The Aristotelian Causalities in Localised Distributed Manufacturing

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ABSTRACT

Half of the total greenhouse gas emissions and 90% of biodiversity loss come from resource extraction and processing. (EC 2020). To counter this, we must switch to sustainable, long-lasting products and slow down the use of resources. It is clear that these systems will not be fixed by incremental changes but by a series of disruptions. This article uses the Aristotelian causalities as a vehicle to break down the concept of "why" industrial design and discuss the underlying value propositions of distributed manufacturing. This critical perspective allows designers and engineers to bridge the knowledge-siloes and rewire the way a product is designed, sourced, built and consumed in relation to the four Aristotelian causalities. The paper discusses the limitations and potentialities for each causality in relation to a distributed manufacturing paradigm and argues for a new sustainable design concept: The Local Limited Edition. A site-specific product design, realised by brands to enrich brand value on local markets, improve market fit and increase attachment, ultimately improving the products' longevity and value of the products.

Keywords: Sustainability, Industrial design, distributed manufacturing, philosophy, Design theory

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1 INTRODUCTION

“We will have to redesign everything around us, our clothes, our food, our furniture, what we value, what is the price of goods, who owns the material, how do we value durability and resilience, and how do we transition to an intangible economy over a physical economy?” Indy Johar cited in Heathcote (2022)

As a result of climate change, the stress in natural ecosystems, and overconsumption, the global transition away from fossil fuels shapes new patterns of design, production, distribution, and consumption aimed at shaping a more climate-neutral society. These major transformations are prompted by practice and research in various disciplines, from a strategic to an operational level. We argue, in this article, that philosophical perspectives can enrich strategic and operational perspectives, by introducing an operational framework for collaboration between knowledge silos. This vision builds on the prerequisite that designing in a complex world requires a worldview that overcomes the deductive epitomes of a positivist knowledge tradition. In addressing wicked problems, logic and discipline separation often fall short when meeting the complexity posed by socio-technical systems. The philosophical viewpoint can provide an integrated worldview that breaks down knowledge silos, and focuses on the underlying value propositions, to encourage reflections across multiple levels of interconnected problems.

The bridge between the philosophical and operational perspectives is based on the premise that each product has transformative power, and thus the act of design encapsulates an act of worldmaking (Hosale, 2018). Both Hosale (2018) and Henning and Rauterberg (2022) revisit Aristotle's four causalities relating it to designerly knowledge (Cross, 1982). This article uses Aristotle's four causalities as a philosophical framework defining an integrated worldview that is applied to assess the relationships and potentialities of localised distributed manufacturing. Can Aristotelian ideas be used to clarify what sort of value propositions that can enable a shift from the unsustainable centralised production paradigm of mass consumption to a more sustainable localised distributed manufacturing paradigm?

According to UNIDO (2014), the industry 4.0 would enable a new type of distributed manufacturing which was envisioned to be one of the most important emerging technologies eight years ago. This vision was enabled because new production and communication technologies enable a new set of competitive advantages for small and medium-sized businesses. These were described as: shorter delivery times, closer proximity to customers, better fulfilment of individual consumer needs, creation of stronger attachment to products, reduction of transportation and thus CO2 emission, meeting the growing demand for novel sustainable production, increasing innovativeness and local competitiveness, and minimising the risk of supply chain collapse have been described as potential benefits (Bruccoleri et al. 2005, Rauch et.al. 2015) when shifting to distributed production. These advantages can be clustered into six megatrends (Rauch et al. 2016): 1) sustainability; 2) rising logistic costs; 3) mass customisation; 4) design democratisation; 5) market and customer proximity and 6) regionalism and authenticity. So far research on distributed manufacturing has focused on the economic aspects (Lombardi 2003), organisational (Rauch et.al. 2015) and social ones (Bessière et. al. 2019).

