Concurrent process coordination of new product development by Living Labs
- an exploratory case study -

Abstract: The risk of new product development investments is that they are wasted if users and customers do not accept their results. Living Labs set out to involve users early on in the process to reduce this risk. The paper tells the story of how Coliquio.com, an internet-based exchange platform for physicians was developed and discusses the contribution of Living Labs to new product development. In literature user-acceptance is a well-known performance indicator for new product success and user-involvement an indicator of development process maturity. As the story suggests, the nature of Living Labs as innovation intermediary is to provide organizational capabilities for the coordination of new product development processes in open-network settings. The paper provides a framework of Living Lab capabilities including team mobilization and idea scouting, match making for teams, product development, user validation and market positioning, graduation of the project financing the project, and venturing for future growth. These capabilities are intertwined and their concurrent coordination is a capability by itself. Where established firm infrastructures are not readily available, Living Labs need entrepreneurship capabilities to rally finance, knowledge, and people in addition to engineering management capabilities inside the firm.

Keywords: open innovation, new product development, concurrent engineering, cross-functional teams, process coordination, Living Labs, entrepreneurship, user-centricity

1 Introduction

New product development, in a general sense, is a formal process with the aim of creating new solutions for market needs. Much to the frustration of many engineers, success of new product development processes cannot be predicted simply by good working, by well coordinating and controlling the involved activities. There is no market impact if users do not appreciate the outcome. And, if users and customers like a product, its adoption can be successful despite poor product development processes. This apparent lack of managerial control levers on a firm´s substantial investment drives the search for alternative ways of organizing new product development.

Partnering in networks and clusters is increasingly perceived to increase success rates of new product development. Common to the many different cooperation approaches is that multiple actors, even users and customers, engage in the joint creation effort. And because many of the actors remain external to the firm they do not add burden to corporate R&D management. Is this a naive hope that someone else will do the work? Or, is this a case of bringing economic transaction logic to engineering that market transactions are more economic when supervision of processes is not feasible? And if so, is this the start of a new market for dedicated suppliers in an innovation value chain?

Living Labs are created to facilitate new product development and, if successful, could enter the innovation market as service providers. We read the rapid emergence of so many Living Labs worldwide as an indicator that some coordination infrastructure for new product development is needed in networks to compensate for the services formerly provided by corporate R&D departments. Not everything done by Living Labs is new and there is little hope that they can escape from the insights already documented in new product development (NPD) literature. NPD is generally modeled as a process of inter-dependent multi-disciplinary activities that are coordinated to create the new product as their outcome. Conceptually, processes are not restricted to firm boundaries and the study of process coordination in a network setting should contribute to understanding the nature of Living Labs as well as to NPD process coordination.

The aim of the paper is to tell the story of the development of the internet-based physician exchange platform Coliquio.com. The founder team joined the Knowledge Worker Living Lab with a first idea in 2007 and graduated with market introduction in 2009. By 2012, the company counted more than 64.000 physicians as users, served by 35 employees of the Coliquio firm. The case Coliquio.com is successful in the sense that a product was developed, that this product enjoys high market impact and that a start-up was founded that has seen high-growth. As a case-study, it lends itself to the discussion the role and contribution a Living Lab can offer with respect to *a)* new product development activities, *b)* user-involvement activities, *c)* entrepreneurial activities, and *d)* the coordination thereof.

This paper brings forward the proposition that coordination of concurrent processes of product development, user-involvement, and entrepreneurship activities impacts NPD success. Innovation intermediaries like Living Labs can make an essential contribution to this coordination. To the scholarly community, the paper contributes a NPD case in a network setting and an analysis of organizational capabilities for NPD in networks. To practice this paper contributes “best” practice for Living Labs and innovation intermediaries in general with focus on discussing the activities undertaken and their coordination. For this purpose, the paper extracts an initial framework of concurrent operational processes provided and supported by the Living Lab.

The remainder of the paper is structured as follows: We set the stage by reviewing new product development literature and then tell the story of how Coliquio was developed within its Living Lab environment. We then turn to the discussion of the role of Living

Labs for NPD coordination. The paper closes with conclusions for theory and practice and directions for future research.

2 Coordinating new product development

The process concept establishes a causal relationship between a set of coordinated activities and an outcome or result of it, the new product in our case. Output-oriented performance measures have been operationalized in the NPD literature as high quality standards (Civerlo, 1991), achieved product functionality, or timely market introduction because demand is typically limited within a 'window of opportunity' (Wheelwright & Clark, 1992b). Such variety of performance criteria makes NPD process management an inherent multi-criteria optimization task for which managerial coordination of development activities is the prime lever.

NPD literature has for a long time focused on means to increase coordination of activities within the development process. This of course is in line with the general production or operations orientation of the industrial age that better coordination increases efficiency and lowers the cost of the NPD process (Susman & Dean, 1992). Case studies from the electronic and software industry indicate that product development can require a million engineering decisions (Eppinger, Whitney, Smith, & Gebala, 1994) and the alignment of thousands of interdependent development activities (Cusumano & Richard, 1995; Cusumano & Yoffie, 1998) which makes coordination a major concern for the quality of results delivered, not only for the cost incurred. The network settings inherent to Living Labs rather increase than decrease the number and diversity of involved participants so that coordination will in addition be a crucial challenge for Living Labs.

