained by the fact that project authority was dispersed across five organizations in three different countries, and the fact that none of these organizations had full control over the project's development strategy. This corresponds with existing research on distributed innovation. For instance, according to Chesbrough and Teece (1996), centralised companies differ from distributed organizations in the sense that the former have established hierarchical mechanisms for settling conflicts and coordinating all the processes needed for innovation, while the latter is characterised by a greater degree of leeway for innovation groups to negotiate about and influence innovation strategy. It is important to emphasise here that autonomy is not necessarily unfavourable for innovation. The lack of a centralised control mechanism allows for the prolonged interaction of multiple competing views and ideas, which might carry with it new combinations of knowledge and spontaneous learning experiences (Pavitt 2005).

2. CONCLUDING REMARKS AND SUGGESTIONS FOR FUTURE RESEARCH

The main objective of this paper has been to explore the concept of distributed innovation. The purpose was to offer empirically based propositions about the specific nature of distributed innovation processes, and mark out avenues of future research through which these propositions can be examined more thoroughly. To accomplish this, it systematically compared and contrasted one widely recognised innovation process model – the Minnesota Innovation Research Program (MIRP) model - with a longitudinal case study of an internationally distributed software development project.

Drawing upon this analysis, we may propose – tentatively - that there are few major differences between the ways in which distributed- and other, non-distributed innovation processes progress over time. Indeed, as we have demonstrated, the case study findings correspond closely with most of the process characteristics of the MIRP model as well as with a number of previous studies of innovation processes. The paper thus offers little support for the argument that current distributed innovation represents something entirely new. Moreover, the paper offers no justification for treating existing theories of innovation as irrelevant in analyses of distributed innovation, or for developing a new and distinct theory of distributed innovation. However, the analysis gives reason to highlight specific political aspects of distributed innovation. More specifically, the analysis suggests that distributed innovation ventures stand out from other innovation ventures in the sense that they entail a higher degree of detachment and autonomy from the organizational environment. One important aspect of this autonomy is that external stakeholders tend to refrain from intervening directly in innovation groups to help tackling emerging technical problems and power struggles. The high geographical distribution of innovation group members makes it more challenging to tackle complex technical problems and intra-project power struggles efficiently.

Before discussing these propositions further, it is important to re-emphasise the methodological limitations outlined in the introductory section: The single case study of the present study is of course not representative of all distributed innovation processes, and there is no proof verifying the proposed ‘generic’ nature of the MIRP model. It is therefore conceivable that the autonomy and power struggles that characterised the LinCo project are reflected in many non-distributed innovation processes. It is also likely that many distributed innovation projects (especially strategically important ones) are not autonomous, but instead closely controlled and coordinated by stakeholders in the external organizational environment. While the paper cannot offer a conclusive answer to the research questions, it is still justified in the sense that it marks out some themes from which we may begin to examine the nature of distributed innovation more thoroughly. More specifically, taking the analysis as a starting point, we suggest the following three avenues of future study:

1. The first one deals with the political dynamics of distributed innovation and focuses on factors giving rise to power struggles about innovation strategy. According to Chesbrough

and Teece (1995), tensions and power struggles are more likely to emerge in distributed innovation ventures than in integrated, centralised companies. There is a need to examine more closely specific features of distributed organizations that bring about or impede creative tension and power struggles, such as group diversity (cognitive and cultural), fragmented structures of ownership and control, multiple organizational stakeholders with diverging innovation performance expectations and various histories of previous cross-organizational collaboration. Here, the SCOT approach (Bijker 1995) might be useful in the sense that it can assist researchers in tracking relationships between heterogeneous interest groups, their changing innovation performance expectations, power struggles and the progress of innovation development.

