

A Distributed Product-Service System for Mask Provision during COVID-19: an Action Design Research Study in Brazil

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ABSTRACT

The provision of Personal Protective Equipment (PPE) for COVID-19 demanded initiatives beyond the sole provision of physical artifacts, urging the development of new services and system innovations in order to produce effective solutions. In this paper the authors report one of such initiatives, where a streetwear brand (ÖUS) and Paraná Federal University have joined efforts to develop a sustainable Product-Service System for mask provision, aiming at the protection of vulnerable school children in the surrounding area of a shoe manufacturing plant in the state of Ceará, one of the epicenters of the pandemic in the country. This consisted of an Action Design Research where, due to the pandemic context, all participants were in social isolation and, therefore, the design process was carried out remotely. In the article, the authors explore in-depth the induction of a more distributed economy paradigm on the PSS Design. A distributed approach presents itself more aligned with the health requirements during pandemic, with a higher potential to contain locally the flow of people. Furthermore, it also addresses the need for generating income locally, thus merging the health and economic concerns of the pandemic.

Keywords: Distributed Economy, Personal Protective Equipment, Product-Service System, Sustainability.

1. INTRODUCTION

Since its first confirmed case on 26th February 2020, Brazil has become (June 2020) the epicenter of the SARS-Cov-2 infection that causes COVID-19 in Latin America (Candido et al., 2020). Regional and nationwide efforts to tackle the pandemic have shown that the industry was not prepared to rapidly supply the large demand of PPE (Personal Protection Equipment) required by the health sector. Indeed, the Brazilian Medical Association registered 7,897 complaints of health workers about the lack of PPE, from March to April 2020 (BMA, 2020). In order to contribute to the provision of PPEs, not only for the health workers but to the population in general, companies from different sectors have voluntarily repurposed their capabilities. Other institutions have also gathered to support these initiatives, such as city councils, professional associations, NGOs, and universities.

A similar phenomenon has occurred around the world, mostly with a product-oriented emphasis, ranging from the design and manufacturing of masks (UEL, 2020), face-shields (Kalyaev et al., 2020; UFPR, 2020), smart masks (Ghatak, 2020), 3D printed ventilators (Zastrow, 2020), ventilators for two patients (Pooler et al., 2020), 3d printed nasal swabs for test kits to door handles that can be opened using an elbow (Zastrow, 2020). Service-

oriented initiatives have tackled issues such as remote medicine (Kavoor et al., 2020), digital patient self-triage and self-scheduling (Judson et al., 2020) and laboratory services for comparing materials for PPE (INOVA USP, 2020). However, there was a lack of studies that consider integrative approaches that integrate products and services for the provision of PPE. Under such context, the authors set the assumption that the Design of an integrated mix of products and services (Product-Service System) for PPE provision would offer an opportunity to drive the economy towards a more distributed approach, thus contributing to merge both the health and economic aspects of the pandemic.

A Product-Service System (PSS) can be defined as an integrated and comprehensive value offer model that combines a mix of products and services, locally viable, appropriate, and relevant. This mix of products and services need to be able to fulfill the needs of each customer, offering a viable business model for the producers/providers. To be effectively sustainable it has to result in positive societal impact, whilst reducing environmental impact and promoting economic equity (Santos, 2018). The development of a PSS enables more radical and systemic innovation such as the adoption of more Distributed Economy, characteristics that were urgently demanded by the pandemic crisis.

Distributed Economy was firstly defined by Johansson et al. (2005) as a “selective share of production distributed to regions where activities are organized in the form of small scale, flexible units that are synergistically connected with each other”. It is characterized by local small-scale production units connected to each other through a collaborative and synergetic network. These local units provide local needs near or at the point of use, including artifacts /services demands across the product life cycle and business process. Hence, they are more capable to offer on-demand solutions and having a higher level of multi-user participation (Santos, 2018). A distributed Economy has the potential to enhance the generation of local income (Rosa, 2012; Duarte & Santos, 2019). Furthermore, due to the multi-user participation aspect, Distributed Economy works as a learning process that contributes to built-up relevant long term capabilities within local communities.

The subject of a Distributed Product-Service System was explored in an Action Design Research project developed in Brazil on an industry-university partnership during COVID-19. The focus of the project was on the provision of masks for vulnerable school students, with simultaneous attention at the system level regarding the reduction of environmental impacts and a contribution to foster the local economy. More specifically, the project explored the adoption of a PSS oriented towards a Distributed Economy.

The 23-19 Project (the name of the project is inspired by the “password” that monsters used when “contaminated” by children on the movie *Monster S. A.*), was part of an “Integrative Learning Activity” (ILA), implemented in May 2020 by the Product Design Course of Paraná Federal University. This ILA has adopted full remote activities and involved a total of thirty students and seven professors from the Design Department of Paraná Federal University (UFPR). On the industry side, the partner was OÜS, a Brazilian streetwear brand specialized in shoes. The company was established in 2008, with headquarters in Curitiba, Paraná capital, Southern Brazil. Its shoes manufacturing process took place largely at Dilly factory, based in Brejo Santo, State of Ceará, Northeast Brazil. This State was one of the COVID-19 country epicenters during the project, with approximately 136.785 confirmed cases and 6.868 deaths in July 2020 (MINISTÉRIO DA SAÚDE, 2020).

