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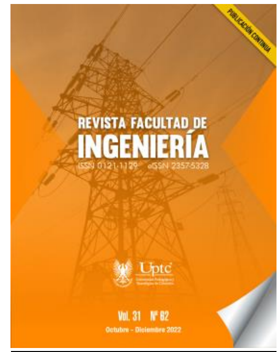

Failed Co-Creation: The Case of the BCNStreet-Lab Project

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Abstract

We present the results of the BCNStreet-lab project, a co-creation process of a prototype that "died before it even existed" and that has led us to reflect on the creative power that participatory design can have among experts. Examining the high variability that the design acquired with the co-creation sessions, we realized

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how an open co-creation process can generate overflows in the design. It makes innovation possible but can also lead to failure, as is this case, because of how risky participatory design of "fluid technologies" and how ineffective reproducing the Quadruple helix innovation model in small projects can be. We tried to account for the fruitful relationship between co-creation and the design of electronic technologies, which happens in the "lobby" of the technical design of the prototype. It generates negotiations and interactions that lead to progress in the democratization of design practices in electronic engineering, computing, and telecommunications. At this point, co-creation is conceived as a space in which institutional practices, social needs, technological imaginaries, economic interests, techno-scientific interests, etc., are brought together, translated and inscribed into the design of technologies.

Keywords: co-creation; engineering; fluid technologies; overtechnification; sociomaterial variability.

Co-creación Fallida: El caso del proyecto BCNStreet-Lab

Resumen

Se presentan los resultados del proyecto BCNStreet-lab, un proceso de cocreación de un prototipo que "murió antes de existir" y que llevo a reflexionar sobre el poder creativo que puede tener el diseño participativo entre expertos. Observando la alta variabilidad que adquirió el diseño con las sesiones de cocreación, se denota cómo un proceso abierto puede generar desbordamientos en el diseño, que hacen posible la innovación pero también pueden llevar al fracaso, como en este caso, debido a lo arriesgado que puede ser el diseño participativo de "tecnologías fluidas" y lo ineficaz que puede ser tratar de reproducir el modelo de innovación de cuádruple hélice en pequeños proyectos. Se intenta dar cuenta de la fructífera relación entre la cocreación y el diseño de tecnologías electrónicas, la cual se da en el "lobby" del diseño técnico del prototipo, genera negociaciones e interacciones y permite avanzar en la democratización de las prácticas de diseño en ingeniería electrónica, computación y telecomunicaciones. En este punto, la cocreación se concibe como un espacio en el que las prácticas institucionales, las necesidades sociales, los imaginarios tecnológicos, los intereses económicos, los intereses tecnocientíficos, etc. son reunidas, se traduce e inscriben en el diseño de las tecnologías.

Palabras clave: cocreación; ingeniería; sobretecnificación; tecnologías fluidas; variabilidad sociomaterial.

Cocriação fracassada: o caso do projeto BCNStreet-lab

Resumo

Apresentamos os resultados do projeto BCNStreet-lab, um processo de cocriação de um protótipo que “morreu antes de existir” e que nos tem levado a refletir sobre o poder criativo que o design participativo pode ter entre os especialistas. Observando as altas aberturas que adquiriram o design com as sessões de cocriação, percebemos como um processo pode gerar spillovers no design, que possibilitam a inovação, mas também podem levar ao fracasso, como neste caso, pelo risco que o design participativo de “tecnologias fluidas” pode ser e quão ineficaz pode ser tentar replicar o modelo de hélice quádrupla de inovação em pequenos projetos. Procuramos dar conta da profícua relação entre a cocriação e o design de tecnologias eletrônicas, que ocorre no “lobby” do design técnico do protótipo, gera negociações e interações e permite avançar na democratização das práticas de design em engenharia eletrônica, informática e telecomunicações. Nesse ponto, a cocriação é concebida como um espaço no qual práticas institucionais, necessidades sociais, imaginários tecnológicos, interesses econômicos, interesses tecnocientíficos, etc. são coletados, traduzidos e inseridos no design de tecnologias

Palavras-chave: cocriação; engenharia; preferência sociomaterial; supertecnificação; tecnologias de fluidos.

