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JAMMING TO DIRECT TECHNOLOGY DEVELOPMENT: AN ANALYSIS OF TWO TECHNOLOGY JAMS

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ABSTRACT

When technology is taken as the starting point for the development of new products and services, there is a risk for so-called technology-push innovations. Instead, the technology-driven perspective could be complemented with a design driven perspective (Verganti, 2009), in order to help create a better balance in desirability, feasibility and viability (Brown 2009). However, design driven innovation processes usually are time-intensive. With the development of Technology Jams we aim to speed up the design driven process, while preserving its other characteristics. These Technology Jams are inspired on musical jams and design jams, where people from different backgrounds explore ideas together in a hands-on way. However, technology Jams take a specific technology and a target context as a starting point for ideation of new products and services. Rapid prototypes are used to give shape to these ideas in order to explore and improve them. In this paper we introduce the concept of Technology Jams. Furthermore, we describe two Technology Jams that we have organised. We discuss how their respective theme, setup and provided working material affected the process and outcome of the Technology Jams. We conclude by pointing out directions for possible future development and additional research in order to iteratively improve the concept of Technology Jams.

Keywords: Technology Jam, design driven innovation, creativity methods, technology driven innovation

1 INTRODUCTION

In design processes, design teams aim to balance desirability, feasibility and viability (Brown 2009). If the starting point of a design process is a specific technology, typically so-called technology-push innovations are the result. A combination of design driven and technology-driven innovation is thus recommended for successful product and service development (Verganti, 2009). As a possible step towards a hands-on approach to combine these two perspectives, we have explored the possibilities of creating a platform where designers and technology developers and their different perspectives can meet in order to help direct such balanced development. We call this platform a Technology Jam. These jams are inspired by musical jams and design jams, but instead of starting with a theme (or music genre), they take a specific technology as a starting point.

In this paper we start by providing a theoretical background to technology- driven innovation, jams in music and jams in design. In the second section of this paper we explain the concept and setup of a Technology Jam. The third section describes two Technology Jam sessions that we have organised in terms of the input, working materials, process, outcomes and collected data of each jam. In this section, we also provide an analysis of the two jams in terms of how the input, working material and setup influenced the process and the outcome of

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the jam. The paper ends with a discussion of possible future work on further development and improvement of the concept of Technology Jams.

2 BACKGROUND

2.1 TECHNOLOGY-DRIVEN INNOVATION

Development teams in research-intensive environments seem to have a different perspective than designers when it comes to balancing desirability, viability and feasibility, the attitude towards the solution space, audience and interests with regard to new innovations as well as the role of design in the development process (Malmberg and Holmlid, 2013; Jahnke 2009). Furthermore, engineers are used to well-defined, technical problems with a focus on the product (Hatchuel & Weil 2003). Yet, nowadays, engineers are confronted with ill-defined, or "wicked", problems (see, e.g. Rittel and Webber, 1973, Buchanan, 1992). A more design driven approach (Verganti 2009) could be applied to counterbalance technology-driven development to provide radical innovations that create value for the user rather than technology-push innovation.

2.2 JAMS IN MUSIC

Musical jams exist in various ways, shapes and forms. We define it as a setting where musicians from different backgrounds, who play different instruments, meet, in order to make music together and try out ideas for songs. Each participant brings the instrument(s) that he or she can play to such a jam session. All the musicians enter with their personal vision of what the music should be like, which is influenced by the paradigm of the musician. When the musicians assemble as a group to create a piece of jazz-music together, they have dialogue with each other. By making music together, they discuss, challenge and react on each other's view and in the end agree on a shared view on the music (Bratteteig and Stolterman, 1997). In other words, the individual freedom is high, jazz groups are highly collaborative and the result is a group achievement (Bratteteig and Stolterman, 1997).

At the beginning of a jam session, some starting point is taken, for instance a music style (e.g. jazz) or rhythm. From that point, the music that is played develops through a process of someone taking the initiative to make a change to the music and others responding to this, by supporting this change and building on it. During a jam session the focus lies on the process, not the results. The aim of a jam session is not necessarily recording a song or musical album, but rather exploring ideas for songs or new musical structures, or just getting familiar with playing together.

