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Translating Sustainability into Action: A Management Challenge in FabLabs

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Abstract: In recent years, the number of new organizations aiming to accomplish principles of sustainability has rapidly grown, leading analysts and scholars to announce almost a new industrial revolution. An example of this is the proliferation of the so-called fabrication laboratories (FabLabs) that nowadays are perceived as being forerunners in innovative and sustainable high-tech production through peer-to-peer collaborative practices and sharing. However, the challenges managers face in translating these promotional aims into organizational action is vastly understudied. To address this research gap, we have studied the management of two FabLabs, in Italy and Finland. In this study, we draw from a psycho-sociological framework applying cultural-historical activity theory, and especially from the concepts of activity system and contradiction. According to this perspective, a sustainable organization is based on promotion, enrichment, regeneration, and flexible change efforts, and it is related to the managerial and ability to bring internal and external stakeholders together to recognize and solve tensions and contradictions collectively. Through our case studies, we have provided new research knowledge on how managers make an effort to translate sustainability into action in the complex context of FabLabs, involving multiple, often competing stakeholders and activity systems. Our analysis reveals multiple tensions in the collective activity, stemming from system level contradictions, which represent a challenge for the daily work of the FabLab managers. In the paper we also suggest how an engaged management orientation towards sustainably can be promoted, and we discuss future research topics.

Keywords: sustainability; stakeholder engagement; activity system; contradiction; activity theory

1. Introduction

During the last three decades, the technological revolution based on digital information and communication technologies has challenged work organizations and production. As a response to this, the number of new organizations, which may be labelled as "sustainable", has rapidly increased. An example is the proliferation of the so-called "fabrication laboratories" (FabLabs), which are usually attended by the students of research universities and universities of applied sciences, freelance professionals, companies and other business providers to foster university-industry collaboration [1–4]. In most cases, they are operated by researchers, teachers and students and other staff with expertise in entrepreneurship and/ or novel technologies. The clients of the local FabLabs are often university students, young entrepreneurs, university staff, designers, IT professionals or architects.

The missions and aims of FabLabs include the fostering of individual and collective sustainable development through the promotion of creativity, self-production principles, collaborative consumption, and community engagement [4,5]. In these contexts, traditional university research and teaching is combined with issues such as digital design and manufacturing tools, for the advancement of higher education and innovative research [6–8]. FabLabs can be defined as easy-access, small-scale, local spaces, workshops or laboratories where design joins with production through the use of 3D modelling software and other manufacturing processes. They have demonstrated their potential in empowering small communities of professionals and amateurs to collaborative produce smart devices.

There is growing interest among organizational scholars towards studying these new organizational forms and work processes [9–12]. Recent studies indicate that FabLabs can potentially enable a historical shift from mass production to new forms of technology-supported production, which is perceived as more sustainable and socially valuable [1,8]. FabLabs can be seen as organizations that are "born for sustainability", holding this value as one of their core missions [13], as well as valuing collaboration, intergenerational equity and multi-stakeholder engagement, which are ingredients of individual and collective sustainability.

However, FabLabs are still a rather new and understudied research context. For instance, we lack knowledge on how the organization and management of their activities is carried out and which challenges managers face in translating sustainability into action in these social contexts.

To address this research gap, we have studied the management of two university FabLabs, in Italy and Finland. In this study, we draw from an organizational psychology framework applying cultural-historical activity theory (CHAT), with a specific focus on the concepts of activity system and contradiction [14,15]. This approach is well-suited to our purposes, given its focus on collaborative work process and collective learning, and its belief that tensions and contradictions are potential drivers of sustainable development [5,16]. Emerging organizations such as FabLabs, are an especially intriguing context for the study of sustainability through the lens of CHAT, as they attempt to generate a collaborative space where diverse and often competing stakeholders and activity systems are brought together [17]. As our research question, we ask: which contradictions can be depicted in FabLab organizations in Italy and in Finland? Additionally, we ask: how do these relate to the promotion of sustainability in the cases studied?

Our study makes four contributions. First, it contributes to research on "new forms of sustainable organizations", such as FabLabs. Second, our analysis adds to research on sustainability efforts by describing how managers attempt to translate it into action when multiple activity systems and facing several contradictions are at stake. Third, activity theory provides a new way of conceptualizing management in new forms of organizations aimed at enhancing organizational sustainability. Fourth, our study provides practitioners with novel insights into promoting and enacting sustainability in their everyday organizational life.

2. Theoretical Framework

The concept of sustainability has a variety of definitions. From a psycho-sociological view [18] sustainability can be described not as something that organizations *have* or *do*, but rather as something that organizations *are* [17]. When sustainability is taken as a constitutive part of organizational values, principles, identity and culture, the management is especially committed to "translating it into action". To be sustainable, in this sense, every organizational/managerial process and practice should be underpinned by specific "pillars" [19,20], such as participation, equity and justice [21], co-creation of value [22], individual and collective capital promotion and regeneration [23,24]. Rather than aiming at avoiding exploitation, depletion and irreparable alteration, from this perspective sustainability focuses on the promotion of individual and collective well-being [25–27], and is concerned with stakeholder engagement and value generation on multiple fronts [28]. Further, sustainability requires the construction of "authentic meanings for individuals and communities, underlining the importance of connections, meaning and purpose" [25] (p. 2).

O'Higgins [29] proposes an explanatory framework, linking a range of stakeholder management approaches to less vs more engaged orientations towards sustainability. When taking a pragmatic orientation, management mainly aims to provide economic benefits to shareholders. Sustainability issues are taken into consideration only when business or law requires it and there is a low level of exchange and collaboration with the wider web of internal and external stakeholders. This orientation reveals a cosmetic or instrumental approach to sustainability, driven by economic concerns, and generating only episodic outcomes.