Traditionally, the complexity of the development process is managed by structuring it in a number of sequential phases such as idea generation, conceptualization, design, manufacturing, and market launch (Lansiti, 1995). Each phase can be assigned to functionally specialized teams that work independently of each other and start only when the prior team has completed its phase. Living Labs focus on user-orientation, which positions them in the very early phase of requirements engineering as well as in the very late phase of market launch of this phase model. With this, Living Labs contradict the simple linear NPD process structure, where communication and interaction between phases is systematically minimized in order to avoid coordination needs. Living Labs instead address what NPD literature describes as the limitation of the linear model, which works well within the individual team but increases the potential of misunderstanding through lack of knowledge transfer amongst multiple teams. This reduces efficiency due to mistakes and rework, which in turn increases overall development time and cost, as well as quality problems (Cordero, 1991; Takeuchi & Nonaka, 1986). Additional coordination mechanisms across team boundaries avoid such disadvantages.

Stage gates (Adams, 2004; Griffin, 1997; Schmidt, Sarangee, & Montoya, 2009) are suggested as such cross-team coordination mechanisms taking a form of managerial review points at the end of each project phase (Cooper, 1990). Gate review decisions are designed to review completed development phases. The aim is to integrate information across various teams that would otherwise stick to each respective functional team only and thus be fragmented across various teams throughout the different development phases. While Living Labs pull together information and interaction with the future user, these gate reviews are concerned with conveying information within the NPD process. User information, however, does play an important role in NPD literature as well. Stage gates particularly bundle information flow between upstream activities like marketing that are close to users and downstream activities like manufacturing, design engineering or sales activities (Brown & Eisenhardt, 1995; Clark & Wheelwright, 1993; Cooper, 1999; Ettlie, 1995). The integration of user- and market-information has been found to reduce ambiguity and uncertainty for all involved teams (Adams, Day, & Dougherty, 1998). Gate reviews are

decisive for judging whether and how the project should continue, be postponed until more information is available, or be eliminated (Cooper, 1990; Schmidt, 2004; Schmidt et al., 2009). But solutions to this challenge are far from satisfactory. Decision processes at stage gates are described as complex and still need better understanding (Hart, Jan Hultink, Tzokas, & Commandeur, 2003; Hauser, Tellis, & Griffin, 2006b) to which the study in the alternative organisational form, i.e. the network setting of Living Labs could contribute.

In the 1980's, concurrent engineering (CE) emerged as a new coordination approach to NPD and was quickly adopted in many industries (Smith, 1997). CE does not change performance criteria, but provides new coordination mechanisms to better reach them. The name is derived from its initial intention to shorten NPD processes through executing product design and related manufacturing engineering activities simultaneously (Clark & Fujimoto, 1991; Susman, 1992; Wheelwright & Clark). Parallelization of development activities reduces the overall process execution time, even when the execution time of each activity remains the same (De Meyer & Van Hooland, 1990). Living Labs, in this respect, introduce a special type of concurrency by involving users parallel to product development.

NPD literature has elaborated important additional effects of activity parallelization such as the early involvement of cross-functional teams in the process and to jointly plan product design, process design, and manufacturing activities, which allows for better multi-criteria optimization on product features, its manufacturability, and so forth (Hatch & Badinelli, 1999; Koufteros, Vonderembse, & Doll, 2001; Lee, 1992). For example, specifications for product definition can as well be used for prototyping (Krishnan & Bhattacharya, 2002), both activities thereby benefitting from the same information (Yassine, Chelst, & Falkenburg, 1999). However in contrast to the Living Lab approach, at the time of dominant corporate R&D departments, involvement of users or other external partners was obviously less of a concern.

CE literature instead was concerned with managing the coordination challenges of parallel work, which inherently means working on the basis of not yet finalized and otherwise incomplete information. Input information that changes bears the risk of having to the work again (Krishnan, Eppinger, & Whitney, 1997; Terwiesch, Loch, & Meyer, 2002) or at least requires frequent exchange of information with other teams and alertness to detect changes and mistakes as early as possible (Susman & Dean, 1992)**.** In contrast to the initial expectation, CE therefore proved to have strong impact on the functional teams, which now need to increase external communication effort (Adler, 1995; Terwiesch et al., 2002). With the advent of Internet, better technical communication measures such as computer-supported work places (Coman, 2000; Portioli-Staudacher, Landeghem, Mappelli, & Redaelli, 2003; Ruffles, 2000) became available so that physical limitations of paper-based communication (Swink, Talluri, & Pandejpong, 2006) and co-location of teams (O'Leary-Kelly & Flores, 2002)disappeared (O'Leary-Kelly & Flores, 2002). Just compare an online CAD viewer with the limitation in the number of versions for a paper design drawing, the number of prints that could be afforded, and the time it would take to mail them to partners. Teams capable of successfully performing in CE processes should therefore be better equipped to perform with users in a Living Lab setting as well.