OÜS has championed the idea of using the manufacturing plant located in Brejo Santo to contribute to the pandemic combat. The intent was to use their manufacturing competencies - materials, production skills. infrastructure, and logistics - to provide PPE for the school children in the surrounding region. To facilitate access to local knowledge the project has integrated local partners, including the Ceará Design Professionals Association (ACDesign) and lecturers/students from Ceará Federal University (UFC) and Cariri Federal University (UFCA).

2. THE IMPACTS OF COVID-19 ON SCHOOL CHILDREN

The study focused on school children between 9 and 13 years old. Worth mentioning that one of the unique characteristics of the COVID-19 pandemic was the low hospitalization and mortality rate among children. On the other hand, children were experiencing additional harm due to social isolation, lack of protective school placements, increased anxiety and reduced public health care provision (Crawley et al., 2020). Social isolation, the withdrawal of peer support, the lack of structure, and support of the school environment, added to the increased anxiety provoked by the risk of COVID-19 infection on their parents. Furthermore, social isolation has resulted in domestic violence exposure and abuse increase (Crawley et al., 2020). In Brazil, the effect of such context on mental health was particularly serious for the most vulnerable children living in the poorest areas of the country, where the health and social services were less present due to the burden provoked by COVID-19 on the public services.

The negative emotions caused by COVID-19 can lead to somatic symptoms among children that, in turn, can cause significant physical and mental discomfort. The study of Liu et al. (2020) reinforces this perspective, having identified that the concern for life and health was associated with a higher likelihood of somatic symptoms among primary school students. This concern was associated with anxiety, but not with depression. The authors inferred that with appropriate health education, the implementation of effective prevention and control measures could contribute to reducing concerns regarding the threat to life and health, thus reducing anxiety (Liu et al., 2020). Thus, PPE along with other health measures has to be widely available to children, particularly those in a vulnerable situation.

When analyzing the adequate level of usage of PPE among children, various contextual factors come into place and are relevant to understand the Product-Service System. The study of Chen et al. (2020) investigating the status of hand hygiene and mask-wearing among primary school students in Wuhan, China showed that 42.05% of the primary school students had a good behavior of hand-washing and 51.60% had a good behaviour of mask-wearing. The study has found that grade, mother's educational background, and residence were variables associated with the level of mask-wearing. However, Chen et al. (2020) also call attention to the fact that personal protection of primary school children is often overlooked when the subject is prevention measures, with more attention given to hand-washing and mask-wearing among healthcare workers. Furthermore, children in social vulnerability may be more strongly affected by diseases or their side effects (Bender et al., 2020). Therefore, during the interaction of a PSS with these children, the school becomes a key touchpoint, as it is necessary to guarantee the continuity of various critical services during the pandemic, such as feeding programs and remote learning.

3. RESEARCH METHOD

The authors adopted an Action Design Research (ADR) method. This is a research method that enables contribution to knowledge via prescriptive proposition and evaluation of artifacts, merging the abductive logic of Design Science Research with the learning cycles that characterize Action Research. Based on Sein et al (2011)'s proposition, the Action Design Research on this project adopted four stages, as illustrated in the next figure:

