# RELATIONSHIPS WITHIN A CLUSTER IN EMERGING BUSINESS FIELDS

## CASE-STUDIES OF OPTOELECTRONICS AND BIOTECHNOLOGY AT TAMPERE

**Toni Mikkola**
*toni.mikkola@tut.fi*

*Tampere University of Technology*
*Department of Industrial Management*
*P.O. Box 541, FI-33101 Tampere, Finland*

**Olavi, Uusitalo**
*olavi.uusitalo@tut.fi*

*Tampere University of Technology*
*Department of Industrial Management*
*P.O. Box 541, FI-33101 Tampere, Finland*

**Kirsi Puustinen**
*kirsi.puustinen@histola.fi*

*Histola Research Ltd*
*Niittyhaankatu 20, FI-33720 Tampere, Finland*

**A work-in-progress paper**

Keywords: Regional clusters, interfirm relationships, emerging business field, high technology

**Abstract**
Since the classic frameworks by IMP Group were developed the characteristics of the business and technology environment have changed dramatically. The modern knowledge economy is creating a new set of rules in the field of value creation. Thus, the relevance and viability of the frameworks should continuously be re-examined and “revisited”. In this paper we focus on two young clusters in Tampere region, optoelectronics and biotechnology, by applying the classic framework of the interaction approach. Thus, we also complement the revisiting work by adapting the framework to emerging business fields.

According to our results it seems that in the modern knowledge economy the interaction approach should be seen in wider context than just between the buyer and seller. There might exist strong dependence and relationship between two actors even that there was no direct mutual trading in traditional way of thinking. For instance, because of a risk of contamination of each other’s reputation in case of product failure companies should manage their relationships not only with their closest partners but with wider network.

The importance of the individuals is emphasized in fairly small clusters. Personal relationships enable the information and social exchange and have definitely influence on the atmosphere. The turnover of workers between companies may be seen as an element of interaction process and should be taken into account in the framework of interaction approach. As well as other elements of interaction process, the turnover has strong influence on the atmosphere.

## 1. Introduction

IMP Group has focused on business-to-business marketing on several levels already for three decades and much work has already been done with focal relationships as well as with wider networks. However since the classical frameworks were developed the characteristics of the business and technology environment have changed dramatically. Some members (e.g. Leek, Turnbull & Naudé, 2000) have enumerated some of these changes such the transition from manufacturing to services in the more mature economies, globalization and the rapid evolution of IT. Also the importance of new knowledge creation and innovation capability is emphasized more and more as a source of competitive advantage. According to von Krogh, Nonaka & Nishiguchi (2000) the modern knowledge economy is creating a new set of rules in the field of value creation. Thus, the relevance and viability of the classical frameworks such as interaction approach should continuously be re-examined or according to Leek, Turnbull & Naudé (2001) "revisited".

The purpose of this paper is twofold. First, this study is preliminary study and we aim to construct a tentative description of the emergence of two regional clusters in Tampere region. We apply the classic framework of the interaction approach to examine the main components of the relationships and interactions behind the emergence. Second, in this paper we may complement the revisiting work of IMP models by adapting the interaction approach to emerging business fields with characteristics of high technology, great future expectations, university environment and emerging business networks. These emerging business networks often take place in times of radical technological change (Eisenhardt & Martin, 2000). The change is usually characterized by nonlinear and unpredictable change, with blurred market boundaries and ambiguous and shifting market players, with no evidently-successful business models. We also expect that in this kind of high technology field the interaction between two companies might often be based on social and information exchange rather than on selling products or services in exchange for money. This makes the context interesting in contrast to "ordinary" business fields and networks.

In this paper we simply define regional clusters as collaborations of several organizations within the same geographical area and industry (see Porter, 1990). According to McDonald & Vertova (2001) regional competitive advantage is created in such networks. We aim to understand what kinds of relationships exist and how those relationships evolve in an uncertain and developing emergence environment. Our study forms a picture of the two high technology clusters from the viewpoint of interfirm relationships. Thus, it creates basis for different actors, such as companies, universities, public and financial actors, to be better prepared to the challenges identified.

