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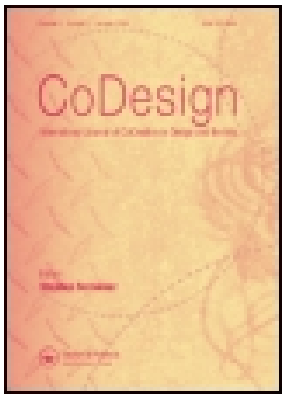

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Collaborative futuring with and by makers

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Maker spaces and ma\ker activities offering access to low-cost digital fabrication equipment are rapidly proliferating, evolving phenomena at the interface of lay and professional design. They also come in many varieties and change fast, presenting a difficult target for, for instance, public authorities, who would like to cater for them but operate in much slower planning cycles. As part of participatory planning of Helsinki Central Library, we experimented with a form of collaborative futuring with and by makers. By drawing elements from both lead-user workshops and participatory design, we conducted a futuring workshop, which allowed us to engage the local maker communities in identifying the issues relevant for a public maker space in 2020. It further engaged the participants in envisioning a smaller prototype maker space and invited them into realising its activities collaboratively. Our results indicate that particularly the information about future solutions was of high relevance, as was the opportunity to trial and elaborate activities on a rolling basis in the prototype space. Insights about more general trends in making were useful too, but to a lesser extent, and it is likely that these could have been gained just as easily with more traditional means for futuring.

Keywords: makers; futuring; lead users; participatory design; full-scale modelling; extended co-design

1. Introduction

Maker spaces that offer access to low-cost digital fabrication equipment are becoming increasingly common in the post-industrial cityscape (van Abel et al. 2011). Their benefits and potential are becoming recognised by advocate communities, industrial players and public sector institutions alike. But making is also a fast moving target. Technologies, practices and communities of makers have evolved rapidly during the last decade. Distributed sharing, design and collaboration platforms have been joined by distributed manufacturing in an increasing range of materials and technologies. At the same time, more traditional crafts have enjoyed a new popularity. Manifestos are many and new frontiers such as bio-hacking and pharma-hacking (e.g. Tocchetti 2012) are becoming more commonplace. There is little indication that the pace of change is slowing.

This state of affairs presents challenges for those who want to advocate maker activities but who are also tied to the constraints of slow planning processes. Here, the

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future-making practices need to be anticipated years ahead to design for them adequately, but it is not easy to identify and specify their requirements sufficiently in advance. The case discussed in the present paper is one of planning adequate maker facilities for the new flagship public library in Helsinki, Finland. The space requirements, ventilation, noise, hazards and many other issues needed to be anticipated in 2013, even though the building is scheduled to open only in 2018. As dramatic changes are difficult to argue for soon after inauguration, the planners needed to envision future making at least seven years ahead – to the year 2020. Another hurdle to overcome in such projects is that the future of making looks quite different depending on whom you ask, and the emerging making field is diffuse enough that few single experts are likely able to convey the future requirements adequately.

The veracity of standard futures exercises such as trend extrapolation, projections and scenario building, a common foresight strategy for libraries (e.g. Staley, Seaman, and Theodore-Shusta 2012), requires identifying experts with reliable input if the results are to be actionable. The best experts in rapidly changing nascent practices, however, are likely those who are closely engaged with making them happen rather than those tracking at it at some higher level.

This is where alternative and more collaborative forms of futuring appeared promising. If the needed knowledge was likely to reside with active maker practitioners, why not work with methods suited to working with them? This was a particularly appealing idea, as Helsinki Library Services were committed to having participatory planning as part of their new flagship project.

The common 'participatory futuring' means such as public Delphis, charrettes and future search conferences, however, aim at a refined consensus over a broad future development (Glenn and Gordon 2009). Given that the library planning needed both trend and solution information, we turned to lead-user workshops (LUW) (Churchill, von Hippel, and Sonnack 2009), which are reputed to identify both key trends and concrete solutions qua lead users having faced many of the future needs in a domain before other people do (von Hippel, Thomke, and M. Sonnack 1999; von Hippel 2005; De Moor et al. 2014). Our previous experience in running such workshops suggested that it could be wise to adjust them for the current purpose. Rather than aiming at one-time trend and solution identification, the workshop might aid more iterative long-term collaboration. Participatory design projects suggest that an evolving real-life prototype and ongoing interactions between designers and users are particularly beneficial arrangements (Hartswood et al. 2002; Büscher et al. 2004; Botero and Hyysalo 2013). In addition, setting the solution identification phase of the workshop in an existing maker space and using it as a full-scale model for a 'hands-on' future appealed to us (Ehn and Kyng 1991; Hornyánszky Dalholm 1998). To aid in the continued engagement between the library planners and maker participants, we limited the lead user search to Finnish maker communities and extended the number of users invited. In this paper we seek to report as its primary contribution the results of the following enquiry: *Can collaborative design arrangements with advanced users result in effective futuring for mid-range planning?*

We shall next examine in more detail the bodies of research in user innovation research and participatory design (PD) upon which we built our set-up and articulated our secondary research contribution. We then provide the background on making and maker spaces as well as the Helsinki Central Library project and its participatory planning practices. We follow this with the description of the data, methods and overview of our workshop. After this we move to the results of the workshop, its yield and how the library planners and participants reflected on it a year later, and end with conclusions.

1.1. Lead-user workshops and participatory design as resources for futuring with makers

The idea to use elements drawn from PD to adjust an LUW may sound like one for which many existing resources would be available. After all, PD and user innovation research are commonly referenced as being among the most formidable approaches to user collaboration (e.g. Buur and Matthews 2008; Pals et al. 2008; Johnson 2013). Nonetheless, explicit mixing and crossover between the two has remained rare. In fact, our literature search in *Google Scholar* and *Scopus* surfaced no reports of explicit methodological mixing of the two, apart from the idea of selecting lead users to participate in PD (Mønsted and Onarheim 2010; Morjaria, Ross, and May 2013). This is rather surprising. There are, after all, plenty of crossovers between, for instance, user-centred design and PD, as well as between open source development and user innovation research.

