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# Me-to-We Design: How Can a Makerspace Nurture the Building of a Collaborative Community?

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**Abstract.** Makerspaces provide communal access to resources such as 3D printers, laser cutters, electronics equipment, and sewing machines. This way, makerspaces aspire to facilitate their users – the so-called makers – in acquiring craft skills, creating products, learning about technology, and meeting other makers. The collaborative qualities of the makerspace community are key to this aspiration. Yet, just like many non-makerspace initiatives, makerspaces often struggle to foster and sustain a collaborative community. In this study, we use the model of me-to-we design to analyze a makerspace that has succeeded in nurturing a collaborative community. We disentangle the makerspace activities into the five stages of the model and, on that basis, arrive at six principles for nurturing collaborative makerspace communities: (1) accept diverse entry and end points, (2) plan for transitions, (3) help makers devise meaningful projects, (4) encourage sharing and lightweight documentation, (5) collaborate toward communal goals, and (6) attend to the social.

**Keywords:** Makerspace, Making, Co-design, Designing social experiences.

## 1 Introduction

Makerspaces are communal facilities that provide their users with access to resources such as 3D printers, laser cutters, electronics equipment, and sewing machines. The users – known as makers – are a mix of creative people who seek to express themselves with the makerspace tools [9] and skillful technicians who seek to share their interest in technology with others [28]. The collaborative qualities of a makerspace are important in attracting makers. To thrive, a makerspace must provide a sense of community that nurtures information exchange, social encounters, informal collaboration, and other forms of sharing among the makers. Yet, many makerspaces struggle to foster and sustain an inclusive and collaborative community, and it is unclear from the existing research under what circumstances such collaboration succeeds. Similarly, many non-makerspace initiatives struggle to capitalize on the capabilities of social activities (e.g., [18, 19]). Thus, there is a need for models of how to design for collaborative experiences. One such model is me-to-we design [24].

In this study, we apply the model of me-to-we design to the activities in a makerspace in a rural municipality in Denmark. Importantly, the model does not imply that collab-

orative activities must replace individual activities. Rather, the makerspace must support activities that span from individual to collaborative. By analyzing the activities in the makerspace, we provide a case-based answer to the research question: *How can a makerspace nurture the building of a collaborative community?* The studied makerspace has managed to build and sustain a collaborative community in which individual projects coexist with social and collaborative activities. We investigate how this is accomplished and arrive at six principles for nurturing collaborative communities.

## 2 Makerspace Communities

Many studies mention the social and collaborative qualities of makerspaces [6, 8, 12, 26]. Yet, in the existing body of research, these qualities tend to be scaffolded in predefined activities such as courses [27], distributed in wider maker networks [10], directed at actors external to the makerspace [17], or assumed as part of the informal exchanges among individuals [13]. Only few studies have investigated discretionary collaborations among users around a shared objective: Hui and Gerber [12] report of a group of makers who collaboratively make objects for an educational program. Davies [4] discovers collaborative projects where makers contribute with diverse skills and value the interdisciplinarity. Toombs et al. [28] emphasize the collaborative effort that goes into taking care of a makerspace.

Most makerspace research investigates how makerspaces facilitate individual makers in creating products on their own and learning about technology [2, 27, 30]. These studies emphasize the creative, immersive, and practical aspects of making [9, 22]. They also emphasize that makers obtain help and inspiration from peers in the makerspace [13] and from online videos and tutorials [9, 29]. For some makers, the social relations in the makerspace are as important as the possibilities for making tangible products [4, 26]. These makers value that makerspaces provide a place to meet others with similar interests.

In spite of their qualities, makerspace communities also cause problems. For example, some regular users stake claims to machinery, even when they are not currently using it, thereby blocking other makers' access to the machinery [1]. Furthermore, several studies find that the community of regular users can constitute a barrier for newcomers, who experience the community as difficult to enter [5, 7, 25]. To make the communities more inclusive, research has suggested recruitment through structured object-focused activities [6], promotion of arts and crafts practices [15], and reconfiguration of the community [25]. Such changes are not easy to accomplish and may have unintended consequences on the long-term evolution of the community [23]. Sustainable models for balancing the individual (me) and social (we) have yet to be developed.

