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# Creative Spaces in a Digital Context – A Critical Evaluation

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## Abstract

Recession and global fall in oil prices have forced the industry on the west coast of Norway to restructure and find new business opportunities through the use of creative spaces in a digital context. This paper aims to investigate and perform a critical evaluation of the overall usefulness of a facilitated creative space in a Norwegian setting. The creative space is "closed", meaning it is open by invitation only. In this creative space, industrial companies are exposed to a design thinking internet of things (IOT) experience, with the aim to come up with new offerings; products, processes or services. The creative space has been developed based on best practice makerspace studies in Europe.

The current paper reports the results from interviews conducted with 7 different companies in 2017, who all have used this creative space, one or several times. The findings indicate different perceptions of the usefulness of the workshop sessions and the facilitator. Several companies found it difficult to permanently change their current way of working, into the design thinking inspired method taught at the creative space. This may be because only small groups of employees were introduced to the new method. Moreover, lasting individual and organizational learning was not much focused. Overall, the companies were found to be more interested in finding a solution to their current problem, rather than creating lasting change and learning in their organizations.

Experiences related to the use of a facilitator, was found to vary, dependent on the companies' expectations to the workshop sessions and facilitators' background and experience. Overall, the study indicates that the creative space was most useful with regards to giving the companies better customers and user insight, access to an increased innovation network, and being an inspiring environment away from "home".

***Keywords: Creative Spaces, IoT, Prototyping, Open Innovation***

# 1 Introduction

The industrial part of Norway working towards the maritime and the oil- and gas sector, has been hit hard by an economic recession due to the global fall in oil prices. Consequently, this industry has undergone major restructuring processes during the last years. They are for instance looking for new business opportunities, by unlocking the potential under the Internet of Things (IoT) umbrella. One particular industrial cluster on the west coast have defined this as the industrial internet. To facilitate the necessary transition and shift of mindset, this cluster has developed a "closed" creative space for its' companies in this area. In this community, the companies can come with a predefined problem definition and be guided through a process to learn the mindset and business opportunities inherit to IoT business models.

This creative space is inspired by the successes of the American IDEO concept and similar initiatives with customized creative spaces for innovation, product and process development in different industrial contexts. The concept is based on makerspace mindset combined with business process modelling and "Design Thinking", which they define as "*a practical, human-centered, prototype-driven methodology for innovation that tackles organizational challenges in creative ways*". In literature “Design Thinking” is acknowledged as a stimulating new paradigm for dealing with problems in many professions, particularly with regards to information technology (IT) and businesses (Brooks Jr, 2010; Martin, 2009). In addition to the soft prototyping tools and tools shop equipment, the creative space makes offerings toward internet of things (IoT) enabled design, open source CAD software, and other digital technologies like virtual reality (VR) and augmented reality (AR). This specific creative space set up in this region is a closed community. Hence, prototype designs and solutions are not shared online, or even within the industrial cluster.

Currently, there are few studies reported in academic literature similar to this case, in which a creative space offers services to the industry, not only in the business to customer segment (B2C), but also in the business to business segment (B2B). Most makerspaces are targeted entrepreneurs *"individual or groups of people building projects for future business"* or makers *"Thinkers who like to make their one things and hack exciting things for non-profitable purpose"* (Jensen, Semb, Vindal, & Steinert, 2016). Hence, the current paper aims to perform a critical evaluation of usefulness of this first commercial creative space for IoT prototyping in Norway. The paper will report the results from interviews conducted with 7 different companies within digital services and manufacturing industry, who all have used this creative space. With this background, the scope of this study has been to better understand: What are the perceived gains from participating in a facilitated IoT inspired prototyping sessions in the creative spaces?

## 1.1 Description of the Developed Creative Space

In makerspaces communities, no specific method is usually used to guide the community users in their prototyping work, and the dominant business models are monthly membership fees, courses and machine rent (Jensen et al., 2016). In the creative space studied in this paper, you enter by pre-registration only. Hence, it is possible to create and use a method to guide the participants through a learning journey of prototyping. Digitalization, business development and sustainability is the core of the process, all based on design thinking and greatly influenced by IDEO and d.school at Stanford University. The main steps in the adapted method used are: to emphasize with the customer or user, defining the need or the problem, ideation with focus om business development, IoT prototyping, and finally testing the prototype on the customer or user as shown in Figure 1. The method is iterative. To ensure that customers' expectations to

new products, processes or services are met, relevant stakeholders like suppliers, customers, or other relevant external source of knowledge are invited to participate in the workshop.