Multi-stakeholder collaboration based on mutuality and communality is at the heart of an engaged orientation towards sustainability. An engaged orientation is open to conflicts and contradictions between the various interests of stakeholders and tries to handle them by finding collaborative resolutions [29]. This management orientation potentially leads to development of users and clients-inclusive innovation communities, where continuous learning, mutual advantage and trust are generated [30,31].

Our activity-theoretical study adds to the previous research taking an engaged orientation on the management of diverse stakeholders—here considered as activity systems—as a key to sustainability. According to this framework, contradictions characterize physiologically multi-stakeholder processes. Contradictions manifest themselves as tensions and conflicts within and between activity systems [15]. The activity system is a representation of historically-evolved and culturally-mediated object-oriented activity [14]. Every organization and organizational stakeholder forms a system, which consists of multiple interlinked but often competing activity systems and their objects. Two interlinked activity systems, which are the unit of analysis of our present study, are depicted in Figure 1 as a model of an activity system consisting of a subject (or group of subjects), an object, mediating artifacts, rules, a community and the division of labor [32] (p. 306). Contradictions might be sources for development and drive for and generate change (new form of activity) in activity systems. In other words, change is perceived as a collective resolution of historically-evolved tensions and contradictions [14,33].
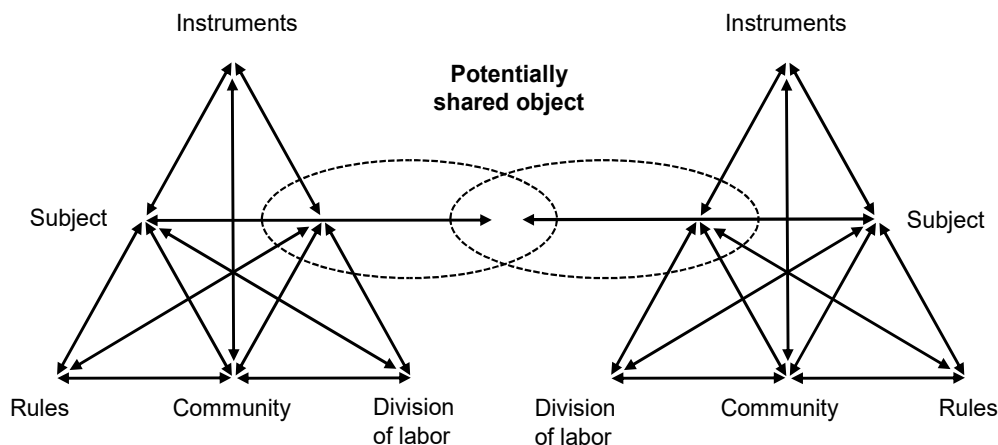
Figure 1. Activity as a dynamic model of interlinked activity systems.

We here define sustainability as a continuous collective effort of a complex network of interrelated activity systems (stakeholders, including managers, employees, clients and other stakeholders), aiming at co-constructing shared value and societally useful outcomes. The facilitation of sustainability should thus be viewed as a complex process that requires joint recognition and analysis of contradictions within and between activity systems, and using this knowledge as a source for organizational change and learning. Taking an engaged, learning-orientation to the management of diverse stakeholders with multiple competing interests, however, represents a challenge, especially for those in a managerial position.

Aim of the present study is therefore to explore the perceptions and efforts of FabLab managers in promoting sustainability in their organization. To address this, our specific research objects are:

1. To identify contradictions within and between the interrelated activity systems in FabLabs.
2. To describe managers' strategies when face the contradictions.
3. To explore how the previous aspects are related to the promotion of sustainability.

3. The Research Studies: Sites and Methodology

The FabLabs under study are based at university campuses in Finland and in Italy. In the Italian case, the novelty of the FabLab stems from being one of the first FabLabs to be established on an Italian campus, serving the institutional purpose of providing high-quality education and innovation research. Founded by a small group of visionary academics, this specific lab was established in 2014 by the Department of Design and Architecture of one of the largest Italian universities, with the aim of becoming a vibrant and collaborative environment for sustaining innovative projects and collaborative learning.

The FabLab under study in Finland focuses on the enhancement of entrepreneurship and creation of new start-ups via creation of technological and social innovations. The Finnish FabLab is a trademark owned by a local university business school, a university of applied sciences (with a focus on entrepreneurship education) and a publicly-funded municipal business promotion service. It was established in 2012 to generate new start-ups and improve entrepreneurship in a Finnish city with sudden high rates of unemployment due to the closure of global telecom giant Nokia. The Finnish FabLab provides an open office space and is expected to help students, young entrepreneurs and others to develop their innovative business ideas into start-ups, products and services.

We applied an exploratory qualitative case study approach [34,35]. The case study is well-suited to this research as it embraces the importance of the establishment of a close relationship between the researcher and the research site. To collect data, we carried out interviews of the managers of the Italian and Finnish FabLabs. These interviews followed the principles of narrative interviewing [36]. The narrative interview situations are viewed as social storytelling events, which link individual and organizational narratives as well as the interviewees and the researcher [37]. The narrative accounts produced in these events are not understood as carrying "the whole truth", objective truth or a true experience of what really happens in the FabLab's daily life, but rather are co-constructions of the interviewees and the interviewer.

