Filtering cube – Identifying heterogeneity driven innovation potential

Teemu Santonen*

Laurea University of Applied Sciences
Vanha maantie 9, 02650 Espoo, Finland
E-mail teemu.santonen@laurea.fi

Merja Saarela

HAMK University of Applied Sciences
Korkeakoulunkatu 3, 13100 Hämeenlinna, Finland
E-mail merja.saarela@hamk.fi

* Corresponding author

Abstract: The knowledge relevant to solve complex problems such as wellbeing challenges requires skills and socio-technological environments which systematically bring people together with different, complementary and even controversial points of view while forming an innovation community. Grounded on intercultural collaboration, Triple Helix, trans-disciplinary and cross-functionality theoretical approaches which are known to foster innovations, we propose open innovation driven *filtering cube* framework in order to evaluate the diversity of participants and topics within innovation events. By following the constructive action research approach, the usefulness of our suggested construct is tested in context of wellbeing innovation event. The observations relating to student reflections of the test event were in-line with the suggestions of our filtering cube construct and indicted somewhat low level heterogeneity among participants. However, the particular innovation event supported various other skills relating innovation capabilities.

Keywords: filtering cube, open innovation, trans-disciplinary, Triple Helix, cross-functional

1 Introduction

According to the Europe 2020 strategy, Europe's future is significantly grounded on the more effective investments on education and innovation. Moreover, the seamless and successful collaboration between Triple Helix actors including educational, private and public sector has been recognized as one of the key driving forces in innovation driven economies (Etzkowitz and Laydesdorff, 1999, 2000). Thus, there is a clear need to foster the role of higher education institutions as engines of innovation in trans-disciplinary collaboration environments, which are referring to a group processes between individuals educated and knowledgeable in different disciplines (Domik and Fischer, 2011; Pohl and Hirsch Hadorn, 2007; Thorp and Goldstein, 2010).

Due to skewed demographic profile in term of ageing (Laine and Maiväli, 2010), Finland is a forefront market for healthcare and wellbeing challenges, which have been addressed as major societal challenges not only in Finland but also in whole Europe by Horizon 2020. According to academics, practitioners and politicians including the incumbent prime minister (Iltalehti, 31.12.2012) as such the existing Finnish healthcare and welfare system is not able to meet the future challenges (e.g. Ryynänen et. al., 2004, Andersen et. al. 2007). Moreover, questions of healthy living and active ageing have a bearing on nearly all sectors of our lives, and are highly relevant from a socio-economic perspective, since it is one of the sectors on which most money is spent (public and private). This does not only offer opportunities for economic and technological innovation, but it has also a great potential for social innovation (Horizon, 2020)

Society's complex societal and wellbeing challenges cannot be solved by any single-disciplinary expertise, instead they cut across different established disciplines requiring expertise in a wide range of areas. Furthermore, there are increased new knowledge requirements for students to enter work environments requiring collaboration with experts from multiple fields, to interact and work with people of diverse backgrounds including those from outside higher education. In preparing students to working life, we argue that there is a clear need to develop interactive learning and innovation environments, which will bring together people from different sectors, backgrounds and disciplines and jointly seek innovative solutions for our challenges. The basic skills in different kinds of collaboration learned in pre-service education and training in various professions, will provide the necessary foundation for further development of these skills in working life. As an outcome Finland can jointly find solutions to healthcare and wellbeing challenges and keep the Nordic welfare state alive, which without significant innovations is expected to disappear.

1.2 Research objective and design

The main objective of this study is to introduce and define a theoretical construct named as *filtering cube* which is able to evaluate the heterogeneity driven innovation potential. Furthermore, in context of healthcare and wellbeing higher-education, we will evaluate the usefulness of our theoretical construct. Therefore this study can be considered as a constructive action research (e.g. Kasanen et. al. 1993). Typically constructive research aims to develop a solution to a practically relevant problem by applying theoretical knowledge and demonstrating the functioning and innovativeness of the suggested solution (Jaatinen and Lavikka, 2008). Cassel and Johnson (2006) have summarized a significant amount of different views, philosophies, typologies and methodologies relating to action research (e.g. Raelin, 1999; Reason and Bradbury, 2001; Chandler and Torbert, 2003). In this study we follow a specific constructive action research framework originally proposed by Kasanen *et al.* (1993) and recently subtly refined by Oyegoke (2011).

According to this framework we should justify the practical relevance of our proposed problem. In our opinion we have done it already partially in this introduction chapter when describing the challenges of healthcare, wellbeing and higher education systems. *Second*, by following the suggestions of the research framework, we should also present the theoretical connection and the comprehensive understanding of the selected topic while designing a construct, which will provide a novel solution for the identified
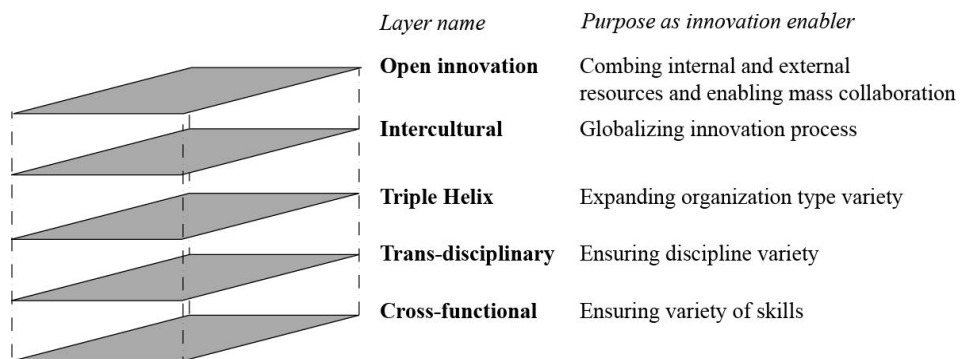
practical experience and theory driven challenges. Due space limitations of the ISPIM conference paper, we will combine the presentation of the underlying theoretical frameworks and the construction of the actual framework for open innovation learning environment. In practice our theoretical construct combines open innovation (Chesbrough, 2003), trans-disciplinary (Domik and Fischer, 2011), cross-functional (Li and Calantone, 1998), Triple Helix (Etzkowitz and Laydesdorff, 1999) and inter-cultural collaboration (Marquardt and Horvath, 2001) approaches into practically manageable framework for organizing innovation events. Therefore, the body of knowledge relating to these domains are shortly summarized in the theoretical foundations chapter and linked to the discussion of the practical relevance of the defined problems. *Third*, obligated by the constructive action research framework, we should also demonstrate that the suggested solution is working. Thus, a pilot testing was carried out in a form of half day length *Care Innovation arena* event in November 2012, which included 264 participants from educational, private and public sector. In action research besides data collection for scientific purposes, researchers typically play an active role in development and implementation efforts. Therefore, authors of this study co-developed and co-implemented the pilot event and collected data not only from main organizer point of view, but also from participant's point of view. Therefore this study can be characterized as a theoretical concept development, which usefulness will be empirically tested with the help of single case study (Yin, 1994). *Finally*, we summarise our research contribution.