Furthermore, PD and user innovation research do have many resemblances. Both place primary agency in the design process in the hands of the net benefactors of the system, both emphasise end users' innovative capacities, both see their work as an empowering and democratising one (Bjerknes, Ehn, and Kyng 1987; von Hippel 2005) and both have devised techniques and set-ups that help the design and collaboration with end-users (for overviews, see Greenbaum and Kyng 1991; Bødker, Kensing, and J. Simonsen 2004; Churchill, von Hippel, and Sonnack 2009; Voss et al. 2009; Bogers, Afuah, and Bastian. 2010) and paid attention to forms of emerging user communities (e.g. Jeppesen and Molin 2003; Hess and Pipek 2012).

Of course, we should not overlook the differences between what the proponents of each approach regard is worthwhile to do with users. User innovation research departed from the observation that many users develop their own solutions in the lack of producer offerings, and at that, they can span the whole of the product development process. These innovations are concentrated upon very few users that typically represent less than 1% of users in a domain (Franke, von Hippel, and Schreier 2006). As the majority of users are unlikely to innovate within a given domain, and thus are not immediately important for understanding the sources of innovation, the view of user innovation research on democratic innovation is one focusing on the ability and opportunity to innovate, akin to Ancient Athens where only the free men were seen to form the Demos of any importance (Hyysalo 2009). In contrast, PD originated from workplace democracy and representative democracy in affecting technological change (Bjerknes, Ehn, and Kyng 1987). This asserted that all people possess viable knowledge of their own work and conditions, which can be usefully brought to design if facilitated properly (Greenbaum and Kyng 1991). To this aim (and along with many other objectives), hundreds of techniques and methods have been used and deployed to date (for limited overview, see Muller and Kuhn 1993; Bødker, Kensing, and J. Simonsen 2004). Experience with PD's futuring tools such as Futures Workshops suggests that a broader and more diverse set of participants may be used, at least when facilitating arrangements support their futuring (Bødker, Kensing, and J. Simonsen 2004; Büscher et al. 2004). These (and several others) are genuine differences in the orientation of the two traditions.

Nevertheless, it appears worth examining whether some crossover between the two might yield more benefit than harm. It indeed would appear to be in the interest of the field of co-design to test whether mixing elements from these two prominent traditions tends towards problematic or dysfunctional processes or outcomes. This is what we have sought to do at workshop level in the present study, and hence our secondary research question is: *What pros and cons emerge from altering the lead-user workshop with insights from participatory design?*

von Hippel (1986) suggested a four-step process for working with lead users: first identifying important trends and key customer needs, then identifying lead users and understanding their needs and possible solutions and finally working with lead users in order to improve or generate product/service concepts. The final step is typically carried out by organising an lead-user workshop (see Chapter 7 in Churchill, von Hippel, and Sonnack 2009). The process has been further elaborated by Urban and von Hippel (1988), Lüthje and Herstatt (2004) and Churchill, von Hippel, and Sonnack (2009), yet the basic two-part structure of LUW has remained the same. The first part is spent on trend exploration, basically each lead user explaining the challenges and trends he or she is facing and then working in a group to iterate these. The second part, used to concretise solutions to meet these trends, is done jointly among the lead users and company representatives (Herstatt and von Hippel 1992; Churchill, von Hippel, and Sonnack 2009).

The key strength, and also downside of the lead user method, lies in the time-consuming task of identifying the lead users (Churchill, von Hippel, and Sonnack 2009; Hyysalo et al. 2015). Also, the costs of flying in some of the world's leading users can be formidable. At the same time, few of these people may be practically available for a local long-term development project. These aspects are likely to be aggravated in a diffuse area such as making, where a considerable number of lead users would be needed to cover its different facets. While we wished to retain the basic LUW format due to its providing insight into both trends and solutions, we limited the search for participants to the pool of maker experts and activists living in Finland who would be more likely to develop a long-term relationship with the library planning process.

To enhance these participants' capacity to envision the future trends and solutions, we produced a set of 'double stimulus' or 'scaffoldings' (Bødker and Grønbæk 1991; Cole 1996; Nardi 1996; Hyysalo and Lehenkari 2003). First, drawing from PD ideas of representing work through pre-filled cards (Muller 1993; Halskov and Dalsgård 2006), we provided the participants with sets of cards in six categories for both trend identification and solution proposals. The second set of scaffolding was used in the solution identification part of the workshop where we turned to ideas of 'full scale modelling' (Hornyánszky Dalholm 1998) to help people achieve a 'hands on future' (Ehn and Kyng 1991). The participants used a same-sized maker space as a proxy for the City Library maker space proposed for 2020 and marked directly onto its machines and surfaces what would be different and what needed to be considered for 2020. While some within user innovation research have drawn from gestalt psychology (Duncker 1945) to warn against the perils of users' 'functional fixedness' on current solutions (such as in this case the MIT-associated fab lab potentially hampering the diversity of maker spaces and future possibilities from surfacing), PD experiences suggest the contrary: a rich contemporary set-up can both aid and ground imagination (Ehn and Kyng 1991; Büscher et al. 2004). The same applies to the third arrangement we drew from earlier work in PD: not limiting the interaction and learning to a single workshop setting but seeking an evolving prototype setting where both planners and makers could 'age together' and 'co-realize' (Hartswood et al. 2002; Hyysalo and Lehenkari 2003; Büscher et al. 2004; Botero and Hyysalo 2013) what solutions work and conduct trials for improving them.

2. Empirical background for the collaborative futuring

2.1. Maker culture and maker spaces

Although 'making' builds on a tradition of handicraft and 'DIY' (do-it-yourself), it today also includes (and more commonly refers to) use of digital manufacturing tools in hands-on fabrication of material artefacts, including electronics and physical computing

experiments, furniture and items for the home or body and prototypes of all kinds. Shared maker spaces typically contain milling machines for making circuits or casting moulds, vinyl cutters, electronics workstations for microprocessor programming and electronics project prototyping, desktop 3D printers and laser cutters. Product designs (often shared digitally) are realised by the users themselves and, due to their digital form, can be designed together with peers in other locations. The low-cost prosthesis project in the MIT fab lab network, for instance, brings together self-selecting team members from a number of labs around the globe who collaborate on the project both virtually and physically in Indonesia (lowcostprosthesis.org 2012).