In recent years, the coronavirus pandemic and the war in Ukraine have further revealed the vulnerability of complex supply chains and motivated a revisit to the romantic visions of taking part of the production ‘home’, to make a more ecological, safe, and socially viable production systems (Bessière et. al. 2019). Taking the food industry as a benchmark example we bring forth two perspectives: First, there is the centralised knowledge and uniform quality control of mass production that enables, for example, Coca- Cola to produce the same taste around 900 bottling plants worldwide. Second, is a local approach to materials, local history, and creative curiosity, developed by a network of chefs in the Nordic countries. According to the Danish Noma chef René Redzepi (2018), the very fundament of "attractiveness" has been fundamentally redefined, when he asks the rhetoric question: *"what do you prefer: The mushroom that breaks through in nature for only two weeks of the year, that also requires huge dedication and knowledge to find and prepare? Or the expensive can of farmed caviar that can be found in any corner of the world?"*.

Both cases employ two fundamental different strategies of attractiveness. On the one hand Coca Cola has created the idealised assemblage with the same taste distributed to the entire world. On the other hand Noma uses the scope of the local materials, climate and traditions as a key to deliver attractiveness and novelty. A full analysis of attractiveness is beyond the scope of this paper; however, Noma's approach

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highlights *time* and *place* as key drivers to the user experience and promotes a more direct engagement between the maker, product, user, and environment. Furthermore, it reconsiders the quantity of production through an approach to local materials and the creativity of highly skilled chefs to capture the essence of a place. This approach can be applied in the design domain and be linked to the six megatrends of distributed manufacturing to assess how it can be implemented in practice. Aristotelian causalities will be used as a theoretical framework, that allows us to reflect on the hypothesis: That a new model of sustainable use, design and production can be developed and enabled by the recent technological development in distributed manufacturing. We argue that one of the reasons for the failure of distributed manufacturing is a lack of sensitivity to local cultures, materials, and production history.

The central argument is not to take a step back in time to production infrastructures before industrialisation, but rather, one in which material sourcing, product development, manufacturing and life-cycle prolonging activities, such as takeback systems, refurbishment, and repairs can occur in local hubs. The local hubs can respond to the requirements of industry 5.0 (EC, 2021) and utilize the visions of Digital Product Passport (DPP) (Adisorn et. al. 2021) to promote more transparency, and enabling consumers to find information about production, material sourcing, design or use from local and global networks. We argue that such vision can result in a new type of social and sustainable mode of production.

2 CONCEPTUAL FRAMEWORK

Techné is an ancient concept that encapsulates the relationship between how and why a product is made, and how it is being used. Aristotle used techné as a framework to describe how the development of a product embodies both an understanding of the world and promoted a new way of living, thus rewiring causalities, and thereby showing an alternative way of making. Aristotle (1934) described the act of making a new object as achieving a new truth about how the world is understood. While the concept of techné is traditionally closely connected to the skills of craftsmen, it is also a key tool in the exploration of knowing, and a significant part of the process of revealing the truth about the world. To Aristotle making was a matter of knowing and revealing a certain path, and for designers and manufacturers, this understanding is essential because it strikes a fundamental paradox in the age of mass consumption: never has the variations of products been wider, and never has the need for a new type of product been greater; not as another style, but as a fundamental revolution of how the product is made and used including its underlying subsystems.

Techné is a relevant concept to approach human relationships with products and their creation since it emphasizes the underlying values and operations in a product. Because industrial-designed products are often created in complex networks of collaborating expert humans and non-humans (Rauch et al. 2016) it is important to understand the underlying principles of the relationship between tools and their human operators. Guttari (2007) suggests that manufacturing facilities cannot be a matter of the organisation of machines alone, but it must be seen as a collective assemblage of material, cognitive, affective, and social aspects installing themselves and working transversally. Thus, understanding the real value within a localised distributed manufacturing system cannot lie in innovation in one part alone; it must address the causal relationships that enable the design, material sourcing, production, use and social dimensions of the products.

3 ARISTOTELIAN CAUSALITIES AND INDUSTRIAL DESIGN

Aristotle (1934) described four fundamental types of answers to the question "why" a certain object is, and this encompasses four causalities (Figure1): 1) *causa materialis* addresses the material or matter out of which the object is made; 2) *causa formalis* accounts for the form or shape of the object; 3) *causa efficiens* accounts for the principles and tools involved in the act of making the object; and 4) *causa finalis* is the purpose of a product. The coming sections will unfold how these causalities can contribute to the qualities of a more sustainable distributed production.