Another main stream of CE research is on organizational design for simultaneously executed activities, often with the use of the emerging technical communication means. A synonym for this stream of research is the cross-functional team (Daryl, 1992; Meyers & Wilemon, 1989) that manages the interdependency across organizational boundaries and combines multi-perspective expertise and know-how into the NPD process (O'Neal, 1993). Rather than meeting only at stage gates reviews, collaboration in such teams is ongoing with regular interaction (Koufteros, Vonderembse, & Jayaram, 2005). In practice such teams have first emerged at specific departmental borders with the assignment to overcome local communication and information barriers (Henke, Krachenberg, & Lyons, 1993) like design for assembly (Boothroyd, Dewhurst, & Knight, 1994), design for manufacturing (Barkan, 1992), or modular design (Hauser, Tellis, & Griffin, 2006a). Studies show that

most firms have implemented multiple cross-functional teams at organizational interfaces in the NPD process and that this is positively related to NPD project success (Hong, Nahm, & Doll, 2004; McDonough, 2000). While early boundary-spanning teams were created to liaise between internal departments, they today frequently include in addition to internal engineers customers as well as suppliers external to the firm (Koufteros et al., 2001; Koufteros et al., 2005).

Cross-functional teams require an adapted role of NPD managers as leaders of such teams. Thus, CE literature provides insight that can be useful for the development of Living Labs, whose development teams can be expected to face similar challenges: CE teams are more autonomous than other functional departments in their assignment as well as in their internal organisational structuring with more self-management for both the individual members and the self-creation of rules and procedures (Olson, Walker, & Ruekert, 1995). Team leader performance includes new criteria for gaining member commitment (Gupta & Wilemon, 1990), to align them with common goals (Galbraith & Nathanson, 1978; Mintzberg, 1979; Thompson, 1967) to align performance indicators (Wheelwright & Clark, 1992a), to diversify risk (Gupta & Wilemon, 1990; Koufteros et al., 2005), and to organize for organizational learning (Henke et al., 1993; McKee, 1992).

Of special interest to this Living Lab study is the role of the user and the challenges aligned with integrating him or her into the NPD process. CE literature is primarily concerned with professional engineers and engineering managers. In contrast, users remain somewhat implicit. Still, CE as such can be seen as a reaction of firms to become more user- and market oriented in response to the general change from supplier markets to customer markets in the 1970's. Pressure in saturated markets increased to shorten product life cycles and at the same time to better differentiate products from those of competitors. This trend continuously increased R&D investments and added a strong economic dimension of R&D investment amortization to NPD performance (Siskens, 1996). Increasingly, success and failure is defined in competitive markets as a product that reaches or misses the window of opportunity, and that does or does not generate sufficient market impact, measured as financial return.

While NPD literature concurs that active involvement of the user in NPD activities reduces failure rates and increases market impact (Bilgram, Brem, & Voigt, 2008; DeBellis & Haapala, 1995; Foxall & Tierney, 1984; Jiang, Klein, & Hong-Gee, 2006; Lettl, Herstatt, & Gemuenden, 2006; Von Hippel, 1986, 1998, 2005b), the user is not traditionally foreseen as a direct participant in the NPD process. Rather, market information is brought into the NPD process through marketing departments that undertake market trend analysis, market segmentation, and positioning or market research as functional team. Techniques like the voice-of-the-customer matrix help to convey user information into the later stages of the NPD process (Ernst, Hoyer, & Rübsaamen, 2010; Griffin & Hauser, 1996; Hauser et al., 2006b; Rouziès et al., 2005). The earlier discussed challenges of coordination between teams have been found for user information as well. This kind of information is however particularly prone to misinterpretation out of context and formal communication means are too slow for high velocity environments (D'Aveni & Gunther, 1995). More recent proposals therefore are to integrate idea generation and product feature evaluation into the sales function (Homburg & Jensen, 2007) and use the customer as direct information source in place of indirect marketing surveys (Cespedes, 1995; Rouziès et al., 2005), which is in line with the Living Lab approach.

Agile / SCRUM software engineering, are practices of iterative development, frequent customer involvement, and daily meetings of the development team, which amongst others aim at direct involvement of users in the development of software products like in the here presented case the software providing the internet-based exchange platform Coliquio.com. This makes use of the fact that software has negligible production delays and costs, compared to physical products, allowing product versions to be generated and changed more frequently. Agile / SCRUM methods are helpful where users do not gain full