In Italy, ten tape-recorded, semi-structured interviews were conducted with the managers, namely three founders (the Head of Department, the Lab Scientific Director, the Lab Manager) and seven collaborators (PhD researchers involved as tutors of the new-born community of students). The interviews, which lasted between 60 and 90 min, included questions on the founding, original missions and the evolvement of the FabLab activities, and the success and challenges experienced by the management leading the labs.

In the Finnish Lab, ten two-hour interviews were conducted with the managers and other key actors, representing a research university and university of applied sciences. Four of those interviewed were operational management and six were employees in responsibility positions in the FabLab. In the Finnish case, a participatory workplace intervention project, called Change Laboratory, was also carried out and facilitated by the second author of this paper. This process took place between February and May 2016 and included ten (150 min) meetings with 21 FabLab members. Our analysis of the management interviews in focus in this paper benefited from these secondary data, and supported contextualization of the analysis of the issues arising from the interviews.

We also carried out participant observation of FabLab activities and board meetings in both countries, over several months, involving a range of managers and staff members (students, researchers, teachers and managers/founders). This reflexive ethnography [38] supported our interpretations based on a limited number of interviews.

The semi-structured and video-recorded interviews from Italian and Finnish contexts and the seminar series in Finland were transcribed verbatim by a professional transcriber. Selected parts of the audio-recorded observational data, and the data from other core meetings were also transcribed.

Our analysis proceeded in the following way. The managers' narratives were first depicted from the transcripts by following an inductive and thematic approach [39]. We conducted the analysis in the original languages (Italian and Finnish) and translated the quotes we present in the findings section. For this, we first engaged in close and iterative readings of all the interview data and started to extract narratives, relevant to our research question, from the data. In extracting the narratives, the interviewees' experiences were organized into sequences with beginnings, middles and ends, or an employment of the narratives [36,37,40]. We gave the singular narratives codes, looked for connections among codes, and progressively clustered the codes in emerging main themes.

We then focused on further analyzing the parts of the transcripts in which the interviewees described the challenges related to the multiple stakeholders' collaboration management. With the aim of deepening our analysis, we then turned to the activity-theoretical concepts of activity system and contradiction. Inspired by these concepts and the seminal work by Engeström [14], we depicted activity systems and traced (a) primary, (b) secondary, (c) tertiary and (d) quaternary contradictions appearing (a) within each element of the activity system, the second (b) between two elements of an activity system (e.g., between a new object and an old tool), the third (c), between the object/motive of the prevailing activity and the new activity that is being developed, and (d) in parallel with the generalization of the new activity between the new activity and its neighboring activities.

The findings section of this article integrates the results of our thematic analysis and our activity-theoretical interpretations of these Research Questions 1 and 2). Furthermore, in this section we add first reflections related to how FabLabs contradictions can be related to sustainability challenges (Research Question 3).

4. Results: Contradictions and Sustainability Challenges in FabLabs' Management

In both the Italian and the Finnish FabLabs, the managers we interviewed identified three main challenges about the handling of multiple stakeholders and activity systems, and their contradictions. Our interpretation of their interviews was inspired by the activity-theoretical typology of primary, secondary, tertiary and quaternary contradictions.

4.1. First Challenge: Creating an Open Organization within Traditional Institutions

A fundamental requisite of both of the FabLabs studied was to create a collaborative and open organization for the facilitation of their missions. There was simultaneous high pressure on the managers for the development of creative research projects and efficient educational approaches (Italy), and for the establishment of start-ups to bring economic growth to the local area (Finland). The aims and perspectives of the distinct activity systems, namely the FabLab managers and the managers of their background institutions (funders, universities, business promotion organizations etc.) clashed in both of the countries examined for this study. Moreover, here was no shared logic on how to interact with one another or with the other key stakeholders, such as the university students, companies and young entrepreneurs, expecting high-quality service from the FabLabs. The following excerpt from an interview of a Finnish FabLab manager illustrates the contradiction of the FabLab being expected to be a flexible and an open organization and to operate simultaneously by following the strict efficiency rules and well-framed principles required by the university management:

Excerpt 1: "These gentlemen (senior managers) meet and come up with solutions without asking people who know about this activity. Who is the expert here? The senior managers of the universities have no clue about the hub as a whole, they talk about the wrong things, they just talk about study credits. We need pedagogical leadership here! Then, a company wants that an outsider that will think outside the box and see things they would not themselves see. Our expertise as educators needs to be put to better use to promote co-creation and multi-professional collaboration, to guide others to see issues. But this is not part of the traditional university practice!" (MN1, Finnish case).

The Italian managers experienced this challenge as the FabLab having "two souls": being an open organization devoted to promoting cultural innovation and social impact versus being an institution meeting university requirements and students' educational needs.

Excerpt 2: "We have two souls and this is our challenge: we need to keep them alive in order not to overlook the complexity of our mandate. We have decided to "stay in" the academy because we want to be a place where learning and cultural innovation walk together." (MN1, Italian case).

According to the "open organization" logic, FabLab managers emphasized the role of social networks and stakeholders diversity (of domains, roles, backgrounds) for promoting innovation and cultural development. However, this open approach often conflicted with the "closeness" of the academic environment, asking for confidentiality procedures, privacy and security policies, and imposing several performance and efficacy requirements for measuring the FabLab projects' quality [41].