This paper is organized as follows. First, we introduce the body of knowledge regarding our theoretical foundations and continue by combing the overall framework. *Third*, we describe our pilot case experiment, while evaluating usefulness of our construct. *Lastly*, we conclude our findings.

2 Defining the theoretical foundations of filtering cube

2.1 Introducing the theoretical framework

In Figure 1 we are introduced the theoretical foundations for our filtering cube construct.

Layer name	Purpose as innovation enabler
Open innovation	Combing internal and external resources and enabling mass collaboration
Intercultural	Globalizing innovation process
Triple Helix	Expanding organization type variety
Trans-disciplinary	Ensuring discipline variety
Cross-functional	Ensuring variety of skills

Figure 1 Theoretical foundations of the filtering cube concept

First, since our construct is strongly related to the open innovation approach (Chesbrough, 2003), we will shortly introduce the open innovation as a theoretical construct. *Second,* the knowledge relevant to solve complex problems requires skills and socio-technological environments that bring together people having shared purpose but different, complementary, and often controversial points of view to form a community. Thus, we will present following four theoretical concepts which can be exploited in order to ensure the diversity of participants: intercultural collaboration (Marquardt and Horvath, 2001), Triple Helix (Etzkowitz and Laydesdorff, 1999), trans-disciplinary (Domik and Fischer, 2011) and cross-functionality (Li and Calantone, 1998). As a result these individual theory layers form a holistic framework, which can be used to evaluate the heterogeneity driven innovation potential within innovation events such as our pilot case Care Innovation arena (later also CI-a). This core is named as a filtering cube.

2.2 Open innovation – Combing internal and external resource and enabling mass collaboration

Open Innovation term derived from experiences from open source software development (e.g. West and Gallagher, 2006), was first coined by Chesbrough (2003) who suggested following definition: *combining internal and external ideas as well as internal and external paths to market to advance the development of new technologies.* Basically open innovation strategy suggests that instead of doing everything by yourself, you should look also for help from external resources. Most importantly, an effective open innovation strategy includes inbound and outbound processes. One should not only search for new technologies and ideas outside (i.e. inbound) of the firm but also export (i.e. outbound) those ideas and technologies which do not fit the firm's current strategy. Besides open innovation processes between companies, also customers and users as an important idea source have been emphasised by scholars (e.g. Piller and Walcher, 2006). The suggestions of open innovators are in-line with the network economy believers who associate business success with the ability to co-operate with external resources and the circulation of know-how (Pöyhönen and Smedlund, 2004).

As usual in rather recent and undeveloped academic literature, the term open innovation appears to be somewhat blurry. In a study by Elmquist *et al.* (2009) an effort was made to clarify the definition and the future research needs relating open innovation. As a result inter alia they identified a tendency towards a broader definition then original application of the term. However, as a main outcome of their study, they suggested two dimensional framework grounded on the locus of the innovation process and the extent of collaboration, as a model to understand open innovation process. In this study, we are mainly focusing in the high number of collaborators and outside process quadrant, which in other words can be defined as mass collaboration also sometimes known as mass innovation (e.g. Santonen, 2012). Mass innovations and a novel thinking outside the box can emerge when combining a wide range and large group of people and their different but complementary insights and creative interaction via loose voluntary networks with the help of communication technologies (adapted from Marquardt beater, 2008; Tapscott and Williams, 2006). As a result of open innovation theoretical construct, the need to collaborate with external resources has been verified. Thus, there is also a need to identify suitable partners for collaboration in context of suggested Care Innovation Arena pilot event.

2.3 Global business environment requires cultural collaboration

Nowadays effective functioning of geographically dispersed, culturally mixed work team is essential for global business success (Hofner Saphiere, 1996), thus making it also important source for novel ideas and future innovations. Our other theoretical constructs do not explicitly note the cultural dimension as an idea source. Thus, in the increasingly extent global business environment, we feel that it is important to also stress the cultural point of view relating to idea generation and innovation processes.

Archibugi and Iammarino (2002) defined globalization as a high degree of interdependency and interrelatedness among different and geographically dispersed actors while introducing the main categories of globalization of innovation by Achibugi and Michie (1995, 1997): *First,* domestic innovations can be expanded to global markets. *Second*, innovations can be generated from the start to global markets and *third*, two or more organizations can establish a joint venture with the aim of generating innovations to global market. Within our proposed filtering cube concept and relating innovation events, the global innovations are interpreted as an aim to establish long-term and formal agreement to perform series of similar events in multiple countries, which will enable both the development of born-global innovations and act as a pathway for domestic innovations to global markets while functioning as a novel learning environment.

Many terms including intercultural, cross-cultural, multicultural and transcultural have been used to describe somewhat similar concept (e.g. Deissler, 2011). Due to our research focus we will mainly follow the intercultural definition and the body of knowledge regarding intercultural learning environments. An intercultural team is a small group of people including two or more cultures and people with complementary skills equally committed to a common purpose, goals and working approach for which they hold themselves mutually accountable (Katzenbach and Smith, 1999; Marquardt and Horvath, 2001). According to Teräs (2007) intercultural disciplines typically include intercultural communication (Gudykunst and Mody, 2002), intercultural training (Landis et. al. 2004) and intercultural education (Räsänen and San, 2005).

While doing development in collaboration with other team members, intercultural learning aims to provide students skills, attitudes and knowledge they need to function with their own culture and across all other cultures (modified from Teräs, 2007). Basically intercultural collaborations generally imply interaction and involve face-to face communication between people from different national cultures (Gudykunst, 2003). However, it has also been argued that online collaboration allows students to develop their technical skills and become more receptive to the capabilities of foreign students (Grosse, 2002; Odenwald, 1996). This notation is important since, in globalized environment, the importance of smooth online collaboration is emphasized. Students working in intercultural teams learn to negotiate, make group decisions and synergy explore different perspectives and sort out differences in online etiquette (Eastman and Swift, 2002; Adler, 2002). These all are crucial skills when students enter working life and start collaborating with foreign co-workers or customers. While experimenting with various asynchronous and synchronous communication methods, students learn to understand the advantages and disadvantages of different communication channels and at the same time are capable of sharpening their communication skills (Zhu et al., 2005).

Mixed results regarding benefits and challenges of intercultural collaboration exists. By conducting extensive literature review Stahl et al. (2010) meta-analysis study

evaluated how task complexity and structural aspects of the team including team size, tenure and dispersion is moderating on cultural diversity in teams. According to their result, cultural diversity leads to process losses due to task conflict and decreased social integration, but has also positive effects owing to increased creativity and cultural diversity. Regardless of the potential challenges of the intercultural driven innovation activities, we believe that there is more to gain than lose and therefore intercultural dimension is added to our filtering cube and learning environment framework.