technical understanding of the artifact, while designers do not gain full understanding of how it is going to be used (Bertelsen, 2000). Similar to cross-functional teams in CE Agile / SCRUM methods aim to create a shared understanding, shared mental models among future users, stakeholders and the development team (Moe, Dingsoyr, & Dyba, 2010) for which detailed operational routines like stand-up meetings, sprint planning, etc. are prescribed (Dyba & Dingsoyr, 2008). While these practices are successful in small software development projects, Hoda et al. (2010) find that current agile methods are limited to what they call "agile sweet spots" individual, small and co-located project teams with an on-site customer. Pikkarainen et al. (2008) confirm that these practices do not offer enough mechanisms when project scope and stakeholders are not clearly defined, nor for extended environments that involve many stakeholder groups and multiple development teams in the same NPD process. This dilemma is rehearsed in NPD literature, for example in the discussion of rapid prototyping and testing (Campbell et al., 2007), which enables interaction and provides stimulus for the user to evaluate and improve preliminary solutions in fast feedback loops. These feedback loops allow lead users to gain experiential knowledge while at the same time enabling analysts to transform implicit experiential knowledge into viable solution specifications. Lead Users are not only beneficial for NPD (Von Hippel, 2005b) but act as opinion leaders to advocate the new solution and therefore contribute to its marketing (Bilgram et al., 2008). But again, for practical reasons, only a limited number of users can be engaged, which makes their selection a critical issue (Lettl et al., 2006) (Franke, Von Hippel, & Schreier, 2006; Lettl et al., 2006).

The guiding research question for the here presented case study is how Living Labs can increase user-centricity and how this can be coordinated in / for larger development networks that are structured in several teams but engage in the same NPD process. It is not the question about functional team coordination per se, which has been found to be not sufficient (Sethi, 2000), nor about user-centricity, which has been found to be positively related to NPD performance (von Hippel, 2005a), but about how both elements can be coordinated to increase NPD process performance.

3 Case Study Research Methodology

Data was collected by one author, who is regularly involved in similar projects as head of the Knowledge Worker Living Lab. The case has been selected because of its narrative value and because it has been the most successful one undertaken, not because of any statistical relevance. Because of its success, the case does not stop or break half way through the NPD process, but allows the study of how it unfolds to the very end of successful graduation from the Living Lab. Of course, there are many other cases, which have not achieved this result. The intended result of this inductive research is conceptualization of Living Labs. We provide an initial framework of processes and capabilities for Living Labs to illustrate our findings. In other words, the aim is to profit from a successful case by analyzing interesting characteristics of it. Generalization of the here presented concept will require more and different quantitative empirical studies.

Therefore the study is a single case study (Bryman & Bell, 2007). Case study design is particularly beneficial because it enables to investigate a complex phenomenon through a rather holistic lens in real-life settings (Yin, 2008). Furthermore, it enables the generation of in-depth understanding by focusing on the perception of people (Patton, 1990; Veal, 2005) in depth and to analyze the mass of data and data sources combined which are related to a several years-long longitudinal case (Stake, 1995).

Data collection was undertaken in a variety of ways. All documents produced within the project including emails, meeting minutes, formal internal documents, contracts, and external publications have been collected in the repository of the Living Lab and give full explicit account of the evolution of the case. Notes from many phone calls, oral

interventions and meetings were available as field notes and were complemented by ex-post interviews with involved individuals.

Data analysis was undertaken through identifying and mapping critical events over the life cycle of the project. Critical events were coded by all authors, which took the practical form of grouping and re-grouping events into meaningful event chains over time (Bonoma, 1985) and a thick description of the case. Gradually, and with the use of literature, this thick description was reduced into the conceptualizations presented and discussed in this paper.

4 Development of the Coliquio Product in the Knowledge Worker Living Lab

On January 9, 2007 one of those frequent discussions took place in the office of the head of the Living Lab: An enthusiastic student came with the idea of creating a virtual social network for physicians. The idea was some kind of me-too implementation of a LinkedIn type of online business-network. The student was still impressed by the lack of exchange opportunities that he discovered during the Christmas break with his family and private physician friends such that he had already invested 5000 € of his own money for coding a software prototype. This first meeting quickly turned into the usual discussion on functionality and uniqueness of the intended web-platform and on its business opportunity. Like in so many other cases, this prototype was so inadequate that it later had to be aborted all together. More important at this moment, however, was the strong visible commitment of the idea holder so that the head of the Living Lab promised him he would take on the project. The only condition being that he would find at least one further partner who dedicate themselves exclusively to the project.

Only a few days later, he indeed turned up with a partner to make use of the Living Lab support for user-centric product development and venturing. By the end of January 2007, they moved into the physical office space of the lab, got access to the digital knowledge repository, and took advantage of regular coaching sessions. For the first three month, the team of two focused on sharpening the product concept and the business idea for which they were prompted to study other knowledge worker platforms and prototypes built for similar purposes in prior projects of the Living Lab. It took the team a few coaching sessions to accept that a me-too business-network was no viable approach. Consequently, they altered the solution in many ways and became increasingly confident that a solution should support the business processes and daily work of physicians as some kind of a “tool”. These findings were supported by reports from previous research projects on new ways of work and knowledge worker collaboration from the Living Lab. In March 2007 the product idea had advanced but the only business reasoning at this stage was that an Internet platform addressing more than 10% of a wealthy target group like physicians would “somehow be able to make money”. And they felt justified in this when they read about closure of first round investment for the US-start-up company Sermo in Q1/2007, which was based on a similar approach in the US.