This contradiction between the ideas of a collaborative and "open hub" vs "performance-oriented institution" seemed to stem from a deep gap between the "traditional" academic culture and the new emerging organizational culture suited for work in the FabLabs. This contradiction was also manifested in the role taken on by many of the university students participating in the FabLab activities. Used to dealing with hierarchical powers, formal and bureaucratic procedures, and temporary relationships, the university students often felt unfamiliar with the request to become co-producers of innovations and business ideas, as well as co-responsible of the shared activities and the common space of the FabLab. As depicted in the next excerpt, students desired do take part in well-framed projects, and the managers felt they needed to force them to engage in more collaborative efforts:

Excerpt 3: "You know, our "typical students" are often concerned with their professional projects more than with others' needs and with broader cultural or societal issues. We have to force them to participate in the lab's life, for generating a virtuous cycle in which they improve themselves through improving this place and vice versa. Sometimes students come asking us to let them access and do their work here, because of the lab facilities. We are trying to fight this instrumental logic!" (MN6, Italian case).

Despite the contradiction and the multiple struggles caused by it, in both countries the FabLab managers clearly acknowledged and narrated the acute and increasing need of a great number of university students and companies for services focused on promotion of issues such as collaborative consumption, and community engagement, creativity and sustainability, provided by the FabLab. The next excerpt captures the managers' appreciation of the unique nature of the FabLab and its staff:

Excerpt 4: "We are drivers and hackers, delivering messages between stakeholders. Our activity concerns establishment of new companies and in fact increases the vitality of the whole country. I really feel the responsibility. We are here to promote youth with entrepreneurial spirit. I see this hub as a platform for collaboration and for creation of new forms of work. We are brokers and messengers. This hub brings together people, generates start-ups, creates local effectiveness and somehow also manages the organization of this. There is no-one else who can take this role. No-one else runs this type of a platform" (MN 2, Finnish case).

Managers wished to facilitate the generation of innovative outcomes, defined by them as societal impact and innovative sustainable processes of production and consumption. They were often quite creative in their own strategies of getting around the imposed constraints, but the opposing requirements created an overall dilemmatic experience without a meaningful way out. This was a pressing challenge, and we interpret it as a primary contradiction within an element (object) of the activity system. Adding to the complexity, the performance was measured in the short term, not serving the sustainability aspect of promoting open innovation and knowledge sharing in the long-term. This tension reveals the multiple ways in which the diverse stakeholders conceptualized the object of their activity system and understood issues such as organizational success and failure differently. In this, the promotion of sustainability of the organization called for the acknowledgement of these differences

and the tensions between the internal development needs and the external requirements directed to the FabLabs.

4.2. Second Challenge: Becoming a Lively Community and a Catalyst of Individual Development

We depict here a second core challenge, which concerns the daily practices of the Italian and Finnish FabLab organizations, narrated by all the managers we interviewed. On the one hand, the FabLab managers were expected to facilitate collaborative exchanges, thus generating a lively and work community. On the other hand, the participants attending the FabLab were typically members of short-term project teams, often without having any other responsibility, and using the FabLab as a "facility" to fulfil their individualistic development needs, instead of viewing the FabLab as a productive community or a network focused on co-creation.

In both of the cases, the FabLabs represented platforms for co-creation and for mobilizing cultural change in the field of digital fabrication, production and social innovation. In the following excerpt, one of the Italian managers highlights the need for the enhanced commitment of all participants and refers to "people who have lived here", emphasizing with this expression that despite the fact that the participants come from different backgrounds and attend the FabLab for different reasons, and for varying time spans, the FabLab should be viewed as a home like, communal organization:

Excerpt 5: "People here should be aware of the fact that they share a common house. The machines and tools are also under their responsibility and they need their work for being tested and implemented. It is not only a matter of sharing facilities, and regulating turns and rules of use. We need a formal agreement for those who want to live here. They must commit themselves in making this place evolve. This is what makes us pioneers in some sense. The knowledge we share will make this place develop, together with the people who have lived here" (MN2, Italian case).

In both countries, multiple activity systems shared the FabLab space and tools for varying time periods. They were preoccupied with their own projects and attended the FabLab activities irregularly and without a real commitment towards the development of the FabLab as a community. For instance, Italian managers highlighted that the university students (forming an activity system of their own) were not accustomed to participating in a creative, open and communal organization. This caused serious problems for the managers; they had to heavily invest in trying to maintain the community alive and functional:

Excerpt 6: "Students working around the same machine share advice, materials, and they are also forced to ask for each others' help. Since they come from different backgrounds, and their projects are complex they cannot work alone. We are there to support them, but we also force them to ask their co-workers before asking us for help and advice. Students often tend to be self-referential and egocentric" (MN1, Italian case).

The Finnish lab started to receive visitors from other Finnish universities, companies and from abroad, which caused additional work ("serving as a tour guide") for which the managers would have needed support from the staff and students of the FabLab. Yet, many students and some staff members, claiming to be overly busy with their projects, avoided taking responsibility. Another pressing problem calling for changed efforts and collective contribution, in both countries, was the taking care of the physical facilities of the FabLab. The staff members had created a set of rules and have weekly meetings to organize their daily practice, but many ignored them. The following excerpt illustrates how this was experienced in Finland:

Excerpt 7: "Some people think this lab is a hotel. In a hotel, you do not have to worry about the cleaning, or if the light bulbs are out or if the color of the printer runs out, you do not have to take care of the kitchen to make coffee, you do not have to worry about these issues. We do not have any caretakers, we need to take care of everything as a community, to make the community functional. In a hotel, you can fully concentrate on your own thing, you do not need to do the laundry. You can focus on progressing your own aims. But this is not a hotel or a restaurant in which one expects to be served.