Factors that may influence the process and outcomes of a jam are e.g. the theme of the jam, the type of instruments that are brought, the number of people joining in the jam, but the process and outcomes also depend on the competence of the various players, their ability to move within the given structures, and their ability to improvise (Bratteteig and Stolterman, 1997).

Furthermore, creativity and the quality of the design outcomes are increased as a result of the different backgrounds of the participants (Bratteteig and Stolterman, 1997). The different placements and related perspectives of the participants influence and reformulate the problem and the related set of implications and solutions (Schön, 1983; Buchanan, 1992).

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Jam sessions in music provide a balance of control through predefined structures on the one hand and freedom to explore new ideas through dialogue within the group on the other hand. This seems to be most important in coming up with innovative designs (of either music or artefacts) (Bratteteig and Stolterman, 1997). It is this notion, as well as other examples of the application of the analogy of jam session in design (see 2.3), that has inspired us to combine the metaphor of jam session with the approach of design driven innovation.

2.3 JAMS IN DESIGN

In 2011 the concept of applying the structure of a music jam to a design process was pioneered in a Global Service Jam. Later on, Sustainability Jams and Government Jams were also organised. These jams last 48 hours, during which people from different backgrounds meet, to cooperate in a way that can be compared to a jam session in music where you "bounce your ideas [for songs] off other people, and play around with what comes back." ("What is a Jam?", n.d.)

The Jams have no fixed structure, but rather some central elements with freedom to "jam" in between. The starting point for Jams is an open-ended theme and the outcome is a demonstration of the (service) concept, using simple prototypes. In between, participants work in small teams (of around 5 people) to develop and explore ideas for new products and/or services (related to the theme) by making prototypes of these ideas. They then evaluate the prototypes with potential users and iteratively improve the ideas based on the outcome of these evaluations.

3 **TECHNOLOGY JAMS**

Inspired by both music jams and design jams, we have developed Technology Jams, which are specifically aimed at exploring how novel technologies, when introduced in a specific context, can open up possibilities for applications that change the relationships between people and products. In the Technology Jams, the participants do not bring musical instruments, but knowledge, skills and tools that can be used for the generation of ideas during the jam. Similar to design jams, we use the concept of (rapid) prototyping in order to allow participants to bounce ideas off each other at a high pace. Such prototypes make it possible for all those involved in a Technology Jam to share a common focus. Or as Kirsh (2010) puts it:

"They can serve as a shared object of thought because they are logically and physically independent from their author. They can be manipulated, probed, and observed independently of their author's prior notion about how to interact with the model. This is vital for talking with clients, displaying behaviour, functionality and detecting unanticipated side effects. It makes them public and intersubjective." (p. 448)

Furthermore, external representations prevent that parts of an idea remain undefined. In other words:

"Unlike a description of the world, or a mental representation, any actual physical model must be selfconsistent. It cannot refer to properties that are not simultaneously realisable, because if it is a valid model it counts as an existence proof of consistency." (ibid, p. 448)

This helps to discover problems with applications early on in the process (Brand Flu, 2013) and contributes to getting the design right before committing substantial resources to further development (Thomke 1998). An additional benefit of rapid prototypes in particular is that the rough nature and everyday ingredients used for this type of prototyping might also lower the threshold of participation for those uncommon to or not confident with visualising ideas (Kelley, 2008).

A Technology Jam starts with the presentation of a novel technology and a selection of the possibilities and limitations of this technology. Furthermore, a specific target context is given for which ideas for new products or services for the presented technology will be developed during the Jam. This target context is the (future) context in which the technology will be used (see also Ramberg et al., 2004; Artman et al., 2005). After this, the participants of the jam are divided into groups of 3-5 people. In these groups they develop ideas for possible applications of the technology within the target context. Ideally, this part of the jam also includes visiting some context, not necessarily the same context as the target context, in order to gather inspiration or information for applications.