The team so far had two members and an idea but no funds to proceed. The search for a seed investor was initiated in March 2007 to raise the amount of money needed for software product development. The Living Lab presented the project in its partner network because the young students’ founders did not know of any potential business angels who would join the team with money and knowledge. One CEO and himself founder of a medium-sized software company considered joining the project by financing initial software development and contributing personal and firm’s software expertise. The offer was to reward him not with money but with shares, “sweat equity”, if the project were to eventually lead to the establishment of a venture. Within a week he agreed, mainly motivated by the technical side of the project and declared this his focus. The team decided to continue searching for a further partner with industry experience and was able to inspire

the CEO and owner of a consulting and training company who had a strong background in the healthcare industry (further on described as the “health care expert”). Further project preparation continued with a review of alternative business incubation services, but finally the team preferred to locate the project in the Living Lab. In mid-April 2007 the project kicked-off with the working title "MedCoss". Based on the agreements, the endeavour was equipped with enough resources to at least reach a Web platform ready to go life from a technology side, and the go-to-market point from a business side.

From May 2007 on the project continued with software product development. The two founders as core team developed use cases, scribbled screenshots, workflows and the like with the use of the knowledge assets of the Living Lab. From May onwards the Living Lab coordinated regular working meetings for team building between the young founders and the experienced business angels. Based on very initial software conceptualization the core team was sent into intensive interaction with industry experts and potential future users. The aim was to learn more about user perspectives on features and interface design of the platform. For this purpose, the health care expert introduced a number of interested health industry experts. These experts were in influential positions such as head and owner of a hospital, or scientific head of a research institute for quality assurance in health care services. They all contributed on voluntary basis with initial "paper prototypes" often of the type of the proverbial napkin drawings. Through the use of Living Lab facilities first prototypes were presented and re-designed in sessions with those users who increasingly engaged in an iterative, experimental approach. Additionally, the core team collected questionnaires with feedback from a broader community. When more people started referring to “their” project public communication and the definition of a catchy brand became an issue. An intellectual property rights law firm and long-standing Living Lab partner worked with the team and introduced the name "Coliquio" in August.

The agenda of the team workshop on June 22, 2007 reveals how many concurrent action lines had been opened by that time: the - at that time still open - question of a suitable brand name, the status and content of the initial technical specification of the software product, the design of key interface screens, a basic business concept and the question which medical experts to involve into further development, as well as how to prepare market-entry.

The priority from July 2007 onwards was the creation of health industry knowledge and acceptance. Several high-ranked medical expert users, chief physicians, and health insurance representatives were motivated to support the venture in a variety of ways with differing intensity. They were actively supporting the software development as users, acting as lighthouses, contributing with postings on the platform, or supporting Coliquio with testimonials published on the website. A so-called "family and friends" list was created containing those who were supposed to be amongst the first users of the intended platform. For liability reasons it was decided to transfer the project into a legal entity with limited liability on September 6th, hours before the Internet platform went live later that day.

But Coliquio was not alone in the market. In August a direct competitor, esanum, had come up online and was financially far better equipped, notably with a much stronger marketing budget that quickly boosted their user numbers. Coliquio just had the few dozen users from their “family and friends” list. In short, Coliquio would need further investments to finance and implement necessary market-entry activities if it wanted to keep up with this competitor. In September, the Living Lab asked network partners to undertake a due diligence to prepare for an investment round. The core team spent most of September 2007 with coaching the friends and family community in making first user experiences. For many of them it was the first time they could interact with a software product they had drawn as paper prototypes before. The core team and its software engineers were occupied with bug fixes and implementation of additional features in reply to their early users. Driven by the new competitor, the core team was further looking for ways to increase

visibility without increasing marketing cost. In this phase they developed the “mail-robot”, a little piece of software that they trimmed to inform platform users frequently via email about activities relevant to them, such as discussions on their posted questions, bug fixes, new features, or relevant new postings. The algorithms to calculate user relevance turned out to become a key technology and core capability of the software for motivation and enhancing continued user activity.

In November, 120 users were registered to the platform but prior Living Lab experience said that some 1.000 users were needed to trigger network effects for self-sustained activities and further growth. To get there required further investment, but despite the preparation, no significant additional investor could be found by the founders. Instead, a further Living Lab network partner, a consulting company, and a pharmaceutical marketing company joined in with a smaller investment but further industry expertise. However, the rather small cash investment enforced a cost target per registered physician of 20 € and a deadline of only 4 months to reach the 1.000th registered user. The new partner provided sales contacts with pharmaceutical companies, but still this remained a daunting marketing task. Several waves of direct mailings to physicians were sent via the white-listed email backend of the Living Lab. The core team further engaged in b2b negotiations with a large privately owned chain of hospitals to bring their physician assistants on the platform. This forced the team to develop a prize model for platform use and the professional services that would come with it. By December 2007 the project decided to freeze the current software platform to safe financial resources and focus on marketing only.