We have tried to say this to the students and companies. In a restaurant, you are served. This activity requires an active attitude. Active participation is a key to everything here!" (Woman 3, Finnish case).

In the Italian case, as an effort by the managers trying to hold the community together, a written agreement and a chart was created to indicate the responsibilities of each activity system. In this agreement, shared and signed by all participants of the FabLab, students and staff members were given designated turns for conducting tasks, such as testing the machines, reporting and sharing their research findings, and taking care of the common facilities and spaces. In the Finnish case, a similar tool, a whiteboard was placed on the wall of the lab facilities with aims similar to the Italian case. However, few participants utilized the tools in practice. This aspect often generated open conflict between the FabLab users and the managers. The next excerpt captures how the Italian manager strived to retain students after the end of their individual projects. Students sometimes experienced the FabLab managers' requests as time consuming, and privileged their work on their individual projects:

Excerpt 8: "Some students are worried about not finishing their projects in time, because of the time they are asked to spend working for the Lab. A student has concluded her project and got her degree, but she has not finished testing the printers and writing up her report. This was the agreement to stay here. Now we need to ask her to come again and to finish what she started, even if this will happen after her graduation" (MN 3, Italian case).

In activity-theoretical terms, we preliminarily interpreted this as a secondary contradiction within the activity system of the FabLab. More precisely, this contradiction manifested itself in both country cases as a conflict among the elements of the activity systems: the subjects (e.g., managers vs students), rules, division of labor, tools, community and the object of the activity. With regard to sustainability, this secondary contradiction highlights the crucial importance of managing a potentially disruptive conflict between individual and collective needs, by finding suitable pathways for sustainable nurturing of the community and the diverse individual professional aspirations. Engaging people with a shared object of activity, sometimes required managers to "force" them towards higher levels of collaboration and co-creation, with varying success and failure. This strategy, however, represented the key for breaking away from a pragmatic view of sustainability, towards an engaged management orientation towards sustainability.

4.3. Third Challenge: Managing Multiple Conflicting Motives and Power Relations between the Many Stakeholders

The third challenge concerns the inter-organizational relations that the Italian and Finnish FabLab managers tried to manage and to develop locally. On the one hand, the managers had a relatively high level of autonomy in facilitating collaboration between the participants representing different organizations, such as the university, firms and the FabLab staff members. On the other hand, the university's senior management wanted to rule the FabLabs and constantly challenged the managers' efforts.

The Finnish FabLab managers had discovered, over time and through experience, that the university students, young entrepreneurs, university staff and companies needed to be viewed as being equally important and interdependent partners in the FabLab activities. On the basis of successful student recruitment and by the FabLab manager's "perfect" matching with companies, multidisciplinary project-teams could potentially add great value to their members' learning and innovation capability, as well as create revenue for the companies which were involved, as highlighted in the next statement:

Excerpt 9: "The university student teams do not do this themselves but with the company, the company needs to be involved. A typical team is multidisciplinary. A company orders a project from us and we need to find and recruit suitable talents and competence for the specific cases. The students' individual motivation, interests and passion pay a crucial role in this" (MN1, Finnish case).

However, in managing the complex web of organizations and multi-professional teams, managers were often frustrated about the lack of support from the university:

Excerpt 10: "I am totally annoyed by the cultures of some of our senior university managers. Our knowhow should be used as a tool by them, but there is a problem. There is no discussion between us and the senior managers. I would like to include the managers in our management team. But they only want to discuss things with one another. They say I should not be in contact with them. I say, damn, what are you discussing? We should talk about the activity together!!"(MN1, Finnish case).

The next excerpt illustrates how the university managers constantly directed requests to the FabLabs. This had led to feelings of "being in a powerplay" and losing control over one's daily work among the FabLab managers:

Excerpt 11: "We have no say about each other's doings. If a manager from the other organization (university) says something I cannot say anything, I cannot influence anything! It affects one's motivation. Some days my time and energy goes into fighting about absolutely ridiculous issues!" (MN3, Finnish case).

The university management dominating the FabLab managers and the lack of shared rules was also a concern for the Italian FabLabs. The conflicts were often about administrative and legal procedures between the local FabLab managers and the university managers.

Excerpt 12: "Yesterday a colleague from the Department of XXXX called me and asked if we could help one of her PhD students, who had to print something with a 3D printer. We had to say no. There are plenty of printers and many FabLabs around here, but you have to pay and to queue to use them. We can be seen as an easy solution... I am sorry, but we cannot legitimate these requests. We cannot accept this "old" logic, based on hierarchy and status issues. We are not a (university) campus facility, we are something more and different!" (MN7, Italian case).

The above excerpt shows that when tensions were perceived as threatening the lab's boundaries, its access rules, and its status and democratic values, managers legitimated resistance and public disagreement as prior strategies for facing the situation. In both cases, the FabLab managers experienced their efforts as "work in progress" and in the development, as depicted in the following excerpts:

Excerpt 13: "There is a lot of oration in academia about how teaching and learning should take place in innovative learning environments. We do this in practice and empower students and we have seen how well it works!! And, we never know what the end result will be!" (MN1, Finnish case).

Excerpt 14: "It is an on-going process . . . still work in progress. But we have plenty of ideas in this direction, and we need to implement all these operations before it is too late!" (MN7, Italian case).

Excerpt 15: "One of the core aims of the hub was to create collaboration between universities and business. (. . .) A core challenge, still, is to develop a shared understanding of the lab activity" (MN7, Finnish case).

Despite the many difficulties, the managers in both countries believed in the importance and potential of the universities' collaboration with students, entrepreneurs, business and labor markets. Managers justified their decision to stay in the academy as a way of fighting its traditional culture, and innovate it "from within".