2.4 Triple Helix – Expanding organizational variety

The Triple Helix model is one of the best-known frameworks for describing the collaboration between university-industry-government relations and explaining structural development in innovation driven knowledge-based economy (e.g. Etzkowitz and Leydesdorff., 1999, 2000). Recently Leydesdorff (2012a, 2012b) summarized the origins of the Triple Helix, explained the differences between various versions and suggested how new dimensions can be added algorithmically including such as local–global or more generic N-tuple of helices. In practice Triple Helix approach is closely related to the network economy (Pöyhönen and Smedlund, 2004) and open innovation (Chesbrough, 2003) approaches, which associate business success with the ability to co-operate with external resources. Thus, besides focusing on the innovation potential of individual persons or organizations it is also important to evaluate the innovation power of larger networks such as National Innovation Systems (later NISs) (e.g. Lundvall, 2007, Freeman, 1987) or regional level implementations of the NIS (Cooke, 2002).

However, in the case of our Triple Helix layer, we are mainly interested in organizational variety instead of national, regional or other geographical scope. Besides typically included university-industry-government organization types, non-governmental organizations (NGOs) can also have important impact to innovation activities (Joske *et al.*, 1999) since also they have intellectual capital (Mesa, 2010). As identified by Heins *et al.* (2010) NGOs are also sometimes referred as non-profit organizations (NPOs), third sector, social enterprise or other various synonyms. Moreover, in addition to organizations, also individual users and customers are important source for innovations (e.g. Piller and Walcher, 2006) especially if they can be characterized as lead user (von Hippel 1986, Urban and von Hippel 1988). Recently this approach has generally been referred as user driven innovation (Wandahl, 2011). Depending on the precision of the organizational classification schema, we propose that filtering cube can also include NGOs and/or user dimension, if it is perceived valuable.

2.5 Trans-disciplinary – Ensuring discipline variety

According to Aram (2004) the term discipline is derived from Latin word, *disciplina*, indicating a branch of instruction or education; department of learning or knowledge (Oxford English Dictionary, 1989). Trans-disciplinarity (TD) collaboration is a participatory and action research based group process by which researchers from various disciplines and actors from other communities work together to develop a shared conceptual framework that integrates and extends discipline-based concepts, theories, and methods to address a common research topic to solve complex real-life problem (Stokols 2006; Pohl and Hirsch Hadorn 2007). A similar concepts as trans-disciplinarity have been defined including different types of interdisciplinary (e.g. Klein, 1996; Klein and Newell,

1998; Lattuca, 2001), pluridisciplinary and cross-disciplinarity by Kockelmans (1975) and intradisciplinarity, and multidisciplinarity by Stember (1998). In all these presented additional concepts are somewhat similar to trans-disciplinarity and as refereed by Aram (2004) can be according to Klein and Newell (1998) summarized as *a process of answering a question, solving a problem, or addressing a topic too board or complex to be dealt with adequately by single discipline or profession.* Thus, for our research purposes we use trans-disciplinarity term, but recognize the existing similar notations indicating collaboration among various disciplines.

Handbook of Transdiciplinary Research (2008) suggest that the past two decades, the trans-disciplinary (TD) orientation in research, education and institutions have aimed to overcome the disconnection between knowledge production and knowledge requests for solving societal problems. Participatory TD research can contribute to the solution of complex problems. Such research succeeds by building joint visions of the issue of concern, by finding a common language, by jointly discussing the trade-offs that result from particular choices, and above all through collaborative learning. TD projects can succeed by effectively dealing with, and profit from, the different backgrounds of the participants. On the other hand, according to Nicolescu (2005), the most complex challenges are teaching of teachers, developing appropriate pedagogy, didactics and professional formation. According to de Mello (2000), Frey (2003) and Thompson Klein (2008), TD education is often hindered by limited availability of supervisors in pertinent methods and by problems associated with students, like lack of strong original disciplinary identity. Holley (2009), Misra et al. (2009) and Spelt (2009), emphasize that the teaching and learning of interdisciplinary thinking is experienced difficult. Difficulties from course designers and teachers point of a view are faced particularly in designing teaching-learning processes that enable students in becoming capable of integrating disciplinary knowledge.

In solving these problems, Domik and Fisher (2010, 2011) argue need to teach students TD collaboration as a competency demand of future work places. Frey (2003), Stokols (2006) and Thompson Klein (2008) have found important to teach students strategy instruments, communication competencies, team development and project management skills. Walter et al. (2007), emphasize importance of teaching, research and application to be combined with in a single project process which should be supported by variety of case study methods, including formative scenario analysis, modelling systems dynamics, integrated risk model, future workshops, and life-cycle analysis. De Nooy-van Tol (2003) reports that training is also needed with other TD project actors, like workplace professionals. A variety of learning formats have been used, like a formal course in communication skills, an atelier in the form of creative sessions, support for using future scenario-casting techniques and workshops.

On the basis of the evolving trans-disciplinary (TD) literature, it appears that implementing TD approach to higher education might be challenging. Therefore, extra effort is required to define truly functional learning environment concept, which is well received by different participating actors.

2.6 Cross-functional – Ensuring variety of skills

While trans-disciplinarity (TD) collaboration emphasises the collaboration among various disciplines, cross-functional approach highlights the collaboration among different units within the same organization when conducting development activities (e.g.

Kahn 1996; Li and Calantone, 1998). Like in the case of trans-disciplinarity, various other terms have been used to describe cross-functional cooperation, yet basically indicating that different kinds of people are working together. Pinto and Pinto (1990) identified such terms as coordination, collaboration cooperation and integration while listing definitions from six different studies. To us in practice cross-functionality means collaboration among employees having different job description and skills such as R&D, manufacturing and marketing while operating under different management unit.

According to Song and Montoya-Weiss (2001) functional diversity increases the amount and variety of information available to team members, which by Milliken and Martins (1996) extend team understanding regarding the problem and potential solution, thus increasing their ability to solve the problem. Furthermore, Griffin and Hauser (1996) listed fifteen studies focusing on service vs. product, consumer vs. industrial market viewpoints which utilized different methodologies and as a result suggested that there is clear scientific evidence that cross-functional collaboration especially between marketing and R&D enhances business success. Among identified benefits of cross-functional collaboration are reduction of redesigns and re-specifications (Norton *et al.* 1994), increasing internal integrity within the organization and with suppliers resulting competitive advantage which is hard to match by rivals (Clark and Fujimoto, 1990). While testing moderated mediation effect relating to knowledge integration mechanisms (KIMs), Tsai *et al.* (2011) suggested that the mediating effect of KIMs in the linkage between cross-functional collaboration and product innovation performance varies by macro vs. micro level perspective of product innovativeness.

Even if the importance of cross-functional approach has been well known for long time, yet there are number of challenges and barriers relating to successful cross-functional collaboration such as 1) lack of communication, 2) information flow, 3) personality and cultural differences, 4) domain specific language and jargon, 5) physical distances and 6) rewards systems and organizational responsibilities (e.g. Gupta et al., 1985, 1986; Ruekert and Walker, 1987; Song *et al.,* 1997).