## 3 Me-to-We Design

Simon [24] originally devised me-to-we design to reconnect museums with their audiences. The overarching aim was to engage museum visitors through the creation of personally rewarding, social experiences. When people have such experiences, they

enjoy themselves and want to revisit the museum in the future. The challenge is to design a context in which people are prepared to collaborate confidently with other museum visitors, that is, with strangers. Me-to-we design posits that this preparedness can be fostered by enabling people to engage through personal, not social, entry points. Thus, the basic principle in me-to-we design is that personal entry points (me) are an effective means of scaffolding social experiences (we).

Me-to-we design provides a five-stage model for moving from individual to social experiences, see Table 1. The stages are progressive in that higher-level stages presuppose the groundwork provided by the lower-level stages. To illustrate the broad applicability of me-to-we design, Simon [24] supplements the museum-related examples with the example of turning the individual, and sometimes loathed, activity of running into a screen-supported social competition. At Stage 1, you listen to music on your phone while running on your own. You can create motivational playlists, but essentially "you consume music as the pavement consumes your shoes" [24]. At Stage 2, your phone tracks your location in real time and provides statistics about your performance. Reviewing your statistics helps you stay disciplined. At Stage 3, you share your statistics online with other runners and use theirs as inspiration. Even without connecting with them directly, you get a sense of community: If they can run that long or fast, maybe you can too. At Stage 4, you form online teams with other runners and take on collective challenges. These challenges make you accountable to your virtual teammates. Running is no longer just about your personal exercise, but also about being part of the team. At Stage 5, you meet with your virtual teammates for real-life running events or for real-time chatting while each of you are running in your own neighborhood. In total, running has been transformed from an exercise that requires personal discipline to an experience that is socially driven – from me to we.

**Table 1.** The five stages of me-to-we design, based on Simon [24].

| | Stage | Definition | Museum example |
|---|---|---|---|
| We | 5 | Individuals engage with each other socially | Visitors experience the museum as a place full of potentially enriching social encounters |
| ↑ | 4 | Individual interactions are networked for social use | Visitors connect with particular people – staff and other visitors – who share their interests |
| ↑ | 3 | Individual interactions are networked in aggregate | Visitors can see where their interests and actions fit in the wider community of visitors |
| ↑ | 2 | Individual interacts with content | Visitors are provided with an opportunity for inquiry, for taking action, and for asking questions |
| ↓ | 1 | Individual consumes content | Visitors are provided with access to the content that they seek |
| Me | | | |

## 4 Method

To examine how makerspaces can nurture a collaborative community, we conducted a multimethod case study [14] in a Danish library makerspace. The case, Vordingborg Makerspace, was selected for its communal qualities as it was open to all citizens in the

local municipality, established in a citizen-driven process, and had a community of about thirty regulars, who to a large extent ran the makerspace. Vordingborg Makerspace is situated in a medium-sized city and occupies three rooms in its public library. These rooms have tools and materials for 3D printing, laser cutting, soldering, CNC milling, t-shirt printing, sewing, and tinkering with electronics and robotics.

The data material for this study comprises 25 hours of observation and interviews with six users and two staff members. The observations were conducted over seven sessions. Six sessions were in the makerspace when the community met on Tuesday evenings; one was from a makerspace trip to the local dump yard to scout for materials. The observations were documented in field notes describing the place, the users, and their activities – individual as well as social. Furthermore, the makerspace Facebook group was monitored. The interviewed users were mainly regulars. These interviews lasted on average 50 minutes and concerned the users' motivation, history of becoming makers, affiliation to the makerspace, accounts of projects, and descriptions of how making interacted with their life. The staff interviews included the main makerspace facilitator and the library manager. They were interviewed about the objectives of the makerspace, the activities in it, the barriers they experienced, and the relation between the makerspace and the library. All interviews were recorded and transcribed.