Excerpt 16: "We are facing many challenges and one can ask: why didn't you open the Lab elsewhere? Because we strongly believe that we can benefit from academia as a place of cultural production; and we have also the ambition of influencing academia's cultural production, somehow . . . " (MN3, Italian case).

In activity-theoretical terms, we preliminarily interpret this challenge as a tertiary contradiction among the object/motive of the new FabLab activity system and other, neighboring activity systems, e.g., the prevailing university activity. This contradiction manifested itself as a power play among the FabLab managers—fighting the traditional university culture, and the senior university management—resistant to change and willing to control the new-born organization. Here, the sustainability challenge seemed to relate to the need to consider the asymmetry of power within a network of multiple stakeholders with conflicting motives—often wishing to stay on their "separate islands"—and not quite figuring out how to engage all the parties with shared objects, rules and work activity.

In the two cases, however, while the managers worked towards engaging students, FabLab employees and other key stakeholders in collaborative and dialogical processes, they tended to exclude the university senior managers from these efforts. When facing the university management, in effect, they seemed to adopt a defensive strategy aimed at protecting FabLab's autonomy and fighting against the university control. Such a situation was perceived as a stressful challenge, threatening managers' motivation and well-being, as expressed for example in Excerpt 11.

5. Discussion and Conclusions

The aim of the present paper was to explore the challenges faced in managing new organizational forms like fabrication laboratories (FabLabs), by translating sustainability into action. Inspired by cultural-historical activity theory and the activity system model, together with the typology of different contradictions created by Engeström [14], we explored FabLabs in an Italian and a Finnish university. Our research questions were: which contradictions can be depicted in FabLab organizations in Italy and in Finland? And further, how do these relate to the promotion of sustainability in these cases?

Our study has highlighted that FabLabs as "born for sustainability" organizations value collaboration, intergenerational equity and multi-stakeholder engagement as a constitutive part of its mission and ethos, which are the core ingredients of a sustainable organization. However, managers face several tensions and contradictions daily and thus struggle in translating these values into action effectively.

In the Italian and Finnish cases, three main contradictions were revealed. The first concerns the tension between managing an open organization within a performance-oriented academic institution. The second one is about the opposing demands of creating a lively community versus managing the participants' individualistic aims. The third concerns the difficulties in the management of diverse stakeholders with competing motives and power relations. In this, a sustainable organization appears as being related to three main challenges:

- A performance-related challenge, concerning how different stakeholders (e.g., the activity systems of the FabLab managers, the students and other client groups, university management, business-promoting organizations, etc.) perceive the FabLab's aims and outcomes and how they conceptualize the *short term* vs *long term* performance standards.
- A belongingness-related challenge, concerning how different stakeholders interpret their role and belonging to the FabLab, and whether they perceive it as a *community* or as a pathway for fulfilling *individual aims and needs*.
- A power-related challenge, concerning how different stakeholders strive to *partner with or to control* the different stakeholders (activity systems) involved and their activity in the FabLab.

The first challenge, in our interpretation, stems from the fact that the FabLabs were struggling with pressing and contradictory demands of efficiency and productivity requirements, respectively related to long-term development and learning aspects and the short-term service-provision requirements. Here, translating sustainability into action means acknowledging the tension between the top-down-directed performance requirements and the long-term goals for promoting open innovation and knowledge sharing. This tension is consistent with one of the earliest definitions of sustainability, namely "The satisfaction of current needs in a way that does not endanger the satisfaction of future generation" [42], which emphasizes the idea of balancing different temporal orientations in order to prompt a sustainable system.

The second challenge emerges since over time, the FabLab managers have established and sustained dialogical and collaborative ways of working with multi-professional teams involving multiple internal and external stakeholders [43]. This finding is consistent with O'Higgins' definition of "stakeholders' engagement towards sustainability", namely the opportunity for "building vigorous, long-term, resilient relationships (...) for continuous learning, co-creating platforms for mutual advantage, (...) in an ongoing atmosphere of trust" [29] (p. 163). Many of the FabLab managers'

practices, however, clashed with the individualistic and hierarchical ways of working which the university students and staff were accustomed to, creating open conflicts and power plays. This finding highlights a fundamental challenge related to the promotion of sustainability, that is how to prioritize and lead towards a reciprocal satisfactory and equitable agreement the diverse stakeholder claims [44].

Finally, the third sustainability challenge stems from the fact that instead of aligning their multiple motives towards a development of a shared object, the multiple stakeholders tended to maintain their own autonomy and used their power, which hampered the flexible and meaningful development of collaborative process. This aspect is consistent with the need not to treat notions of power simplistically in stakeholders' engagement towards sustainability [45]. If underestimated, power differences might compromise the opportunity to take into account diverse stakeholders' interests and values, especially when they contrast with those of the most powerful ones.

If multi-stakeholder collaboration for promoting a sustainable organization is not an altruistic orientation to mutual support, understanding and trust, but a critical challenge in organizations in which different powers, demands, and goals are simultaneously present and intertwined [46,47], specific tools and strategies are needed for managing it. In both countries, FabLab managers lacked an overall and explicit strategy and particular solutions for enabling sustainability within and between the distinct activity systems with different needs and objects. In many cases, the contradictions characterizing the FabLab activity made them feel stressed and uncomfortable, or even generated open conflicts among the stakeholders. Rather than being interpreted as triggers for further learning, such conflicts run the risk to affect individual and collective well-being and to weaken FabLabs' social and relational capital.

