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Open Innovation Ecosystem - Makerspaces within an Agile Innovation Process

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Abstract: Successful innovation seeking and rapid realization of ideas comprises one of the main focus areas for large enterprises. On this account, an Open Innovation Ecosystem is a huge opportunity to break deadlocked and rigid processes and structures to follow up on new ideas and implement them more quickly and also flexibly. This makes Makerspace a promising measure within the innovation process. The OIE allows employees a facilitated networking and communicating across spatial, organizational and hierarchical borders. A first step to formalise the application of agile frameworks in the innovation process was made. The suggested integration of frameworks has to be examined in practice. Furthermore, the importance of prototyping and thereby Makerspaces has to be analysed.

Keywords: Open Innovation Ecosystem, Makerspace, Innovation Management, Agile.

1 Background

Nowadays technology has a very short life cycle due to rapid technological innovation. The challenge of innovation is about getting technology to market more quickly. As companies get bigger, they scale, wherefore things slow down, and they lose the ability to take risks. In addition a company usually operates in a culture driven towards efficiency rather than creativity.

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Until recently developing new products was about specifying the offering, assembling a team, and going into stealth mode for designing, building, and manufacturing. The business's long term sustainability is determined by its ability to address a constantly changing market and economic environment in today's rapidly changing environment.

Large enterprises are mostly successful in specialized market segments and with continuously improving features or reducing the cost of an existing product (incremental innovations). Novel and promising ideas are often rejected for reasons relating either to the content or the organizational context.

2 Motivation

It has been identified that a certain degree of flexibility for the processes is of great advantage. New linear models have been designed, comprising softer overlapping phase transitions. Latest models tend to be more flexible and involving agile frameworks. (Link, 2014).

According to Vetter (2011), there are two main perspectives regarding the innovation processes: object-specific and context-specific. A pure phase and context consideration is no longer appropriate. The approach shifts from purely linear and sequentially to iterative and collaborative.

An idea never emerges in isolation, and the rate of innovation is a function of the number of people connected and exchanging ideas (Bakker et al. 2006). Ecosystems are part of the so-called Open Innovation 2.0, a new paradigm based on principles of collaboration, co-created value, exponential technologies and a culture of exceptionally fast acceptance (Curley and Salmelin 2013).

An Open Innovation Ecosystem (OIE) comprises aspects of Open Innovation, Lean Innovation, and Innovation Labs (Böhmer and Lindemann 2015). Main aspect of an OIE is the creative and open-minded community. One exemplary OIE are the Singularity University labs, which is an open innovation campus where large enterprises, startups and innovators come to use high-tech to create new business solutions (Singularity 2014).

Makerspaces are community-focused high-tech workshops where innovative people meet, socialize, collaborate, and work on new ideas or do-it-yourself projects. New science and relevant technologies are explored and maker can exchange their experience within a network of creative people. The maker movement, also is known as the silent new industrial revolution.

For large corporations the difficulty with most ideas is that they are not sufficient in their initial. Building extremely quick and inexpensive prototypes accelerates the idea generation phase and increased the amount of ideas, being developed. Hardware prototypes have several areas of application and are the only tangible in the initial phase of an innovation process and thus provide a basis for discussion and reputations. Promoting ideas means also acquiring resources, gaining attention and facilitating understanding.

3 Methodology

This paper addresses the research question of how an OIE can unleash the innovation capability of large corporates. Therefore the use of an OIE referred to as Makerspace is analyzed, to address the innovation challenges and opportunities of today's businesses.

There are three subgoals: First, it is to find out how agile frameworks and the Makerspace are used within the innovation process for physical product development. Second, the role of prototyping within the innovation process will be examined. Third, the purpose for the use the Makerspace is analyzed.

A generic innovation process was derived from an intense literature review. For that to happen, several innovation process models of 11 relevant authors were analyzed.

The huge variety of models shows that there is no standard model for innovation processes. Therefore, models were compared to each other by identifying similar and identical phases. To obtain a generally applicable model, the extreme start and end phases where taken for the generic model. Details on the exact procedures within the phases were dismissed. Through this low level of detail a high conformity with real innovation processes is achieved (Verworn and Herstatt 2000).