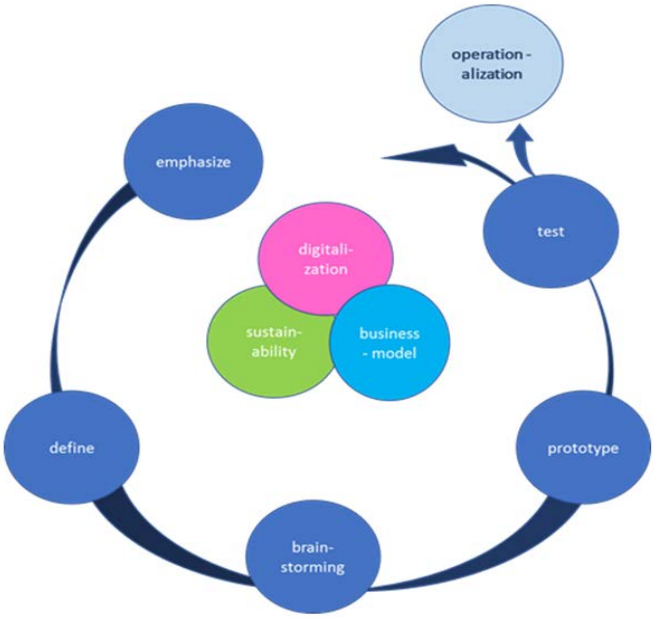


**Figure 1. IoT inspired prototyping method**

The creative space has been developed based on best practices for makerspaces (Jensen et al., 2016), and consists of a large open space with work shop tables, basic work shop tooling, craft tools, tools for soft prototyping (card board, tape etc.), tools for more advanced prototyping as hard wood, metal and laser cutter machine. To further focus on digitalization, there is an area for soldering electronics and mechatronic equipment, in addition to a 3D printer. The space is further equipped with sensor kits connectable to smart phones, tablets or computers, to enable users to build sensors into their prototypes.

# 2 Theoretical Background

## 2.1 Open Innovation and User Involvement

Organizations increasingly find themselves unable to have all relevant competences in-house. Hence, they are forced to open up their innovation processes and engage in open innovation (Enkel, Gassmann, & Chesbrough, 2009). Open innovation may be defined as "*..the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation respectively*" (Chesbrough, 2006). It is further possible to differentiate three core processes in open innovation (Enkel et al., 2009); 1) inbound open innovation, 2) outbound open innovation and 3) co-creation. Inbound open innovation, which is focused in the current paper, is an outside-in process in which a company's knowledgebase is enriched through the integration of suppliers, customers, and relevant external source of knowledge with the purpose of increasing innovativeness (Enkel et al., 2009).

Other researchers have argued for the importance collaboration with peers as a means to increase innovativeness (Ollila & Elmquist, 2011), or increasing innovativeness through the design discourse surrounding a company with product designers, education and research, suppliers, artists, events, showrooms, users etc. (Verganti, 2008). Literature suggest that

especially SMEs may profit from accessing network partner's external resources to fill in and close their internal technology gap, by accessing and utilizing technology developed elsewhere (Grønlund, Rønnberg-Sjødin, & Frishammer, 2010). Carlsen et al. recommends to involve external (end-) and internal users at an early stage through for instance organizing for multi-client development projects, prototyping analysis with clients, and by creating low-threshold channels for eliciting user feedback (Carlsen, Clegg, & Gjersvik, 2012).

## 2.2 Learning and Facilitation

Organizational learning is one of the benefits of being part of a facilitated creative space. According to organizational theory, involving those being affected by a change is important for the learning process. This should be done in the early phases to prepare the grounds for understanding the problem (Kleven & Levin, 2009). Furthermore, appropriate learning arenas should be established to provide communication, reflection and joint learning, which can be meetings or group-based activities.