The observations and interviews showed many activities happening in parallel. In analyzing the data, we used the model of me-to-we design [24] to disentangle the activities and structure our analysis. We acknowledge that the model was originally devised to facilitate design, but contend that it can also be used analytically. As an analytic framework, the model served to deconstruct a case in which a mix of individual and collaborative practices already existed. The analysis proceeded by identifying activities at different model stages and accounting for how makers entered and transitioned among the stages. That is, we coded the field notes, interview transcripts, and Facebook posts according to model stages (Table 1), personal entry points, and transitions among stages. In addition, we recorded differences in which stages the makers preferred.

## 5 Results

The community in Vordingborg Makerspace meets on Tuesday and Thursday evenings. From 6.30 in the afternoon, the regulars gather in the makerspace and engage in multiple activities spread across its three rooms. In the first room (which during regular office hours is the library staff's lunchroom), makers can attend courses. Only separated by a sliding door, the second room is a large open space with tables, 3D printers, and stocks of electronic components. This room also features a coffee cart where makers gather and socialize. The third room is for noisy activities such as laser cutting, CNC milling, and crafting. At times, all participants assemble to receive practical information, see an example, or discuss a project. But most of the time, they are engaged in a multitude of different activities. Because these activities run in parallel, the makers have ample opportunity for seeking assistance, sharing objects, observing what others are doing, and feeling connected to the community. In the following, we disentangle this mix of activities using the five stages of the me-to-we model.

*Individuals consuming content* (Stage 1): The entry point for participating in the makerspace is an interest in technology or a curiosity about the possibilities afforded by the makerspace. The makerspace supports exploration by providing new users a tour of the space and hosting courses about tools and techniques every second week. One week, the course was about 3D modeling. For this course, the participants were handed a computer and instructed to follow along while modeling a nut (i.e., adding the octangular shape, the thread at the center, etc.). One of the participants was a retired engineer and collector of industrial CNC mills. He was already familiar with the makerspace but only visits it to attend courses and discuss technology informally with the other participants. Consuming the course content is suitable for him. Because he does not have a specific project he wishes to complete, he contentedly remains at Stage 1. To transition to the next stage, the makers must have a project idea they wish to pursue.

*Individuals interacting with content* (Stage 2): A project can be a technical exercise proposed by a course instructor, but most projects are defined by the makers themselves. Many makers enter the makerspace with such a project idea as their motivation for arriving. For them, the courses provide the prerequisites for proceeding to work on their projects. Through their projects, they interact with content in ways they experience as pleasurable and rewarding. For example, the interviewed makers enjoyed *"figuring out how things work"* (User 1), *"seeing the final outcome"* (User 1), *"taking on a challenge"* (User 2), *"immersing into a different world"* (User 2), and "*making something where you are not accountable for your time [in opposition to work]"* (User 6). Two of the six interviewed makers avoid the community evenings because they prefer unrestricted tool access and space to immerse themselves. However, the other four make their projects during the community evenings to have easy access to assistance and be able to share their ideas with others. The co-presence during the community evenings also affords makers in transitioning to the next stages.

*Individual interactions are networked in aggregate* (Stage 3): Both the interviews and observations showed that makers are prepared to share. For example, User 4 stated that "*In the makerspace we exchange information just like you in books pass on knowledge and wisdom. It is a place where you can access knowledge.*" Most of the sharing occurs through face-to-face exchanges, but sharing is also made manifest in the Facebook group and curated in the makerspace. The Facebook group counts 390 members. In addition to posts with practical information, the makers share inspirational articles, ask for help, and showcase completed projects. The showcased projects include role-playing objects, engraving in phones, a laser-cut Eiffel tower, and a device to translate Morse code (inputted on an Arduino-based device) to text.

In the makerspace, examples and demonstration projects are kept on display. For instance, example objects are curated near the 3D printers, completed projects are curated in a glass display, and a bulletin board lists the competences of the regular users (Figure 1). Along with the Facebook group, the examples, projects, and other information curated in the makerspace are aggregates of the makers' activities. These aggregates support additional activity and stage transitions in two ways. First, they help new makers get a sense of the possibilities afforded by the makerspace. Second, they provide inspiration for new projects and higher aspirations: If other makers have been able to complete these projects, then my project idea may be feasible too.