Maker spaces include fab labs, which are workshops in the MIT Center for Bits and Atoms' network (Gershenfeld 2005); hacklabs or hackerspaces for exploring electronics and physical computing (Maxigas 2012); commercial machine shops offering paid access to members; and a variety of other spaces that may be independent or associated with a library or museum (Troxler 2011). The number of maker spaces worldwide is growing rapidly: to date there are over 300 fab labs and 1000 active hackerspaces (FABWIKI 2014; HackerspaceWiki 2014), listings that do not account for independent spaces.

There is currently scant research on who uses maker spaces, how and why (e.g. Ghalim 2013; Tanenbaum et al. 2013), but the practitioner view is that there is considerable variation, from students in university fab labs to entrepreneurs to hobbyists (e.g. Eychenne 2012). In addition, new DIY strands are exploring areas such as citizen science and urban agriculture, activities conducted in their own communities and spaces or included in the repertoire of already established maker spaces (Tocchetti 2012).

2.2. *Central Library participatory planning*

The decision to conduct a futuring workshop with makers can be understood properly as an event within the broader citizen engagement efforts in the design of Helsinki Central Library, an estimated €96-million future flagship library to be built in the heart of Helsinki. The Central Library project has organised an array of collaborative design ways of working, with varying degrees of control and decision-making power given to citizens (and correspondingly retained by the library planners. Academically speaking, this participatory planning is hence better seen as a series of co-design efforts rather than PD). In the first stage an open call for ideas was launched online and in dozens of public events, yielding 2800 entries from the public. This was complemented by more focused workshops on topics on which more specific information was needed, including but not limited to new digital learning environments, facilities for families, enhancing spaces for multicultural exchange and the maker spaces we report on here.

Maker facilities and its space reservations were identified as an area needing focused citizen engagement in spring 2012. The participatory budgeting arranged by the library the following autumn underscored this view. When citizen boards made direct decisions on pilot projects built upon the open idea gathering, the pilot maker facility was among the four projects selected to be funded and allocated the greatest sum of money and urgency. There was thus impetus from both the citizens and from planners to focus efforts on the needs for maker spaces.

Meanwhile, it was known to the present authors that southern Finland, Helsinki in particular, had several different types of maker communities and independent professionals and semi-professionals who were highly proficient in making. The situation was not untypical to other European localities, but it did present an interesting terrain for anticipating what the Finnish makers and other citizens may require and prefer from a

public maker space in 2020. The southern Finland maker scene was also very international: alongside native Finns, it included people from several European countries and the Americas and many being internationally well networked.

3. Data, methods and overview of the workshop

The workshop participants were identified by first listing the relevant maker communities, sectors and fields of expertise that would provide a diverse set of perspectives on the present and future of digital fabrication and maker spaces. The sectors of commercial, academic, third sector and local authorities were further subdivided into fields such as ICT, engineering, digital fabrication, 'hacking', 'crafts' and 'support organizations', and both organisations and individuals were identified in the authors' contact networks (established from having been embedded in the Finnish maker scene for several years), in discussion with the library personnel and through snowball sampling (e.g. Goodman 1961). This resulted in a list of 32 individuals, many of whom were involved in more than one relevant field or aspect of maker culture. The list was compiled so that each of the competences sought for the workshop would be held by at least two invited individuals. The workshop date suited 13 participants, who upon a further check presented a balance of male and female and most importantly represented all the competencies desired. Taken together, they held wide and deep knowledge on different facets of digital fabrication, shared workshops, open innovation and peer-to-peer dynamics, as well as experience in organising and facilitating participatory events, including making-related ones, environmental activism and urban gardening, and adult education and peer learning. The 13 workshop participants were of four nationalities. Seven of them were active in international networks related to maker culture, such as the fab lab network, and several were known for their numerous international keynotes they have given on making, open design, open innovation and related topics.

When it came to the actual workshop, in its first phase the 13 participants independently wrote down the most important trends they saw in making and maker spaces for the year 2020 using the pre-filled cards. These cards were post-it notes marked with one of five categories, 'technology', 'activities', 'sharing/organizing/IPR', 'safety/risks' and 'other'. The categories were determined on the basis of our prior research (Kohtala 2013, 2015; Kohtala and Bosqué 2014; Kohtala and Hyysalo, in review). The participants produced 189 trend items in all (see Table 1). Each participant then shared with the others the three most important trends they had written down. The 'top three' trends were mounted on a wall, which was followed by an exercise of all participants identifying which of all the trends they felt were most important (not their own). We then used a variation of the 'World Cafe' technique (Brown 2002) where we moved the most heavily starred issues to three flipcharts and grouped the participants into three groups to discuss the sustainability implications of each (using 'sustainability' category cards) (Figure 1). This was because the sustainability aspects of future making have been a highly neglected area (Kohtala 2013, 2015), something which is also a concern for the library services in setting up their maker space.

The use of simple cards had a three-fold rationale. They would remind the participants that the workshop was interested in many aspects of making and its future, not just, for instance, technology. The pre-categorised cards would also allow us to rely on participants' own coding of the issues they expressed, even if their numbers grew too many for facilitators to track (as it happened, totalling 496 filled cards). In this capacity, the cards further provided a notation for recording items (be these trends or solutions), which the participants could follow throughout the day, which in turn allowed comparisons between trend and solution statements.

Table 1. Examples of trends.