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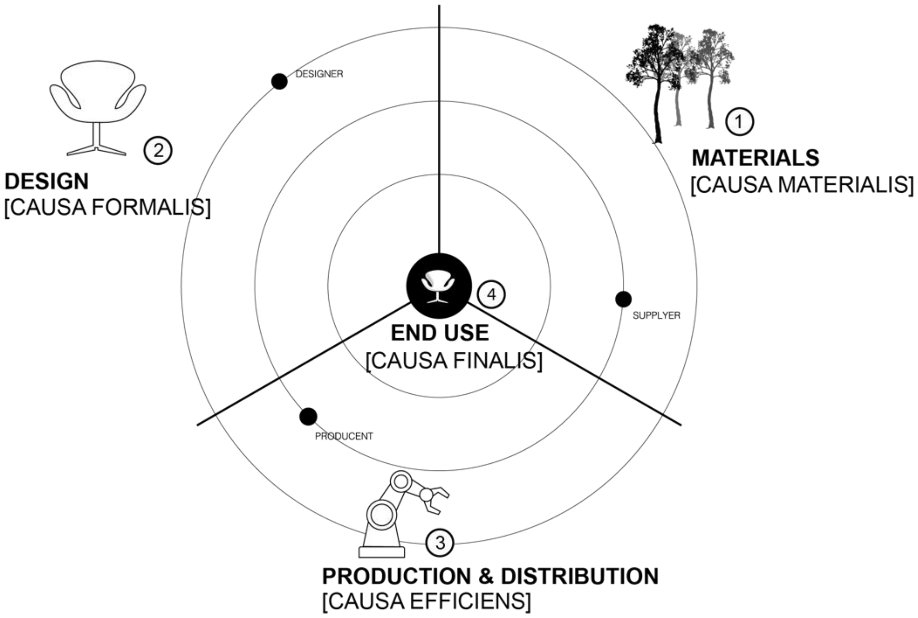

Figure 1. Relationship between causa formalis, causa materialis, causa efficiens and causa finalis in industrial design.

3.1 Causa materialis: the materials

Aristotle considered *causa materalis* of an object as the equivalent to the nature of the raw material out of which the object is composed (Hankinson, 2001). Understanding the physical properties of a material is key for the object to undergo transformations throughout the design process. For a table, this might be the specific type of wood from which is made. Considering the intrinsic relationship between material and its local context in which the material is extracted, transformed, used, we can affirm there is a time and place displacement in the current centralised mass production paradigm. The distant relationship to the material sourcing and other steps of the supply chain blurs product transparency and respective conscious consumption patterns. The challenge in localised distributed manufacturing is concerned with how industrial production can adapt to materials in different regions, while, at the same time living up to quality standards of homogeneous mass production. Solutions to this trade-off must be found in each product category and decisions must be according to specific material requirements and its use and life cycle context. Accordingly, not every industrial production and material sourcing can be fully decentralised, and the solutions will be depending on product context.

As an example, basic materials such as stone, wood, recycled plastic, water, and others could be local materials, while specific standardised materials, rare materials, electronics, or special components would still need transportation. Life Cycle Assessment (LCA) tools such as Målbar (2022) support quality decision-making regarding the materials' climate impact. And this tool is just one of the new types of material sourcing tools that allow designers and manufacturers to take more qualified decisions in the design of local production and assembly. These new climate impact screening tools are essential to bridge the new and more sustainable sourcing.

Other important factors are the local presence of brands, the local storytelling in sales and post-sales services. All these relationships require community-based activities that go beyond material sourcing. The localised distributed production and sourcing strategy can become intrinsic aspects of the products' value proposition. To achieve this premise, designers must rethink the semantic properties of materials because in many cases these properties are associated with local narratives and cultural aspects. Furthermore, the design could then be open for local variations in material choice weaving local and global supply chains and rendering a new type of product design category, such as local limited editions. As an example, a local limited-edition chair might be designed according to local storytelling and be produced from ash wood in Scandinavia and in walnut in North America.