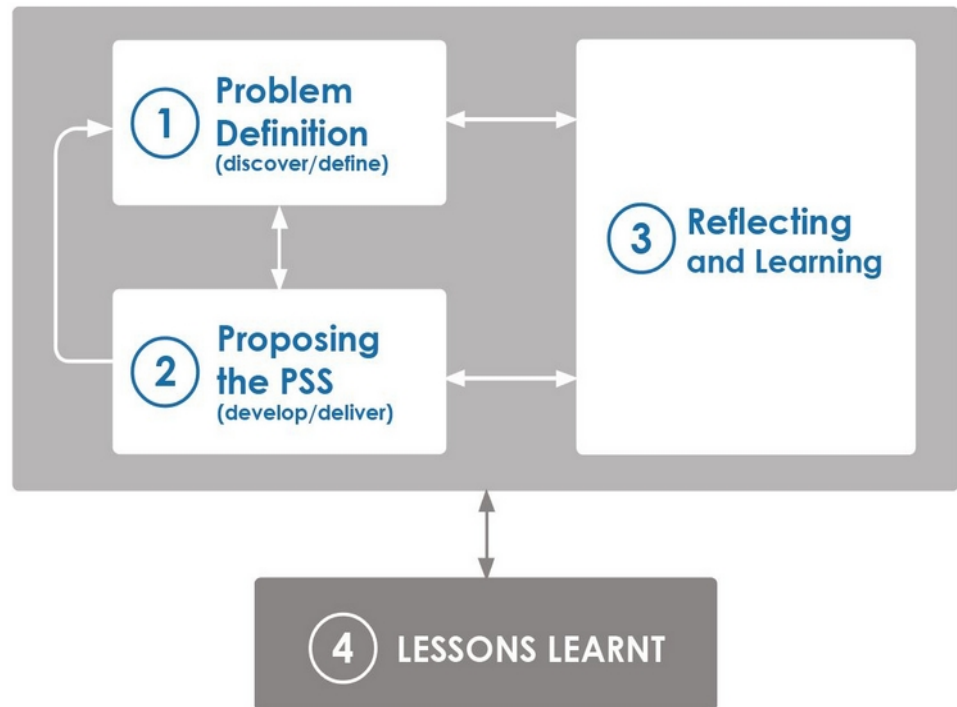


Figure 1. Stages of the Action Design Research Method (adapted from Sein et al., 2011).

The didactic process of application of the discipline involved two main phases, one focused at the PSS level and other focused on the Product Design oriented towards the PSS concept. Next table details the tools used in the first phase of the project, which is reported in this paper:

Table 1. The stages of the ADR method and connection with the project schedule

Stage	Techniques	Results
Stage 01 - Problem Definition	Desktop Research (System); Persona, ; 635 technique; Benchmarking (product/services); Moodboard;	Product+Service System Requirements)
Stage 02 – Proposing the PSS - Generating Alternatives and Detailing (System)	Alternatives: Heuristic Cards for Sustainable Systems; Brainstorming; Storyboard 01. Detailing: Tomorrow headlines; Canvas; System Map; Blueprint; Customer Journey; Storyboard 02	Product+Service System Alternatives and Detailing Concept
Stage 03:Reflecting and Learning	Remote Workshop	Assessing the Viability, Attractability and Strategic Alignment of the proposals
Stage 04: Lessons Learnt	Crossing of Concepts of the Distributed Economy and Final Alternative of PSS	Assessment of the implications of a PSS for promoting a distributed economy during COVID-19

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4. RESULTS & ANALYSIS

4.1. Stage 01: Understanding the Problem (Discover/Define)

On Stage 01 (Problem Definition) the university-industry team focused on understanding the problem as well as the system requirements for the main stakeholders. The activities on this

stage involved the use of Desktop Research, an international Benchmarking of product/service solutions for PPE provision as well as remote open-ended interviews with students and teachers from Ceará State. This stage reinforced the understanding that the sole provision of physical artifacts would not be effective since the masks did require proper management after the usage phase to avoid further dissemination of the virus.

The available knowledge at the time established that the initial spread of the virus occurs by direct contact or through transmission paths to droplets which are found to stable for more than 24 hours (Van Doremalen et al., 2020). It passes through the mucous membranes, primarily the nasal and larynx mucosa and, then, it goes to the lungs, by respiratory tract (Gennaro et al., 2020). There was no vaccine for COVID-19 and, therefore, prevention measures were the main strategy to deal with this virus, including (1) covering coughs and sneezes with tissues; (2) washings hands regularly with soap or disinfection with hand sanitizer containing at least 60% alcohol; (3) avoiding contact with infected people; (4) maintaining an appropriate distance from people; and (5) to refrain from touching eyes, nose, and mouth with unwashed hands (6) use of face masks (CDC, 2020; Gennaro et al., 2020).

The provision of face masks was selected as the main focus of the project since it was a central requirement for the opening up of the schools, although there was no clarity regarding when that would occur. Health care workers were recommended to use certified N95 or Filtering FacePiece 2 (FFP2) when performing aerosol-generating procedures and to use medical masks while providing any care to suspected or confirmed cases (Gennaro et al., 2020). Meanwhile, regular citizens were recommended to wear cloth face coverings in public settings.

The benchmarking has confirmed the need for adding several services into the system in order to support the mask's life cycle. Indeed, due to their toxic nature, masks worn by children during the pandemic must be transported properly to laundry services and/or specialized toxic waste collection. System waste can be treated by various methods (thermal, chemical, biological and mechanical processes or even by irradiation technologies) which can also include incineration, if properly treated fly ash, SO₂ and other pollutants (ANVISA, 2020). In Brazil, COVID-19 waste regulations within health care facilities require the use of a red sac for waste management and services that remove these sacs at least once each 48 hours (ANVISA, 2020).

The information collected at this stage of the project allowed the establishment of the main initial requirements of a PSS for school children mask provision:

1. Allow free access to masks to school children in poorer areas: the system must integrate alternative forms of economic viability that not require payment from those children;
2. Integrate services for the life cycle management of masks (ex: cleaning, tracking, recycling, customizing);
3. Communication with school children have to consider non-digital approaches as some families did not have access to the internet or computing facilities;
4. The system should consider the integration of other facilities in the neighborhood beyond the school itself, due to the precarity of their infrastructure and scarcity of space;

5. Promoting a more distributed economy whilst tackling the pandemic: integrate as much as possible local resources (equipment, skills, and materials) and local stakeholders;
6. Enable effective engagement of school children, gamifying where necessary and possible;
7. Allow more active engagement of factory workers in the system (training, online advice, franchise, home production, among others).

