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Space configurations for empowering university-community interactions

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Abstract

Some see universities as a possible source of solutions to enable a sustainable transition and overcome societal challenges. Findings from three multisite case studies of Desis Labs, FabLabs, and Science Shops shed light on how universities can help empower communities and solve societal challenges locally. Adopting a sociotechnical and flat relational perspective inspired by science and technology studies (STS), we focus on the material and spatial aspects of how these spaces are configured, thereby ensuring practical relevance for policy makers and practitioners. Applying an analytical generalization methodology, we condense the qualitative data into a typology of three ideal space-types (i.e. affording, mediating, and impact-oriented) that represent specific configurations of actors, researchers, students, communities, spaces, infrastructure, equipment, facilitators, etc. The ideal space-types empower communities in different ways, require different resources to create and operate, and translate differently into specific local contexts.

Key words: university third mission; intermediaries; actor-network theory; community empowerment; societal impact; social innovation

1. Introduction

Our research question stems from a puzzle: How can universities effectively collaborate with and empower communities, given the mounting societal challenges for the modern welfare state (Haxeltine et al. 2017) and increasing demands for measurable societal benefits (Olmos-Peñuela et al. 2016)? Our analysis contributes to the literature on the third mission of universities and university innovation systems. The third mission concept has several shortcomings, including: a dominant economic focus (Trencher et al. 2014); a failure to recognize diversity among types of institutions, contexts, and community engagement activities (Benneworth et al. 2016), as third mission perspectives have been shown to be geographically contingent (Loi and Di Guardo 2015); a failure to value the work of knowledge intermediaries (Schlierf and Meyer 2013), which renders non-economic impacts invisible and works against open research behaviour (Olmos-Peñuela et al. 2016); and a failure to account for the essential explorative nature of university-society interactions (Meyer and Kearnes 2013). Thus, one-size-fits-all policy concepts like the third mission are inadequate (Benneworth et al. 2016). The dominant innovation paradigm also lacks transparency and is not democratic, whereas spaces like FabLabs may represent an alternative innovation paradigm (Smith 2017).

We thus take local university specificities and historical trajectories into account, illustrating how specific types of initiatives provide a better fit for certain universities and communities. We also have a political interest in democratizing university-community interactions. Drawing on empirical data from cases, we develop a theoretical framework that reveals how universities may contribute to enable citizens' involvement in innovation, and show how grassroots movements through this type of cooperation may develop their capacity to co-create sustainable solutions. To date, very few researchers have focused on developing theory-informed frameworks for analysing how different models of university-community interactions facilitate the empowerment of local communities. We present findings based on three multisite case studies within the international networks of Desis Labs, FabLabs, and Science Shops. These cases are part of a larger study of twenty social innovation networks in the TRANSIT project (www.transitsocialinnovation.eu).

In the third mission perspective, the two traditional missions of higher education institutions are teaching and research (Bernardo et al. 2012); Humboldtian universities in Europe and the English-speaking world have framed all other activities as a form of charity called community engagement or outreach that has kept society at arm's length (Schoen 2006). These activities are now often referred to as the third mission, typically encompassing everything related to external actors (Benneworth et al. 2016; Jongbloed et al. 2008), or all activities beyond the scopes of the first and second missions (Göransson et al. 2009).

These activities often focus on technology transfer and commercial partnerships (Benneworth and Jongbloed 2010; Bleiklie and Kogan 2007; Olmos-Peñuela et al. 2016; Slaughter and Rhoades

2010; Thune et al. 2016; Trencher et al. 2014), and are mostly measured in economic terms (Trencher et al. 2014). Notably, despite the focus on universities' contributions to innovation during the last two decades (Jongbloed et al. 2008), there seems to be a lack of published evidence that demonstrates the impact of public engagement in the context of third mission initiatives (Emery et al. 2015; Trencher et al. 2013) beyond attempts that problematize the evaluation and current focus of the third mission (Schlierf and Meyer 2013; Trencher et al. 2013).

Nevertheless, scholars have shifted from simple perspective of contributing to economic development to transforming and co-creating society (Trencher et al. 2014), as well as science democracy and public participation (Chilvers and Kearnes 2016), which is the trajectory our three cases build upon. Researchers have analysed the operation and impact of Science Shops previously (DeBok and Steinhaus 2008; Hende and Jørgensen 2001; Wachelder 2003), and more recently in the TRANSIT project (Dorland 2018; Dorland and Jørgensen 2016). This literature is more descriptive than explanatory, which is useful for comparing our cases, but provides little theoretical input for understanding how universities can empower communities. This article takes a more bottom-up and grassroots perspective than Chilvers and Kearnes (2016), aiming at providing empowering knowledge for practitioners and illustrating specific ways to operationalize empowering interactions with communities, rather than public participation in and impact on science (Chilvers and Kearnes 2016), although that itself may be a specific form of empowerment. Research on FabLabs is also scant beyond the TRANSIT case study (Hielscher et al. 2015), with just a few recent publications (Kohtala 2017; Smith et al. 2017); moreover, researchers either did not focus on community empowerment or did not clearly delineate impacts on empowerment. For FabLabs, few if any scholars have focused specifically on university-related sites.

To study the interactions between universities and societal stakeholders and related empowerment processes, we turn to science and technology studies (STS), building on the tradition of Law, Akrich, and Latour, and other performative approaches to innovation and change (Akrich 1992; Bijker and Law 1992; Latour 2007; Latour and Woolgar 2013). We adopt a particular perspective on STS, emphasizing its practical relevance by focusing on how innovative processes are staged (Clausen and Yoshinaka 2007). The staging approach contributes a spatial perspective on university-society interactions to focus on the context and specific actors and objects that facilitate and enable the empowerment process. Adopting this approach enables us to ask who and what are involved and in what ways, as we seek to relate outcomes to particular choices of organisational engagement. This fits well with the relational approaches from STS such as actor-network theory (ANT) and the notions of staging and configuration (Clausen and Gunn 2015; Clausen and Yoshinaka 2007), which refer to the process of determining the final layout of necessary elements. The empirical cases also fit well with a spatial perspective as they all relate to specific spaces and places. Our case studies of the Science Shop (ScS), FabLab, and Desis Lab (DL) networks focus on local initiatives that are place-specific. The research question then becomes: *How can university-community interactions involve and empower communities through specific configurations of spaces?* A spatial perspective helps incorporate material aspects into the analysis, thereby making the findings more practically relevant.

1.1 Article structure

The rest of this article is organized as follows. In the next section, we present the theoretical background by discussing literature on spatiality and STS. Then, we briefly present the methodology of the TRANSIT project (i.e. the source of our empirics) and explain our analytical approach. After presenting the case studies, we analytically generalize the data into conceptual ideal-types, which we then combine into a theoretical explanatory typology of different space-type configurations. We discuss our findings in relation to our objective of empowerment, and provide practical advice on staging these space configurations before concluding with an overall summary of our findings.

2. Spaces

Multiple forms of spatiality exist (Harvey 2004; Law 1999, 2002; Taylor and Spicer 2007), and different spaces, networks, or topologies overlap (Law 1999). Spatial metaphors also abound within STS (Clausen and Gunn 2015). Adopting a space perspective enables us to focus on the spatial and material dimensions of our cases and whether and how university-community interactions can contribute to community empowerment, which we frame in simple terms as the act of enabling actors to reach their goals (Adams 2008).