As mentioned, the empirical part of our study focuses on two young clusters in Tampere region. The laser cluster bases on the research on optics and optoelectronics as well as production engineering and material sciences at Tampere University of Technology (TUT). The laser cluster and its members have been awarded several times after creating a whole new industry and a measure of jobs in Finland. The Health and Biotechnology cluster has several accomplished international success stories and like the laser cluster it consists of several higher education institutes as well as wide range of companies. The Health and Biotechnology cluster has been divided into several branches. In this paper we focus only on surgical implant companies and regenerative medicine companies.

## 2. Literature

*Interaction in the dyadic relationship*

Interaction approach (IMP 82, 1982; see Figure 1) has been challenged several times in order to review the relevance of the framework in the modern business environment. For example Leek, Turnbull & Naudé (2000) reviewed the model in light of the changes related to rapid evolution of IT and e-commerce. However, the model is still considered valid and essentially the basis of the process is considered the same; two parties trade a product/service in exchange for money (Leek, Turnbull & Naudé, 2000). Interaction approach has been interpreted also in wider context without the roles of buyer and seller. The interaction process may take place between two companies and be based on exchange of information and social elements instead of products, services and money. From this viewpoint the interaction approach provide a suitable concept for our purposes to analyse the interaction between different actors within the clusters.

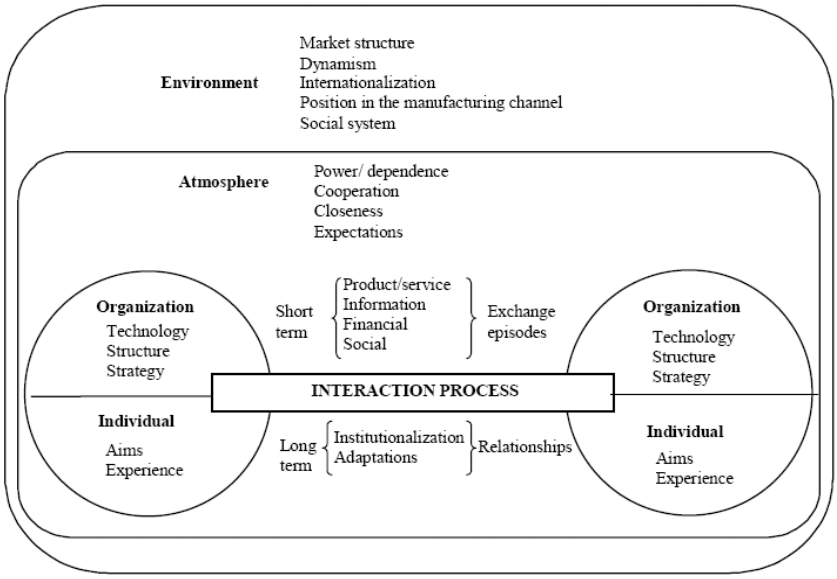


***Figure 1.*** *An illustration of the interaction model (IMP 82, 1982)*

The main components of the interaction approach are four groups of variables describing and influencing the interaction (IMP 82, 1982). First, the interaction and the relation between the organizations depend on both the elements of the interaction and the characteristics of the parties involved. This includes characteristics of the organizations and the individuals representing them. Second, the interaction process includes both long term and short term aspects. Long-term aspect of the interaction process is often considered as relationship including adaptations and institutionalization. Long term adaptations and institutionalization can affect or can be affected by each short term exchange 'episodes'. The exchange of products or/and services is often the core of exchange. The exchanged elements also include information, money and social exchange. Third, atmosphere is considered to be a group of intervening variables, defined by various combinations of environmental, company specific and interaction process characteristics. The atmosphere is a product of the relationship, and it also mediates the influence of the groups of variables. Finally, the interaction is affected by the environment including aspects like market structure, dynamism, internationalization, position in the manufacturing channel and social system. In this paper we are examining specifically emergence environment that have also been divided into components such complexity,

novelty, embeddedness and dynamics related to offering (Möller & Svahn 2009; Lundgren 1995; Tushman & Anderson 1990).