4.2. Stage 02: Proposing the PSS (Develop/Deliver) and Stage 03: Reflecting and Learning

Stage 02 focused on generating, select and detail system alternatives. Due to the social isolation imposed by COVID-19, a remote creativity workshop was carried out, using brainstorming, 635 technique and storyboards. A set of heuristic cards supported the creativity process, contemplating the economic, social and environmental dimensions of sustainability at a system level, contributing to the speed and quality of the creative process. The heuristic cards were made available via an open online platform. Worth mentioning that none of the participants, including the lecturers themselves, have any previous experience in developing a creativity workshop remotely.

The dynamics of interaction were different from conventional face-to-face creativity workshops and have to be learned as the action unfolded. For instance, in the brainstorming session, all participants could write simultaneously their ideas on the same sheet, whilst they present orally their propositions. Clustering and ranking ideas were also carried out with simultaneous handling of information by all participants.

Three main concepts of PSSs were developed: (1) the first concept was a result-oriented PSS for the provision of ownerless masks and their respective life cycle services (e.g. cleaning, recycling) performed by local stakeholders; (2) The second concept consisted of a product-oriented PSS, focused on the donation of masks by involving ÖUS customers as the financiers. In this second concept, when purchasing PPE for his/her use, the ÖUS consumer could also donate a PPE to children in social vulnerability, previously mapped on the PSS platform; (3) The third concept is a user-oriented PSS that consisted of a platform that would integrate local artists to customize the mask's aesthetics, conceived as pre-manufactured kits that would be assembled and sold by the local community, enabling local income generation.

All three concepts, the PSS has emphasized not only the social and environmental dimension of sustainability but, a more distributed economy, the project intentionally integrate green economy principles such as valuing local culture, foster local entrepreneurship, valuing local resources and prioritizing network organizations.

These three concepts were presented, evaluated, and refined with the collaboration of the ÖUS company team and the partners from the State of Ceará. Following their feedback the selected concept merged concepts 01 and 02, integrating services to support the life cycle of masks as well as involving ÖUS customers as one approach to finance the system. Figure 2 shows the Blueprint of the PSS concept.






	Order				Use		After Use	
Blueprint	First contact	Decision support	Acquiring	Manufacturing	Delivery	Use and Monitoring	Maintenance	Discard
 TOUCHPOINTS	- Digital media; - Social networks; - Youtube; - OUS Website and App - Demand Manager (eg NGOs)	- Digital media; - Demand management platform;	- Digital media; - Contact with the manager (tel, email, etc.); - Automatic return via email;	- Web / Application (order tracking);	- Phone / app scheduling; - EPI / Van Delivery OUS Partners; - Physical / Digital Manual (Youtube);	- Signaling / Manual; - Poka-yoke; - Online app tips, email;	- App; - PPE withdrawal support contact;	- App alert for the need to purchase new PPE;
 CUSTOMER ACTIONS	- Search for solutions on the web; - Contact OUS, through the website or tel; - Receive call from the manager; - Line of interaction	- Simulate service registration on the website; - View partnership options delivery times, frequency of maintenance; - View product quality certification;	- Select PPE / sponsorship mode; - Register, receive confirmation of sponsorship; Select PPE laundry and recycling company;	- Track order and delivery status;	- Receive the PPE; - Download application and fill data; - Receive training and feedback on usage data;	- Use of PPE according to app alerts; - Participate in the training provided on the platform;	- Receives alert of the need for hygiene and waits to collect PPE for local laundry;	- Receive warning of need for disposal; - Cooperatives / recycling company collects PPE;
 FRONTSTAGE	- Make content available on digital media; - Contact with manager; - Line of visibility	- Offer online support; - Provide different forms of sponsorship; - Offer PPE portfolio;	- Provide online field for registration and indication of sponsors; - List of cleaning and recycling companies (local);	- Provide website / app status; - Confirm quantity, variety and delivery times;	- Delivery through OUS logistics partner;	- Offer online support with information on the correct use of PPE and signs of wear; - provision of educational material for raising awareness;	- Regular weekly collections; - Offers online support;	- Offers online support; - Indication of times and days of withdrawal;
 BACKSTAGE	- Keep digital media updated; - Search for demand / sponsor work with prospective managers / NGOs; - Line of Internal Interaction	- Prospect different sponsors; - Online exhibition of results; - Design portfolio of PPE of different sizes and strength;	- Receive and manage orders, stocks and distribution; - Organize production of PPE / contact partners; - Receive sponsorship;	- Manufacture Dilly PPE + Component partners + Laboratory; - Update information in the tracking system;	- Offer a platform with usage and care information; - Manage the use and longevity of the items;	- Manage usage, sending alerts reminding you of the necessary precautions (email, msg in the app, etc.);	- Send warning indicating users schedule of possibilities for removing the EPI for maintenance;	- Manage the need for disposal; - Send alert indicating places for cleaning;
 SERVICE OF SUPPORT	- Marketing support; - IT support; - Contact with demand managers (NGOs); - Update demands / Sponsorship;	- IT Support - Design tool based on sponsors; - Logistics partners for delivery and management of PPE; - PPE analysis laboratory;	- IT support; update data on the website / app; - Sponsorship / demand data manager; - Partners: Laundry, recycling company;	- PPE analysis laboratory; - Component partners; - Have IT support to track PPE delivery and update data on the website / app;	- OUS Partner Logistics; - Informational support on conditions of use; - IT support, update data;	- Prepare training content, User Manual; - IT support, update data on the website / app;	- IT support, update data on the need for cleaning the PPE; - Sending alerts; - Maintenance EPI withdrawal;	- IT support, update data, send PPE withdrawal alerts; - Outsourced Logistics; - Recycling company;