I. INTRODUCTION

In this article we examine the case of a failed co-creation process, which accounts for the effects of sociomaterial variability in participatory design in small technological projects. However, this variability is not related to user participation, but to the active and sometimes controversial participation of experts. As [11] points out, a co-creation process can generate negative value results and failures in co-creation practices. We propose an alternative reflection to assess failed co-creation cases, which are not directly linked to the final results but to the experience and make variability, change, and uncertainty a source of innovation and, ultimately, of knowledge.

The sociomaterial variability produced by technological innovation has been a matter of interest in Science, Technology & Society studies (STS) from the analysis of the social construction of technological systems, the application of ANT to the study of technological mediation [14]; [16], the ethnographic studies of infrastructures [24], and the reflection on the democratization of technoscience [3] where emphasis has been placed on uncertainty and unpredictability in innovation processes. These are not linear, they are often intervened by interests, mediations or circumstances that modify the initial objectives and that, together, can make a technology fail before it comes into being [15]; [16]. Sociomaterial variability is problematic, [19] states:

> Variability should be considered as a constitutive characteristic of participatory objects, conceptually, empirically, and normatively speaking. The same or a similar object can facilitate very different modes of engagement and can assume different normative burdens: participatory things must be understood as multivalent [19].

For Marres, variability is a key indicator. It shows how participatory the applied methodology has been, and to what extent the process has been bottom-up or top-down, more directed, or really open. That is why, today, in the field of public engineering, almost any cutting-edge technological design process aims to be as participatory as possible. Nevertheless, as we present in this article, developing these practices —involving participation— is complicated. We have observed that this type of positive correlation between process openness (design) and the sociomaterial variability of the object is a (hypothetical) correlation that can generate overflows and controversies. For this reason —following [3], in the face of variability, changes or uncertainties— our fundamental concern has been to promote participation mechanisms that help to manage uncertainty. Paraphrasing [24], the 'Participation infrastructures' or what [3] called "hybrid forums" would be a notion that encompasses a multiplicity of projects that attempt to resolve techno-scientific controversies in the most democratic and inclusive way possible. These projects have a common characteristic: it is frequent that participation from the STS is not conceived as simplifying machines of collective action. Rather, it is considered a process that can unleash complexity, open a "Pandora's box", stimulate variability or uncertainty.

This variability produces uncertainties that drive innovation through co-creation. Following [18], various experiences in participatory design turn out to be processes of social innovation in which small projects can cause large-scale transformations. Manzini & Rizzo say that in order to promote the link between participatory design and social innovation, "it is necessary that the processes be as open as possible, articulated and to a great extent unpredictable" [18]. In fact, we could say that the variability of the object (obtained) is an indicator of success, which shows up to what point the participation has inscribed the script of the performers in complex socio-material settings.

Considering these precedents, the objective of this article is to go a step further and demonstrate that through Participatory Design (PD) it is also possible to obtain sophisticated technological concepts and test innovation models, which generate advances in design but also increase risk. For example, through the co-creation of technologies, one can obtain what De Leat & Mol call "fluid technologies" to refer to the Zimbabwe bush pump "B" type. For these authors, "the fluidity of the pump's operation is not a matter of interpretation, it is integrated into the technology" [16], a fluid technology adapts to different types of environments, its borders are variable and diffuse, it changes in an indeterminate historical trajectory. Fluid technology is a suitable concept to study long-distance technologies. However, we defend the idea that through PD it is possible to operationalize the concept in a practical manner.