*The network perspective*

The network is a product of its history in terms of all memories, investments in relationships, knowledge, routines, etc. Most partners must accept the changes within the network. That is why the changes tend to marginal and closely related to the past. Stability and development are closely linked. Improvements in certain parts of the network need stability in others, and vice versa. Stable relationships can be crucial when one partner tries to change the use of certain resources. Actors in the network can act. Relationships can facilitate mobilization of large parts of the network when great changes are required. The network model suggests mechanisms where stability and change in industrial systems not only co-exist but are actually interdependent. (Håkansson & Johanson, 1992)

Möller & Svahn (2009) propose three main phases of an emerging business network. 1) The exploration for future business phase covers competition between the actors and collaboration in the exploration and making sense of the application potential for emerging technologies. 2) The mobilization for applications phase concerns actors competing and collaborating in constructing dominant designs and applications. 3) The mobilization for dissemination phase covers actors competing and collaborating in scaling up production and distribution networks in the competition to create markets.

According to Tushman & Rosenkopf (1992) technology as systems focuses on differences in technical complexity across products. The more complex the product, the more subsystems, the greater the number of internal and external interfaces and the greater is the technical and contextual uncertainty. The greater these uncertainties, the greater the intrusion of sociopolitical dynamics in the technology's evolution. Social dynamics are not important for nonassembled or for simple assembled products. For these classes of products, dimensions of merit are unambiguous, subsystems (or processes) are either physically or sequentially linked, and technical progress is carried out by practitioners in a single discipline. For these simple products, differences between alternative technological options can be resolved through technical logic.

Tushman & Rosenkopf (1992) summarize their discussion of the sociopolitical dynamics and technological change in Figure 2. The evolution of technological cycles and the emergence of dominant design are on the horizontal axis while all the networking between technology stakeholders is on the vertical axis. More complex and open the product or concept is higher the social / political / organizational influence on the emergence of a dominant design is. This elaborates and emphasizes the role of networks when a potential dominant design is emerging.

Networks are idea generators and resource sources, but the challenge with them is when they develop; they may also become an obstacle to the change (Håkansson, 1989). Also relationships can become a burden. Relationship may be productive in one dimension, but disadvantages may occur on another. (Håkansson & Snehota, 1998). The evolution of the relationship may also be evaluated using the dimensions of co-operation and competition which are often seen mutually exclusive. Increasing competition and decreasing co-operation are both signals of dying relationship. (Wilkinson & Young, 1994).

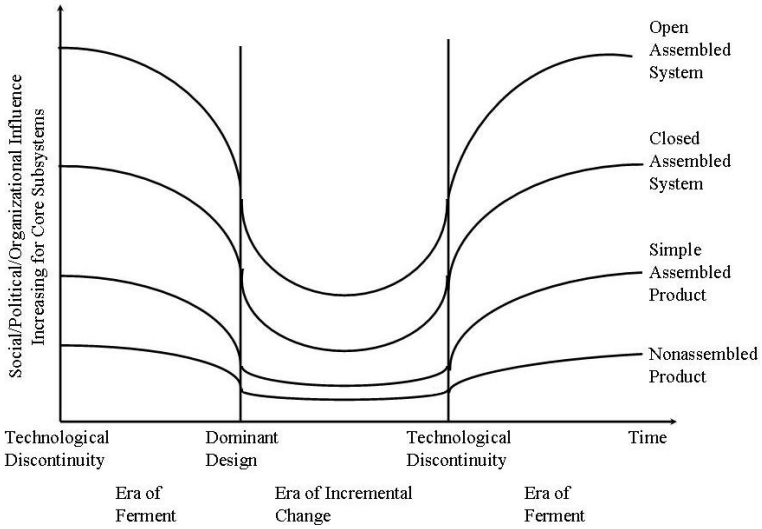


***Figure 2.*** *Toward a Sociology of Technology (Tushman & Rosenkopf, 1992)*

## 3. Research methodology

In our study we analyse the essence and evolution of the relationships within the emerging business networks in the light of two empirical cases: the laser and biotechnology clusters in Tampere region. Within the biotechnology cluster we have at this point focused on surgical implant companies and regenerative medicine companies instead of the whole cluster. The empirical study is based on case study method (Yin, 1989). At the moment our empirical study bases on preliminary interviews with nine persons related to clusters including the directors of cluster programmes as well as academics and industry persons. Our study bases also on secondary material i.e. institute and industry histories, business, trade and academic journals, research reports, archival records and statistics, and news clippings from the mass media. In addition one of the authors has worked in the biotechnology cluster for thirteen years.