This relational approach to space is inspired by theories within STS such as ANT, but helps maintain a focus on the spatial dimensions of relationships and emerging networks. From an actor-network perspective, a simple working definition of empowerment is the process by which one actor enables the agency of another actor. However, Law, who is one of the founding fathers of ANT, admits researchers have neglected materiality and focused too much on networks and the relational dimension, despite the theory being heralded as material-semiotic (Law 1999, 2002; Law and Hetherington 2000). This is problematic, as all actions are situated— that is, they depend in essential ways on material and social circumstances (Suchman 2007). Empowerment is likewise a material phenomenon, as all interactions leading to empowerment take place in a socio-material context (Carlile et al. 2013; Dale and Burrell 2008). This perspective is also helpful as Science Shops, FabLabs, and Desis Labs are composed of entities bound to specific organizational and physical places; for example, a lab is connected to a specific department at a university, which has place-specific particularities (Casey 2003). Because of this material neglect in ANT, we refer to relational *spaces* instead of networks. We conceptualize space as having three distinct dimensions—material, relational, and place-specific. The differentiation into space types is not a division into distinct ontologies, but an analytic distinction between components of a single mesh.

2.1 Materiality of objects and spaces

Materiality itself is not a neutral notion (Carlile et al. 2013). From the Euro-American perspective, the most obvious definition emphasizes the physical dimension: spaces like offices, buildings, and parks (Lefebvre 1991); absolute spaces that can be drawn in an Euclidean coordinate system (Harvey 2004; Law 2002); or spaces defined by measurable distances (Taylor and Spicer 2007). The most tangible definition is that things are 'made of matter' or touchable 'stuff'. Different stuff creates different possibilities for action, which Gibson (2014) described as affordances.

Affordances are action possibilities that are part of the material nature of objects, the environment, or context. In contrast,

empowerment traditionally is seen as a powerful actor delegating power to a weaker actor (Adams 2008) (i.e. the recipient is passive). The actor gaining agency is not passive from an affordance perspective; powerful actors take advantage of the possibilities of objects through enactment. A bridge can be walked upon; water cannot, unless an actor is a water strider. Information and communications technology (ICT) only empower actors with the proficiency to use it. Because the actor and the environment constitute an inseparable pair (McGrenere and Ho 2000), materiality plays an important role in structuring the world. Other scholars within STS also have explored how materiality can be explicitly designed to structure interactions in certain ways, such as through scripts (Akrich 1992). A FabLab and its equipment often are undergirded by intentionality (i.e. a script). Likewise, scripts of Science Shops (ScSs) and Desis Labs (DLs) try to stage interactions in certain ways.

Although the meanings and understandings of objects and materiality (e.g. the value of gold or importance of access to green areas) are relational effects, that is not all they are. The action-possibilities that a space affords are in some ways also structured by its materiality.

2.2 Relational spaces

We use the term relational space instead of network to emphasize the spatial dimension and to analytically separate relations and materiality. However, the spaces are co-dependent; to make an object in one space it may be necessary to work in another (Law 2002; Law and Hetherington 2000), as surrounding spaces and places construct us as we construct them (Dale and Burrell 2008; Weick 1995). Objects and spaces are always enacted in multiple spaces and depend on their inter-relations for stability. A ScS or FabLab needs to operate in a relational space to obtain funding, resources, etc. Additionally, the physical placement of space and a lab's specific department affiliation affect the relations that are established or maintained and possibilities to obtain resources. Indeed, purely relational spaces do not exist, but large variations exist in the extent to which an entity is materially anchored. Relational space is also where agency and human intentions enter the picture, as agency exists when any actor influences another (Sayes 2014).

Elaborating a bit on this interrelation of spaces, we draw on what Latour terms an immutable mobile (Latour 1986). ScSs, DLs, and FabLabs are immutable mobiles: they travel from one university to another while retaining their core forms and functions. Does an Argentinian FabLab resemble a Danish FabLab? What is immutable, and how are manifestations different/similar in different places? The claim by Latour (1986) is that immutability is necessary to move and survive, while mediating (Latour 2007) or negotiating aspects outside the core likewise is crucial to adapt to new contexts. This is an alternative framing of why and how one size does not fit all (Benneworth et al. 2016).

2.3 Places

Places have developed into a very specific term referring to specific local spaces (Taylor and Spicer 2007). Places have 'peculiarities and heterogeneities … special stories and local customs' (Casey 2003: 2245), which affect how manifestations adapt. A specific ScS is an intersection of material and relational spaces. Place also relates to immutable mobiles, that in all ideas there is something fixed that travels.

When an idea like a FabLab is embraced by actors at a university, the concept clashes with the particularities of the specific place. But what is travelling? FabLabs is merely an idea after all. We have observed a wide range of spaces calling themselves FabLabs that seem different, but we assume there is an immutable core. There is also a difference between established 'archetypes' that are part of our institutional landscape and culture, like universities and hospitals, and novel ideas and concepts like FabLabs. Such institutionalized concepts have affordances. A kindergarten, grocery store, or toilet automatically elicits specific behaviour or expectations and sometimes entails regulation and implicit scripts that can be used in staging new iterations of these space-types. As the FabLab idea gains recognition, it also slowly becomes institutionalized and gains affordances. It is dangerous to oversimplify institutions such as universities, however, because they are not monolithic entities, but composed of a wide variety of internal groups (Pinheiro et al. 2016). In such cases, actors actively draw on such archetypes when staging new manifestations of space-types like FabLabs.

3. Methodology

This article is based on three distinct sources of data from the TRANSIT project: two batches of case studies (Jørgensen et al. 2015, 2016) and a meta-analysis (Pel, Bauler, et al. 2017). Researchers studied twenty international networks; in this article, we focus on three (Cipolla et al. 2015; Dorland and Jørgensen 2016; Hielscher et al. 2015). For each network, researchers studied two local cases and international interactions through semi-structured interviews, participatory observations, and document analysis (Jørgensen et al. 2015). The three case studies we present in this article are based on a total of seventy-seven semi-structured interviews of mostly internal staff and volunteers, as well as a few external partners or clients, and participant observation of twenty-five events such as workshops, management meetings, conferences, and festivals, as well as daily activities. However, we did not include all embedded cases within the three case studies; we focused specifically on university-related cases. In their meta-analysis, researchers on the TRANSIT project studied four local initiatives within each network using a concept called critical turning points (CTPs) to map the development of each initiative over time in order to substantiate, solidify, and/or falsify the findings from the in-depth case studies (Pel et al. 2017). Researchers identified six events for each embedded case in Table 1, involving eighteen semi-structured interviews. We do not elaborate further on the case study methodology used in the TRANSIT project, which are detailed elsewhere; we refer to the CTP database through the working paper by Pel, Bauler, et al. (2017) except quotes where the database is linked directly.

Scholars have developed different approaches and models in response to disagreements about the analytical strength of generalising based on qualitative data (Delmar 2010; Flyvbjerg 2006; Halkier 2011; Mason 2006). We analysed the data by ideal-typologizing (Collier et al. 2012; Doty and Glick 1994; Elman 2005; Halkier 2011), a technique that can be traced to one of the founding fathers of sociology, Max Weber (1949). Typologies can be descriptive/conceptual (Collier et al. 2012), explanatory/theoretical, or merely classification schemes (Doty and Glick 1994). A conceptual typology establishes a property space, and its ideal-types relate to its overarching focus, whereas an explanatory typology's ideal-types themselves are complex hypotheses built on multiple levels of theory (Doty and Glick 1994). It is important to remember that a property space defined by these dimensions contain many combinations; such ideal-types do not directly correspond to cases. A two-dimensional

Table 1. Overview of the three case studies and nine embedded cases.