2. The second avenue of research concerns the ways in which creative tension and power struggles might be tackled once they have surfaced. While several authors argue that group tension can produce creativity and valuable new ideas (Pavitt 2005, Roome and Wijen 2006), there is little existing research about the specific circumstances in which project groups can successfully unleash and capitalise on such creativity (Scarborough and Swan 2005). In particular, there is a need to investigate more closely how the exploitation of creative opportunities offered by power struggles can be balanced off with the need to adhere to tight project schedules and budgets. There is also a need to examine how external stakeholders can be mobilised to help mitigating conflicts and turning creative tension into a valuable asset for the innovation group.
3. The third proposed avenue of research has to do with the relationship between geographical distribution, remote interactions and the capacity of innovation groups to tackle complex technical problems and conflicts. An important topic in this connection concerns the question of when co-location and repeated face-to-face interactions are entirely indispensable for these purposes, and when they are less important. A related and highly important topic deals with the emergence and adoption of new information and communication technologies (ICTs), and how these affect opportunities for remote knowledge intensive collaboration and negotiations.

By way of conclusion, it is important to emphasise that there is a need for more research on the process of distributed innovation. As we noted in section one, the single-case analysis in the present paper far from sufficient for the purpose of adequately describing the nature of distributed innovation. The present study has cautiously offered some empirically based propositions about the specific nature of this kind of innovation. Additional and different empirical studies are necessary to ascertain whether these propositions reflect innovation processes in other distributed settings.

References

Acha, V. L. and L. Cusmano (2005) Governance and co-ordination of distributed innovation processes: patterns of R&D co-operation in the upstream petroleum industry. *Economics of Innovation and New Technology* 14:1-21

Asheim, B.T. and Gertler, M. (2005) The Geography of Innovation: Regional Innovation Systems. In J. Fagerberg, D.C. Mowery and R.R. Nelson (Eds.) *The Oxford Handbook of Innovation*, Oxford University Press, New York.

Bijker, W. (1995) *Of Bicycles, Bakelites and Bulbs: Toward a Theory of Sociotechnical Change*. MIT press, Cambridge MA.

Bijker, W. and T. Pinch (1989) The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. In Bijker, W., T. Hughes and T. Pinch (eds.) *The social construction of technological systems*. The MIT Press, Cambridge MA.

Blakeborough, M. and N. Oliver (1998) Innovation Networks: The View from the Inside. In J. Michie and J.G. Smith (eds.) *Globalization, Growth and Governance: Creating an Innovative Economy*. Oxford University Press, New York.

Bonaccorsi, A, and Rossi, C. (2003) Why Open Source software can succeed. *Research Policy* 32: 1243-1258.

Chesbrough, H. W. and Teece, D. J. (1996) "When is virtual virtuous? Organizing for innovation." *Harvard Business Review* 74(1), 65-73.

Chesbrough, H. W. (2003) *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press, Harvard.

Coombs, R. Harvey, M. and B.S. Tether (2003) "Analysing distributed processes of provision and innovation." *Industrial and Corporate Change* 12(6), pp. 1125-1155.

Consoli, D. and P. P. Patrucco (2007) Distributed Innovation and the Governance of Knowledge - An empirical study on Technological Platforms. *SENTE Working Paper* 11, Research Unit for Urban and Regional Development Studies, University of Tampere.

Dahlander, L. and M. Magnusson (2005) Relationships between open source software companies and communities: Observations from Nordic firms. *Research Policy* 34(4): 481-493.

Dosi, G. (1988) The nature of the innovative process. In G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds.), *Technical Change and Economic Theory*. Pinter, London.

Eppinger, S. P. and A. R. Chitkara (2006) The New Practice of Global Product Development. *MIT Sloan Management Review* 47: 22-30.

Ernst, D. and L. Kim (2002) Global production networks, knowledge diffusion and local capability formation. *Research Policy* 31: 1417-1419.

Ernst, D. (2004) The New Mobility of Knowledge: Digital Information Systems and Global Flagship Networks. In R. Latham and S. Sassen (eds.) *Digital formations: IT and new architectures in the global realm*. Princeton University Press, Princeton New Jersey, pp. 89-114.

Fagerberg, J. (2005) Innovation – A guide to the literature. In J. Fagerberg, D.C. Mowery and R.R. Nelson (Eds.) *The Oxford Handbook of Innovation*, Oxford University Press, New York.

Friedman, T. (2001) *The World Is Flat*. Farrar, Strauss and Giroux, New York.

Frost, P. J. and C. P. Egri (1991) The Political Process of Innovation. In C. Hardy (ed.) *Power and Politics in Organizations*. Dartmouth, Aldershot, UK.