To study the technological change in the market, a longitudinal, historical and contextual case is applied. Pettigrew (1985) argues that to understand a change one has to study it as a continuing process in the context in which it appears. He encourages one to adopt contextual and historical perspectives on processes of change. A holistic case study is practically possible, if there has been or is limited number of companies, in the industry. In a case study the most important is the depth of the analysis, both in terms of the number of factors studied and sources of information used (Yin, 1989). To accumulate knowledge our research process had both inductive and deductive phases as suggested by Eisenhardt (1989). Triangulation was also used (Jick, 1979) to construct case studies from a variety of information sources.

As said earlier, the purpose of this preliminary study is to build a tentative picture on both clusters. The interviews for this paper followed the interaction approach and its main components. Our interview method also let the interviewees to describe their view on the emergence of the clusters quite freely. Our further research of the clusters will include an extensive field study with theme interviews with several actors within the cluster. We aim especially to form more comprehensive view of the company members and the interaction processes behind the emergence and stabilisation of those companies.

## 4. Results

*Laser cluster in a nutshell*

Optoelectronics (or photonics, i.e. lasers) is considered as the alliance of optics and electronics, emphasizing the properties of light. Applications include e.g. compact disc players, fibre optic communication systems, bar code scanners, materials processing, radars, sensors, and mobile phones. United States National Academy of Sciences has predicted 21st century to be as successful to photonics as the 20th century was to electronics (Pessa, Kauranen & Pöyhönen, 2005)

The origin of the laser cluster dates back to the mid 1970's and to the Prof. Markus Pessa. He joined TUT in 1976 and started basic research on the structure of metals at TUT. Later on in the early 1980's he moved to semiconductors, especially multilayer semiconductors. In the late 1980s Pessa was among the first in Europe to develop and apply gas-source and all-solid-source molecular-beam-epitaxy (MBE) crystal growth methods, originally invented at AT&T Bell Laboratories. The early 1990 the group focused on optoelectronics with a quite unclear picture about the future development of the technology and industry. The research has however been seen in Europe and Alcatel took the group into the EU projects. At the same time the first company, Tutcore, was founded. In 1996 a part of the company was sold to a US manufacturer, Coherent, and in 2002 it bought all share capital. Pessa's research group was appointed the Finnish Centre of Excellence in 1995. In 1999 TUT founded Optoelectronics Research Center (ORC) to prevent the knowledge leakage and the loss of key personnel.

Primarily the present laser cluster in Tampere region bases on the research on optics, production engineering and material sciences at TUT in addition to research on optoelectronics. The formation of the industry in the region has been supported by several public-financed infrastructure development projects which have enabled the participation of the adapters from various industries. The circumstances have also enabled several companies directly or indirectly spun from TUT to manufacture or exploit diode lasers, fiber lasers, and light modulation devices. Almost ten years after Tutcore (Coherent Finland) Modulight Ltd was founded in 2000 to capitalize on transmitter laser diode know-how from ORC. Only a couple years later four new companies were established. Cavitar Ltd counts on diode laser illumination technology and offer solutions for monitoring different processes accurately. EpiCrystals Inc develops advanced light sources for the next generation projection display applications. RefleKron Ltd is aiming to be a premier provider of customized solutions for pulsed laser systems. Corelase Ltd was founded 2003 as a result of the walk-out of some of the key personnel from Coherent Finland which did not see the potential of fiber laser in the same way that some of the employees did. Today Corelase develops next generation lasers for material processing applications and it became part of the Rofin Group through acquisition in 2007. A brief timeline of the cluster is shown in figure 3.