Case names	Case study description
Case Study 1:	
Science Shops	The Science Shop movement began in the 1970s and the Living Knowledge network was established around 2000. A ScS is defined as providing independent, participatory research support in response to concerns experienced by civil society (Dorland and Jørgensen 2016). The network embraces a narrative about 'opening the ivory tower' that refers to establishing relationships between universities and civil society. The work is usually performed by students as part of their coursework.
Danish Science Shop (VB)	
Irish Science Shop 1 (DIT)	
UK Science Shop 2 (NI)	
Case Study 2:	
Desis Labs	The purpose of Desis is to promote design for sustainability in higher education institutions using primarily student labour. There is no formal open door, and DLs usually design their own projects and actively approach communities. The network was founded in 2014, based on activities dating back to 2007.
Desis Lab Florianópolis (NAS)	
Desis Lab Belo Horizonte (BH)	
Desis Lab Polimi (Polimi)	
Case Study 3:	
FabLabs	FabLabs aim to provide open spaces where people can access digital fabrication equipment. They are not necessarily linked to universities, but we only focus on those that are. Their models, purposes, and capabilities vary greatly. They are less project-based, and more focused on interactions between communities entering the space. The first FabLab can be traced to a course at MIT in 2001.
FL2	
FL3	
FL4	

typology is the typical matrix with four ideal-types when using binary high–low dimensions. Several ideal-type combinations would likely be empirically empty, theoretically unlikely, unsurprising, or overdetermined when using such a two-dimensional typology (Bennett and Elman 2006).

In this article, we construct conceptual typologies around the main aspects of material and relational spaces; we use these as the building blocks for an explanatory typology around ideal-types of spaces for university-community interactions that lead to empowerment. The construction of such typologies is work-intensive, with iterative rounds of coding. We coded the entire data corpus three times, as the continuously emerging categories and patterns needed to be checked across all cases. We used the constant comparative method beginning with the second step of typology development (Hammersley and Atkinson 1995). We identified the most prevalent categories and patterns that emerged as the dimensions of the typologies.

4. Case presentation: the three social innovations

The three cases we focus on are Science Shops (ScSs) related to the Living Knowledge network, Desis Labs (DLs) connected to the Desis Network, and FabLabs, often seen as part of the maker movement. Table 1 provides a short overview and description that is also illustrated in Figure 1. We include empirical examples in the analysis to make the discussion more precise and interesting. Beyond these cases, we have been in contact with ten additional ScSs and engaged with researchers working with DLs and FabLabs. FabLab and ScS cases have been anonymized.

5. Analysis and discussion

In this section, we reveal insights related to the relational, material, and place-based dimensions of empowerment. The three international networks in the case studies together span a wide spectrum of space configurations aimed at facilitating interactions between universities and communities. We map out the property space collectively constituted by the cases.

5.1 Relational space

The first dimension of empowerment is the creation of relational spaces, which we generalize into demand- and supply-based models. The supply-based approach is common among DLs, whereby affiliated researchers and students actively approach communities for projects, trying to transform their knowledge in a practical way to solve societal issues through participatory research. In the demand-based model common among ScSs and FabLabs, communities actively approach universities. ScSs encounter procedural challenges associated with accepting requests, creating visibility, and finding the manpower to translate the requests into appropriate research questions. For FabLabs, which are unfacilitated spaces, the main challenges relate to securing initial funding and sometimes finding part-time caretakers/technicians; like ScSs, FabLabs also struggle to create visibility, which is a general challenge across our cases(Pel, Dumitru, et al. 2017). A difference between DLs and ScSs is that ScSs facilitate new relationships and interactions between external groups across universities. Nevertheless, large variances exist, with VB having a dedicated research staff that enables independent research efforts, and DIT and NI only having administrative staff, like most ScSs, making them entirely dependent on collaborations with university researchers.

In FabLabs, which have little or no staff, relations are structured through the objects made available and conditions of use and access. Membership fees also embody and stabilize relationships and can help define them as casual or serious, whereby some external actors become permanent members, volunteers or caretakers/supervisors, a type of relationship that is unique to FabLabs among our cases. Relationships may also be anchored to members' personal projects, as people affiliate with projects and not with FabLabs per se, and thus may cease to affiliate with FabLabs after their projects are complete. This is problematic for FabLabs, which are based on community relationships. All cases reveal evidence of project-centred temporary relational spaces, but this is not as problematic for ScSs and DLs, which only extend relationships if the original problem is not solved.

The pertinent question centres on who these spaces aim to empower and in what ways. Despite the similarity and overlap between ScSs and DLs, the models are very different, with ScSs initiating relationships with universities on behalf of communities, and DLs starting projects based on curricular needs and research interests. DLs

work specifically on design projects related to sustainability; for example, by developing packaging for micro-businesses in a poor community, NA enabled the community to incorporate its products into the retail system—a very tangible impact that also enhanced members' teaching activities. ScSs aim to solve a large variety of problems experienced by communities by applying faculty expertise in law, environment, health, philosophy, design, etc. Crucially, by taking a citizen-informed approach to problems, ScSs inspire new research areas by viewing knowledge from citizens as equally valid and important, and providing problem-based education.

FabLabs aim to provide access to digital fabrication technology. Although the movement embraces some discourses on emancipating citizens from global production systems, ensuring transparent and democratic innovation, etc., we found no evidence of tangible outcomes that empowered members in our university-related cases. In the few references to what has been produced, outcomes seem to be less important; instead, members emphasize the relational spaces they create and the learning these spaces facilitate. Although some companies emerged from FL3, we have few details. Some non-university FabLabs like the one in Amersfoort (Hielscher et al. 2015) have shown clear signs of empowerment in their interactions with the local Transitions Town, but interestingly, all university-based FabLabs lack clear evidence of outcomes.

Many university-based FabLabs also restrict access to students and faculty, which the founders of FL2 find a bit problematic; essential members disappear from the community upon graduation, thereby restricting long-term community-building. FL2 also hired a technician to instantiate a very specific culture and set of practices by embedding specific behaviours and defining a clear identity to control how the relational space formed and developed, as the entity had no permanent staff members. Other FabLabs also faced restrictions imposed by universities. For example, FL3 encountered challenges in accessing buildings outside normal hours and had to rely on technicians to handle the equipment because of concerns in relation to the coverage of the university insurance(Pel, Bauler, et al. 2017), which limits community interactions. Our findings reveal two dimensions of relational spaces, which we describe in detail below.

Operational model. Operational models can be described as internal/supply-based focusing on transforming knowledge in the university to societal impact, or external/demand-based that aims to translate societal issues into research through co-production of knowledge. This dimension is determined by who takes the initiative to create relationships, and the perspective on who has the knowledge about what the problems are. The demand-based approach is more resource intensive, as staff and/or infrastructure must be available continuously to serve members of external communities who approach them with problems or projects, which then must be discussed, translated, and facilitated. In contrast, the supply-based approach often fits within the normal duties of research and teaching.