Nonetheless, such an approach would lower the dependency of companies in complicated supply chains because transportation of basic materials would be decreased. At the same time, a new layer of local supply chains would be revitalised. Even though the discussion of specific weights between local- and global-sourced materials is outside the scope of this paper, the requirements for sourcing

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local materials can follow at least three tiers: basic, exclusive, and re/upcycled. Basic and recycled materials would be material types available within the local context, while exclusive materials would be rare and small- scale materials which are not locally available. This differentiated sourcing mechanism would have to be qualified by LCA tools. The sourcing of basic and exclusive materials should follow their existence in the local ecosystems and geography, considering bioregions (Vilhena and Antonelli, 2015) which encompass terrestrial, freshwater, and marine ecoregions into a cohesive system and overcomes country- level or region-level approaches.

There is potential in further exploring how the local materials can support the meaning and narratives in product design (Steffen, 2009), and use them as essential value propositions in the final product. Stronger product narratives may result in a stronger symbolic meaning, driving a more sustainable mode of consumption. The limitation of the number of units of a local edition being established by the availability of local resources and their regeneration is one example of how these material narratives can drive a more sustainable pattern of production and consumption.

3.2 Causa formalis: the design

Aristotle (1934) describes *causa formalis* as the causality that defines the final form into which material is transformed. This involves two main steps. The first step is the design activity of bringing forth or inventing a new model of the shape of the object. The second step is the formal representation of the object through drawings, diagrams, descriptions, physical models, digital models, production files, etc. Before industrialisation, the formal representation of a design was primarily made using drawings, and physical- or mental models. There was a close link between the process of designing the actual object and its representation because the two were often performed by the same person – the craftsman – who could easily make variations depending on ideas, feelings, special wishes from the customers or changes in material supply and other requirements.

These steps in the design process have become separated since the 19th century when Wedgwood division of labour in the pottery industry became prevalent in mass production (Forty, 1986, pp. 32 – 34). This separation was essential to produce products of high uniformity and consistency and frames the fundamental difference between the craftsman and the industrial designer. Before industrialisation, craftsmen often had a great role in the creation of objects, with a high degree of freedom, hence each handcrafted product had its own marks and character. After industrialisation, most products must be homogeneous, and they are manufactured in multiple processes often executed by more companies geographically separated. However, recent developments in CAD/CAM technologies have reintroduced the made-to-order paradigm and companies use these techniques to give the customer an option to customise or even personalise certain features of a product while keeping costs at or near mass production prices. Companies that offer mass customisation can give themselves a competitive advantage over other companies that only offer generic products (Pine, 1999).

In a framework of localised distributed manufacturing, the following question must be posed. Can there be localised and limited versions of mass customisation, that use local history, craftsmanship traditions (e.g. details in joints), or local materials variations, to enrich the overall design? Could one imagine that one chair has a different joint detail in Japan and another in India, related to the local history and culture? The design would encompass address become the DNA of the product, and the product details and materials would be adapted to the unique qualities of the local context.

Making place-specific designs seems to be outside the traditional domain of industrial design, however, when approaching the design of buildings, there are buildings that "relate" to the place, and even involve the spirit of the place or genius loci (Norberg-Schulz, 2019). The underlying vision is to make a sensible design that adapts to its place and its users and thereby fits into the culture of the place. The techniques involve mapping of location, local climate, existing physical objects (buildings and landscape) as well as historic events and narratives from local people. As such the investigations include positivistic data about the place as an object (Lynch, 1984) phenomenological data on the experience of the place (Norberg-Schulz, 2019) and lastly the constructivist dimensions about the local powers and interests, hence seeing the context as a social construction (Gehl 2003). These techniques are developed for architectural design practice and cannot be directly translated into industrial design practice. However, understanding the local history, traditions, and people as well as the available raw materials, and networks for production will support industrial design practice in accommodating local requirements. Telling these stories would consequence add to the storytelling and value proposition of the products, potentially increasing the level of attachment and thereby the likelihood of increasing the lifetime of the product.