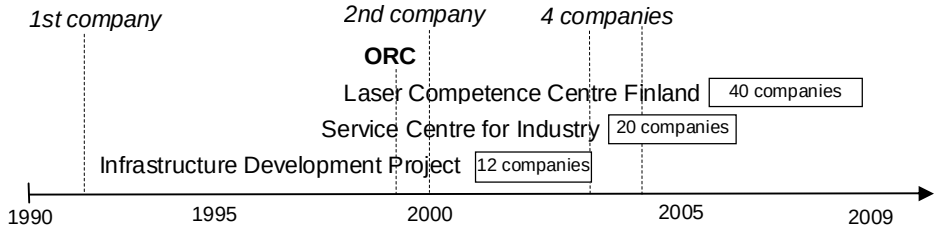


***Figure 3.*** *Evolution of the laser cluster, ORC and manufacturing companies*

In 2009 the laser cluster covers several units of TUT and nearly 40 companies and other high education institutes. Cluster's expertise covers the entire development chain including technology oriented basic research, end users' application development, system integration and testing of lasers, as well as aspects of training and education. Combined turnover of the spin-off companies from TUT was over EUR 20 million in 2007 and estimated turnover in 2010 is nearly 40 million. The whole industry of photonics in Finland including both manufacturers and adapters has over 300 million turnover. ORC's research portfolio is about EUR 5 million of collaborative R&D grants and contracts and it is running about 25 national and international research projects with dozens of universities and companies worldwide. Investments in equipment make ORC one of the best equipped academic research units in Finland and the largest university-based research centre in Europe in the MBE crystal growth technique and complete optoelectronic device processing and characterization facilities.

*Biotechnology cluster in a nutshell*
Another case in Tampere region is the Health & Biotechnology cluster. This is a significant cluster because of its wide biotechnological expertise in education, research and business. There is powerful co-operation and social networking between companies and researchers of the cluster. The cluster has several accomplished international success stories such as bioabsorbable implants, tissue engineering and immunological innovations. Several units of the University of Tampere (UTA) for example Regea, Institute for Regenerative Medicine, represent important roles in the field of medical education, new treatments, applications and expertise. Regea focuses on stem cell research and tissue engineering. Certain units of TUT, for example the Institute of Biomedical Engineering and the Technical Research Centre of Finland (VTT) collaborate closely in the area of medical and healthcare research. The investment and development program called BioneXt Tampere is a good example of strong public sector support for development of this cluster, by 2008 investments totaled 140 million euros and indirect impact of 221 million euros. Health and biotechnology cluster has three focus areas. The main expertise area in the cluster, biomaterials and tissue engineering, is divided into implants, regenerative medicine and ophthalmology treatments. The second one, information and communication technology for health care (Bio ICT), enables to measure and analyze the operations of the human system in innovative ways. The third one, immunology, includes hi-tech research for vaccine and infectious diseases. Today the biotechnology cluster counts about 50 companies and 600 employees work in research and development.

In this paper we investigate the relationships between surgical implant companies and regenerative medicine companies in the region. Implant technology started in 1977 with research on biomaterials by the team led by Professor Pertti Törmälä at TUT. The first implant company, Biocon Ltd was founded in 1982. The second company, Bioscience Ltd was founded in 1984 to develop, manufacture and market bioabsorbable implants for orthopedics and sport medicine. In 1996 both companies merged into Bionx Implants Ltd. Bionx Implants was listed at NASDAQ, New York, as the first Finnish biotechnology company in 1997. Also in 1997 Bioabsorbable Concepts Inc (BCI) was founded as a spin-off from Bionx Implants. BCI develops antibiotic releasing implants. Inion Ltd was established in 1999 based on knowledge transfer and the walk-out of some of the key personnel from Bionx Implants. Inion develops mainly maxillofacial, orthopaedic and spine implants. The investment and development program BioneXt Tampere started in 2003. Also in 2003 CONMED Corporation purchased Bionx Implants Ltd and Bionx Implants was renamed ConMed Linvatec Biomaterials Ltd and during that same year BCI`s name was changed to Bioretec Ltd. In 2004 Biomire Ltd was founded as a spin-off from Bioretec Ltd. Biomire develops drug-releasing implants for treatment of cancer. Also in 2004 Regea was founded by the University of Tampere and other

partners. Regea focuses on stem cell research and tissue engineering. The first spin-off of Regea, Histola Research Ltd, was found 2004. EvoStem Finland Ltd was founded in 2005 as a second spin-off and has developed stem cell based tissue regenerating treatments for horses. The third spin off Ovumia Ltd was found 2007. Ovumia offers infertility treatments. Scaffdex Ltd was established in 2006 by a key person from ConMed Linvatec to develop scaffolds for tissue engineering. Ozics Ltd was founded in 2008 by a key person from Inion, developing novel implants. Novagenesis Ltd, founded in 2006, specializes in the development of unique regeneration products for nervous system. A brief timeline of the area is shown in figure 4.