Figure 2. Final Blueprint matrix detailing the final concept generated.

In the ordering phase, the system does require registration from clients (school directors) which then can select local stakeholders able to clean or recycle their masks. Also, in the use phase, the system does include learning activities for both the children as well as lecturers. Its operation does require additional IT supporting services, enabling school directors to closely control the situation of PPE among its students. This is in line with the proposition of Bender et al. (2020) that states that the provision of information about COVID-19 would help to reduce students' fears and anxieties about the disease and support their ability to deal with possible secondary impacts on their lives. In this way, education can encourage students to become champions of disease prevention and control at home, at school and in their community, disseminating good practices to others, including adults, on how to prevent the spread of the virus.

This Blueprint unveils that the PSS concept does require partnerships with stakeholders that are not currently connected with the issue of mask provision. This includes recycling cooperatives, NGOs inserted within low-income neighborhoods, and even city council educational departments. The lack of stakeholders in Brejo Santo with specific competencies for cleaning and recycling masks would require the involvement of training and certification organizations at the system level.

The Customer/Business Journey presented in Figure 3 graphically represents the various stages on which the school directors and the school children would have to be involved as well as their relationship with the company. It is possible to see the interconnections between OÜS's customers (who can purchase and/or donate a PPE through the OUS platform) and the representatives of collective spaces for children (public or private) who wish to order PPEs. The concept proposes that in addition to purchasing PPE for their children, private institutions could sponsor PPE for public institutions, where there is a scarcity of resources and poor facilities.