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3.3 Causa efficiens: production and distribution

Aristotle identifies 'the craftsman' as central in *causa efficiens*, since (s)he is responsible for the change of material into form and worldmaking. *Causa efficiens* identifies *'what makes of what is made and what causes change of what is changed'* and so suggests all sorts of agents, non-living or living, acting as the sources of change or movement or rest (Lloyd, 1996).

The description of 'bringing forth' must be seen as a unified process (Waddington, 2005). Hence the act of design, production, choice of materials and use works in a continuum, reshaping the relationship between object and consumer. In other words, the way things look is, in the broadest sense, a result of the conditions of their making (Forty, 1986), including domains such as mechanical engineering, robotics, and electronics, as well as more traditional craftsmanship, such as woodworkers, potteries, carpenters etc. It is beyond the scope of this article to fully unfold each domain, however, using the conceptual lenses allows the authors to investigate the potentialities and barriers in design for a world of distributed manufactured products.

Considering a localised distributed manufacturing framework where production is closer to consumers, there is an opportunity to re-think the factory as an aggregated cyber-physical system or micro-factories with a high level of automation. A new level of collaboration between smaller scale automated production systems and networks of craftsman with specialised know-how could be achieved in similar fashion to what is observed in small-scale production systems in the DIY (Do-It-Yourself) communities (Zanetti, et al. 2015).

So far, there is no large-scale example of localised distributed manufacturing. The example closest to address such requirements are the many networks of Makers and FabLabs (Gershenfeld, 2005), which offer custom-crafted furniture created with entry-level manufacturing equipment, such as CNC mills and 3D printers. Though the success of these approaches points to the value of having a closer connection and interaction between the customers on the one side and the designers, engineers, and craftsmen on the other side (Lindtner, et al. 2016), they are still not considered viable alternatives to traditional furniture manufacturing regarding craftsmanship, product quality nor production scalability (O'Neil and Pentzold 2021).

The era of industry 4.0 and the maturity of critical technologies (such as sensor and actuator networks, intelligent controls, optimisation software and cyber-physical systems, etc.) have made researchers argue that smart and agile distributed manufacturing systems will soon be available and in a short time become the preferred way to produce (Kuehnle, 2015). Parallel to the research focus on agility and changeability (see Pullan 2014; Nylund, Salminen et al. 2012; Deif 2015), research in distributed manufacturing has also evolved around the concept of mini-factories. Initially focused on creating production franchising networks that would allow for mass customisation (Zäh and Wagner, 2003) it evolved to plug+produce concepts that would make it possible to roll out geographically distributed production units. More recent studies have pointed to the mobile factory network, in which mobile and smart factories can be placed in proximity to the customer (Rauch et al., 2016). Different versions of the mobile factory unit have been tested both in research as well as in industry, for instance, the CassaMobile-project supported by the EU and Nokia's 'Factory-in-a-box' concept. Even though these recent developments offer unique possibilities for the industries, we can argue that two main interactions are not addressed: 1) the interaction between the local community and the design(er); and 2) the interaction between the local craftsman (manufacturer, production engineer, woodcraft) and the 'intelligence' in the smart production unit. How can these interactions be facilitated? And to what extent can streamline and automated production technologies help enable the logistic challenges? Zanetti et al. (2015) described how the near future would allow small-scale fabrication units to be located within a shopping mall and they would be able to directly interact with the customers while being close to them in terms of design expectations, quality, and environment, costs, and delivery time. Considering that mass customisation created the possibility of customised design variations, one can imagine that distributed manufacturing would then produce custom designs according to local nuances, within local communities of production and use. This could lead to rethinking users beyond the role of consumers, empowering them in more active and responsible participation within local communities (as proposed in the UN 12th sustainable goal (UN, 2015)).