A clear definition of "agility" was acquired from several fields of research. Analyzing various terms, like "agile methods", "agile process", "agile practices", an agile framework is specified including agile values and principles and methods.

Existing agile frameworks and its elements were identified and subsequent those elements were matched within the generic innovation process. The use of agile frameworks within physical product development and the use of an OIE was examined.

4 Findings

The phases of the proposed innovation process model are not strictly separated from each other, nor are they closed to the outside. That means customers, competitors, suppliers, researchers, inventors, users and further stakeholders can be included. Indicated by the circular design of the phases, the innovation process is not necessarily passed linearly, but can be passed iteratively. Taken all together, the proposed model does not include any prescriptions how the process is actually conducted, besides the tendency from left to right.

During the first phases, trends, market needs, and new technologies are screened and thus the innovation process is initiated. The recognition phase appears in innovation process models by Myers and Marquis (1969) and Corsten (1989). If initiated by the market, also known as market pull, the innovation is likely to be incremental (Rothwell 1994). In case of initiating the process by a technology push, a disruptive innovation is more likely (Disselkamp 2012).

During idea generation, ideas are gathered in order to generate a pool of ideas. An idea generation phase is included in the innovation process models by Myers and Marquis (1969), Cooper (1983), Corsten (1989), Rothwell (1994), Herstatt and Verworn (2001), Verloop (2004) and Hansen and Birkinshaw (2007). Afterwards, one or more ideas are selected based on agreed criteria. These criteria can comprise risk and attractiveness (Herstatt and Verworn 2001) and also firm-specific guidelines and capabilities (Cooper 1983). Szinovatz and Müller (2014) suggest the selection of several ideas which compete in the following process.

The phase “Concept Development” is mentioned in innovation process models by Myers and Marquis (1969), Cooper (1983), Corsten (1989) and Herstatt and Verworn (2001). It contains a draft of the product including marketing and technical concepts in form of prototypes. Following this, the concepts are tested in their respective field. Prototypes serve to test functionality and effects on users and thus also allow an insight into market acceptance (Cooper 1983, Corsten 1989).

From these results the product is fully developed. The development phase is included in the innovation process models by Myers and Marquis (1969), Cooper (1983), Corsten (1989), Rothwell (1994), Herstatt and Verworn (2001), Verloop (2004), Hansen and Birkinshaw (2007), Brockhoff (1989) and Szinovatz and Müller (2014). Prototypes for test markets are built and production processes for later large-scale production are tested (Cooper 1983, Corsten 1989, Herstatt and Verworn 2001).

Once, testing is finished and a fully functional and look-alike prototype is available production is started and followed by the launch. Launch is considered by Myers and Marquis (1969), Cooper (1983), Corsten (1989), Rothwell (1994), Herstatt and Verworn (2001), Verloop (2004), Hansen and Birkinshaw (2007) and Brockhoff (1989).

Controls can be embedded which have the purpose to examine KPIs after introduction to market delivering input for screening in case of a market pull. The control phase was adopted from Cooper (1983).

The terms “agile” and “agility” are often associated with agile software development. However, Kettunen (2009) reveals that the term agility has been used in various business competence areas comprising different disciplines addressing different point of views and different levels. The following definition for agility was derived from an analysis of definitions from several fields of research by Sharifi and Zhang (1999), Yusuf et al. (1999), Christopher (2000), Highsmith (2002), Cockburn (2002), Boehm and Turner (2004) and Qumer and Henderson-Sellers (2006).

Agility is the capability to react, and adopt to expected and unexpected changes within a dynamic environment constantly and quickly; and to use those changes (if possible) as an advantage.

A framework compromises the space in which a project team can act freely and continuously improve itself (Brandes et al. 2014). An agile framework comprises agile values and principles as well as methods, which are commonly coupled through a process. Agile frameworks are used within several steps of the innovation process.