Category	Post-it contents	Location[a]	Value for library[b]	When[c]
Technology	Nano material will arise in making	1	N	F
Technology	Network of shared 3D printers	1	S	T
Activities	Culture of collaborative making in public	1	S	T
Activities	Create + broadcast yourself with easy interactive tools	0	S	T
Sharing organising IPR	"Distributed thingiverse": sharing protocols, platforms for making	1	N	T
Sharing organising IPR	Open data, both public and private, is mainstream	0	NTK	T
Safety and risks	Desire to make things which exceed natural/ recycled resources	1	S	T
Safety and risks	3D model wars (IPR related), companies vs. communities	0	Q	F
Other	Overall equality (and more girls) engaged in technologies (pros or hobbyists)	1	S	T
Other	Self growth, empowering and therapeutic use of learning by/and making	1	N	T

[a] 0 = other wall; 1 = top wall, no. of stars.
[b] Q, questions previous ideas; S, supports our ideas; N, new issue; NTK, nice to know, not entirely relevant.
[c] F, future (2020); T, today (2013).

The afternoon part of the workshop was held in the fab lab. At this point the head of Central Library planning introduced the library's plans in detail to the participants. We instructed the participants to add notes directly onto the machines and surfaces regarding solutions (see Table 2 and Figure 2). In this exercise, we used the same pre-filled

Figure 1. Trend identification in the workshop: working alone, presenting to others, prioritizing and elaborating.

Table 2. Examples of solutions.

Category	Post-it contents	Location of post-its in the fab lab	Value for library[a]	When[b]
Technology	Design the extraction of the fumes from the start, don't add it later	Laser cutter	S	F
Technology	Choose low-cost accessible technologies that will be found more easily also elsewhere	Misc	S	T
Activities	Personal ['scout's'] badge in which skills, experience etc. are collected – add item when [able to] use new tool	Large milling machine	N	T
Activities	Access 24/7/365	Glass wall next to exit	S	F
Sharing organising IPR	Hierarchy of good–bad materials on display (critical material thinking)	Bookshelf/ display case	N	T
Sharing organising IPR	'Video diary' corner: save videos of instructions etc.	Soldering stations	N	T
Safety risks	Culturally independent [i.e. neutral] symbols for security or safety functions	Large milling machine	NTK	T
Safety risks	Ergonomics: lighting, posture, work time	3D printer, computer space	S	T
Other	Everything on wheels	Toolboxes	S	T
Other	Create user stories that help explain what anyone of us can do in the space	Misc	N	T
Sustainability	Site-specific energy information/data	Misc	N	T
Sustainability	Grouping jobs together; less waste, less energy, less time	Misc	N	T

[a] S, supports our ideas; N, new issue; NTK, nice to know, not entirely relevant.
[b] F, future (2020); T, today (2013).

cards as in the morning part of the workshop. This phase proceeded for 90 minutes and produced 307 solution or requirement ideas.

The final part of the workshop moved into collaborative mode from the individual and discussion-based format. Participants formed three groups and began to envision the activities, technologies and outreach of the pilot maker facilities. This proceeded by documenting the ideas directly onto the floor plans of the pilot maker space and then presenting and discussing them with the entire participant group (Figure 3).

These exercises proceeded with little need for encouragement or facilitation; the participants seemed to be strongly motivated to spell out their ideas. This indeed was what we had expected, and this expectation was the basis for having the inspiration cards as

Figure 2. Examples of solutions posted directly on the surfaces of the fab lab.

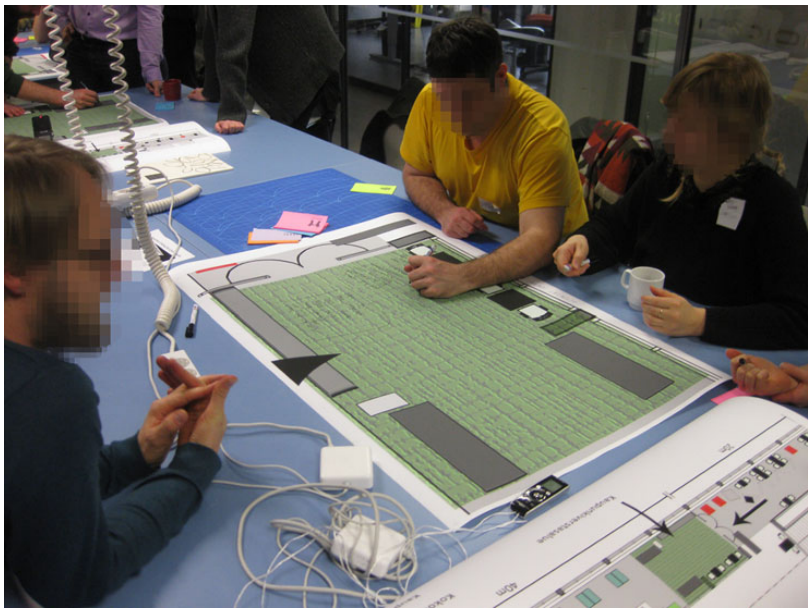

Figure 3. Concretising the equipment and layout of the pilot maker space directly onto its floor plans in small groups.

unambiguous and 'down-designed' as possible (i.e. simple graphics as category reminders). The only facilitation interruption occurred in the fab lab part of the exercise, when participants were noted as using many 'other' category cards and the 'miscellaneous wall' we had arranged (for cards that could not be placed anywhere in the fab lab), as well as fewer than expected 'technology' cards. We therefore asked them to concentrate on technology issues briefly at the end of the exercise, followed by a similar request to focus on sustainability issues.

The workshop set-up was arranged to produce several types of data for the planning and academic analysis. Four separate audio recorders and two video recorders were arranged to cover most talk and physical interaction that might take place in both settings. As the number of people in these set-ups was relatively high – 13 participants, 4 facilitators and 6 library planners following the event – we were aware from the outset that an adequate full transcription of the recordings might be unfeasible, particularly for the afternoon sessions when the participants scattered to parallel actions and talk sequences. The audio and video data were hence used as a back-up repository for the less intensive documentation methods.