In such learning arenas, an internal or external facilitator is often viewed as useful. The term facilitator refers to a person who is skilled to assist participant learning through problem-based learning (PBL). The role of the facilitator consists of guiding the group through the various stages of PBL. The facilitator should monitor the group process to make sure the involvement of all group members (Koschmann, Myers, Feltovich, & Barrows, 1994). One important role of the facilitator is to direct suitable questions to the participants, to act as a metacognitive instructor that guides the progress of higher order thinking skills by inspiring the participants to justify their thinking and to externalize self-reflection. Another view of the facilitor's role is to assist the participants in understanding what questions that should be asked to define the problem, to identify the facts, and to have an autonomous learning and problem solution (Gallagher, Sher, Stepien, & Workman, 1995). The role of the facilitator may also be viewed as one who organize for effective learning. According to Kolb (Kolb, 1984), such learning is seen when a person progresses through a four stage learning cycle: (1) having a concrete experience (2) reflective observation (3) abstract conceptualization, and (4) active experimentation. However, effective learning may only take place when a learner is able to execute all four stages of the model. Therefore, the learning arenas and facilitation should focus on completing the leaning cycle.

## 2.3 The Creative Space and Prototyping

Many companies find it increasingly challenging to develop successful new products, process or technologies. Particularly the fuzzy front end is of importance as it determines a company's potential to find promising new product ideas and ways of producing this product at a reasonable cost (Soukhoroukova, Spann, & Skiera, 2012).

To experience successful innovation processes, it is important that both the organization and the physical space is aligned to support communication, which again supports and spurs innovation (Allen & Henn, 2007). "*Make Space*" is a collection of best practice experienced from IDEO and d.school on how to set the stage for creative collaboration including prototyping (Doorly & Witthoft, 2012). Another contribution to this field is based on research in a Norwegian setting "*Idea Work*". This book highlights the importance of space and work space in the context of idea work and innovation, as well as for prototyping (Carlsen et al., 2012).

A study performed among manufacturing companies in Norway, reports that special areas to develop, build, play with prototypes, and test new concepts, are common. These areas are fitted

in a workshop manner and are highly focused on function rather decor elements like fancy colors, furniture or appearances. Signs of wear and tear are common, they are not your typical "show off" room; rather the users have taken ownership in the area (S. Aschehoug, Schulte, & Ringen, 2014).

# 3 Research Design

## 3.1 The companies

The present paper reports the results from a case study performed autumn 2017. Criteria used to choose a relevant sample related to the research questions were; if the phenomenon to be studied may appear, and if it is feasible and ethical (Yin, 2009). The companies selected have all participated in the facilitated workshop, one or several times. They have in-house development departments and manufacture their products in Norway, or deliver services to the Norwegian market.

All companies were sampled from the west coast of Norway, in which the creative space is physically located. This area is typically concerned with traditional ship-yard, marine and offshore supplier companies, often family owned. The industry was booming until 2015, when falling oil prices hit this part of the industry hard. In two years, nearly 30.000 jobs were lost in this sector (Mohsin & Holter, 2016), forcing companies in this sector to find new and innovative ways of earning money and smarter ways of doing the work with less resources. With this crisis in mind, the companies participating in the workshops were motivated when coming to the creative space. Table 1 summarizes key company characteristics.

**Table 1. Company characteristics**

| Company | Specialization | Employees | Turnover KNOK | No. interviews |
|---|---|---|---|---|
| Comp A | Engineering and service company | 40 | 84 000 | 1 |
| Comp B | High, marine propellers | 31 | 41 000 | 1 |
| Comp C | Development of software solutions | 6 | 5 400 | 1 |
| Comp D | Development of offshore solutions | 129 | 258 000 | 1 |
| Comp E | Development of cranes, lifting and handling equipment for offshore | 2 | 3 800 | 1 |
| Comp F | System supplier for offshore | 297 | 675 000 | 2 |
| Comp G | Equipment and systems supply for aluminium industry | 53 | 302 000 | 1 (Skype) |

## 3.2 Data collection, analysis, validity and limitations

A research protocol describing data collection methods was developed and reviewed with research colleagues before conducting the interviews. Semi-structured interviews were conducted at the companies' facilities between October-November 2017, based on a pre-developed questionnaire with 30-40 questions. The interviews lasted for 1-2 hours.

The collected data was coded into the categories motivation and involvement, customer focus, creative space premises, facilitator's role, method used and outcome, and analyzed in a matrix display to find patterns, themes, similarities and differences between the companies.