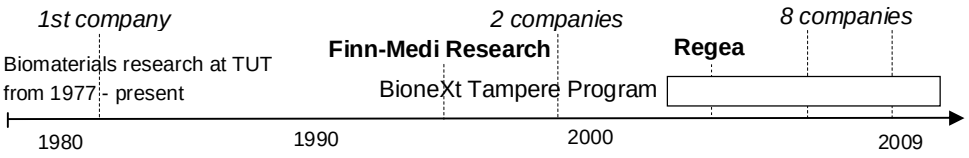


***Figure 4.*** *Evolution of the surgical implant and regenerative medicine companies*

**5. Discussion**

Implant technology started from biomaterials research at TUT and the first companies produced biodegradable surgical implants. The next generation combined bioactive substances (e.g. antibiotics) and biomaterials. Regea started the latest trend, namely regenerative medicine combining stem cell technology and biomaterial scaffolds. Regea has strengthened its position as a national centre for tissue engineering and a generator of new companies. In the same way starting from the research on structure on metals and semi-conductors the laser cluster offers today transmitter laser diodes, diode laser illumination technology, advanced light sources, pulsed laser systems. Interorganizational development projects have brought together actors from various kinds of backgrounds creating new research and business fields.

In both cases there is a quite long flameless combustion after the first companies and before proper infrastructure development for the industries. However new health technology companies are established at an increasing speed in the Tampere region. Same phenomenon can also been seen within the laser cluster. Especially within the biotechnology cluster several new companies have generated spin-off companies. The networks have expanded substantially and merged with some other industries through interdisciplinary research. Both cases date back to individual researchers, their research groups and first spin-off companies but still they have formed complex and dynamic clusters around them.

The growth in number and size of the biotechnology companies in the region has boosted the BioneXt Tampere program. The program has allowed the creation of a competitive biotechnology cluster by promoting research and product development in biotechnology and co-operation of service providers, companies and investors. It has also started and prepared different projects, contract negotiations and brought participants together by identifying expertise, resources and funding, and it has developed the infrastructure as well as national and international marketing campaigns. The aims have been similar within the laser cluster but the results have so far been more superficial, but not indeed meaningless.

The combined dynamics of the individual companies and the regional strategic support has created a further acceleration in the growth and the region is now attracting especially biotechnology companies from other towns and countries. The main reasons for this interest

seem to be suitable facilities for companies, international reputation of the know-how of the university institutions, an institutional and company culture of co-operation, support and incentives for new companies, availability of experts, a positive political attitude and financial support for facilitating the development and finally, historically a very strong research and development track record in both fields. There are also established service companies like Finn-Medi Research Ltd (1995), which is a biotechnology development company offering services for research and business development, clinical trial services and coordinating development programmers.

There are co-operative projects in the clusters based on the belief and evidence that co-operation within the cluster brings new power. Several companies are working in the same field but they are not necessarily competitive because they develop complementary projects and products aiming for different market segments. The co-operation is however often indirect. This means that different actors do not work directly with each other but use and support same shared services related to research or commercialization. This indicates that in addition to direct seller-buyer relationships or for example mutual research collaboration there are relationships that bases more on information and social exchange through the network. Still these actors share common challenges and atmosphere in similar environment.