2.7 Filtering cube – Visualising the dependencies between key dimensions.

As a result of our above theoretical discussion, we argue that it is important to identify the composition and level of heterogeneity of the innovation event participants and topics in order to estimate the innovation potential. In practice the higher level of heterogeneity should lead to greater creativity and innovation power, which however might be disappear and cancelled if the level of heterogeneity increases the critical threshold level. Moreover, our construct is able to separate different sources of heterogeneity, which makes it possible to compare the impact of each heterogeneity source as an enabler or suppressor.

In Figure 2 we have visualized the dependencies between the trans-disciplinary, Triple-Helix and cross-functional dimensions in a form of filtering cube. Moreover, in Figures 3 to 5 we have presented different points of view to our filtering cube construct, which enables a closer look from each viewpoint. It is noted that within each dimension, in some cases there might be a need to present layer depended classification themes (e.g. cross-functional skills might vary between education and private sector). In Figure 6 we have illustrated how intercultural dimension can be added to our framework by combining multiple countries or other geographical regions together via multiple cubes.
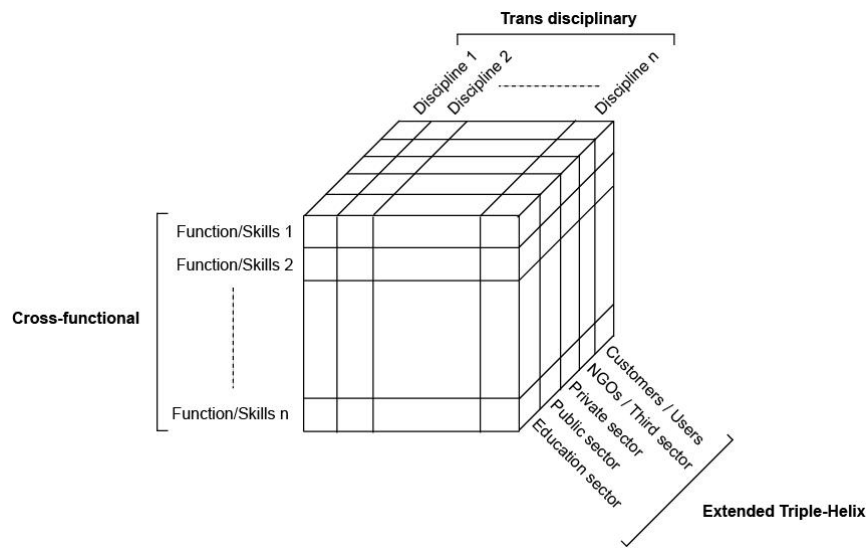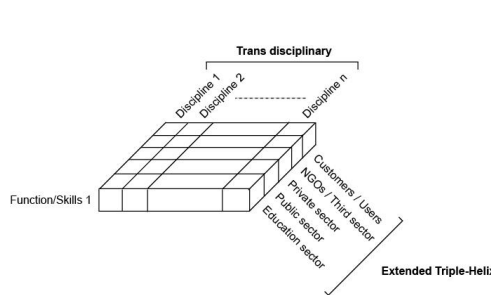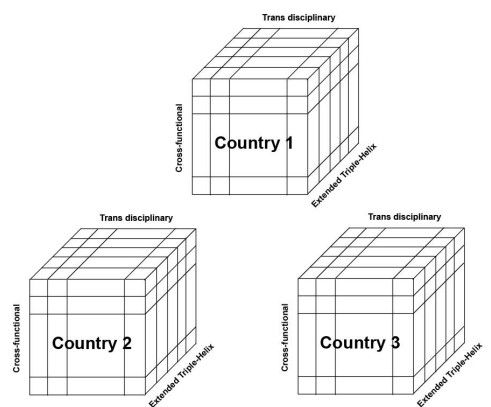
Figure 2 Filtering cube
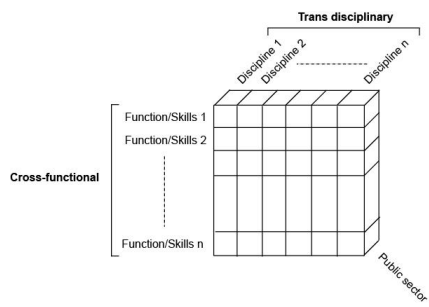
Figure 3 Filtering cube from one Triple Helix viewpoint
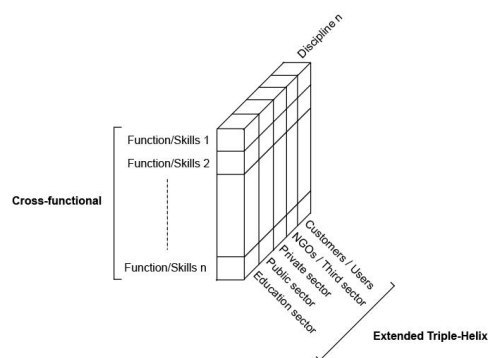
Figure 4 Filtering cube from one discipline viewpoint

Figure 5 Filtering cube from one skills viewpoint

Figure 6 Filtering cube from intercultural viewpoint

3 Case study: Care Innovation arena (CI-a)

As obligated by a constructive action research approach (Kasanen *et al.,* 1993; Oyegoke (2011), the usefulness of our proposed construct must be tested. Therefore to make use of our construct, in the following we will describe the structure and participant profile of the Care Innovation arena pilot event (later also CI-a) with the help of the suggested framework.

3.1 Description of the pilot event

Besides testing the functionality of our theoretical construct, the other purpose of Care innovation arena pilot event was to improve and strengthen innovation knowledge and capabilities among wellbeing actors. This generic goal was divided in the following more specific viewpoints: 1) teacher viewpoint, 2) student viewpoint and 3) working life collaboration viewpoint. This particular target group distribution can be linked to our construct's extended Triple Helix dimension, which purpose is to verify the organizational variety of the given event. However, within this study we are especially interested to evaluate the student viewpoint within the educational sector organization.

In all eight fifteen-minute keynote presentations were held during the event. The keynote presentations utilized one-to-many communication approach (Hoffman and Novak, 1996) also known as mass communication (e.g. Lasswell 1948; Katz and lazersfeld, 1955) in which the main stage oral presentations supported by power point slides were acting as a marketing medium. This set up provided for keynote speakers an effective opportunity to execute open innovation outbound strategy and reach many participants at once. However, this implementation approach did not enable genuine interaction between presenters and audience. Therefore, after each presentation extra fifteen-minute timeslot was reserved for presenter to meet face-to-face those people who were interested to swap opinions or ask questions. This follow-up face-to-face communication enabled one-to-one marketing approach for presenter in which individual needs and wants can be notice (Pepper and Rodgers, 1996). Moreover, it was highlighted that speakers should hang around after their presentation and organized fifteen-minute Q&A-meeting moment in order to encounter informal and random conversations with the audience members. In practice nearly all key note speaker followed this suggestion.