The next layer of the documentation was still photographs taken by both facilitators and library personnel. Altogether 691 photographs recorded what was generated at every phase, every note written and the sequence in which they emerged. These provide a visual trace of the flow of the workshop process. The written cards, 496 in total, were the next layer of the outcomes of the process. Finally, each of the facilitators made field notes after the day to record their observations about the dynamics between participants and participant reactions to the processes, materials and outcomes during the day.

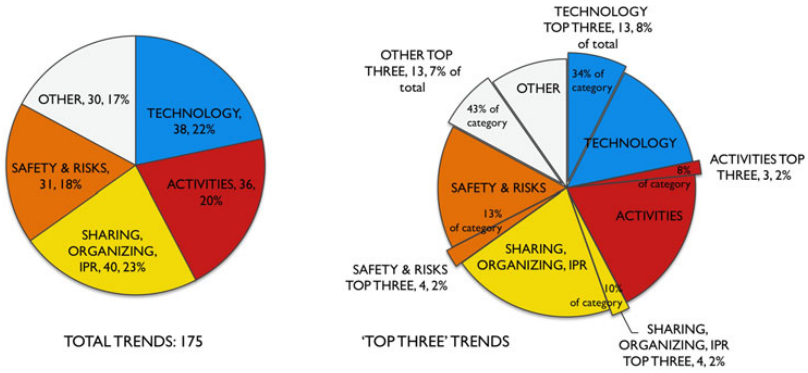

Figure 4. The trends' main themes represented in proportions.

The analysis of the data has proceeded in several layers, but in this article we resort to the overview analyses we conducted. The post-its were first photographed in location to enable reconstruction of the outcomes if needed. All markings on the post-its, categories therein, the number of stars, the author of each marking and their physical placement and sequence in the events were tabulated.

The items were then assessed by the library planners, who went through all trends and solutions and marked which ones were immediately relevant, which ones applied to the future planning, which ones were old news and which ones confirmed items they had uncertainty over (see Tables 1 and 2). In effect, we asked them to assess the immediate yield of the workshop contents for their own planning work, albeit much of the yield of the workshop emerged in the dialogue and interactions it started between library staff and makers, as we document below.

Regarding the immediate yield from the workshop, we then moved to assess the distributions and trend–solution pairings of the issues raised in the workshop to see if there were differences between trend and solution information and information gained in different aspects of making.[1] This also involved merging identical contents into one item and grouping the trends and solutions into inductive themes (such as 'handicraft') (Figures 4 and 5). With regard to the longer-term influences of the workshop, we rely on nine interviews with the participating makers and eight interviews with the library planners and the manager of the maker space in a year range prior and subsequent to the futuring workshop. These interviews were coded for content and key themes and then cross-compared.

4. Futuring with makers for the Helsinki Central Library: workshop results

The trends the participants produced in the first part of the workshop were rather equally distributed among the pre-determined categories (Figure 6, left), with 'sharing, organising, IPR' as the largest category (at 23%) being only slightly larger than the smallest, 'other' (at 17%). The most important trends (to the participants) tended to fall in the 'other' category, where they comprised 43% of the category and 7% of all trends in total, and 'technology', whose 'Top 3' constituted 34% of the category and 8% of the total number of trends (Figure 6, right). Examples of the trends are seen in Table 1 and their thematic clustering in Figure 4.

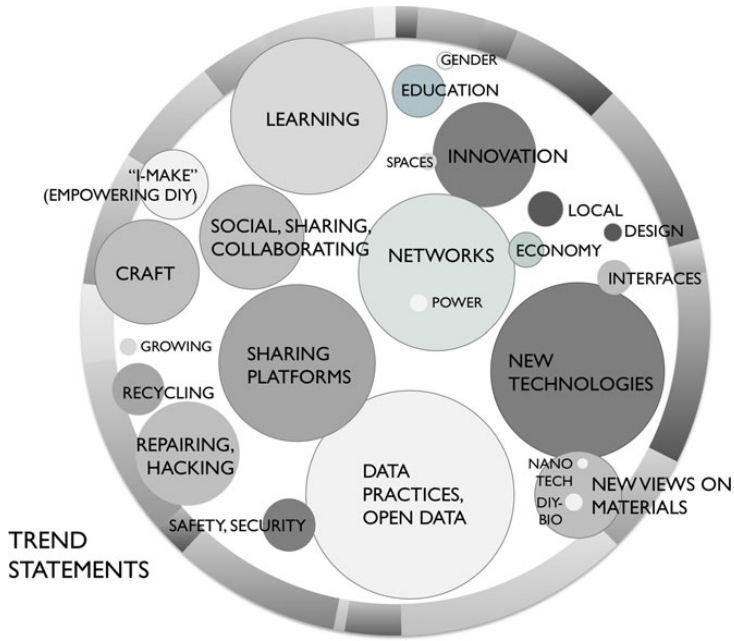

Figure 5. The solutions' main themes represented in proportions.

In the afternoon, the participants' solutions included warnings and 'wish lists' as well as future concepts (see Table 2 and Figure 7). The distribution of the solutions according to category shows a change from the trend distribution, where the 'other' category constituted 37% and the second biggest category was 'technology' at 19% (Figure 8). The solutions' thematic clustering is illustrated in Figure 5.

As stated, the library planners went through the rich range of trends and solutions and marked their relevance for them, first as either already relevant today or for the planning of the 2020 maker space. They then assessed their relevance with regard to what they already knew. At the one end were issues which were *news* to the planners: issues unrecognised by them prior to the workshop. Many trends and solutions *supported* information the planners had or *questioned* this information. At the other end were issues that appeared to be of low relevance to planning, in their words 'nice to know', either because these were implausible, mostly contextual or expressed an issue the planners could not possibly do anything about (see Tables 1 and 2).

The comparison of these relevance scorings reveals that the relative amounts of 'nice to know' items were close to identical (25% and 23%), as were those of the items that questioned extant ideas (6% and 5%), albeit with some difference with timing (i.e. now versus future). A significant difference in all counts lies in the relative amounts of ideas that support and those that were new to library planners (in trends 55% supporting and 14% new; in solutions 27% supporting and 45% new) (Figure 9). Moreover, the real difference lay in the amounts of supporting and new items that were of relevance already in the planning of the pilot maker facility – ideas that could be reacted to now.