In January 2008, an article on web 2.0 portals was published in a widely read medical journal. Coliquio was one of the three named providers and rated as the most convenient and easy to use interface with a “critical incidents reporting feature” (CIRS) identified as being unique. Financially, the situation was more difficult. Despite high initial interest no further investors committed and contacts with potential customers did not turn into a sufficiently high rate of paid contracts. The team increased awareness measures and took part in the competition for the “eHealth Innovation Prize 2008” in Germany. Various public relation releases appeared and articles in daily newspapers with the Coliquio-“story”, which helped. But still, the target user number was missed with only 800 registered users at the end of the critical 4 month period.

The sea change came for Coliquio in February 2008 when they were awarded the eHealth Innovation Award 2008, which triggered broad press echo and in turn dramatically increased the number of registered users. This break-through doubled Coliquio registrations in only a few weeks and set the self-reinforcing network growth going. In April, the eHealth innovation prize was officially handed over. In July 2008 5,000 physicians were registered and 10,000 by the end of 2008 – 23 months after the first talks.

Based on this success-story of growth, the Living Lab supported the team in their search for potential investors and a major financial investment deal was closed in June 2008. This first significant financial investment made Coliquio a rather stable growing venture so that it was graduated from the Living Lab to move to commercial environments. And the team agreed to start paying a regular monthly salary for the founders from July 2008 on. In 2012 the number of users reached 64,000, outperforming the main competitor. By then the firm had grown to 35 employees.

5 Discussion

We have discussed the case from the perspective of the Living Lab which hosted Coliquio as one of many projects because our aim is to understand what capabilities and processes enable Living Labs to perform as innovation intermediary. If this project was based on persistent capabilities of the Living Lab, success could be replicated in further

projects and in the form of a valuable project portfolio generate competitive advantage for the Living Lab.

New product development has explicitly been named as dynamic capability through which firms - and Living Labs alike - can remain strategically successful in innovation competition but that more NPD research is needed to understand what these capabilities are (Eisenhardt & Martin, 2001). Coliquio shows success in a number of dimensions: they won a Swiss innovation prize as well as the German eHealth innovation prize, the solution was rapidly and widely adopted by users, its brand got positively known in the physicians' community and they developed core-technologies like the mailing robot and the CIRS feature that could not be imitated by competitors. In addition, a quick calculation of acquisition cost per registered customer for Coliquio, which is less than some 20% of competitor's per-user acquisition costs, shows that this transformed into economic success for the Coliquio project as well.

What contribution does the Living Lab make to the project, or in other words, what would not, or only to lesser extent happen without its support? And especially, what is done to involve users in the process? Is the Living Lab rather a test-lab where real users validate prototypes? Or, is a Living Lab an environment where users drive development? Do Living Labs strengthen the user-centric coordination of NPD processes, and if so, how do they do that?

The case describes two major milestones, or in NPD language they are stage gates that structure the overall process. The first one is the point of matchmaking between the core team and its additional partners from software and health-care industry. At this stage gate, necessary resources to engage in the project are committed, which is the result of scouting ideas and mobilizing initiators by the Living Lab. It is a review point where those initiatives are eliminated, which have no chance of succeeding because of scarcity of resources. The second stage gate is the team´s graduation from the Living Lab, which again has measurable review criteria, like an available product, initial customers, a supporting organization or start-up venture, and funding for market-introduction. Setting the stage gates and working with the project team towards passing them is a contribution of purposeful activities by the Living Lab. In the Coliquio case, for example, the Living Lab forced the initiator to find a partner before being allowed to join, they introduced them to business angels and network partners, and they initiated the preparations for the financing deal for graduation. Such Living Lab contribution, and in such short time frames of within a few months, are only possible if they are based on routine and experience that the Coliquio team cannot have had in their first project. Very much like NPD processes evolve from the experience of many developed product, this is a learned pattern of action that evolved over time from experience with many projects.

Two circles in the overview given in Figure 1 represent the two stage gates, which structure the Living Lab process into three basic phases. The remainder of the discussion section is structured to discuss the capabilities in more detail along the elements of Fig. 1.