In addition to obtaining fluid technologies, we also argue that possible innovation models can be tested. For example, the PD can be used to test the "innovation propellers" model, a kind of "innovation formula" originally proposed and later expanded by [4][5]. In this case, the participation device can become a dialogic space that calls for the collaboration of people representing different sectors of society: companies, universities, organized society, and the administration (each of them represents a helix).

However, as we explained, trying to innovate with "fluid technologies" or test innovation models with co-creation methods, only adds variability to the design results and is a source of uncertainty. In this case, it is related to increasing complexity that stems from the interactions between experts in the fields of engineering (computing, telecommunications, sensors), urban planning, companies, and universities.

This article starts by situating the controversy that we are trying to resolve through the project: urban overtechnification (Section 2). In section 3, we give details of the composition of what we call "dream team innovation". In Section 4, we provide details of the results of the co-creation sessions. In Section 5, we examine the results and failures of the co-creation process. We conclude this work with a reflection on the possibility of co-creation to design fluid technologies and to reproduce sociotechnical relationships in an artificial way.

II. UAB Open Labs and the Overtechnification Problem

Our stage is the UAB Open Labs, a network of open innovation spaces of the Autonomous University of Barcelona (UAB). This is an infrastructure for open innovation [10] that has an activity program to foster transversal multidisciplinary projects and the creation of thematic communities, thus encouraging teachers, students, and citizens to make an active use of innovation and experimentation methodologies. From this starting point, our activities as professionals have consisted in the identification of challenges, problems, or controversies that neighborhoods and cities are facing and can be solved through the available lab infrastructures for fast-prototyping, and the co-creation and testing of different

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participation devices. In this context, we are constantly looking for challenges that, in line with those pointed out by [7], can become a tool to hybridize different knowledge, promote the generation of ideas, and integrate different groups in innovation projects guided by the philosophy of free software and hardware.

In this exploration of controversies, we identified the challenge of urban overtechnification, a phenomenon little documented in the STS so far, which contemplates the negative impact on the urban landscape (and functioning) produced by the progressive increase in installation of technological components (such as sensors, antennas, cables, and cameras) in the urban public space. A growing set of technologies that affects the standard and aesthetics of the urban landscape. Following [17], this problem would be closely related to neoliberal urban planning of smart cities. In the case of Barcelona, it puts at risk the perceived quality of public space buildings, facades, and urban elements (traffic lights, lampposts, seats, pavements, etc.). Sometimes, they include rules for catalogued, protected, and strictly regulated buildings that dictate each device or element installed within Barcelona's public space. It may have been a key factor to prevent Barcelona —one of the most beautiful cities in the Mediterranean— from becoming a kind of urban dystopian and preserve its aesthetic architectural value.

However, sometimes these bureaucratic regulations do not go in pace with the technological development of the city. There is a contradiction between the care and protection of the city's aesthetics and the technological impulse that it generates, which places us in front of a paradox. On one hand, the City Council encourages citizen innovation by supporting the creation of cooperatives, companies, and community technology platform projects. That support aims at "turning around" community and democratizing technological infrastructures by supporting small scalable collective innovation formats to spread this common philosophy [21]. Many of these projects need devices or technological elements to be installed, which concern urban landscape design and somehow affect it. On the other hand, the City Council staff use the normative regulations and hinders the free development of public and private technological projects within the city's urban space. For instance, in Barcelona, the regulations to implement technologies date back to 1999 and forbid installing any "technical element" on facades, viewpoints, or balconies. In this controversy, there is a third axis: the citizens, who observe the development of these technologies with distrust, revealing hints of the current Digital Divide within the population. During the co-creation sessions, merchants pointed out that this type of urban technologies alter the beauty or aesthetics of their neighborhood and make it ugly.