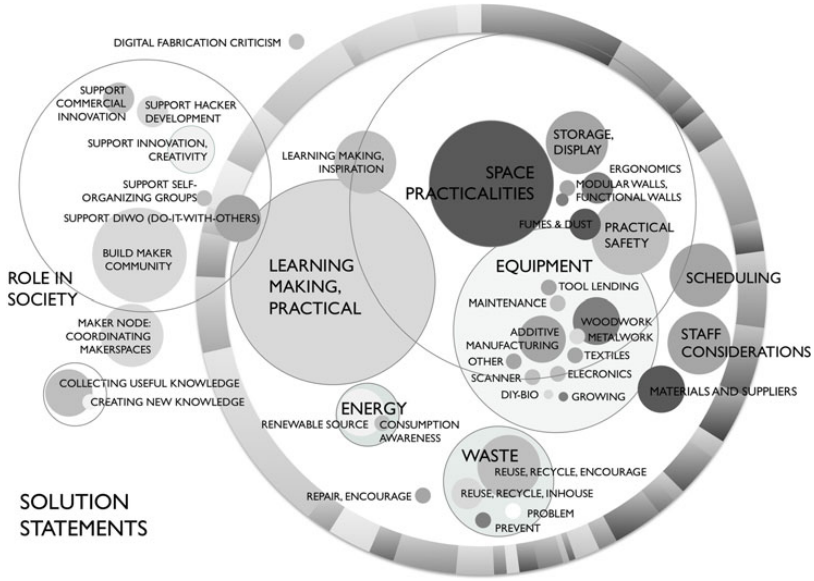

Figure 6. Breakdown of trend categories.

Breaking these distributions down according to the categories the participants used (to denote which area their trend or solution primarily concerned) reveals where these differences are accentuated. The top, leftmost pie charts in Figure 10 compare technology trends (upper) and solutions (lower) and demonstrate that the share of new ideas in trends (24%) compared to the solutions (48%) has doubled (200%). This might be expected, as the technical details could arguably be more challenging for library planners. However, it was in technology where the lowest ratio of novelty in solutions to trends emerges! The ratio of novel solutions triples in sharing, organising and IPR (339%, top-middle

Figure 7. Generating solutions, on equipment and surfaces (left) and on the 'misc' wall (right).

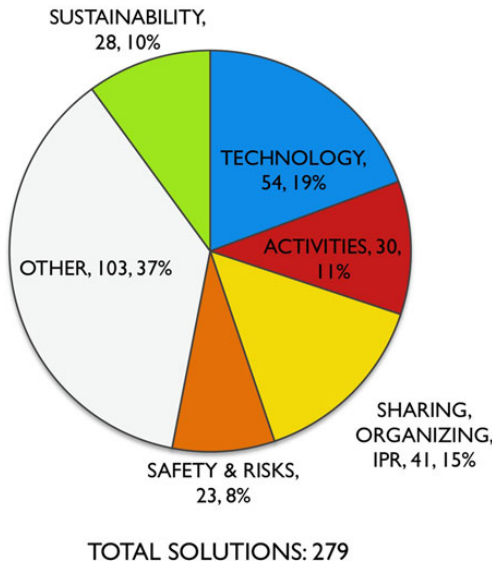

Figure 8. Breakdown of solutions.

diagrams) and safety/risks (283%, top right) even as its overall share remains lower, as well as in 'other' (307%, bottom-most right). The most dramatic change is found in activities, where the share jumps from just 3% to 50%, a 16-fold (1667%) increase (bottom-most left).

To us this indicates that it had been relatively easier for library planners to grasp the overall contours of maker practices and their avenues of change than to concretise what these would entail in practice. Even more remarkable is that most of the relative increase in all categories deals with issues the library planners assessed as being relevant already for the setting up of the prototype facility: in other words, with issues that presented actionable knowledge.

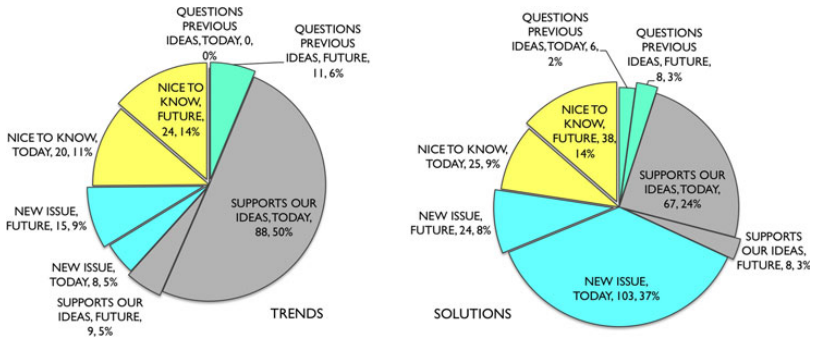

Figure 9. Scoring of relevance to library planners of trends (left) and solutions (right).