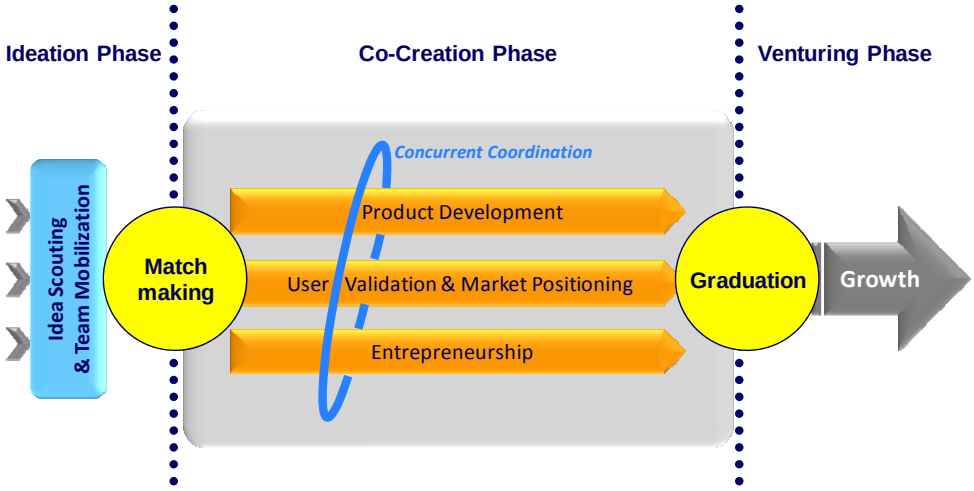

Figure 1: Capability Framework for Innovation Intermediaries

Ideation phase - Idea scouting and team mobilization

Users, physicians to be precise, with their need to exchange expertise between practices are at the very beginning of the case. But it is not the users themselves who launch the project, it is an unrelated external person, an inexperienced student even, who senses the need and sees an opportunity. At this stage the opportunity is vague and no product development activities have yet taken place, meaning that there is nothing that could be discussed or validated with users yet. Still, the Living Lab regularly invites such brainstorming and keeps the doors open for idea holders. The aim is to scout promising ideas and mobilize teams to develop them. Besides general readiness and openness as meeting point, the Living Lab enables this early project phase with concrete instruments like idea competitions, business plan competitions, patent research, or the use of online databases and expert panels to validate initially sensed ideas. With their domain knowledge; in this case of new ways of knowledge work, they provide judgment capabilities to shape promising projects. In doing this, the Living Lab engages in an earlier phase than what will be the focus of the NPD literature, namely with developing the assignment for development projects, finding the team and the necessary resources to undertake it.

What emerges from the case is a link between early stages of NPD and entrepreneurship, which is the theory of opportunity recognition (Singh, 2001). In entrepreneurship as well, user involvement is of central concern, but as an opportunity from a marketing point of view. Rather than having the user drive the development, the entrepreneur serves users in making his/her latent needs explicit and providing solutions for it. A second conceptual intersection point between NPD and entrepreneurship emerges from the team building efforts in the case. The student was motivated to search for a mate first, then for a larger team of partners that contribute technical competence and industry knowledge, clearly leading to the type of cross-functional team described in CE literature. Team building equally is an essential activity for entrepreneurs to build resources for their emerging venture (Aldrich & Kim, 2007). NPD literature reports cases on how such team building can be supported by intermediaries (Hargadon & Suttopn, 1997; Katzy & Crowston, 2008) but more research is needed to generalize knowledge on team characteristics that allow predicting project success, which has for example being found for the learning ability of the team (Strehle, Katzy, & Davila, 2010).

The phase concludes with a formal commitment to engage in a concrete idea, the point of matchmaking, which is a little understood process that as well merits more research (Howards, 2006). After the first stage gate, project activities rapidly increase. We bundle

their discussion in three parallel streams plus a discussion of how the Living Labs coordinates them.

Co-creation phase - Product development

Specifications were designed, prototypes built and validated with users. With a seasoned software development manager in charge, it comes as no surprise that this process followed CE best practices with little help needed from the Living Lab. But the case shows how the Living Lab interfered with coordinating the interaction between the software development team and the rest of the project. Most prominently, when they transferred the software development to direct leadership by the core-team for short-term services to the lead users of the initial prototypes in Fall 2007 and then suspended it in November 2007 to focus the project on market entry only. Current literature on Living Labs is underdeveloped with respect on how the interaction between user interaction and development teams is coordinated. As we have seen in the literature review, Agile / SCRUM methodologies are known to work in small teams, but more research is needed to understand how multiple teams can be coordinated in processes that require multiple teams to contribute. In the case of Coliquio, a legal team contributed the brand name, a financial team contributed due diligence for the finance round, a marketing team contributed sales contacts, and so forth. But they did not destroy the autonomy of the project team. But much remains to be understood, on how the autonomy of the team can be balanced with its integration into a supportive infrastructure.

Co-Creation phase - User validation and market positioning

In line with discussions about Living Labs, user involvement does play an important role in the case. The Living Lab contributed a significant number of experts in rather high-ranking positions like head or owner of a hospital, or scientific head of a health-care research institute to which the founders otherwise would not have had access. The Living Lab further coached the interaction between lead users and developers, and its methodological competence and domain knowledge from prior projects made the process run smoother.

A recurring theme in the Coliquio case is how intensive cooperation with a small number of highly engaged users is combined with the interaction with larger numbers of potential customers. For example, lead user engagement was combined with the collection of questionnaires during early conceptualization, intensive bug-fixing support of lead user in the validation phase was combined with the development of the mail-robot that can automatically serve large user numbers, and marketing campaigns during market entry were combined with intensive negotiations of larger b2b deals. In doing so, Coliquio did avoid a number of the identified pitfalls. They did not get trapped in the small team “sweet spots”, as they are called in software engineering, that remain meaningless to larger communities. And they combined the technical dimension of validating the usability of the product with the commercial dimension of validating commercial viability in markets. A number of routines within the Living Lab support thorough understanding and growth into a process that is referred to as scale-up process in entrepreneurship literature (Garud & Karnoe, 2003).