After this ideation phase, the groups present their ideas to each other. Then, idea selection takes place. For the continued development of selected ideas, new groups are made based on who wishes to work on which idea(s).

During the concept phase that follows, tangible prototypes are made for the selected ideas, using everyday materials. These prototypes are then used to evaluate the product or service idea gathering insights for continued development.

4 TWO TECHNOLOGY JAM CASE STUDIES

To explore the concept of Technology Jams we organised two such Jams, with different setups and concerning different technologies and contexts. Through these Technology Jams we have explored how the variations in the setup influenced the process and outcomes of the Technology Jam. We have focussed on the following questions:

1. How does starting with a technology, rather than a specific theme like in a design jam, influence the process of a Technology Jam?
2. How does the material that is provided influence the way people express ideas and concepts for products or services?
3. How does the material support the process of jamming together?
4. To what extent was it possible to jam, considering what this looks like during a musical jams?
5. What knowledge was created during the Technology Jam?

The first part of this section describes both Technology Jams in terms of their input and collected data. The questions above are discussed in the second part.

4.1 JAM 1 – CAPACITIVE COUPLING IN TOURISM

4.1.1 *Input*

The technologies that provided the starting point of this Technology Jam were printed electronics and capacitive coupling. The printed electronics technology used was under development by a Swedish research institute. This version of

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printed electronics technology allows production of electronic components and circuits using inkjet printing or roll-to-roll (newspaper) printing. Capacitive coupling technology makes it possible to use the capacitive properties of the human body to determine how an item is touched or grasped (Sato et al. 2012) or to send information as a high frequent signal through the body e.g. from an object to a device such as a tablet or smartphone, or vice versa (Gavhane et al. 2012). The target context for this Technology Jam was tourism. The Technology Jam started with an introduction to the printed electronics and capacitive coupling technology, including their possibilities and restrictions, as well as the introduction of the target context. The material that was provided for the jam consisted of both prepared elements and open-ended materials, such as post-its. The prepared material contained icon-cards of components that can be produced using the printed electronics technology as well as elements from the context of tourism (see Figure 1).

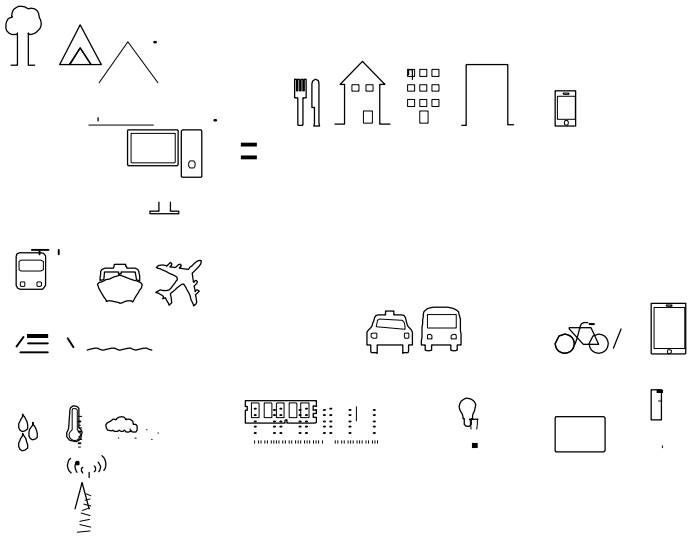

Figure 1 – Prepared material for Jam 1: icon-cards related to technology and context

This Technology Jam took place on the campus of Linköping University. The participants of the Jam were six researchers (1 female, 5 male) from the division of Human-Centered Systems at the university and one (male) industrial designer. They were divided into two groups. One group stayed in the workshop room and used the available material to generate ideas. The other group went outside to gather inspiration for ideas on the campus of the university.