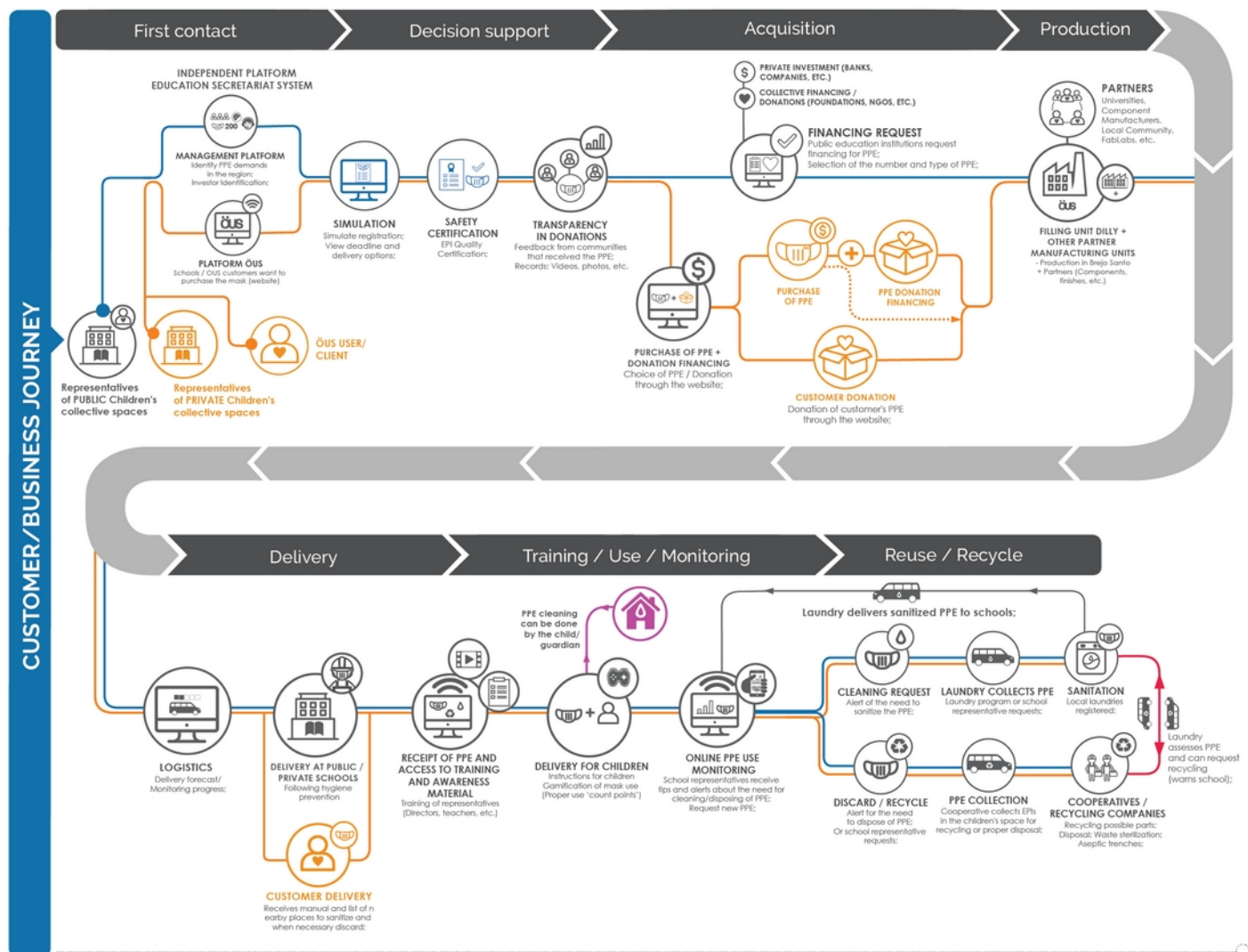


Figure 3. Final proposition for the Customer / Business Journey.

The System Map in Figure 4 represents key material, information, and financial flows among the main stakeholders of the PSS concept. The proposed system map was divided into four clusters of activities: Design, Manufacturing, Logistics, and Use (Figure 4). All these clusters employ a distributed approach, including the use of local cooperatives of transportation to implement the logistics required around the masks.

PSS: PPE MANAGEMENT IN COLLECTIVE SPACES

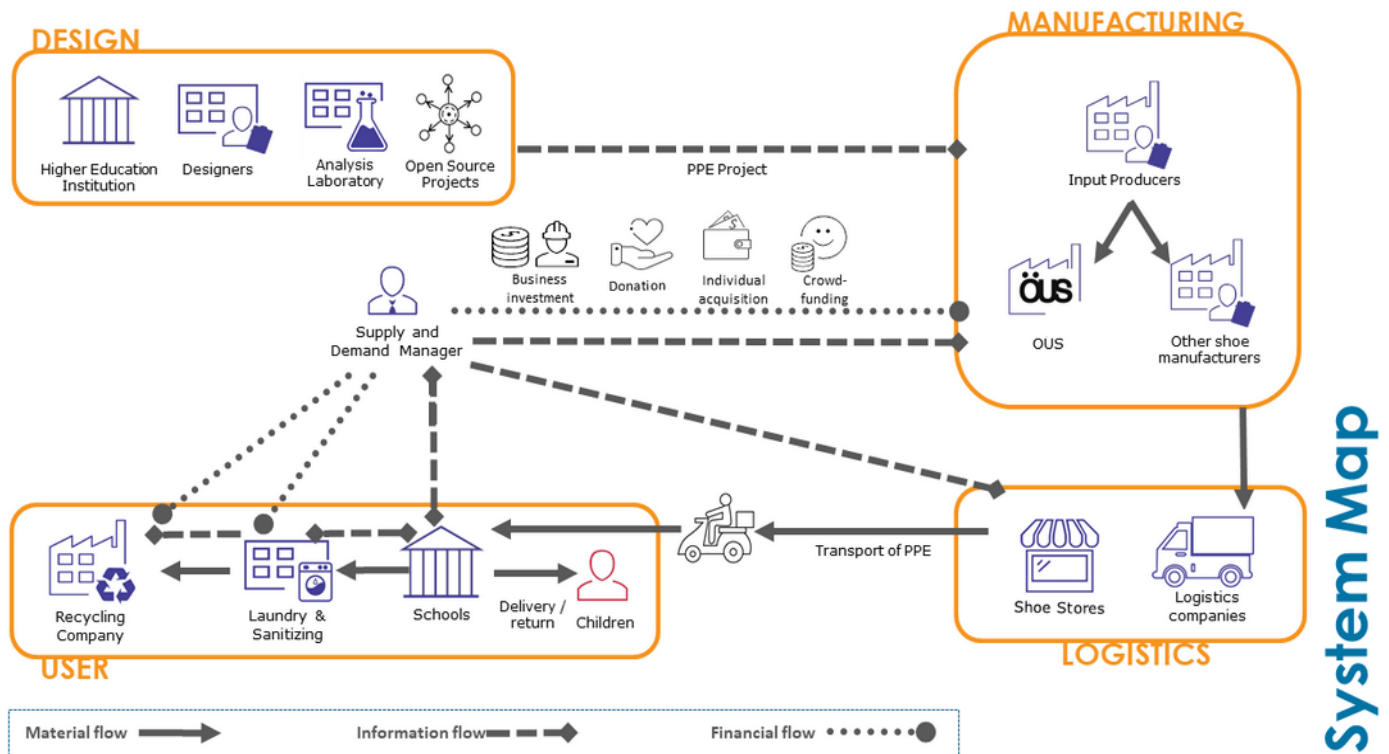


Figure 4. Final System Map for the final concept.