The space round the main stage and event hall was divided into following four thematic sectors in order to support different kinds of innovation domains: 1) pedagogical innovations (Kirti, 2007), 2) socio-cultural innovations (e.g. Geels, 2004; Peck et al. 2009; Mutsikiwa and Basera 2012), 3) wellbeing-service innovations (den Hertog, 2010; Agarwal and Selen, 2011), and 4) wellbeing-technology innovations (Wang, 2005). This classification theme can be linked our framework's trans-disciplinary variety perceptive, since the topic between themes varied. The communication and collaboration within these themes were arranged with the help of more "passive" poster stands and more "interactive" innovation mill workshop area (in Finnish Innomylly). The communication model within these two approached were basically based on kind of "one-to-small group" communication, in which from one to few presenters managed the communication and collaboration between presenter(s) and audience. The audience size varied from few persons to small group (i.e. maximum about ten persons). The main difference between poster stands and innovation mill workshop areas was the intensity of interaction. The

purpose of the innovation mill workshop areas was to engage intensive interaction and experiment interactive innovation tools, whereas poster stands nature was more passive.

The event structure and collaboration processes including keynote presentations, poster stands and innovation mill workshop area is summarized in Figure 7. In the figure the inner circles represent intensive interaction between presenter and audience while enabling even one-to-one interaction, whereas at the same time out circle illustrate typically passive one-to-many mass communication model. The four different innovation themes were defined as sectors, which helps illustrating that for each theme area it is important to offer activities in each circle.
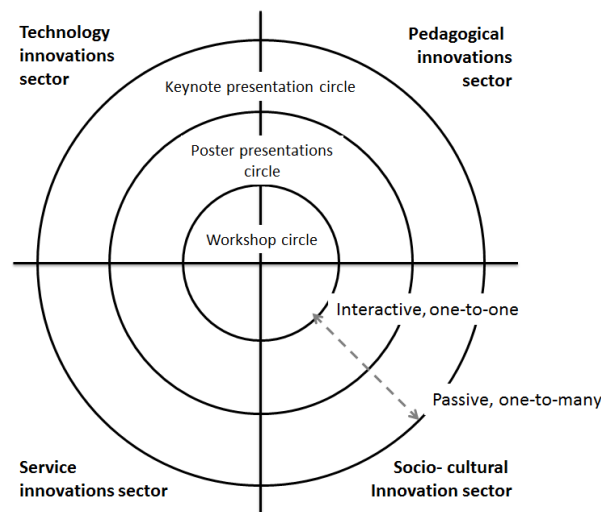
Figure 7 Structure of Care Innovation arena event.

3.2 Event participant profile mapped to filtering cube construct

Care Innovation arena event in November 2012 collected 264 participators, of which 213 were students from different disciplines – nursing and health care (103), social sciences (58), culture (47), business (4) and technology (2) – and the rest 51 participants were miscellaneous teachers (32), entrepreneurs (6), administrators of the public sector (8), researchers (2) and participators from NGOs (3). In Figure 8 we have mapped Care Innovation arena event participants to the proposed filtering cube construct, which helps to visualize the event participant's profile and test the usefulness of our construct. As shown in our construct, it appears that event participation was highly dominated by students and especially nursing and healthcare student, whereas other participant profiles were much lower in numbers. From participant heterogeneity point of view this is not necessarily a good point, yet we are not arguing that event itself cannot be a success. The construct is just indicating how much and how participants are differing in terms of their organizational, discipline and skills profile. As noted in the theoretical foundations chapter, it will be interesting to evaluate if the participants made any observations regarding the heterogeneity of participants, which from the presented innovation theories point of view includes both benefits and challenges.
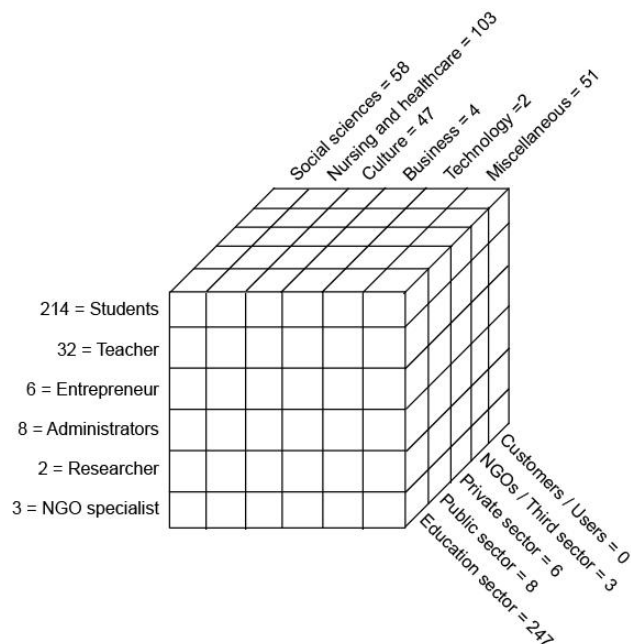
Figure 8 Structure of Care Innovation arena mapped to filtering cube.

3.3 Participant feedback from event – Student view

In all event had 213 students participants, which were divided into four groups. Three of the groups (2 x 30 and 1 x 35 students) provided their feedback via group conversation and one group (1 x 47 students) via reflection paper. Rest of the participants gave voluntary feedback through e-mail or via informal interviews including a few face-to-face interviews which were conducted among keynote speakers, poster stand presenters and innovation mill actors. However, in this study we focus only on the student feedback, which was collected in a form of course reflection (N=47).

Reflection is known and important method for evaluating learning processes in which students analyze and compare their performance and actions relating to other students and course objectives (e.g. Collins, 1990; Frederiksen and White, 1997; Koschmann, 1995; Lazear, 1999). Thus, this data source was assumed to provide the most reliable opinion from students' point of view and genuinely reflect what they had learned during the event. Depending on the course, the learning tasks and objectives varied. Moreover, it must be noted that the participation to the Care Innovation arena event was mandatory for the students, which might effect on the results. Learning and innovation skills like creativity, critical thinking, communication and collaboration (Stokols 2006; Pohl & Hirsch Hadorn 2007), added with entrepreneurship skills (Thorp & Goldstein 2010), are being recognized as the most critical skills needed in preparing students for the increasingly complex life and work environments in the future. Therefore, we are going to use this classification as a guideline for our reflection analysis and evaluate which student viewpoints can be linked to these key capabilities. In the following we will

present the results from the student reflection analysis while the example collection of excerpts is presented in Appendix 1.

The CI-a event gave students ideas for their thesis, for new innovations and entrepreneurship (excerpts 1-2, 5). It also encouraged students' positive attitude for innovation and entrepreneurship, emphasized importance to believe in own ideas and to make them happen, and not to give up in front of barriers (excerpts 1, 5). Students felt they learned new ways to study, and use of creative innovation methods. Students recognised own and others creative thinking, learned to use idea creation techniques and create new and ideas in innovation sessions. In innovation sessions students worked creatively with others, like develop, implement and communicate new ideas to others effectively, learned to be open and responsive to new and diverse perspectives, as well as incorporate group input and feedback into the work (excerpts 1-5). The CI-a event was also seen important and helpful for creating contacts and it encouraged students for networking as well as understanding the importance of networking both in innovation process and in entrepreneurship (excerpts 1, 4, 6).