The values and principles of frameworks can vary depending on their origin. Agile frameworks with origin in software development agree with, but are not limited to the values and principles of the Agile Manifesto of Software Development. However, this study considers all frameworks as agile if they facilitate agility following the definition above. Despite differing origins, the values of frameworks which are not explicitly related to the Agile Manifesto or whose authors do not claim their framework to be agile correlate with the values and principles of the Agile Manifesto.
Morris et al. (2014) replace the word "software" in the Agile Manifesto with "innovation" and thus transfer the agile approach to the development of innovations.

Existing agile frameworks were identified and their elements analysed to find possible applications within the innovation process. Based on their methods they were integrated into the suggested generic innovation process (see Figure 1). To combine agile frameworks a defined stage gate process could be used (Link 2014).

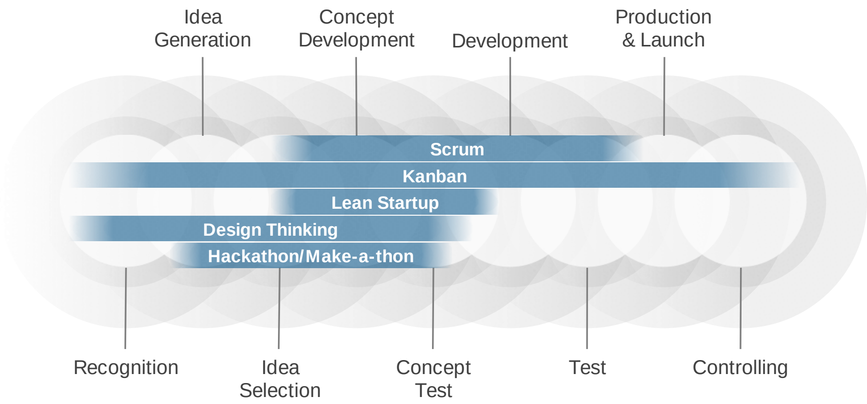

Figure 1 Agile Frameworks within the generic innovation process model

Scrum

Scrum is described as an iterative and incremental framework for projects and product or application development (Sutherland and Schwaber 2012). Today, it is claimed the leading agile development framework (ScrumAlliance 2014).

Practicing Scrum, input from end-users, customers, the team itself and other stakeholders is received by the Product Owner and written down as features in the Product Backlog (Sutherland and Schwaber 2012). For the innovation process this means that Scrum does not cover the first two phases. However, the prioritisation of ideas by the Product Owner (Sutherland and Schwaber 2012) can be seen as the idea selection phase in the generic innovation process.

The following structured process for development starting with Sprint Planning for each Sprint, Daily Scrums – brief daily team meetings during which the progress is analysed and the remaining hours of work are recorded –, Sprint Review and Sprint Retrospectives (Sutherland and Schwaber 2012) corresponds to iteratively passing the phases Concept Development to Test. Iterations between Concept Development and Concept Test before heading to iterations between Development and Test are also conceivable. The Sprint Review following each sprint is used for an exchange of information between *Product Owner* and Development Team about the product, market, and both parties themselves (Sutherland and Schwaber 2012). The *Product Owner* can adapt the product by updating the *Product Backlog* with new insights.

Kanban

The term "Kanban" is known from its application in logistics, where it is used to mark a specific status of stock only when new material is needed, preventing an accumulation of unnecessary stock. In 2007, D. J. Anderson presented Kanban for software development publicly (Epping 2011).

Kanban is here considered as an agile framework as suggested by Highsmith (2009). There are no predefined processes or roles in Kanban, but it optimizes the current processes by mapping them, limiting work in progress and eliminating waste (Anderson

2010). Kanban is no alternative for existing processes or other frameworks but rather a supplement which can be applied in every phase of the innovation process given that a process exits. The more the existing process is defined, the simpler it is to identify the task categories and activities for the use of Kanban.

Kanban evolves iterations with no fixed length, but uncouples prioritisation, development and implementation, and so all activities can follow their respective rhythms.

Lean Startup

Lean Startup is a new way of developing innovative products, emphasising short iterations, understanding the customer and pursuing great visions and aims (Ries 2011). The term Startup does not only refer to small and young companies but also includes large corporations, to be exact every “human institution designed to create a new product or service under conditions of extreme uncertainty“ (Ries 2011).