Other financial alternatives have been integrated into the map, such as private investors, donations, crowdfunding and individual acquisitions. A central stakeholder emerged on the PSS Design: a supply and demand manager. Its role is to coordinate the flows among the various stakeholders, synchronizing the demands of the schools with the manufacturing firms and service providers and, also, presenting the existing demands to potential donors.

The business proposition underlying the PSS concept is synthesized on the canvas presented in Figure 5. The 23-15 Team concluded that the PSS concept had the potential to reach not only primary schools but any other collective spaces for children in the State of Ceará (ex: daycare centers, nurseries, scout groups, churches, playgrounds in shopping malls). Again, the business focuses on a distributed economy paradigm, involving local stakeholders for supply/demand management, manufacturing, fundraising, education, logistics, hygiene and recycling of PPE (Figure 5).

PSS: PPE MANAGEMENT IN COLLECTIVE SPACES

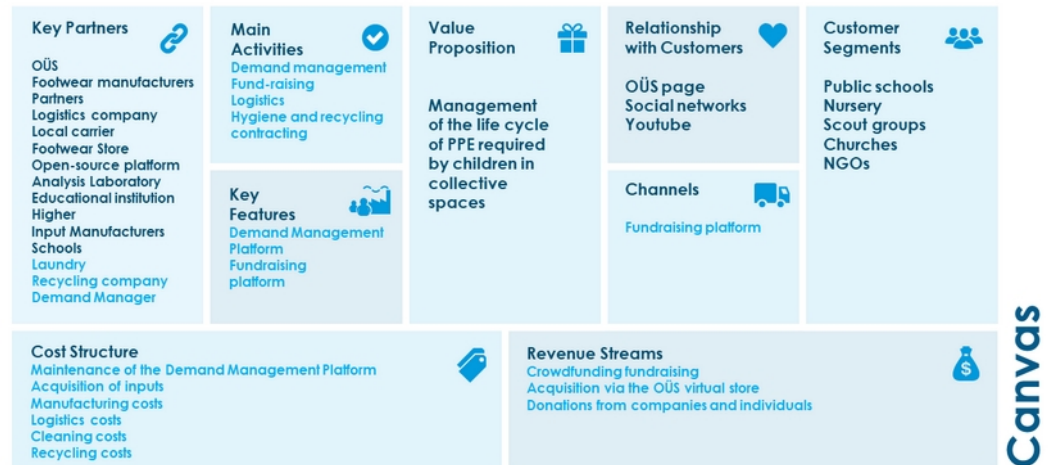


Figure 5. Business Model Canvas for the Distributed PSS for Mask Provision

To freely distribute the knowledge embedded into the system, the concept adopted an open-source ethos. As a result, the products developed subsequently to the PSS Design, as illustrated in Figure 6, are now freely available on creative commons license. The mask concept proposed by the 23-19 team sought to employ materials and mechanisms already used and known by the partner company ÖUS, to facilitate and make their production feasible. Some of the differentials of the mask concept are found in the possibilities of personalization and customization that the child would have, through patch bonding, name writing, different ways of fixing the mask lace on the back of the head. The mask also proposes the application of a thermochromic pigment, which changes color if the child's skin temperature exceeds 37°C. Such mechanisms alert teachers, guardians of the children, or any other stakeholders present in the system, helping to control possible contamination

This open ethos was widely adopted by do-it-yourself (DIY) and maker communities during the COVID-19 pandemic. According to Zastrow (2020), as soon as the health systems around the world were at risk of running out of crucial equipment to treat people and protect health workers, these communities have initiated immediate actions to close the gap. Groups virtually gathered by social media and apps such as Facebook and Whatsapp have become centers of PPE supply and demand. An example is "Open Source COVID19 Medical Supplies", a Facebook virtual community with more than 70,000 members where volunteers shared trade, materials, sterilization procedures and other sources tips (Zastrow, 2020). The implications of such ethos on the project are seen on the System Map where other shoe brands could be integrated without any copyright barrier.