Finally, only six out of 47 student reflections included positive notations which emphasised participant or topic heterogeneity point of view. Moreover, just two reflections mentioned over excessive focus on technological innovation. In our opinion, these observations are in-line with our filtering cube suggestions, which proposed that the event participants were not significantly differing in terms of their organizational, discipline and skills profiles due over overweight of student participants. Since the heterogeneity of participant or topics related innovation possibilities were not widely noticed by student reflections, we argue that in the case of Care Innovation arena event, there is a possibility to increase the heterogeneity of the event in order to enhance the innovation and creativity potential even further. However, due various other reflection observations, we conclude that heterogeneity is only a one innovation source.

4 Conclusions

Grounded on intercultural collaboration, Triple Helix, trans-disciplinary and cross-functionality theoretical approaches which are known to foster innovations, we proposed open innovation driven *filtering cube* framework in order to evaluate the diversity of participants within innovation events. Besides theoretical concept development, we summarized the preliminary results from the pilot implementation in context of healthcare and wellbeing higher-education and identified the usefulness of our construct. The observations relating to student reflections were in-line with the suggestions of our filtering cube and indicted somewhat low level heterogeneity among participants. Although, the innovation power derived from diversity could have been higher, multiple other indicators proposed that Care Innovation event itself supported various skills relating innovation capabilities. Thus, it is argued that heterogeneity is just one dimension to foster innovations. Our pilot testing has limitations. Only student reflection were analysed whereas other data sources including e.g. teachers were omitted. Furthermore, testing was conducted only in one education driven innovation event in which the number of female participants was overweight comparing the generic distribution of university students or population. Therefore, more empirical evaluation is needed to verify the usefulness of our filtering cube construct.

References

Adler, N.J., (2002), International Dimensions of Organizational Behavior (4 ed.), Cincinnati, OH: South-Western

Agarwal, R., Selen, W. (2011). Multi-dimensional nature of service innovation. International Journal of Operations & Production Management, 31(11),

Andersen, T. M., Holmström, B., Honkapohja, S., Korkman, S., Söderström, H. T., & Vartiainen, J. (2007). The Nordic model. Embracing globalization and sharing risks.

Aram, J.D., (2004), Concepts of interdisciplinarity: Configurations of knowledge and action Human Relations; Vol. 57, No. 4; pp. 379 - 412

Archibugi, D., Iammarino, S., (2002), The Globalization of technological innovation: Definition and Evidence, Review of International Political Economy, March, 9:1, pp. 98-122

Archibugi, D., Michie, J., (1995), The Globalization of Technology: a new taxonomy, Cambridge Journal of Economics 19, 1: pp. 121-40

Archibugi, D., Michie, J., (1997), Technological Globalization or National Systems of Innovation? in Archibugi, D., Michie, J., (eds.), Technology, Globalization, and Economic Performance, Cambridge: Cambridge University Press

Cassell, C., Johnson, P., (2006), Action research: Explaining the diversity, Human Relations; Vol. 59, 6; pp. 783-814.

Chandler, D., & Torbert, B. (2003). Transforming inquiry and action interweaving 27 flavors of action research. Action Research, 1(2), pp. 133-152.

Chesbrough, H. W. (2003). Open innovation: The new imperative for creating and profiting from technology. Harvard Business Press.

Clark, K.B., Fujimoto, T., (1990), The power of product integrity, Harvard Business Review, 68 (6), pp. 107-118.

Collins, A. (1990). Cognitive Apprenticeship and Instructional Technology. In Idol, L. and Jones, B. F. (Eds.), Educational Values and Cognitive Instruction. Hillsdale, NJ: Lawrence Erlbaum.

Cooke, P. (2002). Regional innovation systems: General findings and some new evidence from biotechnology clusters. Journal of Technology Transfer, 27(1), pp. 133-145.

de Mello, M. F. 2000. Transdisciplinary Evolution in Education. In R. W. Scholz, R. Haeberli, A. Bill and M. Welti (Eds.) Transdisciplinarity: Joint Problem-Solving Among Science, Technology and Society, Workbook II: Mutual Learning Sessions. Haffmans Sachbuch Verlag AG, Zurich, pp. 380-383.

De Nooy-van Tol, J. 2003. Needs for Training of Professionals. In B. Tress, G. Tress, A. van der Valk and G. Fry (Eds.) Interdisciplinary and Transdisciplinary Landscape Studies: Potential and Limitations. Wageningen, DELTA Series 2, pp. 129-135.

den Hertog, P., Wietze van, d. A., de Jong, M.,W. (2010). Capabilities for managing service innovation: Towards a conceptual framework. Journal of Service Management, 21(4), pp. 490-514.

Domik, G. & Fisher, G. 2010. Coping with Complex Real-World Problems: Strategies for Developing the Competency of Transdisciplinary Collaboration. In N. Reynolds and M. Turcasanyi-Szabo (Eds.) KCKS 2010, IFIP AICT 324, pp 90-101.

Domik, G., & Fischer, G. (2011). Transdisciplinary collaboration and lifelong learning: fostering and supporting new learning opportunities. In Rainbow of computer science (pp. 129-143). Springer Berlin Heidelberg.

Eastman, J.K., Swift, C.O., (2002), Enhancing Collaborative Learning, Discussion Boards and Chat Rooms as Project Communication Tools, Business Communication Quarterly, 65(3), pp. 29-41

Elmquist, M., Fredberg, T., Ollila, S., (2009), Exploring the field of open innovation, European Journal of Innovation Management, Vol. 12 No. 3, pp. 326-345.

Etzkowitz, H., L. Leydesdorff., 2000. "The dynamics of innovation: From national systems and 'Mode 2' to a Triple Helix of university-industry-government relations". Research Policy 29, pp. 109-123.

Etzkowitz, H., Leydesdorff, L., 1999. "The future location of research and technology transfer". Journal of Technology Transfer 24 (2–3), pp. 111–123.

Frederiksen, J. R. and White, B. Y. (1997). Cognitive Facilitation: A Method for Promoting Reflective Collaboration. In R. Hall, N. Miyake, and N. Enyedy (Eds.), Proceedings of the

Second International Conference on Computer Support for Collaborative Learning, Toronto, pp. 53-62.

Freeman, C., (1987), Technology Policy and Economic Performance: Lessons from Japan, London, Pinter.

Frey, G. 2003. Training Needs fot Interdisciplinary Research. In B. Tress, G. Tress, A. van der Valk and G. Fry (Eds.) Interdisciplinary and Transdisciplinary Landscape Studies: Potential and Limitations. Wageningen, DELTA Series 2, pp. 118-123.

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Research policy, 33(6), pp. 897-920.

Griffin, A., Hauser, J.R. (1996). Integrating R&D and marketing: A review and analysis of the literature. Journal of Product Innovation Management, 13(3), pp. 191–215.

Grosse, C., (2002), Managing Communication within Virtual Intercultural Teams, Business Communication Quarterly, 65(4), pp.22-38

Gudykunst, W.B.; (2003), Cross-cultural and Intercultural Communication, Sage Publications Inc.

Gudykunst, W.B., Mody, B., (eds.), (2002), Handbook of International and Intercultural communication (2 ed.), Thousand Oaks, CA: SAGE.