Process vs. impact: Relations as means or ends. The second dimension of relational spaces is defined by the focus on relationships as either ongoing interactions (process) or outcomes (impact). FabLabs must build long-term relationships, as members are their sources of labour (volunteers), knowledge, and sometimes funding. For university-affiliated FabLabs, the relational space seems to be the goal; the ongoing relationships and interactions are what facilitate learning and innovation in the community. ScSs also aim to establish university-community relationships, but only temporarily around projects, as the focus is on outcomes. DLs adopt a transition agenda and focus on teaching communities about sustainability and solving social problems through design, and is outcome-focused, although some individual DLs may focus more on ongoing relationships.

As shown in Fig. 2, our analysis reveals three ideal-types of relational spaces:

- Type A: Citizen-informed research. Communities must actively approach universities, at which point relationships with appropriate researchers are actively established through a facilitated translation-process. This type is impact- and outcome-oriented; although permanent relationships are sometimes established, it is not the goal. Relationships often cease after projects are completed.
- Type B: Academically-oriented research. University actors define projects and approach communities based on student needs and research interests. Rather than building relationships, the objective is to solve specific challenges and create positive impacts by transforming university knowledge into specific outcomes through a process of community participation.
- Type C: Bottom-up interactions and relationships for learning and empowerment. Although this ideal-type is not based on approaching communities and facilitating interactions, building permanent relationships is important, as communities provide many resources that enable learning, innovation, and empowerment. Providing infrastructure and resources to attract and empower communities is thus essential.

The empirical data do not support top-down defined interactions for learning and empowerment as an ideal-type (Type D). This type represents more traditional outreach and education activities conducted in communities described in the introduction.

The traditional ScS model is type A. VB shares characteristics of types B and C, whereas DLs tend to be type B. Desis Polimi falls somewhere between A and B, showing that the types are partly context-dependent. Finally, FabLabs tend to be type C, as they rely on creating new long-term relationships and are unfacilitated.

5.2 Material space and objects

Materiality appears in form of the spaces and objects by which initiatives facilitate new relationships and interactions. Objects are also produced during interactions between communities and universities; objects like scientific documentation from ScSs, or new product packaging from DLs facilitate agency.

In all cases, initiatives produce knowledge objects in the form of reports, blueprints, documentation, handbooks and other documents both in physical and digital forms. However, only ScSs typically use knowledge objects to directly facilitate empowerment, for instance by providing scientific documentation to communities about pollution that can be used in interactions with public authorities. One of the challenges here is to translate knowledge into a suitable material form, as knowledge cannot travel without being manifested (Czarniawska-Joerges and Sevón 2005). Instead of issuing a scientific report, VB transformed findings from its project on the carbon footprint of food into a visual presentation based on the food pyramid, thereby enabling its use in the kitchens and cafeterias of public institutions. Especially for ScSs, knowledge objects play a significant role in this empowerment process, while DLs and FabLabs do not explicitly use knowledge objects to facilitate empowerment. NAS designed product packaging that complies with standards and fulfils legal requirements, thus enabling access to the

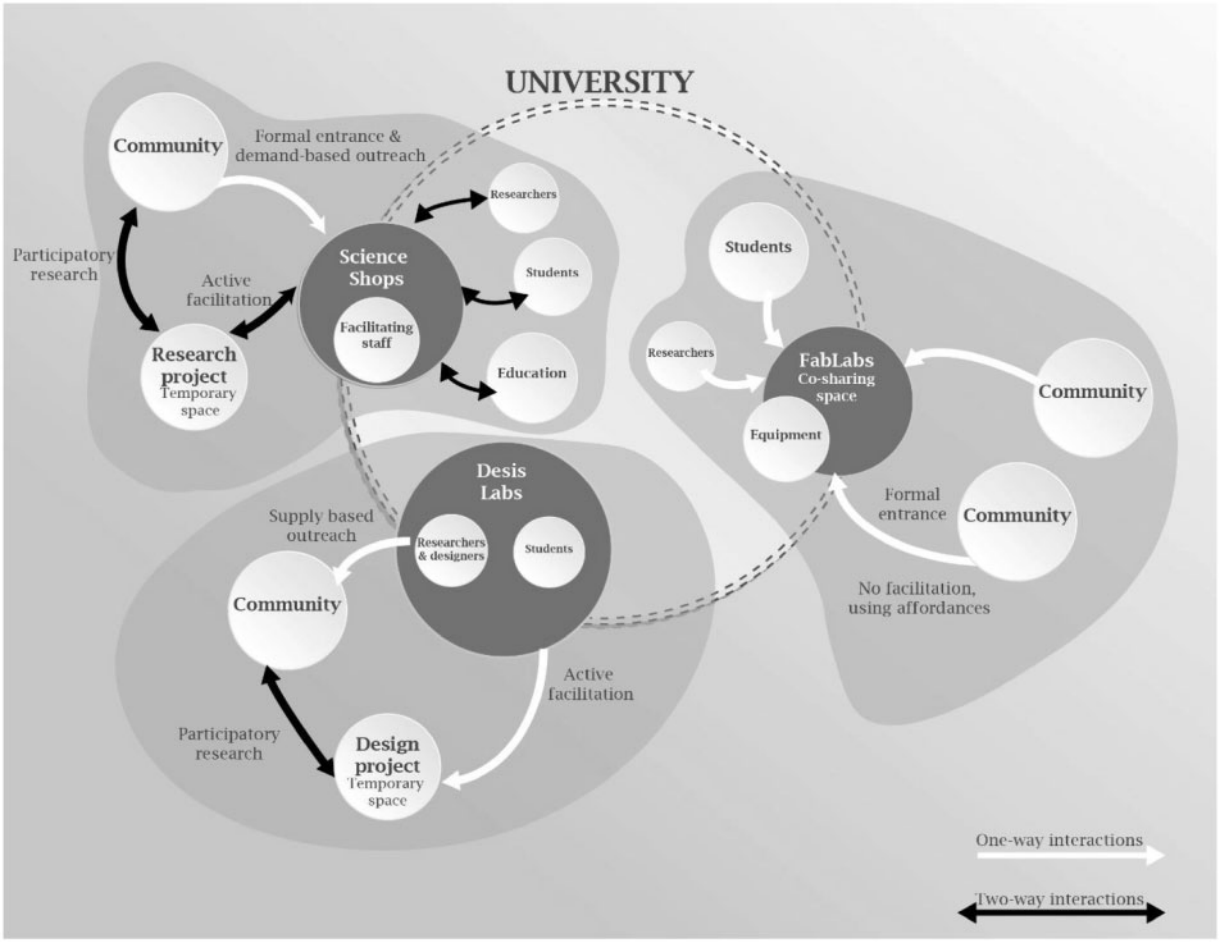

Figure 1. Generalized illustration of the three types of university-community interactions in the cases, showing differences in how community interactions are established and facilitated.

retail system, which is a very different type of object. This difference might be because ScSs often have staff specifically dedicated to defining knowledge needs and evaluating appropriate forms of knowledge outcomes for empowerment. Members affiliated with both DIT and VB explained how crucial it is to analyse and translate a community's needs before approaching university partners. DLs, on the other hand, tend to focus more on material objects. Polimi works more with urban spaces (e.g. a new food market meant to attract local produce from the surrounding countryside in Milan), facilitating empowerment through the physicality of the space and the relationships created around it. This approach yields few knowledge objects.

