



Design for Sharing – Libraries of Things as a Product-Service System

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Abstract: Sharing can be a way to confront ecological and social challenges. Libraries of Things offer the process of sharing in a convenient way that fits into everyday life of users. These Libraries offer access to a broad range of items to everyone at a low price. The items offered should be of high quality to minimize risks, to enhance the flow of the sharing process and to create as little maintenance effort and cost as possible for the library. The contradiction of offering high quality products for a relatively low price could be solved by a cooperation between manufacturers using Libraries of Things as a distribution platform. The Libraries could thus help the manufacturers to adapt their business to circular economy. This paper doesn't present a ready-made solution yet but rather reflects upon the role of design within this area of product-service system and defines further fields of research since Lending Libraries haven't been reflected from a design-angle yet.

Introduction

The scope of design is widening: in the recent past the focus has shifted from designing an object to designing Product-Service Systems (PSS), in which the product is embedded. In the past, the design was designed in a linear design process, following aspects of functionality. Design for Sustainability approaches from the very beginning (Green design, eco-design,...) mainly included aspects of ecological matters (e.g. Burall, 1991; Fiksel, 1996; Mackenzie, 1997; OECD, 1998; Tischner & Charter, 2001; Boks & McAlloone, 2009; Pigosso et al. 2015). The focus shifted to PSS as "a mix of tangible products and intangible services designed and combined so that they are jointly capable of fulfilling final customer needs" (Tukker &

Tischner, 2006). In a corporate context, McAlloone and Pigosso (2017) in their review described the shift of focus from products towards PSS and even predicted the upcoming development, which will be referred to within this paper. The reason for the analysis was, amongst others, whether "we are effectively developing our competencies, in order to be more effective in our approach to continued sustainability enhancement" (McAlloone, Pigosso, 2017). For the years to come they predict a collaboration within and beyond the borders of value chains (see Figure 1). Within this paper, Libraries of Things (LoT) will be analysed using this framework as a referencing set.

	-20 years	-0- today	+10 years
Main goal / objects	Product	PSS	Collaboration
Expected results	End-of-pipe -> proactive	Proactive -> Sustainable	Sustainable -> restoratory
Main aim	Tool building	Tool implementation	Consolidated integration
Basic Approach	Singular problem approach	System approach	Holistic approach
Envisaged cost-benefit	Sustainability = cost	Sustainability = no extra value	Sustainability = business
Sustainability ambition	Environment	Environment + (social)	Environment + social capital + economic
Business mindset	Linear economy	Closing the loops	Fully circular economy
What are we changing	Improve the product	Improve the process	Improve our competencies
Decision-making level	Operational	Tactical	Strategic
	<i>The rise and establishment of ecodesign (1990-2010)</i>	<i>A systems perspective on ecodesign (2010-2020)</i>	<i>Perspectives for a sustainable and circular economy (2020-2030)</i>

Figure based on: Mc Aloon; Pigosso (2017)
From Ecodesign to Sustainable Product/Service-Systems: A Journey Through Research Contributions over Recent Decades.
In: Stark et al. (eds.) 2017: Sustainable Manufacturing, Challenges, Solutions and Implementation Perspectives.
Springer Open, pp. 99-111.

Figure 1. Shift from Ecodesign to Sustainable PSS. Source: own picture based on McAlloone & Pigosso 2017

LoTs are PSS and they are hubs focussing on collaborative consumption and sharing of items for everyday use (Robison & Shedd 2017). There are at least three reasons for it to be expected that LoT will spread in the future:

(1) In industrial nations, the digital transformation leads to a growing gig-economy, which is leading to unsecure income. At the same time, digitization, the rise of the robots as well as artificial intelligence lead to a growing low-pay sector and, in these societies, the rate of unemployment due to technological displacement of people by machines (Stengel, 2017; Chang et al., 2016; Berger & Frey, 2016; World Economic Forum, 2016; Ford, 2015; Cowen, 2013; Frey & Osborne, 2013). LoT guarantee access to everyday items even for people with low income or unsecure income, without the necessity to buy anything.

(2) LoT have the potential to reduce the energy and resource demand for the production of these items, since fewer items are needed to cover the same number of users. LoT reduce the consumption of new products, since collaborative usage is enabled and organized. Thus fewer items are used more efficiently, a) because they are used longer until they can't be repaired anymore and b) they are used more intensely since the otherwise idle times are utilised (USND, 2014; Tabor 2013). Rising world population will lead to a rising number of consumers in the next decades. Already today's world population is consuming resources 30% too fast than the planet can provide them

permanently (WWF 2016). Consequently there is a high demand for a smarter way of meeting humans needs. LoT could be a smarter way to maintain the material standard of living and simultaneously reducing resource consumption.