Gupta, A., Raj, S. P. and Wilemon, D. (1985), The R&D-marketing interface in high technology firms. Journal of Product Innovation Management, Vol. 2, pp. 12-24

Gupta, A., Raj, S.P. Wilemon, D., (1986), Model for studying R&D marketing interface in the product innovation process. Journal of Marketing 50: pp. 7-17

Handbook of Transdisciplinary Research. 2008. Gertrude Hirsch Hador, Holger Hoffmann-Riem, Susette Biber-Klemm, Walter Grossenbacher-Mansuy, DominiqueJoye, Christian Pohl, UrsWiesmann and Elisabeth Zemp (Eds.). Swiss Academies of Arts and Sciences. Springer Science + Business Media B.V.

Horizon 2020. The EU Framework Programme for Research and Innovation. http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=h2020

Heins, E., Price, D., Pollock, A. M., Miller, E., Mohan, J., & Shaoul, J. (2010). A review of the evidence of third sector performance and its relevance for a universal comprehensive health system. Social Policy and Society, 9(4), pp. 515-526.

Hoffman, D. L., Novak, T. P. (1996). Marketing in hypermedia computer-mediated environments: conceptual foundations. The Journal of Marketing, pp. 50-68.

Hofner Saphiere, D.M., (1996), Productive Behaviors of Global Business Teams, International Journal of Intercultural Relations, Vol. 20 No. 2, pp. 227-59

Holley, K. 2009. The challenge of an interdisciplinary curriculum: a cultural analysis of a doctoral-degree program in neuroscience. Higher Education, 58(2), 241-255.

Jaatinen, M., Lavikka, R., (2008), Common Understanding as a Basis for Coordination, Corporate Communications: An International Journal, Vol. 13 No2., pp.147-167

Joske, F. G. B., Broerse, J. E. W., Zweekhorst, M. B. M. (1999). The triple helix enriched with the user perspective: A view from bangladesh. Journal of Technology Transfer, 24(2-3), pp. 235-246.

Kahn, Kenneth B. (1996), "Interdepartmental Integration: A Definition with Implications for Product Development Performance," Journal of Product Innovation Management, 13 (2), pp. 137–51.

Kasanen, E., & Lukka, K. (1993). The constructive approach in management accounting research. Journal of management accounting research, (5), pp. 243-264.

Katz, E. and P.F. Lazarsfeld (1955), Personal Influence, Glencoe:Free Press.

Katzenbach, J.R., Smith, D.K., (1999), The Wisdom of Teams: Creating the High-Performance Organizations, Harper Collins Publishers, New York, NY.

Kirti, S. C. (2007). Fostering critical thinking in business courses: Pedagogical innovations and strategies. The Business Review, Cambridge, 8(1), pp. 148-153.

Klein, J.T., (1996), Cross boundaries: Knowledge, disciplinarities, and interdisciplinarities. Charlottsville: The University of Virginia Press.

Klein, J.T., Newll, W.H., (1998), Advancing interdisciplinary studies. In W.H. Newell (Eds.) Interdisciplinarity: Essays from the literature. New York: College Entrance Examination Board, pp. 3-22.

Kockelmans, J. J. (1975). Interdisciplinarity in Higher Education. Penn State Press.

Koschmann, T. (1995). CSCL: Theory and Practice of an Emerging Paradigm (Computers, Cognition, and Work). Hillsdale, NJ: Lawrence Erlabaum.

Laine, V., Maiväli, M., 2010, Finland: adjusting to an ageing population, Economic analysis from the European Commission's Directorate-General for Economic and Financial Affairs, Volume 7, Issue 4, European Commission, Brussels.

Landis, D., Bennett, J.M., Bennett, M.J., (eds.), (2004), Handbook of Intercultural Training (3 ed.), Thousand Oaks, CA: SAGE

Lasswell, H.D. (1948), "The Structure and Function of Communication in Society," in The Communication of Ideas, Bryson, ed., New York: Harper and Brothers

Lattuca, L.R., (2001), Creating interdisciplinary: Interdisciplinary research and teaching among college and university faculty. Nasville, TN: Vanderbild University Press.

Lazear, D. (1999). Multiple intelligence approaches to assessment. Tucson, AZ : Zephyr Press.

Leadbeater, C., (2008), We-think: Mass innovation, not mass production: The Power of Mass Creativity, Profile Books.

Leydesdorff, L. (2012a). The triple helix, quadruple helix,…, and an n-tuple of helices: explanatory models for analyzing the knowledge-based economy?. Journal of the Knowledge Economy, 3(1), pp. 25-35.

Leydesdorff, L. (2012b). The Triple Helix of University-Industry-Government Relations (February 2012). Encyclopedia of Creativity, Innovation, and Entrepreneurship, New York: Springer.

Li, T., & Calantone, R.J. (1998). The impact of market knowledge competence on new product advantage: Conceptualization and empirical examination. Journal of Marketing, 62(4), pp. 13–29.

Lundvall, B-Å., (2007), National Innovation Systems-Analytical Concept and Development Tool, Industry and Innovation. Sydney: Vol. 14, Iss. 1, p. 95.

Marquardt, M.J., Horvath, L., (2001), Global Teams: How Top Multinationals Span Boundaries and Cultures with High-Speed Teamwork, Davies-Black Publishing, Palo Alto, CA.

Mesa, W. (2010). The composition of intellectual capital in non-profit orchestras. Journal of Intellectual Capital, 11(2), pp. 208-226.

Milliken, F. J., & Martins, L. L. 1996. Searching for common threads: Understanding the multiple effects of diversity in organizational groups Academy of Management Review. 21: pp. 402-433.

Misra, S. Harvey, R. H., Stokols, D., Pine, K. H., Fuqua, J., Shokair & S. M. 2009. Evaluating an interdisciplinary undergraduate training program in health promotion research. Am J Prev Med, 36(4), pp. 358-365.

Mutsikiwa, M., & Basera, C. H. (2012). The influence of socio-cultural variables on consumers' perception of halal food products: A case of masvingo urban, zimbabwe. International Journal of Business and Management, 7(20), pp. 112-119.

Nicolescu, B. 2005. Towards transdisciplinary education and learning. Paper presented at. 2005 Science and Religion: Global Perspectives conference.

Norton, J., Parry, M. E., Song, X. M. (1994), Integrating R&D and marketing: a comparison of practices in the Japanese and American chemical industries. Engineering Management, IEEE Transactions on, 41(1), pp. 5-20.

Odenwald, S., (1996), Global Work Teams, Training & Development, 50(2), pp.54-57

Oxford English Dictionary, (1989), The. J.A. Simpson and E.S.C. Weiner (Eds.) Oxford: Clarendon Press, pp. 734 – 735

Oyegoke, A. (2011). The constructive research approach in project management research. International Journal of Managing Projects in Business, 4(4), pp. 573-595.