4.1.2 ***Collected data***

During the Technology Jam session, pictures were taken of the ideas that were developed by the group that worked in the workshop room. Furthermore, written notes and short descriptions were made for all the ideas and concepts that were developed. These written notes were digitised after the workshop. After the ideation phase, both groups gathered in the workshop room and presented their most interesting ideas to each other. These ideas were documented on a whiteboard by the facilitator of the Technology Jam (see Figure 2) and written in a digital form after the Jam.

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Figure 2 - Idea documentation during Jam 1

Idea selection took place by vote of popularity and the groups were reformed based on the ideas that the participants wanted to continue working on. The concepts were documented by taking pictures of the configuration of the icon-cards (Figure 3, left) and sketches of the concept (Figure 3, right), complemented with notes on the verbal descriptions of the concept, which we digitised after the Technology Jam.

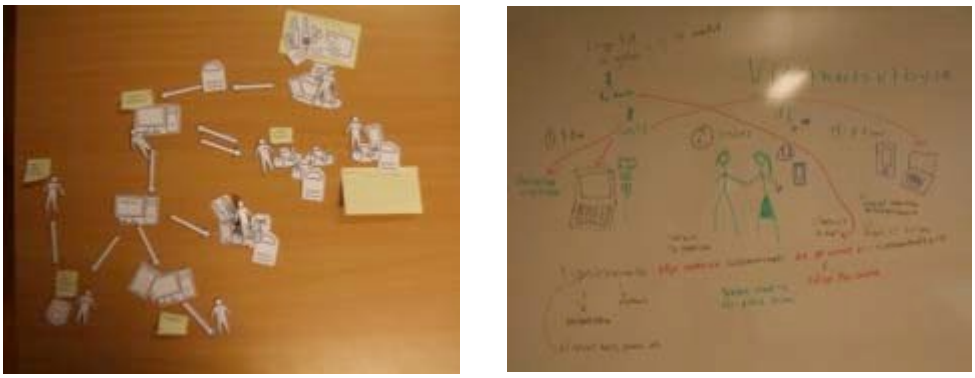

Figure 3 – Concept documentation during Jam 1.

4.2 JAM 2 – DYNAMIC QR CODES IN URBAN ENVIRONMENTS

4.2.1 ***Input***

In this Technology Jam, five researchers (1 female, 4 male) of the division of Human-Centered Systems and one (male) interaction designer participated. The technologies that were the starting point of this Jam were printed electronics and Dynamic QR (DQR) codes. The DQR code technology was under development at the same research institute that was developing the printed electronics technology. DQR codes differ from a regular QR code in that several pixels in the code are printed as a display. This makes it possible to turn these pixels 'on' or 'off' (display light or dark pixels). This, in turn, makes it possible to change the pattern of light and dark pixels in the (dynamic) QR code. A smartphone app can then be used to read the current state of the DQR code and provide specific feedback based on the state the code currently has. The target context for this jam was an urban environment. The Jam took place in the centre of a city, so that the groups had access to this context.

The material that was provided for the Jam contained the same materials as the first Jam, but a material was also provided for making quick prototypes. Figure 4 shows an overview of the materials that were available.

Figure 4 - Design material during Jam 2

4.2.2 ***Collected data***

The ideas were documented on post-its first and elaborated later on with descriptions as well as advantages and drawbacks of an idea, using a template (see Figure 5). These ideas were later copied into a digital format.

Figure 5 - Idea documentation during Jam 2

The concepts were documented and presented in the form of prototypes as well as storyboard, film and photos, see Figure 6 and 7.

Figure 6 – Two prototypes that were developed during Technology Jam 2

Figure 7 – Presentation of the use of the service in a storyboard (left) or short film (right)

4.3 ANALYSIS

4.3.1 ***How does starting with a technology, rather than a specific theme, influence the way of working during a Technology Jam?***

Regular design jams take a theme that can be interpreted in various ways as a starting point for a design process. Technology Jams take a specific technology or a combination of technologies as the starting point. This setup has several

consequences for a jam. First of all, it becomes more important for the participants to understand the, possibly unique, added value of the technologies used in the jam, in relation to similar or neighbouring technologies. When compared to jams in music, it is like jamming in a specific music genre or only taking a certain type of songs as the starting point for a jam rather than just beginning to play. Especially in more complicated forms of music, it is helpful to understand the characteristics of the specific type of music in order to feel comfortable jamming. For the Technology Jams this means that learning (about the technology) might be required before it is possible to have a successful jam.