The presented results should be regarded as indicative as the case study reflect personal opinions of the interviewees. In addition, depth in each company was sacrificed over breadth to cover more companies. Triangulation was achieved through observations when visiting the creative space, in addition to reviewing relevant documents. As the purpose of this research was to perform a critical evaluation of the gains of such workshops and to learn more about the facilitators' role and the importance of the creative space itself, the presented results may be used as a basis for more in-depth research in each company to gain better validity.

# 4 Results and Discussion

Table 2 summarizes the main outcome per category and activity based on the interviews. The companies vary in their response, although they show consensus in some areas.

**Table 2. Results from interviews**

| Main Category | Description | Yes |
|---|---|---|
| The creative space and prototyping | Useful and inspiring physical workplace | 6 (8) |
| | Useful to get away from "home" | 6 (8) |
| | Increased insight into design thinking method | 8 (8) |
| | Rapid prototyping (with or without IoT) perceived as useful | 3 (8) |
| | Workshop method adequately adapted to specific cases at hand | 4 (8) |
| | Continued use of workshop method (or parts) in own organization after workshop | 5 (8) |
| Inbound open innovation | Increased customer insight and cooperation | 8 (8) |
| | Increased user and supplier insight | 5 (8) |
| | Increased innovation network (external partners) with IoT, VR and AR competence | 4 (8) |
| Learning and facilitation | Prepping and involvement of organization before workshop | 7 (8) |
| | Successful involvement of organization after workshop | 3 (8) |
| | Problem solving focused by company | 6 (8) |
| | Organizational learning focused by company | 2 (8) |
| | Facilitator perceived as useful | 4 (8) |
| | Management commitment present | 5 (8) |
| | Innovation part of company strategy | 8 (8) |
| Other | Workshop results have led to successful innovations | 0 (8) |
| | Workshop results have made contributions to innovation projects | 4 (8) |
| | Multiple user of facilitated creative space | 7 (8) |
| | Cost issues (workshop perceived as too expensive) | 2 (8) |

## 4.1 The Creative Space and IoT Prototyping

The creative space itself is reported to be inspiring due to its differentness and to invite to active participation. The large ceiling height is perceived to give room for innovation and "large, new" thoughts. Others' focus more on the functionality of the creative space (tables, tools etc.) as being inspiring as shown in figure 2. Most of all, the companies high-lights the importance of being able to get away from work as the most useful thing about the creative space, it being physically located elsewhere.

The creative workshops have succeeded in increasing the companies' general competence and understanding of the design thinking method. As one of the interviewees reported: *"we need to get comfortable in being outside our comfort zone"*. Especially the idea generating phase was reported as a take away, and something the companies later have implemented in their own organizations.

**Figure 2: The creative space**

When going more into the details, the results were more nuanced. Some were positive to rapid prototyping method and thought it was both useful and feasible due to the many tools and equipment available in the creative space. Companies reported to have continued to use prototyping in their organizations afterwards, or to have showcased solutions in their subsequent customer dialogue. Others reported not to have succeeded with their prototyping at all.

The creative workshop is set up in an IoT digital context. This includes soldering electronics and mechatronics, but also QR tags and blue tooth sensor tags for real time temperature and humidity tracking connectable to smartphones and pc's. These tags may be used to simulate IoT possibilities in prototyping as shown in figure 3. In addition to these possibilities, companies' expectations to IoT prototyping were reported to be 3D modelling (digital twin) and 3D printing. There are however practical limitations in digitalizing the rapid prototyping method due to time constraints. A real 3D model on prototype level requires minimum 1-5 days of computer work, whereas a VR model requires even more time to build. Unrealistic expectations regarding what is possible to achieve in ½-1 day may explain this result. In-house tools for simple 3D scanning may improve the user experience and better match companies' expectations to prototyping in a digital context.

**Figure 3: QR code, sensor tags and mechatronics**

## 4.2 Inbound Open Innovation

An adapted design thinking approach is currently being used in the creative space, in which understanding and emphasizing with the customer and user is central in the method. The companies reported to have increased their internal understanding of customer insight through

the process. Shifting focus from internal issues towards defining the customers' needs was perceived as a gain by all companies. Some of the companies further reported to have invited customers or other relevant partners to the workshops to gain more understanding in line with recommendations in literature (Grønlund et al., 2010; Verganti, 2009). The successfulness of this was mixed, as the customers at times were either not prepared, or not motivated for active participation and sharing of knowledge. Some customers were not present at the work shop due to too short notice in advance.