This type of controversy revolves around the phenomenon of urban overtechnification: a type of urban-technological development that is part of the imaginary of post-industrial cities and that sometimes do not have much consonance with the local culture; thus, it ends up generating obstacles for experimentation and search for innovation. We think that there may be a solution. Our reasoning is that urban design utopias do not need to be against the technological utopias, and the regulation (of urban landscape) does not have to be an obstacle for creative and innovation processes. Faced with the difficulties posed by a normative and even political solution, one of our hypotheses is the design of a prototype capable of bringing together different types of technologies in an integrative and interoperable technological concept. It could be cataloged (in the future) as an urban technology standardized element [1], and help establishing a creative space that respects the urban design standards and regulations of the city.

III. PARTICIPATION DEVICE: THE INNOVATION DREAM TEAM

We will begin by describing the characteristics of the "participatory device" in this project. To design the co-creation process, we got inspired by the notion of "hybrid and open forums". [3] point out that hybrid forums are public spaces, where groups can meet to discuss technical options, involving heterogeneous groups and spokespersons (politicians, technicians, and lay people). Moreover [6], hybrid forums do not work on their own. Controversies are also affected by informal meetings or various formats of "open forums", where rather than producing a symmetrical device for managing uncertainty. In the field of technological innovation, models that promote practices that follow the line of "hybrid forums" have been established with some differences, closer to modelling. For example, in our project we tried to implement a hybrid participation model based on the quadruple helix of innovation, which following [5], is a way of conceiving participation between spokespersons for companies, universities, government, and citizenship. The latter would be the fourth helix, and environmental associations would be the fifth [4]. As we have pointed out, the problem that brings us here lies within the first and third helix, that is, the interactions between companies and universities.

Although we did not know what the results would be like following these models or notions, it was necessary for us to define some guidelines to guarantee the participation and social distribution of the knowledge obtained. In the first place, we followed the principle of open innovation based on a decentralized heterarchical network, capable of building and consolidating inter-organizational networks [25], except for bureaucratic requirements. No participating person or organization would preside the design process or would exercise a hierarchical role. Second, co-creation sessions would be held periodically to exercise a minimum coordination over the group, and assuming a creative process of maximum indeterminacy. Third, it was stipulated that the final result would be transferred to the networks of the social and solidarity economy, seeking a principle of redistribution of knowledge that would have repercussions in an expansion of the productive base of technology-based cooperatives. The project data would be open and available on the UNICORN platform developed by the UAB University (https://reptes.uab.cat/processes/bcnstreetlab)

By defining these characteristics of the process, we activated the collaboration network of the Strategic Research Community (CORE-smart and sustainable cities), an organized a structure within the Autonomous University of Barcelona that motivated the creation and initial dynamization of the labs. It already counted with a consolidated community of collaborators, that for our project, made it possible to form what we call an innovation “dream-team” in the “sport of innovation.” In the first place, we summoned the companies of the UAB technology park. These were:

- Sens-Solution: a company specialized in sensor engineering in charge of hardware development based at PRUAB (Research Park UAB)

- Mass Factory: a company specialized in computing in charge of developing an application (app) to operate with the hardware obtained from the PRUAB (Research Park UAB)

Without much discussion, we agreed to design a prototype that would initially integrate the following technologies: Beacons (Bluetooth), temperature and humidity sensors, and CO2 sensors.

This initial idea was sufficient to submit the project to the competitive call for "Investments in information and communication technologies to carry out experimentation and innovation projects in the city of Barcelona", which at the end of 2018 assigned € 9,600.00 to the project for its initial execution. The support of the Barcelona City Council, beyond opening the possibility of manufacturing the prototype, allowed us to consolidate a participation device with more participants. These were Sens-Solution, a company specialized in sensor engineering; Mass Factory, a company specialized in computing; Creu Coberta Merchants Association, in charge of citizen innovation; XOBBCoop, a technology-based cooperative that would coordinate and seek a way to transfer the results to the social and solidarity economy networks (SSE); CORE-Smart Cities (UAB), in charge of coordinating the process together with XOBBCOOP; and the Barcelona Institute of Culture, Barcelona City Council, main funder.