3.4 Causa finalis: end use

According to Aristotle, *causa finalis* is the final cause, or the end result of the creative process (Hankinson, 2001); a chair is for sitting, a sailboat is for sailing etc. In other words, *causa finalis*

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deals with the use phase and life of the product, or post-purchase customer behaviours (Mugge et al. 2010). Although customer behaviour research has mainly been focused on buying behaviour, understanding consumer-product relationships are crucial to understanding the life of a product. First, we must acknowledge that some products generate greater satisfaction and stronger customer attachment than others. Product satisfaction is directly linked to the experienced satisfaction related to the product performing better than expected or promised (Mano and Oliver 1993). This cognitive evaluation of a product's utility has a direct effect on the degree of satisfaction; however, user satisfaction is not a purely cognitive and utilitarian endeavour. Bloch (1995) showed that beautifully designed products can provide consumer's direct pleasure. This hedonic judgment is linked to the appearance of the product and leads to the experience of pleasure for a product, and pleasure serves as a mediator for their effect on satisfaction (Mano and Oliver 1993). Utility and appearance do not only affect satisfaction but are also reasons for people to consider a product as treasured (Kamptner, 1991); special (Csikszentmihalyi and Halton 1981); important (Richins, 1994), or favourite (Wallendorf and Arnould, 1988). These studies suggest that treasured product design must make a great utility and a strong appearance, but it also suggests that customer expectations are important to meet. Based on these premises, local adaptions would never have to compromise the quality of the design.

Literature in the field of product design verifies that product attachments are more complicated because people only develop attachments to products that have a special meaning to them (Wallendorf and Arnould, 1988). Hence, strong customer-product attachments are associated with stronger feelings of connection, affection, love, and passion (Mugge and Schifferstein, 2010). Thus, a person is more likely to handle the product with care, repair it when it breaks down, and postpone its replacement (Mugge et al. 2005). To obtain a special meaning, a product should provide the owner with more than just its basic function, and developing a strong product attachment is crucial for products to last. This observation requires products to evoke rich sensory, enjoyable, and maybe surprising interactions to evoke pleasure during use, and thereby increase the level of attachment. Several studies conclude that people become more attached to products that serve as a reminder of the past (Wallendorf and Arnould 1988; Kleine et al. 1995), hence making products that foster enjoyment is likely to be most successful if it also supports the accumulation of memories. Page (2014) found that enjoyment and pleasure was the primary reason for customer-product attachment to newly purchased items, whereas memories were highest for older possessions.

However, the memories connected to a product are typically not under the designer's control since they involve an individual's connections to people, places, or events that are important only to that individual. In a localised distributed manufacturing framework, in which the product is built near the consumer, we can hypothesise that it will be possible to make memorable social events and interactions as part of the purchase and post-purchase that would generate memories and might stimulate a closer relationship between the people buying and the people producing and maintaining. As such, the product would be linked to a product-service system that would accommodate both customer- and product-related needs over time. This can be a unique opportunity for the physical shop to respond to the growing competition from the web shops and create meaningful user experiences as part of the purchase and product life- prolonging repair activities (e.g. repair, rent, refurbish). This stronger relationship between product design, production, repair, marketing, and post-purchase services could be an essential value asset for the products, leading to both a potential increase in the lifetime of the product and strengthening the relationship between brands and customers. It is therefore crucial to evaluate a product's *causa finalis* in relation to product attachment and satisfaction in the light of the user's expectations, utility, appearance, and memories.

4 DISCUSSION

This paper uses Aristotle's causalities to reflect upon and conceptualise an interdisciplinary design framework for distributed manufacturing. Aristotle's causalities are used both as a theoretical approach to structure the arguments around four aspects of industrial design, to analyse them regarding the literature, and as a speculative tool to imagine a new type of distributed design activity. The activity could be applied by international brands and small-scale industries who are interested in closely linking local communities, consumers, and brands in a new sustainable production paradigm.

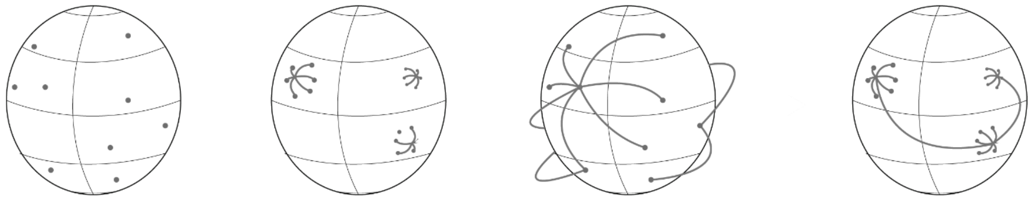

Figure 2. Four stages of industrial production: 1) local; 2) regional; 3) global; 4) multilocal and distributed.