4.3.2 ***How does the material that is provided influence the way people express ideas and concepts for products of services?***

During Technology Jam 1 the material that was provided consisted of both ready-made materials consisting of various iconographic icon-cards and open-ended materials such as post-its. The focus, however, was the use of the ready-made icon-cards. During the jam, the participants organised these icon-cards in system-like constellations that showed relations between aspects of the technology, context and actors within the ideated product of service. During the concept development phase, the concepts were visualised in a similar way, yet more elaborately, see Figure 3.

To build on each other's ideas, participants would replicate (parts of) such constellations by taking the same icon-cards from the pool of cards and arranging them in the same way. By leaving out/adding cards with respect to a previous idea or arranging the cards in a different way than before, alternative ideas could be visualised.

During Jam 2 the same materials (open-ended as well as ready-made) were provided, but in addition material for making prototypes was provided. Unlike in the first Technology Jam, the participants were not directed in their use of materials. During the ideation phase, mainly post-its were used for the documentation of ideas. This documentation consisted of a concise description of an idea in a few keywords and lacked the mapping of relations between technology, context and actors. During the concept phase, the prototypes were used in scenarios/videos that did include a view of the other actors in the application.

On another level, this difference in the use of materials during the jams, led to a difference in the externalisation of knowledge. During the first jam, the material that was used provided the possibility to document not just an idea, but also related assumptions for the context and relations between people and products. During the second jam, these assumptions were not documented on the post-its and often not explained verbally either. This meant that information necessary to describe the idea, in order for someone else to fully understand it, could remain in the heads of a participant, or that the description of the idea was an ongoing representation (Blomkvist & Segelström, 2014). This could also cause fewer aspects of the idea to be thought through.

This also has consequences for the process of building on each other's ideas. Even though it was just as easy to copy ideas by gathering an identical set of icon-cards and arrange them in the same way as it was to write a similar idea on a new post-it, the information that was copied with these two ways of transfer, differed. If relations changed from one idea to the other, this was clear from the changes in the configuration of the icon-cards during the first jam. During the second jam, relations could change unnoticed if these changes were not

articulated verbally, because they were not visible on the post-its. This also meant that the risk of participants not having common ground with regard to a specific idea was larger during the second jam as the semantics of one idea do not have to be similar in another idea.

4.3.3 *How does the material support the process of jamming together?*

During the first jam, the physical nature of the material and the fact that ideas would be built from several separate elements made it possible for multiple persons to work on an idea at the same time and alter things simultaneously (see Figure 8). Moreover, it was possible for all participants to follow the train of thoughts of the creator of an idea and contribute their own thoughts to these ideas, since the generation of an idea happened in stages, by adding new icon-cards or moving around icon-cards to reshape relationships. As a result of the physicality of the material and the possibility for people to join in the generation of ideas, ideas were generated at a high pace and ideation became a team effort.

Figure 8 – adjusting material to communicate ideas

During the second jam, the participants used post-it notes to generate and document ideas. This meant that participants would only show 'finished' ideas to each other, while the process of coming to this idea, for instance through associative thinking or through trying out and evaluating different alternatives, happened mostly inside the heads of the person who generated a specific idea. This made it harder for all participants to both follow and build on each other's trains of thought. As a result, jamming happened mostly in the form of people continuing on ideas that other group members mentioned or wrote down on the post-its. The generation of ideas thus became an individual activity, similar to what happens in a brainstorm, where others can build on finished ideas but not on the creative process that lead to that idea.