For FabLabs, empowerment is created through interactions around their equipment and the relational spaces they enable where heretofore unrelated actors meet and interact. FabLabs create new communities. However, again details about outcomes are sparse; the most tangible outcome seems to be the emergence of some companies from the co-working spaces that FL3 provided. The embedded cases reveal some examples of physical goods produced, but based on our own observations, these goods do not seem to empower the actors involved in producing them. The materiality is easy to spot. Equipment configures the staging process—in FabLabs, tools, machinery and the space attract members and facilitate interactions that enable companies to form. The significance is hard to spot, however. For example, we do not know how crucial FL3 was in the emergence of the new companies, or what the learning facilitated around the equipment actually enabled in the end. According to an informant from FL3, university FabLabs are 'cross-faculty, cross-discipline—I don't want to say interdisciplinary, but multidisciplinary, trans-disciplinary. That's exactly what we represent for the university, something that represents something that brings donors 'round'' (Voss 2017a: sec. 1). Materiality is thus a configuration tool for creating relational spaces that to some extent enables grassroots innovation, as new companies have been observed to emerge. However, the produced objects do not seem to enable local agency.

In contrast, in ScSs, materiality mostly provides greater visibility in local communities and facilitates access to scholars. Connecting with an ScS is much less resource-intensive than exploring a campus and trying to figure who might be able to help with specific research questions. This illustrates the demand-driven ScS model that depends on communities actively approaching scholars. There is some commonality with FabLabs here. DLs, on the other hand, are supply-driven; physical spaces mainly function as offices for their own staff and as temporary contexts for community interactions. Office space is more crucial for DLs than ScSs, as they conduct projects themselves, whereas ScSs to a large extent depend on university actors who already have their own spaces. Thus, material space

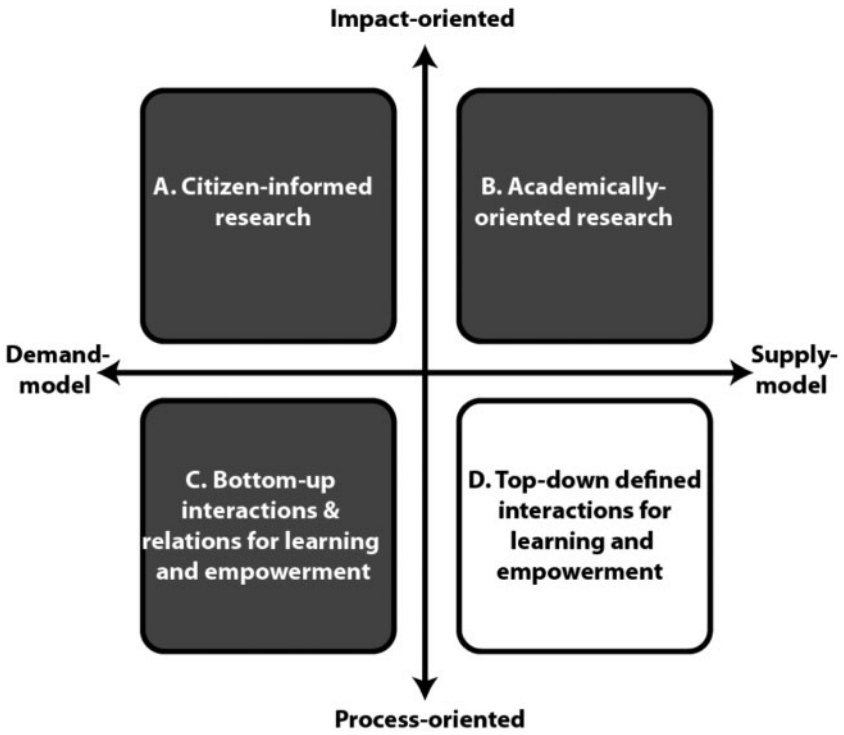

Figure 2. Relational space in university-community interactions: dimensions and ideal-types.

has three different functions in university-affiliated innovation initiatives:

Creating relations. Initiatives try to create visibility and lower the cost of establishing relations with communities through geographic placement, the design of digital spaces, advertisements, news stories, social media, etc. This role of material space is especially crucial for demand-driven models.

Objects as facilitators of interactions. Some initiatives, notably FabLabs, rely on material objects to facilitate ongoing interactions and maintain relationships. Communities are empowered by the equipment in the space and interactions with other members around these objects.

Objects as carriers of agency. The objects produced by projects is another source of agency. These include products that fill an unmet need, knowledge objects that can be enacted to gain agency or facilitate learning, or objects that play a part in services and systems.

Our analysis reveals that materiality is a critical co-carrier of agency, as materiality does not carry agency on its own. As pointed out earlier, knowledge cannot travel unless manifested (Czarniawska-Joerges and Sevón 2005). Importantly, the "low" designation in Fig. 3 is not negative; it signifies a different and less resource-intensive way to operate. The predominant ideal-types for materiality are:

- Type A: The meeting grounds. Spaces are materially-configured to foster new relational spaces as outcomes, where materiality attracts members and fosters interactions between them.
- Type B: Co-working space for learning and innovation. In these spaces, empowerment stems from the process and not the outcome.
- Type D: Producers and designers. These types of spaces aim to produce material outcomes that empower communities.

The empirical data do not support discursive space as an ideal-type (Type C). This type represents initiatives that never get off the ground (i.e. meetings and discussions around projects and initiatives that do not materialize).

These types represent archetypical characteristics of materiality in the property space. Although we assign types based on overall tendencies, all of our cases exhibit characteristics of multiple ideal-types. From a materiality perspective, DLs tend to be type D, ScSs tend to be type B, and FabLabs tend to be type A. It is not that FabLabs do not produce objects, for that is indeed their purpose. However, objects are not what empower users, as revealed in the quote from FL3 above.

5.3 Place: the local sociomaterial context

Place has a specific materiality that can structure or limit the options for staging the material and relational spaces laid out above. The focus for the relational space perspective in contrast are not considering the implications of the specific sociomaterial context of relevance. University and education systems comprise one of the most crucial context-dependent case variables: they potentially provide access to resources, but at the cost of complying with their systems. University governance policies and organizational structures largely determine how material and relational spaces are configured (e.g. the extent to which initiatives can be embedded in curricula and/or research, whether a university values social responsibility or community outreach, etc.).