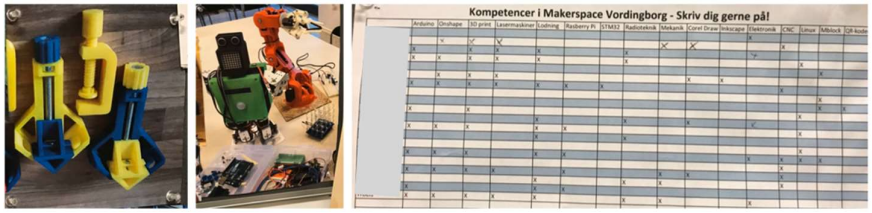


**Figure 1.** Aggregates of participation displayed in the makerspace**.**

*Individual interactions are networked for social use* (Stage 4): While the majority of the makers perform their individual projects, our observations also include examples of collaborative projects, such as parents making with their children. One collaborative project was especially large and involved making an unmanned underwater vehicle (UUV). The idea for the UUV project arose from a makerspace field trip to a technical university. After the field trip, the project was announced on the makerspace Facebook page to encourage participation and, then, a private Facebook group was established for the project. The project was undertaken by four of the regulars, who contributed expertise in different areas. For example, one was responsible for the Arduino programming, while another made the 3D drawings and printed propellers. In addition to the delegated technical tasks, the project required a lot of discussion and coordination among the participants. Many of these collective activities took place at a whiteboard in the makerspace and were summarized in Facebook postings. The makerspace welcomes collaborative projects because they create ties among the makers and make grander project ideas feasible. Therefore, the makerspace supports these projects by financing materials. However, the UUV project eventually stalled, maybe because it lacked an external purpose. In an interview, one of the participants explained that the motivation behind the project was to have "*something to fall back on when we are there [i.e., in the makerspace] anyway*" (User 4). Over time, this motivation gave way to other activities in the makerspace and outside of it.

*Individuals engage with each other socially* (Stage 5): The social qualities of the makerspace are found at all stages. Specifically, the course participation and UUV project demonstrate that many users value the makerspace as much for the social encounters as for the project outcomes. Stage 5 stands out by having contribution to the community as a distinct element. The contribution may be internal to the makerspace or by promoting it externally. For example, one maker described that his entry point was to bring his individual hobby of electronics tinkering from his home to the makerspace where he could talk with others with similar interests. From that starting point, his participation soon transitioned into helping others and promoting the makerspace with a demonstration project at a local conference. Others are motivated by communal goals such as making youth interested in science, technology, engineering, and mathematics (STEM) disciplines. These makers have transitioned out of the project focus characteristic of Stages 2-4. Instead, they enjoy contributing to the makerspace and the local community by helping others, servicing tools, giving courses, organizing field trips, promoting the makerspace, and the like. Without their contributions, it would not be

possible to run courses every second week on the community evenings, thereby limiting Stage 1 and the possibilities for new makers to become part of the community.

## 6 Concluding Discussion

The studied makerspace succeeds in facilitating activities that span all five stages in the model of me-to-we design [24]. This way, the makerspace nurtures a collaborative community that attracts new makers and remains attractive to the regulars. On the basis of the analysis, we propose six principles for establishing and sustaining a collaborative makerspace community. With these principles, we aim to articulate the practical implications of our analysis. That is, we aim to support me-to-we *design*. We acknowledge that the principles are based on one case. The six proposed principles are:

*Accept diverse entry and end points.* Consistent with prior research [9, 26], our results show that makers enter the makerspace at different stages and end their cross-stage transitions at different stages. Many of the observed and interviewed users value the community evenings because they provide ready access to help, add social qualities, and allow for contributing to the community. Another group of makers avoids the community evenings. These makers are motivated by immersing themselves in their creative processes, prefer to work alone, or feel underrepresented in the community [7, 25]. They have the opportunity to share their projects or attend the community evenings but prefer not to. In the studied makerspace, both staff and users acknowledge the makers' diverse motivations and accept participation at all stages of the me-to-we model.