Figure 2 summarises the four stages of industrial production, starting with local production by craftsmen (1) that evolved to regional production overseen by guilds (2). The industrial revolution and mass production (3) renders the web of industrial production and sale. In this paper, we propose for a (4) new multilocal distributed manufacturing framework, where the design model is open to local variations in material sourcing and production of a new type of a limited edition - not limited by numbers but limited by local resources. The framework builds upon existing aspects of former types of craftmanship, industrial production and promotes more sustainable production and consumption of products, based on informed LCA analysis, mini-factories, bioregions, local networks, and communities. Using the philosophical framework to question and break down knowledge silos, we critically inquire on how an interdisciplinary design framework for distributed manufacturing could find new meaningful value propositions. In the paper we discussed the four challenges:

- Causa materialis (materials): How can distributed manufacturing adapt to materials in different regions, while, at the same time living up to quality standards of homogeneous mass production?
- Causa formalis (design): How can design propose localised versions of mass customisation, that integrate local materials, industries and culture?
- Causa efficiens (production and distribution): How can the interactions between the designer, the craftsman (manufacturer, production engineer, woodcraft) and the ‘intelligence’ in the local production unit be facilitated? And how can these interactions be in service of the local user?
- Causa finalis (end use): How can distributed manufacturing support the creation of memorable interactions that would stimulate long-term relations between brands and the user, ultimately prolonging the life of products?

Each of these questions could be further addressed, such as taking into consideration the scale of local, and the scalability of distributed manufacturing regarding economies of scale or scope. Furthermore, how to deal with the cost-effectiveness of setting up local production hubs and their respective socio-economic, political, or cultural issues. How to deal with the competitive evolution and uncertainties that have traditionally led to new forms of centralisation (Lombardi, 2003)?

While each question can be further addressed and lead to new streams of discussion, we take a step back and analyse the broader scope. The current state of knowledge promotes specialisation over integration and systemic overview. When analysed in isolation, each causa can be optimised based on specific requirements (e.g. material performance, production lead time, or design standardisation, etc), however, for this to occur, other interrelated aspects need to remain rather abstract or ill-defined (e.g. meaningfulness, long-term use, repairability, local sustainability, etc). Overcoming these barriers requires breaking down silos of knowledge, and more open forms of discussion between different stakeholders and disciplines. From this openness, new multi-localities can emerge.

Another critical problem of new technologies and the respective seducing new revealed potential described by Heidegger (1977) as the concept of "standing-reserve". By this, he described how the discovery of new technologies, is seducing in itself, and that they create a new opportunity waiting for someone to exploit, and when the opportunity is revealed, it is extremely difficult to undo. We can exemplify that in the proposed localised distributed manufacturing framework in which products are locally produced, a local limited edition made in Japan might be worth more for a collector in New York than the respective local edition. In such a scenario, the potential for decreasing the climate footprint would somehow be lost. Even though this may occur in some products (e.g. luxury), the potential for extending product lifetime, for creating new local limited edition custom designs may enable brands to empower local communities around the world.

The potential for curated material sourcing, production of parts, assembly and post-sale services, such as repair cafes and take-bake systems may allow brands to increase their local presence and build

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communities. These local hubs would become knowledge facilitators connecting brands to local communities building stronger alliances between brands and local communities and users, thereby improving user attachment, product longevity and local innovativeness.

Heidegger would still question if we would be able to uninvent the products and fast fashion we have today, even though we would find it beneficial. Once the opportunity is revealed it is impossible to go back, the opportunity would always be standing reserve (Heidegger, 1977). In this light, one could question if humanity would be able to escape the unsustainable means of production and designs that rely on heavy transportation networks that exploit labour and environmental health to create the lowest price. However, we consider that increasing storytelling, local knowledge and materials, combining craftsmanship with intelligent production means, and developing products that stimulate long-term relationships with users can promote a more sustainable mode of consumption, one that is rooted in and drawn upon the ecological fabric surrounding every aspect of the product and its cycles.

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