For instance, ScSs relies heavily on students as researchers and researchers as supervisors. This fits very well with project-based education systems if ScSs can award ECTS credits. In the absence of project-based education, ScSs would have to rely on volunteers. DLs have the advantage of often running their own design education

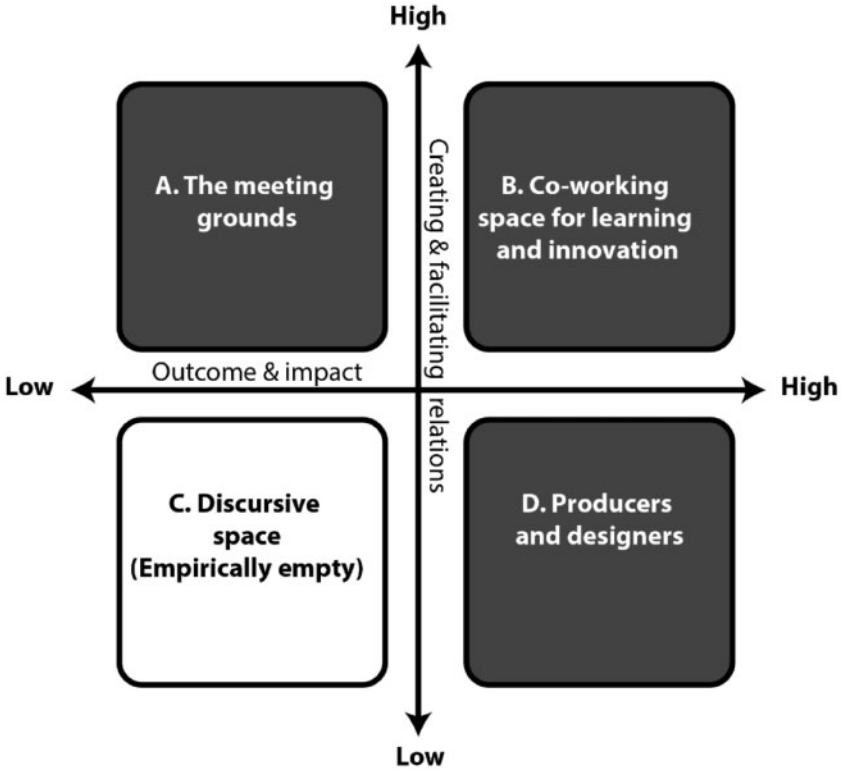

Figure 3. Materiality in university-community interactions: dimensions and ideal-types.

programs and can thus use their students to run projects internally. ScSs provide more diverse partnership opportunities, however, as they can be based in engineering, law, or philosophy departments or be interdisciplinary, whereas DLs are exclusively design-related.

Finally, neighbourhoods, communities and local problems influence the kinds of projects DLs and ScSs initiate. In some areas of Brazil, poverty and social exclusion are major problems, and both NAS and BH thus work on more projects of an economic nature, helping to incorporate these groups into the economic system. For Desis Polimi, local problems relate more to sustainable consumption and living, and therefore have projects focusing on co-housing and use of more locally produced food. Brazilian DLs must overcome distance-related challenges; many communities that they are trying to help are located far away, which can make maintaining interactions difficult. Another ScS, NI, faces a similar challenge as it tries to cover an entire region, resulting in long commutes. For VB, projects in the 1980s and 1990s focused on pollution and work environment, because of the societal problems in local communities and the technical focus of the university. For FabLabs, problems are closely tied to members' demographic characteristics. The two most crucial place-specific variables affecting our cases are:

- University and education systems: Governance policies and organizational structures largely determine the extent to which innovation communities can be embedded or interface with the university to take advantage of existing resources.
- Local context and neighbourhood: Clients and projects depend on the actors and social challenges present in the local context.

We do not condense these dimensions into ideal-types, as they mostly determine which ideal types are most relevant from the two previous sections. When projects cannot be embedded in the education system, a supply-based model makes more sense, and ScSs have indeed been observed to adopt such models if they do not have access to students and are unable to award ECTS points.

5.4 Typology of ideal space-types

Combining the ideal-types from the material and relational dimensions and eliminating those combinations without empirical support yields three ideal space-types:

- **Affording spaces** have affordances but are passive. These are co-working spaces, meeting grounds, and contexts that enable bottom-up interactions through a demand-based model. Materiality is crucial in this space-type, given its dependence on community actors approaching and becoming members, volunteers, and carrying out the interactions that their spaces afford. Most FabLabs fit here, although some do have staff members who coordinate events, lectures, projects, etc. The basic elements in a FabLab are equipment that enable interactions and attract members. These spaces are very place-dependent, as the materiality needs to provide relevant action possibilities for actors present in the local context. Learning is the biggest focus in the empirics, although hypothetically, material outcomes might empower potential members just as well or even better. Empowerment thus occurs through learning from the interactions and activities enabled by the space. Some companies have emerged from such spaces.
- **Mediating spaces** connect community members with researchers and students who have relevant competences to help solve their problems. Projects are citizen-informed in this demand-based model, but staff translate and define knowledge needs and

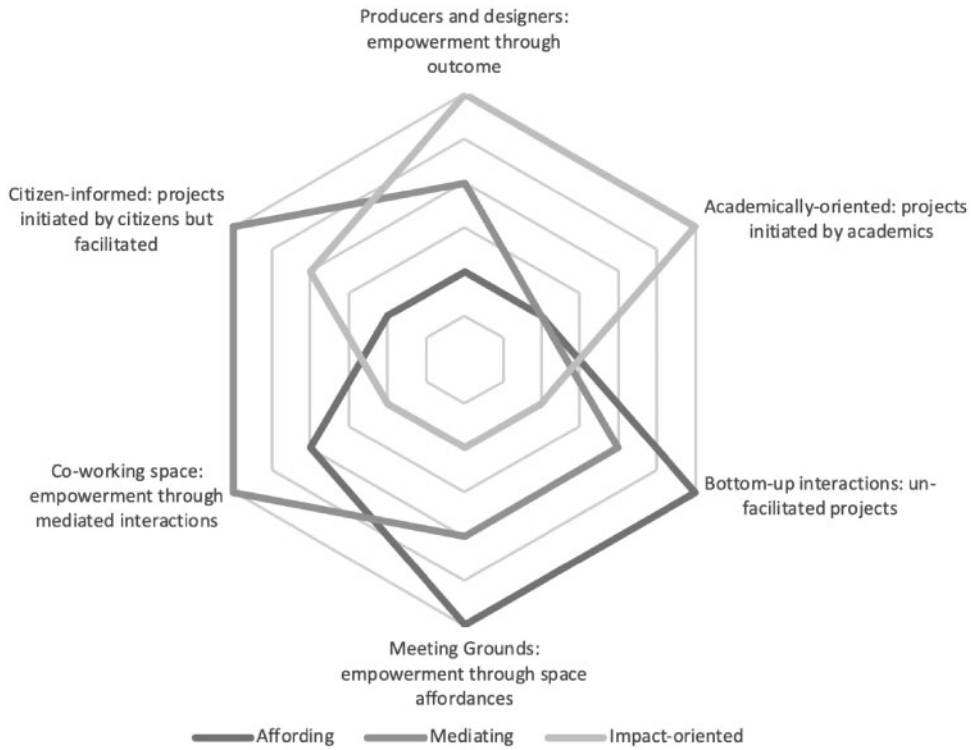

Figure 4. Ideal-type property space illustrating the six dimensions and how the three ideal-types relate to them.

research projects. The other dominant aspect is co-working space that enables two-way interactions in which citizens' knowledge is viewed as equally valid and communities gain agency (e.g. by learning new skills). Specific configurations of actors, researchers, students, communities, and facilitators enable empowerment. This ideal space-type also encompasses meeting grounds and producers, as it facilitates new relationships and interactions. An understanding of the desired project outcome is necessary to translate knowledge and define needs, but to a lesser degree than the impact-oriented space-type. Although mediating spaces typically are small entities with just one to three staff members, they establish deep relational spaces with universities, taking advantage of available resources. ScSs tend to be mediating spaces, as illustrated in Fig 5.