*Plan for transitions*. The analytic benefit of the me-to-we model [24] is that it calls attention to the transitions among its stages. The co-situated activities on the community evenings afford transitions because the makers are exposed to courses, projects made by peers, and inevitable social encounters all at once. The me-to-we model shows how participation can gradually transition from individual toward communal activities. This appears an intuitive approach to the inclusion of new makers [6]. However, we also find that transitions are multidirectional. For example, some newcomers transition back and forth between courses and projects (Stages 1 and 2). Relatedly, some experienced makers transition back and forth between communal activities (Stage 5) and the early stages of participation (Stages 1 to 3) when they volunteer for teaching, guide new users, and share completed projects. Makerspace staff may enrich makers' participation by reflecting on the qualities of the stages and scaffolding transitions among them.

*Help makers devise meaningful projects.* Makers are interested in the technical and expressive possibilities of physical computing and fabrication tools [10]. These tools enable ordinary people to engage in advanced fabrication, and the makerspace assembles the tools in the local community. While insufficient technical skills can be a barrier to makerspace participation [6], newcomers in the studied makerspace can acquire these skills through courses, exercise sheets, and peer assistance. We find less support for the transition from being familiar with tools (Stage 1) to making projects (Stage 2). Prior research has emphasized that meaningful projects are key drivers of learning [2, 20]. However, we (and others [4]) find that makers are presumed to have a meaningful project idea and the self-sufficiency to pursue it. Without support for devising meaningful

projects, makers may struggle to identify worthwhile project ideas. Better support for devising projects could include assistance in refining an initial idea, but it could also involve a shared catalogue of projects proposed by other makers or needed by citizens who are not themselves able to undertake the projects.

*Encourage sharing and lightweight documentation.* Like in other makerspaces [12], our case displays a community with much willingness to share information through file sharing, material exchanges, peer tutoring, course teaching, and the informal flow of advice, news, and creative input. Yet, documentation of completed projects is only shared to a limited extent. Makers may use their documentation of their own projects for reflection and learning about the project process [29]. But documentation may also support others in developing new meanings and mediate contacts among people [11]. By aggregating interactions (Stage 3), shared documentation makes some of the otherwise invisible makerspace activities visible. Thereby, documentation such as a short video may show how key steps in a project were accomplished. Users may however abstain from making or sharing documentation because they feel that their projects do not demonstrate enough skill or because documentation is a time-consuming activity that may require users to repeat parts of their process for the purpose of video-recording them [29]. Makerspaces should encourage the sharing of documentation but should also emphasize lightweight documentation to make it manageable to produce.

*Collaborate toward communal goals.* Collaboration connects makers around a shared goal [9] and allows for undertaking advanced projects. While valued, projects with interdependence and a shared objective are rare in the studied makerspace. We find two reasons for this. First, collaboration adds complexity [21] because objectives require negotiation, work must be divided, activities must be articulated, and mutual interdependences may stall progress. Because making is a leisure activity centered around a pragmatic identity of 'just doing' [3], the complexity can cause more frustration than joy. Second, the UUV project was not motivated by an actual need; the makers merely wanted to have a project to fall back on. While we acknowledge the difficulty of balancing leisure and obligation, we suggest that makerspaces consider reaching out to the local community outside the makerspace with an invitation to collaborate about projects that matter to the local community. Being anchored in local needs, these projects will likely be meaningful to makers who resonate with the needs. Proposals for such projects could be catalogued and kept on display in the makerspace or they could be presented on a community evening to stir interest and make connections.

*Attend to the social.* The social qualities of makerspaces should not be underrated. Studies have found that makerspaces provide conditions conducive of wellbeing for both youth and adults. Makers feel empowered by immersing in productive activity, but they also enjoy meeting others and being part of a community [16, 26]. We observed intense engagement among users with similar interests as well as unexpected encounters among users across age and group boundaries. Sustaining a constructive social atmosphere requires ongoing care [28]. The staff in the studied makerspace cared for the social atmosphere by serving coffee, facilitating meetings among users who could learn from one another, providing opportunities for users to take ownership, organizing social activities that celebrate the community, and so forth.

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