IV. The Co-Creation Sessions

The BCNStreet-lab project consisted of the co-design and prototyping of an integrative urban element based on a printed circuit board (PCB) that enabled assembling and connecting heterogeneous technological components (for example, different types of sensors, Bluetooth beacons, Wi-Fi, etc.). As we pointed out, this process is fully automated. For example, the KiCAD software allows us to create projects, provides different libraries, tools, or subprograms to edit schematics and PCB design. Traditionally, the design and manufacturing process of a PCB has been a competence restricted to the specific technical knowledge of electronics, informatics, and telecommunications technicians [20]. They are design and manufacturing processes, in which non-experts have had little to say. However, by co-creating the “zero phase”, during which the components and characteristics of the design can be decided, the engineer has to transform them into technical drawings and specifications. This “zero phase”, in our case, is the definition of the list of components; it is done prior to the planning of the components, which after a debugging process, is introduced as a guide and objective of the technical design and manufacture. Therefore, co-creation has a democratizing effect on the definition of the "list of components", which is open to the participation of non-experts (or lay people). Thus, not only technical characteristics are decided, but there are also political, ethical, market or social issues and questions on the table. These aspects or challenges are translated by engineers as a set of technical characteristics inscribed and drawn in the object’s design. This is more complex than drawing and simulating a PCB on its own.

Although the elaboration of this “lists of technological components” can lead to tensions and changes, [22] points out that the elaboration of lists is an effective way to organize things; they precede maps and organizations, enable establishing hierarchies or no, creating more lists, extend or shorten them. The participatory elaboration of lists turns out to be a known and easily understood method for the participants.

The co-creation days consisted of iteratively defining and redefining the “list of integrated technologies”. In each co-creation day, the participants proposed integrating a component related to the main challenge: a solution for urban over-technification. The group’s deliberations or agreements were discussed in the preparation of a dynamic list of technologies. With this method, it was expected to have the basic guidelines for technical design and manufacture of the first prototype. Below we present ethnographic observations and summaries of the co-creation sessions, focusing on the evolution of the “list of components”. With each co-creation session, the list changed and introduced more and more variability in the design.

A. Co-Creation and Fluid Materials

The dynamics of the first and second sessions were interesting, since the engineers displayed a certain type of "technological imagination", which led to abandon the initial definition of the prototype and iterate a new version. Engineers began to speculate on the types of technologies that could be integrated, from simple technologies to the more sophisticated and even controversial ones. The list of technologies was growing rapidly. It is not about integrating a beacon (Bluetooth), temperature and humidity, and pollution sensors; for the participating engineers, the possibilities were far greater:

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In the third session, the traders participated. They needed to know the flow of people who pass through the shopping street, to know in what time and day there are more influxes of people, and to know which commercial establishments is the one most people enter. Therefore, the engineers started to speculate on other types of technologies that could be integrated into the prototype: They included Wi-Fi signal sensor, Infrared ray emitter, Camera (visual learning), Pollen sensor, Power supply by electricity (not with photovoltaic panel).

In the fourth session the engineers resolved to transmit the data generated by the prototype, using LoRaWAN technology, a network protocol used for the Internet of Things, which can send data over long distances (20 km), is low power consumption, low data transfer, etc. The prototype will be equipped with a network connection gateway installed by the collective "The things network". Once again, the "list of technologies" was extended: Bluetooth beacons, 3G / 4G / 5G modem, temperature

/ humidity sensor, electrical pollution sensor, Wi-Fi signal sensor, infrared emitter, camera, pollen sensor, LoRaWAN transistor and wired power supply.

Subsequently, the prototype design continued to undergo alterations and redefinition. And finally the collective decided to close the "co-creative technology list" with a guide to assemble a printed circuit board with a minimum of 10 heterogeneous technology components.