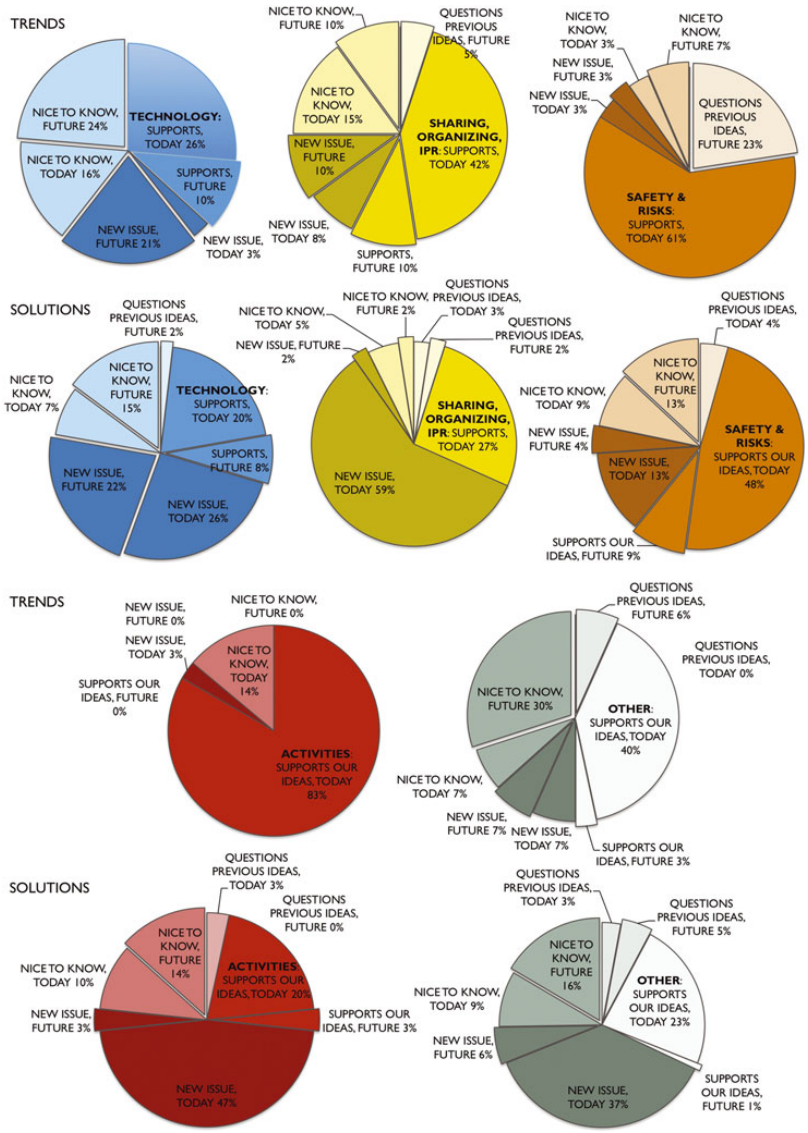

Figure 10. Relative relevance scorings of trends (upper pie charts) and solutions (lower pie charts) in each of the categories.

That technology solutions feature 'only' a 100% increase as new in comparison to trends may be due to technology-centred public discussions related to making that cover also concrete solutions. Hence, it might have been more difficult for planners to concretise all the other areas as solutions even as the broad trends appeared mostly familiar.

The final collaborative exercise focused on the near future. The first set of results emerged from the maker practitioners engaging with the challenge of setting up maker facilities in a small space in a protected building, in effect solving the library planners' internal debate over what equipment should be in the space and how to place it directly in the floor plans. Second, the makers soon converged on the idea that they should take active part in hosting events and making full use of the facilities on a regular basis. They thus came to suggest that the library lend the space for pre-arranged co-hosting, an idea the library planners themselves had previously made successful for participatory events and music gigs but which they had had no way of proposing to the makers previously. Third, the makers elaborated the outreach ideas for the new 'city workshop' and, after several imaginative marketing and campaigning ideas, converged on the notion that the very best outreach would, in fact, also come through active engagement with the various maker communities and indeed letting the maker facility be hosted by makers for makers.

5. The workshop event as part of the planning of Helsinki Central Library maker facilities

As noted, the workshop was first envisioned about a year before (in spring 2012) it took place. A year after the workshop, in 2014, the library planners and participants reflected on the past year and the workshop's role for them in semi-structured hour-long interviews. The planner in charge of running the pilot maker space and leading the group that planned the maker-related areas in the future library deemed the rise in her competency as substantial during the year and attributed the workshop to kick-starting this. The workshop had further provided her access to a network of people known to be knowledgeable, willing to answer further questions and even assist. Over half of the participants in the workshop had stayed in active contact with her throughout the year. The idea that the maker communities could independently host activities in the pilot maker space had also found some realisation: three different groups had appropriated the spaces for their activities, both open and closed events.

Of the 13 participants, 9 were interviewed a year-and-a-half later in half-hour semi-structured interviews. Most of the participants stressed the value of the city library in Helsinki urban life and its forward-looking approach: 'It makes sense: it's not about books anymore. It's a very logical way [for the library] to re-invent itself and a really positive one'. For most of the makers, the connections to the city library and the pilot maker facilities were clearly established (or consolidated) because of the workshop. The makers also stated their stakes in its success: they were aware of how the pilot space was supporting their own communities and activities, and many of them were also investing time and attention in the pilot facilities. All the participants interviewed had at the very least visited the space. More than half had participated in its development workshops and many had attended the opening ceremony. At least two makers were regular users of the maker space's equipment, and several were actively involved in their own community's activities hosted there, as mentioned above (the most notable being a regular public repair event).

With respect to the 2018 maker space, a larger space is being specified for preparations and finishing productions, possibilities to work with recycled items and inclusion of running water utilities. These plans are partially attributable to the heightened awareness of the sustainability implications of and decisions on setting up maker spaces which the workshop clarified. Overall, the planners stressed that the workshop and further concretisation provided a clearer idea of which technologies and directions to monitor more closely and from whom to gain further insight as the planning progresses. They

specifically emphasised that the pilot maker space 'has clarified the concept of *how the library services* for a maker space are to be realized'. A clearer idea of who uses the services and how they are used has emerged, 'cool enough for design school hipsters and clear enough for a hairdresser doing vinyls for her window – this not easy but doable once you get it', as well as identifying the core importance of 'having competent staff to help out with the equipment to lower the threshold of trying (digital-physical making), which really is the library role as opposed to what other maker spaces offer'.

With respect to affecting the maker scene in Finland, the participants interviewed reported that they had continued to work within their own respective networks but that the lack of a common physical *space* was inhibiting community building: 'the maker community in Finland is not closely bound together; we don't have a real fab lab place or open space … we dream of having a open community space', reported one maker. The potential for evolving maker practices, as well as understanding how to empower citizens via making, hence hinges to an important extent on actions of organisers such as the library, as both a social and physical entity.