One of the common challenges is how to go to the markets. Further sustainable growth will ultimately depend on creating income streams that can only be realized in the international markets. The challenge is that customers usually have prejudices for new technology. Even if new technology offers clear advantages, there are several rational and irrational market mechanisms that may hamper a fast conversion towards new products. It is a huge benefit when there are many companies for example in the field of biodegradable materials with their own market segments, in that together they have greater credibility and create a greater trust in new technology. On the other hand there may be a risk of contamination of each others reputation in case of product failure. Thus, common appearance and reputation is recognized important and other members of the clusters cannot be forgotten. Otherwise the network could develop into a burden. Together the actors may decrease the need of social, political and organizational interaction influence on the emergence of dominant designs.

Both clusters studied are still fairly small. Because of common background of the key persons of the clusters it seems that the companies and the workers representing them are quite familiar with each other. However especially in the biotechnology cluster the expansion and diversification of the community makes this much more difficult in the future. In both cases there were also a good number of spin-off companies which indicates the entrepreneurship in the region. On the other hand it is a form of the turnover of workers and means knowledge loss for other companies.

The future goal of both clusters is to create internationally competitive business activities and significant science divisions. Therefore the right kind of environment and magnetism has to be created that on the one hand brings more international and national players to the region, and on the other facilitates international collaboration in research and development but also in sales and distribution. It is important in the future that companies from abroad locate in the region, where plenty of space and infrastructure is available.

## 6. Conclusions, Implications and Future Research

According to the interviewees it seems, that in the modern knowledge economy interaction and particularly the classic framework of interaction approach should be seen in wider context than just between the buyer and seller. Regional innovation networks related to high

technology and emerging business fields, such as laser and biotechnology clusters in Tampere region, form complex systems to manage. It seems that there might exist strong dependence and relationship between two actors even that there was no direct mutual trading in traditional way of thinking. These relationships sometimes base on third party or shared network and services.

Because of a risk of contamination of each other's reputation in case of product failure companies should manage their relationships not only with their closest partners but with wider network. Driven by common interest to promote and commercialize the potential of the cluster different actors should co-operate even that there were some competition between them. Some company's failure with biodegradable materials may delay other companies in the same field to get their products to the markets. On the other hand together these actors may decrease the need of social, political and organizational interaction influence on the emergence of a dominant design.

The importance of the individuals seems to be emphasized in both cases. In these fairly small clusters similar backgrounds especially among the key persons do help in finding common interests and in monitoring what is happening in other companies. Personal relationships enable the information and social exchange and have definitely influence on the atmosphere. However because of growth at some point one cannot know everyone. The cluster attracts people from various locations and with various backgrounds and the cluster becomes too big to know inside out.

On the other hand in both clusters there was some turnover of workers. Companies are competing to have the best skills available. Several spin-off companies indicates that individuals are also interested in establishing new companies based on their own competence. The turnover of workers may be seen as an element of interaction process and should be taken into account in the framework of interaction approach. As well as other elements of interaction process the turnover has strong influence on the atmosphere.

Both the laser cluster and biotechnology cluster are interesting cases to use when revisiting the classical frameworks created by IMP Group. They both come from nowhere and base on the work of some strong individuals. In addition the amount of spin-off companies and fast growth of the networks and individual companies as well as expansion on new complementary research and business fields make the cases fascinating. The clusters are also expected to work together in the future and already some collaborative research has been done related to biotechnical manufacturing processes.

In the next phases we have several avenues to go. First, we may try to find out whether the relationships within a cluster formed based on emergent technology have similar characteristics to those (the relationships) of "ordinary" networks. Second, we may analyze the interaction through other concepts: the four dimensions of a relationship: capability, mutuality, particularity and inconsistency (Ford et. al, 1986) and the Webster's (1992) scale: 1) Markets and transactions, 2) Repeated transactions, 3) Long term relationships, 4) Buyer-seller partnerships (mutual, total dependence), 5) Strategic alliance, 6) Networks and 7) Vertical integration. In addition, because of the importance of the individuals we may analyse the informal networks and interactions on individual level and compare those with the formal ones between the companies and other larger units.

## References

Eisenhardt, K. M. (1989) “Building Theories from Case Study Research”, Academy of Management Review, Vol 14, pp. 532-550.

Eisenhardt, K. M. and Martin, J. (2000) “Dynamic capabilities: What are they?”, Strategic Management Journal, Vol 21 No10-11, pp. 1105-1121.