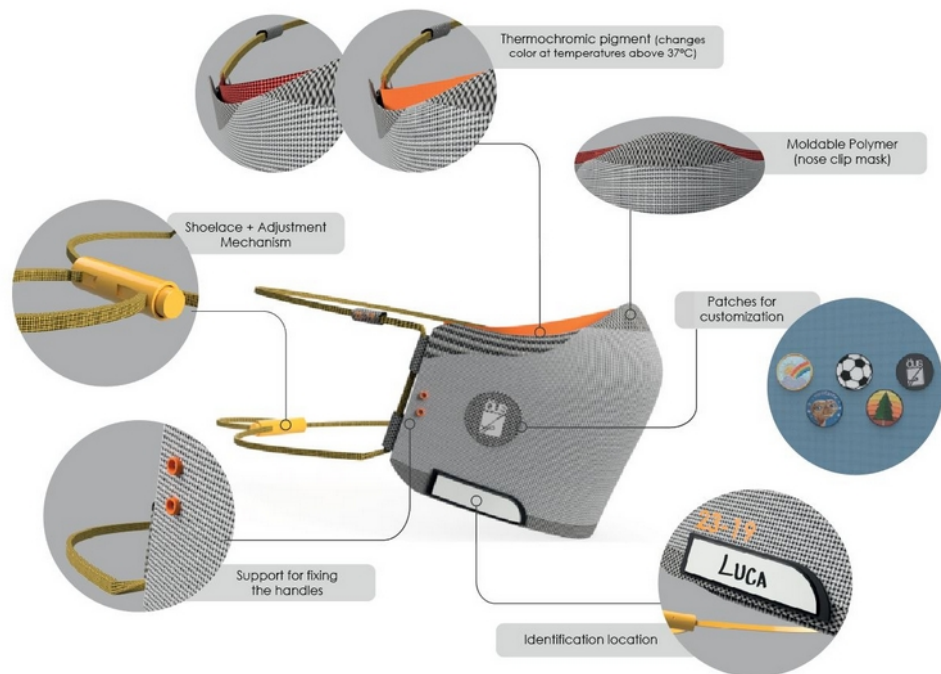


Figure 6. Masks Designed for the PSS Concept.

4.3. Stage 04: Lessons Learnt

The pandemic has unveiled that highly centralized global supply chains, often operating with the logic of lower margins and large scale production, resulted in greater vulnerability and poor resilience to global disruptions at the local level. That was the case of Brejo Santo, in the State of Ceará. Similarly to Shokrani et al. (2020) analysis, the knock-on-effect of halting the economy due to the quarantine in combination with the rapid increase in demand at a global level has resulted in a shortage of PPE. Stringent border controls over international trading and other logistical and public accounting constraints have prevented fast supply from low-cost mass manufacturer sources (ex: China, Indonesia) (Kalyaev et al., 2020).

This rapid Design project, where all participants worked remotely, showed that demand for a more distributed economy during COVID-19 was relevant not only for the Design and Manufacturing stages of PPE but, also, for all life cycle stages. As anticipated by Yu et al. (2020), health-related waste increases exponentially during a pandemic, with potential sources including not only hospitals but a wide range of installations, including domestic waste (ex: masks). This rapid increase in waste volume requires agile responses that centralized solutions cannot provide. If improperly treated, it may accelerate the spread of the disease.

Shokrani et al. (2020) argue that such situation demanded swift adaptation of local supply chain networks, with a critical need for speed associated with a higher emphasis on the use of local resources and competencies, with cost-effective and rapid production. Indeed, on the Action Design Research project reported in this paper, the COVID-19 context has organically driven the Design team to a concept characterized by the adoption of a Distributed Economy approach. The forced role immersion of the entire Design team as mask “clients”, living in social isolation and with health concerns rivaling economic concerns, has contributed to following this direction.

5. CONCLUSIONS

The study has shown that the Design of a Distributed Product-Service System for mask provision for children school was able to address the divide between health and economic concerns that appear during COVID-19. While the effectiveness of the PPE, which is necessary for this health emergency context, could be reinforced by the actors and activities distributed throughout the PSS, the economy can be strengthened by the efficiency given by the proximity of such network. Hence, although a rapid conclusion of the pandemic was certainly the desired outcome, it presents itself as an opportunity to drive a Distributed Economy.

The project itself has been testing and improving to be implemented by the ÖUS company. The distributed approach of the project attracted several partners, such as Brejo Santo's city hall and the local education office. These stakeholders were mobilized in favor of the project implementation feasibility and the reflection of the project, which is systemic. The secretary of education agreed with the learnability aspect of the PSS, as it fosters the local economy and involves an extremely relevant collaboration network in facing the pandemic.

It is still necessary to elucidate some points of experience with remote teaching, regarding the context of the Design graduation experience. Some stages of the project demanded greater interaction between the participants, as in the case of the creative workshop, being access to the internet and open online platforms of fundamental support for a live debate. However, it should also be noted that despite the group of students and project participants having access to the online system, there is still a gap in Brazil regarding this aspect. Within the target research, for example, in order to obtain the feedback of children on the alternatives of masks generated, the bridge between teachers and parents was made using video calls by cell phone, which involved limited interactions, to show the concepts. Thus, it is important to highlight that many regions still have poor access to the internet, or simply do not have access, which must be considered to have a more inclusive education and economy. Considering these diverse factors, it is important to highlight that developing a PSS that has effective implementation measures, especially for vulnerable communities and children, is really a challenge.

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