On a personal level the most internationally active lead-user participants did not find the workshop particularly impactful to themselves, but five of the nine participants interviewed found the diversity of backgrounds and domains in the workshop to be the most memorable part. For two people, this variety had pushed their own ideas further, based on what they heard from others and challenged themselves to represent important ideas that had not yet been discussed. They remembered their own contributions more than a year later, and one stressed that his ideas have continued to influence his thinking on urban maker spaces and distributed production. One participant attributed his enhanced knowledge of the potential of maker practices and citizen learning to the workshop, reporting that this has implicitly (if not directly) impacted his workplace and its strategic discussions.

6. Conclusions

In this paper we have reported on what we believe is a new variation, if not a new way, to conduct futuring collaboratively as part of a major development project. Drawing from user innovation research and PD, we did not seek to work with the 'renowned best experts' such as university professors or consultants, but with the future users to chart where their practices may be heading and what solutions this may provide. Such a democratic approach to futuring and mid-range planning was predicated on findings that some users live in the future of others, through having already faced the needs of the rest of the user population earlier (von Hippel 2005). Our work was equally predicated on how PD has demonstrated how ordinary workers and citizens have been capacitated to become competent in the design of complex technologies (Bødker, Kensing, and J. Simonsen 2004; Voss et al. 2009).

Our mix between these two approaches allowed us to harvest and then weight a substantial amount of trend information related to the diffuse and fast-moving area of maker activities, technologies, organising and regulations. Even more importantly, it provided a considerable stock of concrete solutions, and it was there where the most novel information arose for the library planners, as evidenced by the relevance scoring and retrospective reflections. The wealth, concreteness and coverage of different aspects of making (not only technologies but sharing models and so on) would have been difficult to glean from mere experts. It is not clear that experts would have had a similar kind of motivation to participate in the further elaboration of solutions after the workshop as representatives from user communities who might actually use the spaces themselves. The more traditionally used 'participatory futuring' techniques such as charrettes, public

Delphis and future search conferences would equally have been unlikely to produce such concrete solution understanding.

This is thus where we see the primary contribution of our experiment: collaborative futuring with participants appears to provide relevant and substantive information for planning. The gained insights are such that it would be difficult or more costly to attain them by other means. In normative terms such an approach to futuring allows a more democratic engagement with the implicated user communities.

The secondary contribution of our experiment concerns the particular set-up we used. Placing the workshop as part of concrete and long-term engagement with user communities was a strategy that worked well. The event created networks and conditions that allow updating the view of 2020 maker space requirements on a rolling basis, particularly through the real-life prototype space. The 'hands-on futuring' through full-scale prototyping clearly facilitated this engagement: the high yield and high relevance scoring of solution information in the workshop and the yield of live prototype suggest that instead of functional fixedness on present-day solutions, such concretisations can become springboards for envisioning as well as offer concrete discussion points between planners and participants that allow learning between the parties.

However, it is less clear how to assess the consequences of not aiming for top lead users but instead emphasising the local communities and their most 'lead-user-like' participants. User innovation research would be concerned to assess the objective quality of ideas, but in real-life set-ups this is difficult to do without a control or comparison group. We can, however, conclude that, at least for this planning project, and when augmented with the PD means, both the trend and solution information contained a substantial amount of novel and well-justified assertions by participants that were scored as relevant for the planners and endorsed by peers from other making communities. The gathering of representatives from different maker sub-cultures allowed cross-validating the ideas: some trends and some solutions were regarded by many as important, while some were downplayed by others. We hence cautiously assert that the facilitative arrangements and principles from PD may go some distance in compensating for not working with globally top lead users: the workshop did not collapse or produce mere trivialities for the client.

The opportunity for the affected citizen communities, through their representatives, to have the democratic possibility to steer the direction of socio-technical arrangements is commonly seen as a key criteria for successful PD (Asaro 2000; Bødker, Kensing, and J. Simonsen 2004). The current arrangements offer an example of how traditional PD formats for inclusion can be modified for 'lead user-like' participants[2] (cf. Mønsted and Onarheim 2010). With this in mind, three issues stand out. First, for the kinds of participants we worked with, turning inspiration cards into simple category markers did not stale the participants' capacity to envision. Participants who have at least fair lead user characteristics will have extensive solution and trend information, and such people could even be hampered by the use of complex creativity props in elaborating what they find important.

Second, keeping participants working alone or in small groups for the majority of the day ensured they would have due opportunity to express the assessments and solutions related to their deepest competence area, and judging from our workshop results this appears to have been beneficial. It would have also been detrimental to our capacity to record and analyse participant views if we had moved into group work from the outset – the aim was to give voice to the diversity, not to forge consensus. When group work began in the final phase of the workshop the solutions for the set-up of the pilot maker space were

such that they were agreed on and implemented by the Helsinki City library. Had many participants not specifically stressed the difficulty of attending any more than a one-day workshop, the collaborative ideation and collaborative further trend exploration might have been phased in a more iterative fashion.

Third, one could ask if still wider participation from the maker communities and perhaps including non-maker citizens might have achieved the same results. Perhaps. But having participants who were deeply immersed in current and future making did allow us to work without any prompting on the substance of future making and gave the maker communities an unfiltered way to represent their case to the planners and continue elaborating it with them with broader constituencies involved, including the myriad of citizen interactions in the prototype maker facility.

To sum up, the complementary elements offered by user innovation research and PD did play out well in the current case, offering a proof-of-concept that some purposeful cross-breeding from these traditions can be achieved. How this can be done differently, in a more widely democratic way or more effectively by adhering more to the principles of one or the other approach is a quest we invite others in co-design to join.

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Notes

1. In another line of inquiry, we assessed the implications that the participants saw for the trends and solutions for environmental sustainability (Kohtala and Hyysalo, in review) but leave this more detailed analysis aside here.
2. We are thankful to the anonymous reviewer for this formulation.

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