The current research indicates that the main take-away from the workshops was the network effect. Building networks with customers, suppliers and other actors with specialized technology competencies was reported to be important. The workshops have focused on bringing IoT-, Virtual Reality (VR)- and Augmented Reality (AR) technology brokers to meet in with traditional manufacturing companies in a creative setting. Although no specific new innovations had been developed at the time of the study, the long-term effect of thinking in new ways and having new technology partners in your network may still be beneficial.

### 4.3 Learning and facilitation

The creative space itself may be viewed as a learning arena for individual and organizational learning. However, based on the interviews, only one company reported holistic organizational learning being important as recommended in literature (Kleven & Levin, 2009). In general, the process of participating in a workshop appears to be driven by a need to fix a problem, or to come up with a clever solution to a pre-defined problem. Building individual or organizational learning is not much focused by the participating companies, which makes successful involvement of more people in their home organization difficult. This may explain why the usefulness of the facilitated workshops is perceived low.

The results indicate that the companies seem to lack understanding of the long-term work process involved in a successful innovation. Based on the interviews, clarification of expectations towards the workshop in advance seem to be insufficient. Although prepping of the organization is reported to take place, companies' expectations are not aligned with the work shop method. According to literature, innovation starts with a fuzzy front-end phase, before the more structured new product development process, followed by commercialization (Reinertsen & Smith, 1991). The workshops only cover the initial fuzzy front-end phase. Indeed, two companies reported that the workshop was particularly useful in the early phases, as a guide to choose the "right" path to follow. Moreover, the interviews indicated that the more concrete problem definition in advance, the more useful workshop is perceived. This result is in line with earlier studies in open innovation which indicate that specific designed innovation challenges or described problems produces the highest quality ideas, based on the quality criteria novelty, usefulness, and feasibility compared to completely open innovation sessions (S. H. Aschehoug & Ringen, 2013).

This perception of the workshop being a "highway" to innovation may also influence the companies' understanding and the overall the low rating of the facilitators role. Statements like "*there is no added value of having the faciliatory there*" underpins this view. Such statements may also indicate that individual learning is currently insufficient, and that Kolb's learning cycle in incomplete in the workshop (Kolb, 1984). According to Kolb, effective learning may only take place when a learner executes all four stages of the model.

Some of the interviewees have been exposed to the same workshop method many times, consequently the exciting newness diminishes over time. Interestingly, two of the companies reports that the creative space functions well because of the facilitator being there and adding credibility and legitimacy to the process and de-mystifying the process.

For many of the companies, the workshop was their first experience with a design thinking related methodology. Hence, all companies reported that the session had given them increased insight into design thinking. Nevertheless, some felt that there had been too much focus on the method itself, instead of adapting the method to the specific problem statements at hand. This criticism may be connected to the facilitors' role in the sessions. One of the facilitators was at the time, fresh out of school, with theoretical knowledge at hand, but without industrial experience. The other facilitator had substantial industrial experience but was without formal training in design thinking. The sessions reported to be most successful were the ones with the industrial experienced facilitator. Hence, this study indicates that the facilitator indeed is important, but finding the perfect balance between experience and academic training may be difficult. However, having industrial experience may make it easier to adapt the design thinking method to the challenge at hand.

## 5 Conclusion

The makerspace communities have received great interest lately and are believed to improve innovativeness among its participants. This paper investigates and performs a critical evaluation of the overall usefulness of a "closed" IoT inspired creative space for industrial companies in a Norwegian setting.

Overall, the companies had different perceptions to the usefulness of the workshop sessions. Some thought it great, but leaving the workshop, it was easy to fall back on old and established ways of doing things, as only small groups from the companies had been introduced to the new method. Organizational learning was focused by one company only, the others being more engaged in fixing a product or process problem. The usefulness of a facilitator to guide the companies through a design thinking journey was also mixed, and most likely influenced by the companies' expectations and dependent on the facilitators' industrial experience.

New and better understanding of customers and users, together with increased innovation network were reported to be the most useful results from the workshops. Together with an inspiring environment away from "home", these findings justify continued use of creative spaces. However, based on the current findings, there are no grounds to conclude that such spaces are a quick fix to the next big innovation, nor the "holy grail" to increased innovativeness. Used wisely, design thinking workshops in a creative space may be the seed to other innovations though increased customer and market insight combined with organizational learning. To strengthen the results from the current study, in depth interviews of more participants is recommended for future work.

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