Lean Startup follows the Build, Measure, Learn cycle which comprises the following actions according to Ries (2011): First, hypotheses are defined. Value hypotheses make assumptions about a product’s value to the customer, growth hypotheses about the way customers become introduced to the product. Next, a minimum viable product (MVP) is built as fast and as resource-efficient as possible only including features which are needed to test the hypotheses. The next step is to measure the MVP’s success and draw the right conclusions from the results. Based on the collected data a decision regarding the product has to be made. If the hypotheses were validated the product strategy is maintained, if not the strategy is pivoted. The length of the Build, Measure, Learn cycle has to be minimized in order to achieve a high adaptability.

Lean Startup does not provide any methods for ideation. Ries (2011) and Blank (2014) argue that this is because they never had a lack of ideas. Therefore, Lean Startup starts with idea selection and concentrates on intense Concept Development and Concept Test by iteratively running through the *Build-Measure-Learn* cycle in order to avoid wasting time developing a product nobody is willing to pay for.

Design Thinking

Design Thinking has gained attention during the recent years through IDEO, a well known Design and Innovation consulting firm and the establishment of so-called d.schools in Stanford and at Hasso Plattner Institute in Potsdam which deal with a broad understanding of design (Vetterli et al. 2011).

Design Thinking contains a process which comprises the phases understand, observe, define point of view, ideate, prototype and test, which are usually not passed linearly (Plattner et al. 2009). During understand the problem is defined, observe focuses on analysing the identified target group by confronting people with the problem and observing their interaction within their environment (Plattner et al. 2009). In the generic innovation process these can be integrated into the Screening phase.

During ideate, ideas are generated, e.g. with methods like brainstorming, structured and the most promising ones according to attractiveness, feasibility and profitability picked for further development (Grots and Pratschke 2009). This phase corresponds with the Idea Generation phase in the generic innovation process.

The prototype phase serves to build prototypes quickly in order to receive feedback as fast as possible and gain new ideas from the prototypes (Grots and Pratschke 2009), matching the Concept Development phase of the innovation process.

During *test*, feedback from users including their reactions to and interactions with the prototype gives design thinkers a hint which course further development should adopt (Plattner et al. 2009). Test matches the Concept Test phase in the innovation process.

If the tests are successful the process of Design Thinking is finished and social, technical, and economical feasibility are considered, if not, the results of the tests enter the phase define point of view as feedback in which the process restarts (Plattner et al. 2009).

Hackathon/Make-a-thon

According to Raatikainen et al. (2013) „a Hackathon is an event where people in small groups participate in an intensive prototyping activity for a limited amount of time.“

The term Make-a-thon was used by Design and Innovation consulting firm IDEO describing an event similar to a Hackathon but differing in terms of participants and products (Zhang 2012).

Briscoe and Mulligan (2014) do not exclude hardware development from Hackathons so Hackathons and Make-a-thons are used synonymously in the following. Hackathons are a fast way to explore ideas with high technical and market uncertainties and decide whether an idea is worth following (Komssi et al. 2014).

Komssi et al. (2014) propose a process for Hackathons, starting with the creation of ideas and team building. Ideas can be also gathered before the actual event so more time for concept development is available during the Hackathon itself (Komssi et al. 2014). Teams are built by letting participants choose which idea they want to follow based on personal interests and skills (Briscoe and Mulligan 2014, Komssi et al. 2014). This can be considered as the Idea Generation and Idea Selection phases in the innovation process where idea generation does not have to be included at the Hackathon event itself and idea selection is based on the participants' interests and skills.

This is followed by the prototype development phase which can take several hours to a few days (Briscoe and Mulligan 2014). This corresponds to the Concept Development phase in the generic innovation process.

After the set time prototypes are presented to an audience to show the functions which demonstrate the product's concept and its value (Komssi et al. 2014). Testing the technical feasibility is achieved through testing the prototype's functionality, for obtaining information about the market acceptance the audience's reaction to the presentation can be seen as a first acceptance check, longer Hackathons might include real costumer involvement. After the Hackathon it is decided whether the idea is followed up or abandoned (Komssi et al. 2014).