- **Impact-oriented spaces** enable members to conduct projects independently and proactively establish relationships with communities with a focus on creating positive impacts through project outcomes. Based on the supply-driven model and comprised largely of producers and designers, these spaces are larger than mediating spaces, as they contain enough resources to run entire projects independently. Most DLs share these characteristics. In impact-oriented spaces, design departments, educators, or lab staff use available researchers, students and infrastructure to solve social innovation and sustainability problems. This ideal space-type thus depends less on universities and does not mediate relationships. Community empowerment is tied to project outcomes, typically in the form of new products, urban spaces, and/or systems. They also enable citizen-informed projects based on various forms of participatory research and design methodologies.

The three ideal space-types illustrated in Fig. 4 map out the property space revealed in our empirical data. They can be used as three

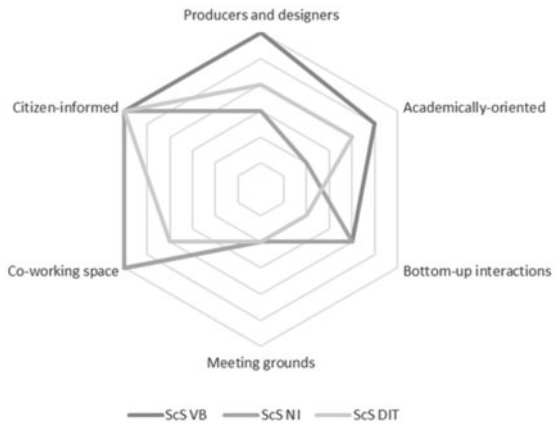

Figure 5. A comparison of the property spaces covered by the three ScS subcases.

models for how to configure an innovation space based on the available resources and infrastructure. Mediating and impact-oriented spaces are able to capitalize on the project-based nature of university curricula by having students work on socially useful real-world projects instead of virtual cases and exercises. Affording spaces usually require greater investments in equipment and space, but offer new learning opportunities that would be unavailable otherwise and require less staff. In addition, interactions in affording spaces are more bottom-up in nature, as no facilitation, translation, or other types of steering mechanisms are in place, for better or worse. Figure 5 illustrates how the three ScS cases are situated in the property space based on a qualitative evaluation. Clearly, ScSs share characteristics of the last two ideal-types. VB covers a larger portion of the

property space, as it was a large entity that operated two distinct citizen-informed and academically-oriented initiatives. DIT operated as a sub-unit of a more conventional community engagement centre and thus was a bit more traditional in their community interactions and less of a co-working space. Figure 5 also illustrates how the dimensions are not opposites and exclusive; instead, resources determine how wide an area can be encompassed.

6. Staging university-community interactions

Analytically separating the material, relational, and place-specific elements provides little insight into how innovation spaces are staged, as sociomateriality is inherently inseparable. In this section, we adopt a more action-oriented perspective on how such spaces can be staged and configured. Typically, the actors engaged in staging are individuals or small groups of academics. It is thus a bottom-up process that hinges on both individual characteristics and place particularities.

6.1 Staging new relational spaces

Spaces need to be designed to accommodate and connect the social and material elements of the relational space(s) they are meant to contain. Materiality and relationality are inherently intertwined (Law and Hetherington 2000), thus relational spaces are materially brought into being. The first challenge, designing visibility, is crucial, especially for affording and mediating spaces that rely on active approaches from potential partners. Visibility in relational terms is communities being aware of the initiative and being able to encounter and approach it easily. An example from FL4 illustrates this challenge: 'anyone north of Cambridge wouldn't go to a site in the south, anyone in the south wouldn't go north, and the same all over' (Voss 2017b: sec. 1), and in this case the 'middle' did not have any appropriate spaces. In the end, this FabLab partnered with the local university at the cost of conforming to the university's needs, policies, and infrastructure, to get a space with a location that had the appropriate visibility and material characteristics.

Staging can overcome this challenge by increasing visibility through geographic placement or specific design elements such as scripts (Akrich 1992), which can enact brands and labels that can increase digital visibility and help distinguish from other types of initiatives (Dorland 2018). For instance, giving an affording space a well-known label like FabLab can attract members, but only if the placement is accessible. People familiar with the concept also intuitively know how spaces are set up and how to interact. The ScS label is not well-known, however, and many find the term unintuitive, requiring more framing and advertising work. Names and labels are powerful objects, and by enacting a label, a space can be attached to a well-known network and instantly increase visibility, which in relational terms is the first step in establishing a relation that in time can constitute an actor-network.

6.2 Staging interactions and empowerment

Linking, facilitation and translation are the core activities of mediating and impact-oriented spaces. The innovation lies in connecting actors across university boundaries, translating knowledge, facilitating interactions, and ensuring impactful outcomes. Mediating spaces that rely on researchers and students affiliated with their universities must analyse the knowledge needs inherent in requests to identify researchers and students with relevant knowledge, and then translate requests into applicable research questions appropriate for course projects, master's theses, etc. Those affiliated with supply-based, impact-oriented spaces must determine how their knowledge and competences can solve challenges for communities (i.e. how their knowledge can create positive local impacts).

Empowerment often stems from project outcomes (i.e. products, systems, or knowledge objects) in which materiality plays a crucial role. Potential outcomes include scientific documentation, prototypes, packaging, visualisations, service systems, new urban spaces, etc. It is crucial to evaluate outcomes against needs. For instance, DLs and ScSs in our cases asked questions such as: Did the new packaging enable the rural community in Brazil to introduce their local food product into the retail system? Did scientific documentation on water pollution help communities successfully engage local authorities? Sometimes ScSs determined that projects did not solve problems as intended, or identified new challenges in light of new insights, and thus facilitated the development of subsequent project proposals together with civil society actors and university researchers. In this iterative process, outcomes often lead to new interactions.

Staging interactions in affording spaces is altogether different. Although members coordinate activities, they rarely engage in conscious analysis and identification work. Key staging activities involve determining the framework conditions, configuring the equipment, stipulating rules of access and use, hiring technicians, enrolling community members as volunteers, etc., in the hope that a relational space enabling innovation and learning emerges. FL2, for instance, hired a distinct team of part-time technicians to in an attempt to instantiate a very specific culture and set of practices, and considered different rules of access that would either include or exclude casual users in contrast to serious members (Pel, Bauler, et al. 2017). Here, empowerment predominantly emerges from interactions with equipment and other actors in the space, but how people interact and which actor enter can still be staged as illustrated above, although we have little empirical evidence of exactly which actors are empowered and how. Our observations seem to indicate that end products (i.e. the material objects produced in FabLabs) rarely solve social problems. Multiple relational spaces may emerge over time, some of which may become companies (e.g. FL3), whereas others may transform into events, courses, or new initiatives (e.g. FL4, which helps unemployed people) that constitute other types of empowerment outcomes. In all cases, sparse information exists on what these companies achieved, or in the case of FL4, whether any unemployed people eventually found employment. It is also very clear from the empirics that FabLabs that attempt to ally with universities are deliberately conservative in their framing to gain support, as illustrated by FL4 (Voss 2017c: sec. 1): 'I talked about the space in terms of safety first. I described it as a "community workshop", I never used words like "hackspace". I told people how it would allow people to develop new skills. We presented very conservatively, and I think that helped us.' Specifically, FL4 created a discourse around STEM learning. However, creating such a discourse also creates expectations around what an entity does and delivers, which might be why university FabLabs have such a strong focus on learning rather than outputs.