Ford, D., Håkansson, H. and Johanson, J. (1986) “How do Companies Interact”, Industrial Marketing and Purchasing, Vol 1 No 1, pp. 26-41.

Håkansson, H. (1989) Product development in networks. In Håkansson H. (Ed.) In technological development: a network approach. Groom Helm, NY, pp. 84-128.

Håkansson, H. and Johanson, J. (1992) A Model of Industrial Network. In Industrial Networks, A New View of Reality, Routledge, London**.**

Håkansson, H. and Snehota, I. (1998) The Burden of Relationships or Who’s Next? In Naude, P. & Turnbull, P. W., Network Dynamics in International Marketing, Elsevier Science, Oxford.

IMP 82 (1982) In Håkansson, H (Ed.) International Marketing and Purchasing of Industrial Goods, John Wiley & Sons Ltd, Hamphire.

Jick, T. D. (1979) “Mixing Qualitative and Quantitative Methods: Triangulation in Action”, Administrative Science Quarterly, Vol 24, pp. 602-611.

Leek, S., Turnbull, P. and Naudé, P. (2000) Is the Interaction Approach Any Relevance in an IT/e-commerce. The 16th International Conference on Industrial Marketing and Purchasing. Bath, UK, 2000.

Leek, S., Turnbull, P. and Naudé, P. (2001) Interaction, Relationships and Networks – Past, Present and Future. The 17th International Conference on Industrial Marketing and Purchasing. Oslo, Norway, 2001.

Lundgren, A. (1995), Technological innovation and network evolution, Printer, London.

McDonald, F. and Vertova, G. (2001) “Geographical concentration and competitiveness in the European Union”. European Business Review, Vol 13 No 3, pp. 157-65.

Möller, K. and Svahn, S. How to influence the birth of new business fields – Network perspective, Industrial Marketing Management (2009), doi:10.1016/j.indmarman.2008.02.009

Pessa, M., Kauranen, M. and Pöyhönen, P. (2004) Optiikka ja optoelektroniikka Pohjoismaissa 2004, Tampere University of Technology, Optoelectronics Research Centre, Report 1, Tampere.

Pettigrew, A. M. (1985) The Awakening Giant: Continuity and Change in ICI, Basil Blackwell, Oxford.

Porter, M. (1990). The Competitive Advantage of Nations, Macmillan, New York, NY.

Tushman, M. L. and Anderson, P. (1990) “Technological discontinuities and dominant designs: A cyclical model of technological change”, Administrative Science Quarterly, Vol 35 No 3, pp. 604-633.

Tushman, M. L. and Rosenkopf, L. (1992) “Organizational Determinants of Technological Change: Towards a Sociology of Technological Evolution”, Research in Organizational Behaviour, Vol 14, pp. 311-347.

Webster, F. E. (1992) “The Changing Role of Marketing in the Corporation”, Journal of Marketing, Vol 56 No 1, pp. 1-17.

Wilkinson, I. F. and Young, L. C. (1994) “Business Dancing-The Nature and Role of Interfirm Relations in Business Strategy”, Asia-Australia Marketing Journal, Vol 2 No 1, pp. 67-79.

von Krogh, G., Nonaka, I. and Nishiguchi, T, edit (2000) Knowledge Creation – a Source of Value, Macmillan Press, Great Britain.

Yin, R. K. (1989) Case Study Research, Design and Methods. Sage Publications, Inc.

### Interviewed persons

Dr. Harry Asonen (CEO, Corelase)
Dr. Auvo Kaikkonen (CEO, Ozics Oy, former CEO, Inion)
Prof. Markus Pessa (Director, Optoelectronics Research Center)
Prof. Piet Haers (Maxillofacial Surgeon, London, UK, co-founder Inion)
Dr. Pekka Savolainen (Director, LCC Finland)
Prof. Pertti Törmälä (Chairman of the board and CSO, Bioretec; board member, Histola Research)
Dr. Petteri Uusimaa (President & CEO, Modulight)
Pertti Viitanen (CEO, Bioretec and Biomire, former CEO Conmed Linvatec Biomaterials)
Dr. Tero Välimaa (Director, BioneXt Tampere)