Ghosal, S. and C.A. Bartlett (1988) Innovation Processes in Multinational Corporations. In M.L. Tushman and W.L. Moore (eds), *Readings in the Management of Innovation*, Ballinger Publishing Company, Cambridge, Mass.

Glaser, B. G. And A. L. Strauss (1967) *The Discovery of Grounded Theory: Strategies for qualitative Research*. Aldine Publishing Company, New York.

Grabher, G. (1993) Rediscovering the Social in the Economics of Interfirm Relations. In G. Grabher (ed.) *The Embedded Firm: On the Socioeconomics of Industrial Networks*, Routledge, London.

Hansen, M. T. (1999) The Search- Transfer problem- the role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly* 44: 82-111

Hildrum, J. (2007) When is frequent face-to-face contact necessary in innovation? A comparative study of two distributed product development projects. Forthcoming in *Economics of Innovation and New Technology* 17: 467-484.

Huston, L. and N. Sakkab (2006) Connect and Develop: Inside Procter and Gamble's New Model for Innovation. *Harvard Business Review*, March – April: 58-66.

Initiative for Distributed Innovation (2005) Proposal abstract: Fostering Innovation in Organizations Through Geographically Dispersed Teams and Networks. Massachusetts Institute of Technology (MIT). Accessed at <http://www.distributedinnovation.org/index.php?p=abstract>

Kline, S. and N. Rosenberg (1986) An overview of innovation. In R. Landau and N. Rosenberg (eds.) *The Positive Sum Strategy: Harnessing Technology for Economic Growth*. National Academy Press, Washington D.C.

Kogut, B. and A. Metiu (2001) Open-Source Software Development and Distributed Innovation. *Oxford Review of Economic Policy* 17: 248-264.

Narula, R. (2003) *Globalization and Technology: Interdependence, Innovation Systems and Industrial Policy*. Polity, Cambridge, UK.

Nohria N. and R.G. Eccles (1993) *Networks and Organizations: Structure, Forms and Action*. Harvard Business School Press, Boston, Mass.

Pavitt, K. (2005) Innovation Processes. In J. Fagerberg, D.C. Mowery and R.R. Nelson (Eds.) *The Oxford Handbook of Innovation*, Oxford University Press, New York.

Porter, M. (1990) *The competitive advantage of nations*. Macmillan Press, London.

Richardson, G.B. (1972) The Organization of Industry. *Economic Journal* 82: 883-96.

Rogers, E. M. (2003) *Diffusion of Innovations*. Free Press, New York.

Rothwell, R., Freeman, C., Horlsey, A., Jervis, V. T. P., Robertson, A. B and J. Townsend (1974) SAPPHO updated - project SAPPHO phase II. *Research policy* 3: 258-291.

Sawhney, M. and E. Prandelli (2000) Communities of Creation: Managing Distributed Innovation in Turbulent Markets. *California Management Review*, June-August: 24-54.

Sölvell, Ö. and I. Zander (2000) Cross-border Innovation in the Multinational Corporation – A Research Agenda. *Journal of International Studies of Management & Organization* 30(2): 44-67.

Sölvell, Ö. and I. Zander (2004) Cross-Border Innovation in the Modern Multinational - Three Dilemmas. In M. Serapio and T. Hayashi (eds.), *Internationalization of Research and Development and the Emergence of Global R&D Networks*. Elsevier, Amsterdam.

Scarborough, H. and J. Swan (2005) The politics of networked innovation. *Human Relations* 58 (7): 913-943.

Van de Ven, A. H., Angle, H. L. and M. S. Poole (1989), eds., *Research on the management of innovation: The Minnesota studies*. Harper & Row, New York.

Van de Ven, A., D.E. Polley, R. Garud, S. Venkatraman (1999) *The Innovation Journey*. Oxford University Press, New York.

Van de Ven, A. H. and M. Scott-Poole (1990) Methods for Studying Innovation Development in the Minnesota Innovation Research Program.' *Organization Science* 1: 313-322.

Von Hippel, E. (2006) *Democratizing Innovation*. The MIT Press, Cambridge MA.