6.3 Summary

We have described the *predominant* modes of empowerment in relation to our space typology, meaning that they are all present in all spaces, just to different degrees. In addition, we have identified which ideal-types most effectively enable specific modes of

empowerment. The empowerment modes discussed above can be summarized into three types:

1. Objects as carriers: Knowledge objects, products, or the multitude of objects supporting services and systems. These objects are the outcomes of projects, and communities might gain agency by enacting them (e.g. by enabling them to participate in social systems from which they had been excluded, raising awareness about social problems, filling material needs, etc.).
2. Objects and spaces affording interactions: In contrast to objects used as carriers of agency, these objects afford interactions that empower during the process, often in the form of learning and innovation, as exemplified by FabLabs.
3. Mediated learning and knowledge generation: Increasing specific knowledge in communities by enabling members' participation in projects (e.g. action research), thereby increasing their competences and abilities (e.g. scientific methods, project management skills, communication skills) to solve problems independently in the future.

7. Conclusion

We have sought to understand how university-community interactions can involve and empower communities through specific space configurations. To answer this question, we have suggested a framework for analysing universities' third-mission activities focused on community engagement, democracy, and empowerment. We developed our framework by analysing three case studies on initiatives aimed at fostering university-community interactions: ScSs, DLs, and FabLabs. We contribute to the third mission literature by adopting a situational and sociomaterial perspective on how such initiatives are configured and staged, thus enabling a discussion and reflection of how local communities may become empowered through participation in university activities. The analytical framework reveals how materiality and relationality can be combined to yield novel insights into the staging process of complex spaces, and how the material, relational and place-specific aspects must be equally considered when creating specific configurations. Our findings contribute to a number of discussions on how one size does not fit all (Benneworth et al. 2016). We offer practical suggestions and mental models that can span the country-specific characteristics that make global best practices impossible (Göransson et al. 2009). We have focused on the significance of university-level characteristics and the potential for community empowerment rather than internal governance, which has been a focus in earlier research (Thune et al. 2016). Moreover, we have revealed the role, potential and problems associated with knowledge intermediation in non-commercial interactions (Meyer and Kearnes 2013; Schlierf and Meyer 2013), whereas most previous research focused on knowledge transfer, technology, and business activities (Kalar and Antoncic 2016).

Our typology of spaces illustrates the principal configurational elements observed across the cases and reveals three different ideal types: affording spaces, mediating spaces, and impact-oriented spaces. Together, these elements embrace the complexity inherent in the staging of university-community interactions and enable us to understand the heterogeneity that can produce community empowerment. Describing specific elements of each space type is beyond the scope of this article, but is an important opportunity for future research.

These three ideal space-types differ widely in terms of their structures and operating costs, as well as their capacities to facilitate interactions with communities. Most importantly, they empower communities in different ways: affording spaces facilitate interactions that provide learning and innovation opportunities, impact-oriented spaces focus more on project outcomes as carriers of agency, and mediating spaces comprise a middle ground, by translating and facilitating citizen-informed projects while emphasizing final co-produced knowledge and its impacts. Mediating spaces also provide access to new knowledge, supporting the finding by Benneworth and Cunha (2015) that social innovation processes help create new forms of knowledge and inspire new research. Mediating- and impact-seeking spaces are also different illustrations of what Chilvers and Kearnes (2016) conceptualize as reflexive participatory practice, which frame preconditions and participatory processes very differently. The SI university activities described by Benneworth and Cunha (2015) also illustrate that both impact-oriented and mediating spaces generate new resources that support core teaching and research activities. The more societal form of the third mission is insufficiently funded (Göransson et al. 2009), which we suspect is even worse now, a decade later. A policy implication is thus to increase the legitimacy and visibility of this form of third mission activities, for instance, by developing supportive programmes and implementation of other types of indicators and measurements of impact. It is important to continue to adopt the bottom-up and citizen-informed approaches, by making more resources available for enactment by practitioners, and in this way support the local strategic reflections that the heuristics of this paper may contribute to. Another critical discussion is the third mission perspective. Although it has not been our focus, activities in innovation spaces, particularly those in mediation and impact-oriented spaces, are tightly connected to teaching and research while empowering communities. In line with Trencher et al. (2014), we thus argue that we should move away from framing activities aimed at empowering communities and solving societal problems as a 'third' mission, and instead view them as integral components of teaching and research. However, unlike Trencher et al. (2014), we argue that not everything needs to be co-created, which inherently is more resource-intensive. Each of our ideal space-types enables a different form of empowerment:

- ***Affording spaces facilitate empowerment by providing contexts for experimentation and facilitating interactions that enable learning.*** Empowerment is structured by the affordances, the action-possibilities inherent in the relations between actors and objects; however, potential outcomes are not readily apparent, both in our cases and in the literature, which is a finding in and of itself. Empowerment might occur through the production of new types of knowledge in multidisciplinary research collaborations or the development of new skills and competences among students and/or community members (e.g. unemployed individuals). Some serious thought should be put into overall objectives. Although affording spaces provide greater capacity for interactions, they are expensive to establish. Finally, these spaces are more flexible, and communities are responsible for their own empowerment through a bottom-up process, which can be seen as a more democratic type of innovation and empowerment than traditional third mission activities, as argued by Smith (2017).
- ***Mediating spaces effectively co-produce and mobilize knowledge to create positive impacts and affect societal relations at the micro-level.*** Over time, staff members develop knowledge related to identifying and translating knowledge needs, as well as evaluating outcomes and ensuring their relevance. Mediating

spaces emphasize two-way interactions through participatory research, community-based research, co-production, etc., and the knowledge bases of communities and researchers are equally valid. Specific configurations of actors, researchers, students, communities, spaces, infrastructure, and facilitators enable the translation and co-production of knowledge that leads to empowerment.

- ***Impact-oriented spaces effectively create material objects with relational impacts that empower communities by changing and structuring social relations***. This space-type less effectively co-produces and mobilizes knowledge, as no dedicated staff exist to perform this function. Impact-oriented spaces are self-contained and operate by allocating existing resources such as students to research projects to empower communities, but staff members must simultaneously perform all of their regular university-related duties. This type of space is potentially cheaper to both create and operate, but fewer resources are dedicated to community interactions, which makes a demand-based model impossible and likely limits reflexive participatory practice compared to mediating spaces. This type of space may be imagined as a transition building upon existing resources and spaces.

Although FabLabs tend to be affording spaces, ScSs tend to be mediating spaces, and DLs tend to be impact-oriented spaces, a one-to-one relationship does not exist between the ideal space-types and the cases. It is especially surprising that the material outcomes for FabLabs tend to be of secondary importance and rather vague, despite the network's huge popularity and rapid expansion. Notably, initiatives from all networks can be found within each category, and some initiatives operate more than one type of space simultaneously, which requires substantially more resources. Often, universities operate several of these spaces. These ideal space-types reveal how specific configurations can empower communities in different ways and should be chosen depending on the needs of the local context and available resources.

One of our essential arguments is that materiality matters, and materiality played a crucial role in all three cases. Materiality and place-based characteristics impact the relationships and interactions that can be established. The findings support Law and Hetherington's (2000) assertion that relational spaces are materially enacted and vice versa; they are where relational and material aspects interact and manifest. Our findings contribute to practical and theoretical understandings of the roles of materiality and spaces in university-community interactions, the dynamics of which have been relatively underexplored in the literature.

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