Our findings point to the fact that to help managers to cope with the above described challenges, there is a need to establish new frames and understandings of sustainability as a continuous process and a contradictory and dilemmatic journey. An expanded and engaged management orientation towards sustainability might help managers to avoid defensive stances and transform conflicts into "translation tools" in problem-solving processes, in which stakeholders could be involved in designing new and shared tools, objects and rules of the activity. If welcomed, tensions and paradoxical dilemmas can be therefore used to "reframe" conflicting situations and feeding collective learning processes—see also the notion of expansive learning [15]—in order to coordinate, develop and sustain the dialogue between multiple stakeholders better, acknowledging their multifaceted nature and interests.

It is important to note that our study presents a few limitations. First, data could be considered as narrow in scope and based on interviews only. Our interpretations of the different contradictions and their relation with sustainability issues are thus only preliminary. We are currently working on a systematic analysis of a larger data corpus, collected in other fields. Through an analysis of an enlarged data corpus, our aim is to make more profound comparisons to test quality of our findings and to provide in-depth information on the FabLab managers across cultural contexts.

References

1. Maldini, I. Digital makers: An ethnographic study of the Fablab Amsterdam users. In Proceedings of the Matter of Design—5th STS Conference, Politecnico di Milano, Milano, Italy, 12–14 June 2014.
2. Hatch, M. *The Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers*; McGraw-Hill: New York, NY, USA, 2013.
3. Diez, T. Personal fabrication: FabLabs as platforms for citizen-based innovation, from microcontrollers to cities. *Nexus Netw. J.* **2012**, *14*, 457–468. [CrossRef]

4.   Lawton-Smith, H.; Bagchi-Sen, S. The research university, entrepreneurship and regional development: Research propositions and current evidence. *Entrepr. Reg. Dev.* **2012**, *24*, 383–404. [CrossRef]

5.   Kajamaa, A.; Galuppo, L.; Ivaldi, S.; Scaratti, G. Facilitating creativity and social sustainability: A mission impossible for the management of Fablabs? In *Facilitating Sustainable Development Through Creative Approaches—Integrating Arts, Technology and Management Perspectives*; Schulz, K.P., Mnisri, K., Guimaraes da Costa, N., Shrivastava, P., Hüsig, S., Eds.; PUN—Editions Universitaires de Lorraine: Nancy, France, 2017; ARTEM OCC 2017 Edited Volume; in press.

6.   Celani, G. Digital fabrication laboratories: Pedagogy and impacts on architectural education. *Nexus Netw. J.* **2012**, *14*, 469–482. [CrossRef]

7.   Paio, A.; Eloy, S.; Rato, V.M.; Resende, R.; de Oliveira, M.J. Prototyping vitruvius, new challenges: Digital education, research and practice. *Nexus Netw. J.* **2012**, *14*, 409–429. [CrossRef]

8.   Maffei, S.; Bianchini, M. Emerging production models: A design business perspective. In *Designing Business*; Faust, J., Junginger, S., Eds.; Berg Publisher: London, UK, 2015.

9.   Kira, M.; van Eijnatten, F. Socially sustainable work organizations: A chaordic systems approach. *Syst. Res.* **2008**, *25*, 743–756. [CrossRef]

10.   Engeström, Y. *From Teams to Knots: Activity-Theoretical Studies of Collaboration and Learning at Work*; Cambridge University Press: Cambridge, UK, 2008.

11.   De Mul, J. Redesigning design. In *Open Design Now, Why Design Cannot Remain Exclusive*; Van Abel, B., Evers, L., Klaassen, R., Troxler, P., Eds.; BIS Publishers: Amsterdam, The Netherlands, 2011.

12.   Anderson, N.; Potocnik, K.; Zhou, J. Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework. *J. Manag.* **2014**, *40*, 1–37. [CrossRef]

13.   Mirvis, P. Unilever's drive for sustainability and CSR—Changing the came. In *Organizing for Sustainable Healthcare*; Mohrman, S.A., Shani, A.B., Eds.; Emerald: Bigley, UK, 2011; pp. 41–72.

14.   Engeström, Y. *Learning by Expanding: An Activity-Theoretical Approach to Developmental Research*; Orienta-Konsultit: Helsinki, Finland, 1987.

15.   Engeström, Y.; Sannino, A. Discursive manifestations of contradictions in organizational change efforts: A methodological framework. *J. Organ. Chang. Manag.* **2011**, *24*, 368–387. [CrossRef]

16.   Ivaldi, S.; Scaratti, G. Narrative and conversational manifestation of contradictions: Social production of knowledge for expansive learning. *Learn. Cult. Soc. Interact.* **2018**. [CrossRef]

17.   Galuppo, L.; Gorli, M.; Scaratti, G.; Kaneklin, C. Building social sustainability: multi-stakeholder processes and conflict management. *Soc. Responsib. J.* **2014**, *10*, 685–701. [CrossRef]

18.   Barus-Michel, J.; Enriquez, E.; Lévy, A. *Vocabulaire de Psychosociologie*; Eres: Paris, France, 2002.

19.   Kira, M.; van Eijnatten, F. Socially sustainable work organizations: Conceptual contributions and worldviews. *Syst. Res.* **2011**, *28*, 418–421. [CrossRef]

20.   Lifvergren, S.; Huzzard, T.; Docherty, P. A development coalition for sustainability in healthcare. In *Creating Sustainable Work System*; Docherty, P., Kira, M., Shani, A.B., Eds.; Routledge: London, UK, 2009; pp. 167–185.