B. Synchronization Problems

The co-creation sessions managed to connect people and their ideas that perhaps sparked what Ingold [9] calls “creative engagement”, which is achieved through face-to-face interaction and is acquired as the group or network grows. Once the conceptual design of the prototype electronics was defined, the engineers would use the infrastructure of the UAB Open labs for the technical design and manufacture of the parts. This would allow us, in theoretical terms, to open up to new knowledge and open up the participation to more people. However, some problems emerged: first of all, the university’s machine, necessary to design and manufacture the PCB, was broken and could not be used at that time. A replacement was planned but it would take longer than our time margins.

Second, the company in charge of developing the hardware could alternatively cover this activity in exchange for a budget increase of more than 100%. The company's argument was that the cost of integrating the amount of technologies involved an investment of time in hardware and firmware development. So, they asked for a more than reasonable adjustment, which was not acceptable due to the small funding assigned by the City Council.

Third, one of the companies expressed their interest in endowing the product with industrial property, a position different from the innovation culture of the UAB Open labs (closer to the open-source philosophy) and the definition agreed by the design team.

Fourth, the university informed us that next year (2019-2020) a call would be opened to finance advanced prototypes, but only teams led by tenured professors could apply. This aspect left us out of the competition. The only professor on our team was

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Jordi Roig, currently retired. The rest of us were associate professors, support staff, and other stakeholders.

Although we had alternatives to cut the theoretical design of the PCB, finally the merchants told us that if the prototype did not have the tracking option, it would not be of any use to them. These events, impossible to foresee, led us to stop the project and eventually to return the grant money. As engineers often say "the project went into hibernation" waiting for a better economic scenario.

V. COMMENTS: WHAT WAS WRONG?

Reflections on related processes can be multiple; however, before any criticism, we consider that the project objectively met some of the experimentation objectives. The scheme (Figure 1) exemplifies the indeterminacy produced by the interaction between different knowledge and practices. In our case, this interaction unleashed an unlimited imaginative impulse aiming to integrate a maximum of technologies in a versatile unifying urban element. Its design began with the integration of 3 components, and after the co-creation sessions, it incorporated 10 components.

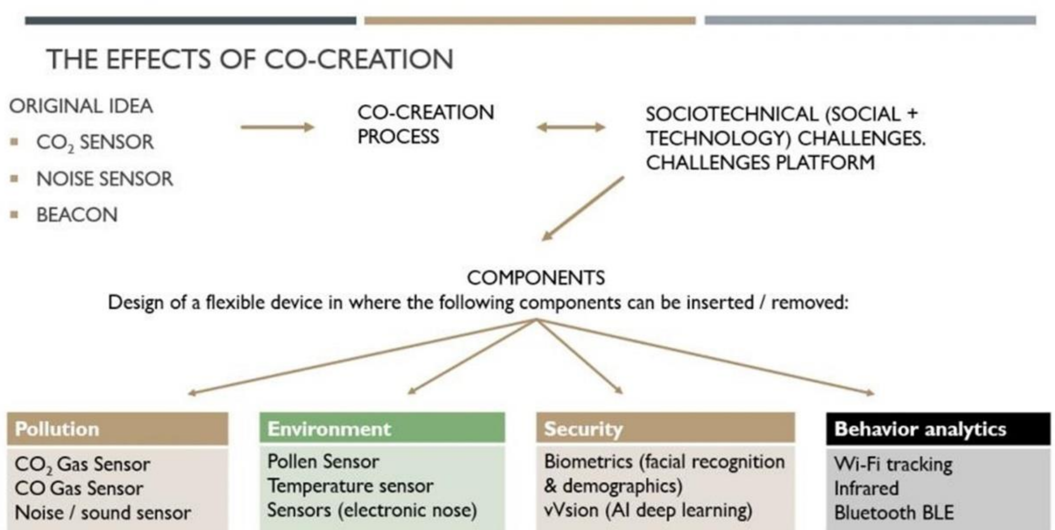

Fig. 1. Scheme that summarizes the effects, alternations, or changes that co-creation produces in the design of the prototype.