Co-Creation phase - Entrepreneurship

Next to the expected processes of product development and user validation the Coliquio case shows strong engagement with entrepreneurship. The visible result of this process is the establishment of a limited company in September 2007 and the financial deal with which the project graduated from the Living Lab to pursue further growth. In contrast

to many other projects, the creation of a new venture is not a side-event at the very end of a technical development project, but a fully concurrent priority that started at the very beginning, when the Living Lab asked the idea holder to find a partner to fund the development project. It is noteworthy that the team favoured the Living Lab over the traditional business incubator. How does this relate to new product development?

A start-up venture is the ultimate form of team autonomy to which cross-functional teams, as described by concurrent engineering, converge the more they get independent from their mother company and move into a network. If a NPD project is not assigned by some superior management, team leaders become increasingly entrepreneurial in seeking their opportunities that they believe in. It is somewhat surprising that similarities between engineering and entrepreneurship are so little researched as both are creation process that in cases like Coliquio are heavily interlinked. More research is needed to better understand this dimension of venturing capabilities and their integration in the NPD process, which could equally contribute to the entrepreneurship literature.

Co-Creation phase - Coordinating concurrency

There is general belief that the early bird gets the worm: that faster market entry means higher success. Concurrent engineering approaches shorten time to market and should therefore be beneficial. But Coliquio was slower than its competitor and therefore under heavy pressure at the end of their first year.

We believe that the case points to the fact that concurrent engineering in fact is as much about balancing multi-criteria optimization as it is about parallelization of activities. Coliquio was slower but more thorough in optimizing all dimensions of its solution so that their product did receive positive critiques on its usability and on its unique technology, in addition to reduced customer acquisition costs to less than 20% of the quicker competitor's costs.

Only simultaneous execution of the many activities allows for rapid improvement cycles for all of these dimensions, but requires maturity of coordination. The Coliquio case shows the strong role of the Living Lab, which emerges as the only partner in position to undertake this coordination. Frequent meetings of cross-functional teams, for example for user identification, motivation and interaction are reported. Regular board meetings have been organized and moderated, additionally access to lead users, investors, technology providers and marketing experts has been established by the Living Lab. It is the Living Lab that organized frequent and regular stakeholder meetings for the discussion of operational, tactical and strategic issues. This generated the general commitment of the stakeholders and ensured that activities were focused towards common goals. What emerges from this description is a dominant role for Living Labs as process coordinators in support ***of*** the teams rather than taking over user-centric activities ***for*** the teams.

Venturing phase - Growth

The phase after graduation of Coliquio from the Living Lab is not the focus of this case, but it is implicitly present because successful graduation from the Living Labs means successful entrance into this phase as a high-potential investment opportunity. Stage gates are review points in the NPD process, which define measurable targets at a predefined date that a project needs to meet to progress. The Knowledge Worker Living Lab of the case adopts this approach for its projects, like investment professionals do for the venturing phase to maintain the dynamics of the process and quality of the project portfolio.

6 Conclusion

Living Labs have enthusiastically been created in many regions following a recent European political initiative, however not all about them is new. It is the role of scientific reflection to establish the link between new interpretations with established knowledge and also to isolate new contributions to the knowledge base. The first contribution of the paper is a narrative of how the software product Coliquio was developed in the Knowledge Worker Living Lab. This four-year longitudinal case tells a story on how one Living Lab worked in one concrete project and provides exemplification for scholars in their conceptualization work and for Living Labs practitioners as a comparison to their own practice.

This paper frames Living Labs as organizations to undertake new product development processes, more particularly as a new approach to increase user-orientation. It is not new to NPD literature that user-orientation is positively correlated with successful adoption of the product. New, rather, are some of the ways to engage users, which is a search that Living Labs share with engineering methods like rapid prototyping and agile software engineering techniques, and opportunity recognition in entrepreneurship writing, just to name a few. Most writing on Living Labs is about ways to engage users. The discussion section goes into more detail on how the phenomena of such innovation intermediaries brings in contact hitherto distinct streams of theory like software engineering and product development, engineering and entrepreneurship, or engineering and project portfolio management, which provides stimulus for future theory development in multiple facets.

The story told in this paper is rich on insights on how to coordinate the entire NPD process around latent user needs. The nature of the Living Lab as innovation intermediary is to provide infrastructure for an open network of partners that jointly execute the innovation process. Without such Living Lab they would lack the support that corporate R&D departments enjoy inside a firm. In summary the case discussion concludes that open networks require coordination capabilities for successful NPD processes, which in turn requires stable organizational configurations. We do not expect that users on their own or market mechanisms for the trading of IPR and licenses will suffice the coordination needs that the many involved partners need for the creation of reasonably complex products and services.

The paper provides a framework, which contributes to academia a conceptualization of organizational capabilities for innovation intermediaries in networks. To practice this framework contributes a model that can be developed into a business excellence or benchmarking model for innovation intermediaries similar to those known from the quality management movement. The result of this inductive, single case study, of course need to be applied with the necessary caution until they have been validated to be generally applicable. This will require further empirical studies.

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