21.   Roloff, S. Learning from multi-stakeholder networks: Issue-focussed stakeholder management. *J. Bus. Ethics* **2008**, *82*, 233–250. [CrossRef]

22.   Porter, T.B. Managerial applications of corporate social responsibility and systems thinking for achieving sustainability outcomes. *Syst. Res.* **2008**, *25*, 397–411. [CrossRef]

23.   Di Fabio, A. The psychology of sustainability and sustainable development for well-being in organizations. *Front. Psychol.* **2017**, *8*, 1534. [CrossRef] [PubMed]

24.   Di Fabio, A. Positive Healthy Organizations: Promoting well-being, meaningfulness, and sustainability in organizations. *Front. Psychol.* **2017**, *8*, 1938. [CrossRef] [PubMed]

25.   Di Fabio, A.; Rosen, M.A. Opening the black box of psychological processes in the science of sustainable development: A new frontier. *Eur. J. Sustain. Dev. Res.* **2018**, *2*, 1–6. [CrossRef]

26.   D'Angelo, C.; Gozzoli, C.; Gazzaroli, D.; Mezzanotte, D. New custodial cultures. Experiences and consequences on prison police's well-being. *World Futures* **2018**, *74*, 360–378. [CrossRef]

27.   Gozzoli, C.; Gazzaroli, D.; D'Angelo, C. Who cares for those who take care? Risks and resources of work in care homes. *Front. Psychol.* **2018**, *9*, 314. [CrossRef] [PubMed]

28.   Hemmati, M. *Multi-Stakeholder Processes for Governance and Sustainability: Beyond Deadlock and Conflict*; Earthscan Publications: London, UK, 2002.

29. O'Higgins, E. Corporations, civil society, and stakeholders: An organizational conceptualization. *J. Bus. Ethics* **2010**, *94*, 157–176. [CrossRef]

30. Hasu, M.; Toivonen, M.; Tuominen, T.; Saari, E. Employees and users as resource integrators in service innovation: a learning framework. In *The Handbook of Service Innovation*; Agarwal, R., Selen, W., Roos, G., Green, R., Eds.; Springer: London, UK, 2015; pp. 169–192.

31. Heiskanen, E.; Hyysalo, S.; Kotro, T.; Repo, P. Constructing innovative users and user-inclusive innovation communities. *Technol. Anal. Strateg.* **2010**, *22*, 495–511. [CrossRef]

32. Engeström, Y. Activity theory and the social construction of knowledge: A story of four Umpires. *Organization* **2000**, *7*, 301–310. [CrossRef]

33. Cabiati, M.; Ripamonti, S.C.; Pozzi, M. Creating knowledge and enhancing change in organisations. The contribution of authorship and expansive learning in a case study. *Learn. Cult. Soc. Interact.* **2016**, *11*, 97–104. [CrossRef]

34. Hartley, J. Case studies in organizational research. In *Qualitative Methods in Organizational Research*; Cassell, C., Symon, G., Eds.; Sage: Thousand Oaks, CA, USA, 1997; pp. 207–229.

35. Yin, R.K. *Case Study Research: Design and Methods*, 4th ed.; Sage: Thousand Oaks, CA, USA, 2009.

36. Czarniawska, B. *Narratives in Social Science Research*; Sage: London, UK, 2004.

37. Kajamaa, A. *Unraveling the Helix of Change: An Activity-Theoretical Study of Health Care Change Efforts and Their Consequences*; Unigrafia: Helsinki, Finland, 2011.

38. Liberati, E.G.; Gorli, M.; Moja, L.; Galuppo, L.; Ripamonti, S.; Scaratti, G. Exploring the practice of patient centered care: The role of ethnography and reflexivity. *Soc. Sci. Med.* **2015**, *133*, 45–52. [CrossRef] [PubMed]

39. Miles, M.B.; Huberman, M.A.; Saldana, J. *Qualitative Data Analysis: A Method Sourcebook and the Coding Manual for Qualitative Researchers*, 3rd ed.; Sage: Thousand Oaks, CA, USA, 2014.

40. Ricoeur, P. *Time and Narrative*; University of Chicago Press: Chicago, IL, USA, 1984; Volume 1.

41. Padgett, J.F.; Powell, W.W. *The Emergence of Organizations and Markets*, 2nd ed.; Princeton University Press: Princeton, NJ, USA, 2013.

42. World Commission on Environment and Development. *Our Common Future (The Brundtland Report)*; Oxford University Press: Oxford, UK, 1987.

43. Spinuzzi, C.; Bodrožić, Z.B.; Scaratti, G.; Ivaldi, S. Coworking is about community: but what is community in coworking? *J. Bus. Tech. Commun.* **2019**, *33*, 112–140. [CrossRef]

44. Greenwood, G. Stakeholder engagement: Beyond the myth of corporate responsibility. *J. Bus. Ethics* **2007**, *74*, 315–327. [CrossRef]

45. Greenwood, G.; Anderson, E. 'I used to be an employee but now i am a stakeholder': Implications of labelling employees as stakeholders. *Asia Pac. J. Hum. Resour.* **2009**, *47*, 186–200. [CrossRef]

46. Ivaldi, S.; Scaratti, G. The formation of germ cell for organizational learning. *J. Workplace Learn.* **2016**, *28*, 224–244. [CrossRef]

47. Scaratti, G.; Galuppo, L.; Gorli, M.; Gozzoli, C.; Ripamonti, S. The social relevance and social impact of knowledge and knowing. *Manag. Learn.* **2017**, *48*, 57–64. [CrossRef]