Others

Beside the frameworks mentioned above, there are still more agile frameworks; for example Extreme Programming, Feature Driven Development, Crystal Family and Dynamic Systems Development method. Since those frameworks have a strong orientation on software development they are not included here.

Iterative prototyping is used as a method within agile frameworks for implementation of iterative approaches.Cantone and Marchesi (2014) adjusted the principles of the Agile Manifesto from software development to the development of products that include physical components. Examples for the application of agile frameworks in physical product development are the development of a sports car for the X-Prize competition using Scrum and Kanban (Denning 2012), Johnson Controls applies Scrum for development of car seats (Schröder 2014). Design Thinking is widely used across industries (Plattner et al. 2009), an example for the application in physical product development is the development of a new category of bicycles for adults at IDEO in cooperation with Shimano (Brown 2008).

While iterative prototyping is relatively simple to adopt in software development, producing physical prototypes is more difficult as it requires significant resources. However, the possibilities to create physical prototypes have improved through rapid prototyping and development of affordable 3D-printers (Vetter 2011). At the same time, the number of Makerspaces has increased offering nearly everyone the opportunity to work with professional machines and tools. DiResta et al. (2015) recommend using Makerspaces for prototyping because paying a small monthly fee is more favourable than purchasing the machines. Hatch (2013) calls this development the democratisation of hardware innovation.

The use of Makerspaces makes it easy to iteratively prototype within the innovation process of physical products. Based on a classification by Hallgrimsson (2012) the prototypes objectives were segmented into four main categories: explorative, communication, usability and design, and verification. Explorative prototyping aims at making ideas come alive, act as a proof of concept for ideas and give unexpected insights about an idea. The purpose of prototyping for communication is demonstrating the product to customers, investors, or using it as a model for product photos; for this appearance is given priority. Usability and design prototyping focuses on receiving feedback from users through analysing interactions with the prototype. Verification prototyping aims at verifying product specifications such as the functionality and ability to manufacture and assemble the product.

Therefore, prototyping can be used in nearly all phases of the innovation process, which makes it a determining element for the application of agile frameworks for the development of physical products. Iterative prototyping can be seen as core element of agile frameworks, and is supported by a Makerspace.

A Makerspace is here characterised as a publicly accessible workshop which provides members with machines and tools and offers access to a creative community. This community can be divided into generalists and specialists regarding the members' knowledge. Generalists have a broad knowledge covering several disciplines, specialists have gained in-depth expertise in a single discipline. The community of a Makerspace can support several methods within agile frameworks. Members could attend brainstorming sessions, give interviews or can be included in user tests.

Successful innovation seeking and rapid realization of ideas comprises one of the main focus areas for large enterprises. On this account, an OIE is a huge opportunity for large enterprises to break deadlocked and rigid processes and structures to follow up on new ideas and implement them more quickly and also flexibly. This makes Makerspace a promising measure within the innovation process. The OIE allows employees a facilitated networking and communicating across spatial, organizational and hierarchical borders.

5 Discussion

Understanding the potential and the use of an OIE will allow startups, as well as corporations to exchange knowledge and collaborate creatively. Small entrepreneurial teams of large organizations and field impact partners are enabled to drive innovation by moving quickly from ideas to prototypes.

A first step to formalise the application of agile frameworks in the innovation process was made. The suggested integration of frameworks has to be examined in practice. Furthermore, the importance of prototyping and thereby Makerspaces has to be analysed. It is also suggested that the Makerspace supports other methods besides prototyping. For that to happen interviews with members of UnternehmerTUM's MakerSpace at Technical University of Munich will be conducted. This includes the identification of methods used within the innovation process, the motivation for using a Makerspace and the methods applied there, the role of prototyping within the innovation process, the influence of the community in the Makerspace and limitations of the Makerspace. Furthermore, the interviewees' background regarding company size and the product in development should be considered. This step will reveal the relevance of prototyping and Makerspaces within the innovation process.

Collaboration among members of the Makerspace's community from different companies arises issues regarding IP rights. This aspect has to be taken into account in further research.

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