4.3.1 *To what extent was it possible to jam, considering what this looks like during a musical jams?*

In a jam in music, people with different instruments, who have skills in playing their instrument, come together. It could be that a specific theme or type of music for the jam is agreed upon, but usually a jam starts with one of the participants beginning to play a rhythm figure or melody. The others then join in, where everyone can input their ideas and influence the music, in different degrees of improvisation. Since the music is experienced right away and by everyone at the same time, everyone can evaluate and improve simultaneously, or refrain from doing changes. Since it is hard to evaluate ideas for songs entirely in your head, especially if it is someone else's idea for a song, it is

required to externalise these ideas by playing them. This also creates a common reference (the music itself) for all participants.

A technology jam is less open and starts with a specific technology and target context. During the first jam, externalising and creating a common reference was possible because of the iconographic working material. During the second jam this did not happen during the ideation phase, as ideas were written on post-its and elaborated verbally. This meant that (parts of the) knowledge about an idea might remain inside participants' heads. Or stated differently: if the material expresses the content of an idea or is transparent towards the process leading to the idea, it is easier to share ideas among participants. On the other hand, writing down ideas may have limited the pace of ideation, in comparison to a music jam; jams are not about writing down the music, but just trying and seeing what comes back. Since the concept phase involved creating tangible prototypes of ideas rather than writing them down, the generative process resembled the process of jamming more closely.

4.3.2 ***What knowledge was created during the Technology Jam?***

Creating external representations helps to build new knowledge (Chandrasekharan and Nersessian, 2011). This can happen through the reflective dialogue between designer and the design material (Schön, 1983) or by using representations to communicate ideas to team members (Ramberg et al., 2004). In the latter case, it is not just the representation in itself, but also the information that is communicated through bodily action that give meaning to the representation for the other team members (Tholander et al., 2008).

During the first jam, the participants generated knowledge about the possibilities, limitations and unique value of the capacitive coupling and printed electronics technology through the exploration of ideas and concepts. Furthermore knowledge was created about the actors that would be involved in running the service if it would be implemented. However, the two groups developed ideas and concepts in isolation from potential users. Besides, no 3-dimensional prototypes were created that could be evaluated with such potential users. The knowledge that was created did therefore not include the assessment of the ideas or concepts by potential users.

During the second jam, knowledge about the possibilities, limitations and unique value of the technology was also developed, as well as knowledge regarding stakeholders in the ideated products and services. Finally, the development of 3-dimensional prototypes of the concepts helped to made ideas selfconsistent (Kirsh 2010). Besides, making these prototypes allowed the participants to learn new things about the use of the technology through *active experimentation*, *concrete experience*, *reflective observation* and *abstract conceptualisation* (Kolb, 1984). However, the participants chose not to evaluate these prototypes with potential users.

In both jams we noticed that if the jam materials could be used to express an idea or concept in its entirety it was easier to expand the knowledge space with elements coming from the concept space (Hatchuel & Weil 2003).

5 **CONCLUSION AND FUTURE WORK**

In this paper we presented Technology Jams as a way to direct technology development and balance technology-driven and design driven innovation. The concept of these Technology Jams is inspired by musical jams. Through the

analysis of two Technology Jams that we have organised, we have documented how the setup of such a jam influences the process and outcome of the jam, both in terms of ideas for technology development and the creation of new knowledge.

During the further development of Technology Jams we will explore questions such as how the constellation of participants influences the process and outcomes of a Technology Jam, how one might jam with people from different backgrounds, taking into account frictions that might occur between designers and technology developers (Malmberg and Holmlid, 2013) as well as possible reservations towards design as an innovation driver (Cox, 2005).

Furthermore, we are interested in how training and experience of the participants would influence the process and outcomes of the jam. Is some form of preparation required in order to achieve optimal results? In music jams, you usually jam with people who have some level of mastery over a specific instrument, so can we actually call Technology Jams a jam, when the participants are relatively inexperienced with the type of jamming that takes place during a Technology and/or are unfamiliar with the technology used in the Jam?

We plan to use the insights from the two jams and the questions above to iteratively improve the Technology Jam concept in order to support design driven technology innovation.

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