This variability points to a double promise: First, in terms of engineering design, the integration of heterogeneous components in a single PCB can be considered a possible solution for the fight against urban overtechnification, while being in line with urban landscape ordinances.

Second, new conceptualizations are being made through the co-creation between different types of engineering, and it is possible to reach the concept of fluid technologies. This type of technology, according to [12], is generally achieved through a prolonged sociotechnical process in time, in which a multiplicity of mediators intervene, sometimes impossible to reproduce through an *ad-hoc* participation device. However, as we have observed, the concept can be partially operationalized, which invites us to imagine the design of nested or unified technologies through assemblies of heterogeneous materials. In the engineering field this is called technology integration, which is a leitmotiv practice of almost any electronic engineering project. In fact, a PCB is a materialization of multiple assemblies. But there is a detail that makes the difference between what is technological integration and a fluid technology: unlike the “planned” integration of technologies, a fluid technology is not a planned design. It is developed through the contributions and interactions between agents before technical design and manufacturing processes take place. These precedents are positive contributions to consider in the realm/field of co-creative engineering.

The failed BCNStreet-lab experience also shed light on the greyer side of innovation. Following [17], the variability that participatory design provokes is not only affected by the meeting of materials, ideas, and people; it also varies by institutional, value, geographical, political-economic or population constraints. Lodato and DiSalvo point out that participatory design does not manage to mitigate the frictions that arise when trying to combine knowledge, practices or ideologies that operate in different institutional frameworks; ideological imbalances can occur. The case of BCNStreet-lab can be a small but demonstrative example of these constraints. The main problem of the project is, perhaps, related to the dream team innovation model, a device of *ad-hoc* participation, which tried to combine open hybrid forums with the quadruple helix artificial innovation model. Currently, this model tends to be used as the formula for promoting public-private collaboration for technological development. A controversial issue, as pointed out by [23], is that importing models of participation in technology is risky because they fail to interpret local technological imaginaries and traditional practices to produce innovation. For instance, the interactions between universities and companies can follow different rhythms and objectives and be controversial [13], the valuations of the process are relative, and the result of a final product is not precisely linked [11]. BCNStreet-lab can be an example of this situation, which acts in two opposite directions. According to [15], if we evaluate the participation focused on the design object, it achieved a certain creative trajectory supported by the active participation of heterogeneous actors. But if we focus on the "participation device", it did not manage to mitigate or synthesize the potential conflict of interest that emerged in the short trajectory of the project, not even to anticipate that the co-creation group could break down due to practices that show the volatility of the group when the economic difficulties to develop the prototype arose.

VI. Conclusions

By presenting the details of the co-creation process of the BCNStreet-lab project, we have tried to account for the fruitful relationship between co-creation and the design of electronic technologies, a type of relationship that happens in the "lobby" of the technical design of the prototype, generates dialogues, negotiations or interactions, and enables progress in the democratization of design practices in electronic engineering, computing, and telecommunications. In this line, co-creation is conceived as a space in which institutional practices, social needs, technological imaginaries, economic interests, and techno-scientific interests of the experts are enrolled [8] and inscribed. They translate into the inclusion (or not) of the design functionalities [2]. However, the attempt to include all the "expert" voices in the design can lead to excessive prototype designs that exceed the real possibilities of the projects and result in a failed co-creation.

Disclosure Statement

We declare that there are no potential conflicts of interest.

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AUTHORS' CONTRIBUTION

Juan-Carlos Vidal-Rojas: Research, formal analysis, methodology, writing-review and editing.

Marcos Cereceda-Otárola: Research, data analysis, model definition, implementation, validation, writing-original draft.

Konstantinos Kourkoutas: Research, data analysis, model definition, implementation, validation.

Jordi Roig-de-Zárate: Research, data analysis, model definition, implementation, validation.

Marc Vallrribera-Ros: Research, data analysis, model definition, implementation, validation.

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