Peck, C.A., Gallucci, C., Sloan, T., Lippincott, A. (2009), Organizational learning and program renewal in teacher education: A socio-cultural theory of learning, innovation and change, Educational Research Review, Volume 4, Issue 1, 2009, pp. 16-25.

Peppers, D., Rogers, M. (1997). The one-to-one future. New York: Double Day Publications.

Piller, F.T. and Walcher, D. (2006), "Toolkits for idea competitions: a novel method to integrate users in new product development", R & D Management, Vol. 36 No. 3, pp. 307-18.

Pinto, M. B.,Pinto, J. K. (1990), Project team communication and crossfunctional cooperation in new product development. Journal of Product Innovation Management 7: pp. 200-212.

Pohl, C. & Hirsch Hadorn, G. 2007. Principles for Designing Transdisciplinary Research. Proposed by the Swiss Academies of Arts and Sciences, oekom Verlag, München, 124.

Pöyhönen, A., Smedlund, A., (2004), Assessing intellectual capital creation in regional clusters. Journal of Intellectual Capital, Vol.5, No. 3; pg. 351.

Raelin, J., 1999, Preface, Management Learning, Vol. 30, 2, pp. 115-125.

Reason, P., Bradbury, H. (Eds.). (2001). Handbook of action research: Participative inquiry and practice. SAGE Publications Limited.

Ryynänen, O-P., Kinnunen, J., Myllykangas, M., Lammintakanen, J., Kuusi, O., (2004), Suomen terveydenhuollon tulevaisuudet, Skenaariot ja strategiat palvelujärjestelmän turvaamiseksi; Esiselvitys, Tulevaisuusvaliokunta teknologian arviointeja 20, Eduskunnan kanslian julkaisu 8., Suomi

Räsänen, R., San, J:, (eds.), (2005), Conditions for Intercultural Learning and Co-Operation, Helsinki: Finnish Educational Research Association

Santonen, T., (2012), Massidea.org – a greener way to innovate in "Green Technologies in Food Production and Processing", Yves Arcand and Joyce Boye (eds), Springer Science+Business Media, USA pp. 541-568.

Song, M., & Montoya-Weiss, M. (2001). The effect of perceived technological uncertainty on Japanese new product development. Academy of Management Journal, 44(1), pp. 61–80.

Song, X. M., Montoya-Weiss, M. M., & Schmidt, J. B. (1997). Antecedents and Consequences of Cross-Functional Cooperation: A Comparison of R&D, Manufacturing, and Marketing Perspectives. Journal of Product Innovation Management, 14(1), pp. 35-47.

Spelt, E. J. H., H. J. A. Biemans, H. Tobi, P. A. Luning, and M. Mulder. 2009. Teaching and learning in Interdisciplinary higher education: A systematic review. Educational Psychology Review 114.

Stahl, G., Maznevski, M., Voigt, A., Jonsen, K., (2010), Journal of International Business Studies, 41, pp. 690-709.

Stember, M., (1998) Advancing the social sciences: Through the interdisciplinary enterprice. In W.H. Newell (Eds.) Interdisciplinarity: Essays from the literature. New York: College Entrance Examination Board, pp. 337 - 352.

Stokols 2006, Toward a Science of Transdisciplinary Action Research. Am J Community Psychol. 38: pp. 63-77.

Tapscott, D., Williams, A.D., (2006), Wikinomics: How Mass Collaboration Changes Everything

Teräs, M., (2007), Intercultural Learning and Hybridity in the Culture Laboratory, University of Helsinki, Department of Education, Helsinki University Press

Thompson Klein, J. 2008. Education. In Hirsch Hadorn et al. (eds.), Handbook of Transdisciplinary Research. Swiss Academies of Arts and Sciences. Springer Science + Business Media B.V., pp. 399-410.

Thorp, H. & Goldstein, B. (2010). Engines of Innovation. The Entrepreneurial University in the Twenty-First Century. The University of North Carolina Press.

Tsai, K. H., Hsu, T. T., & Fang, W. (2012). Relinking Cross-functional Collaboration, Knowledge Integration Mechanisms, and Product Innovation Performance: a Moderated Mediation Model. Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration, 29(1), pp. 25-39.

Urban, G., von Hippel, E. (1988). Lead User Analyses for the Development of New Industrial Products. Management Science 34(5): pp. 569–82.

Walter, A., Helgenberger, S., Wiek, A. & Scholz, R.W. (2007). Measuring societal effects of transdisciplinary research projects: design and application of an evaluation method. Evaluation and Program Planning 30 (4): pp. 325-338.

Wandahl, S., Jacobsen, A., Lassen, A. H., Poulsen, S., & Sørensen, H. (2011). User-driven innovation in a construction material supply network. Construction Innovation, 11(4), pp. 399-415.

Wang, Z. (2005). Organizational effectiveness through technology innovation and HRM strategies. International Journal of Manpower, 26(6), pp. 481-487.

West, J. and Gallagher, S. (2006), "Challenges of open innovation: the paradox of firm investment

von Hippel, E., (1986) "Lead Users: A Source of Novel Product Concepts," Management Science 32, no. 7 (July): pp. 791-805.

Yin, R., (1994), Case study research: Design and methods (2nd ed.), Sage, Newbury Park, CA.

Zhu, Y., Gareis, F., O'Keefe Bazzoni, J., Rolland, D., (2005), Focus on Intercultural Communication: A Collaborative Online Project Between New Zeeland and New York, Business Communication Quarterly, 68(1), pp. 81-96.

Appendix 1: Student reflection excerpt examples

Excerpt 1: (Woman 1). …"I listened every presentation with great interest and felt I got something from all of them: either new perspectives or strengthening for my previous thoughts. So the CI-event gave me perspective and skills to innovate and develop wellbeing products and services." … "Entrepreneurs, that shared their business ideas, products or activities, inspired with confidence in innovation and entrepreneurship. They created picture of venture, persistence and belief in your ideas and yourself. Especially I recall Jukka Jokiniemi's sentence: "What you can dream, you can carry out." I got ideas for my thesis, and especially I put behind my ear how to carry it out. With my projects I'll certainly keep in mind that crowed-searching, which could be used in many ways in developing process if there's need for involve the crowd in."

Excerpt 2: (Woman 2)… "Of innovations I learned, it would be wise to start with broad view in order to find the grain of cold, that might one day become profitable business. Again it is most important to listen different people from different backgrounds, as well clients as those you collaborate with."

Excerpt 3: (Woman 5)… "Of this event I learned to be more creative and open with my thesis idea. It is useful to share and develop ideas with others."

Excerpt 4: (Woman 7). …"Saarinen emphasized in her presentation the importance of enriching meetings of aged people living in care home and their closest relations. Wow! This could be, no actually this will be my thesis theme. Finally I found it! I was thrilled!"

Excerpt 5: (Woman 8). …"I've been dreaming of entrepreneurship in my future. This event with many interesting cases of innovation and entrepreneurship strengthened and inspired me to reach my dream."

Excerpt 6: (Woman 9). …"It was very useful to get to know what others do, and to learn and experience different working- and learning methods."…" From this event I got plenty of food for thought and excellent contacts I'll need in near future."