By focussing on supporting projects dealing with home energy efficiency, a much greater effect can even be achieved. A study of the Pacific Energy Center showed that Tool Lending Libraries that are lending tools to residents for free, in order to perform home energy audits, "reduce energy demand by 157 megawatts and save 92.5 million kilowatt-hours of electrical energy in the year 2011" (DENT Instruments, 2013).

(3) Due to ecological and technological change, two decisive societal constraints will change and societies affected by this change will have to adapt to the new "environmental" constraints to avoid negative consequences. This is the central idea of the transition theory. It implies the observation, which is taken over from natural evolutionary process, that societies feature experimental niches in which innovations can evolve and be tested, which differ from standardized structures and conventions, as shown in Figure 2. In case the development of LoT, which are more easily adaptable to changing constraints, takes place in these niches, they have the potential to become the new predominant institution (Rotmans & Loorbach, 2010).

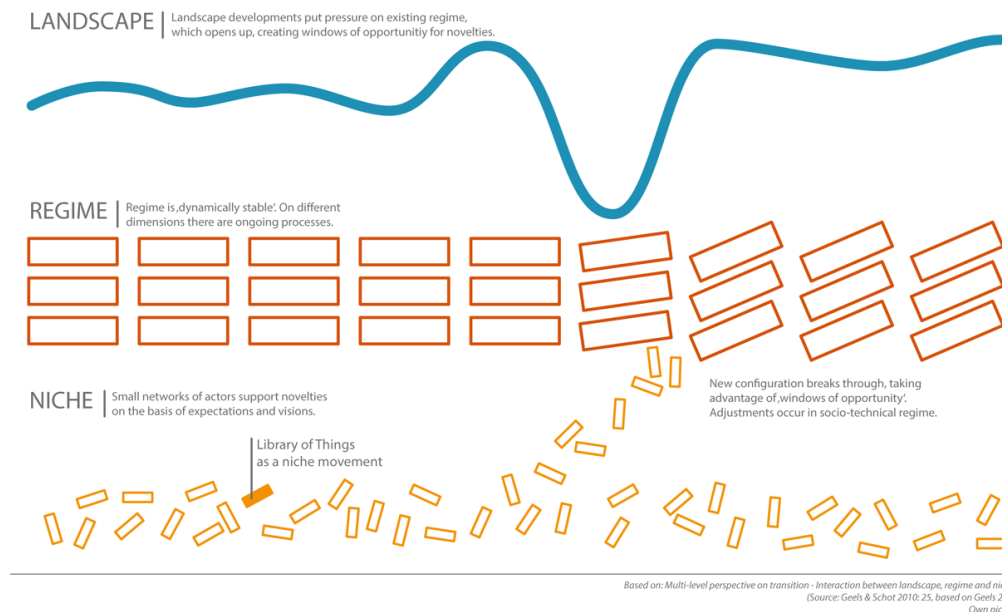


Figure 2. LoT as a niche movement - Transition Theory. Source: own picture based on Geels & Schot, 2010

Research Questions

Currently, LoT gather their items following two different strategies: in one model, functioning items are donated by private people and the LoT will lend these items as 2nd hand items, prolonging their lifetime. But "many consumer products are of mediocre build quality and hence fail quickly when subjected to the intensive use that a lending service entails. Poor design and a lack of spare parts often make it impossible to repair such products, leaving no alternative but to discard them at the first failure. Even if repair and maintenance are possible, the efforts required to keep these products in proper working condition is often disproportionate." (Opsomer, 2017) These items thus have to be filtered out. Furthermore gathering items by donations can only be an interim solution. When the attics and garages will have been emptied, a new model needs to be found to provide the LoT with the needed items.

The second possibility is to purchase the items, which partly is already done today. If products are bought to be used collaboratively, they should be long-lasting and be designed to support the sharing process as well as possible. The research questions this study is dealing with are:

- 1) How can companies be convinced to design items that are shared easily, even though this is against their own business model?
- 2) What can a business model look like, which is based on an LoT as a distribution-platform for existing companies?

This study focusses on the possible contributions of the product within the Product-Service System and the possible changes of the underlying business models.

Methodology, Limitation and Scope

In order to answer the research questions, first a desk research about existing LoT was conducted and their potential contribution for transformation was reflected using the transition theory. A full survey of relevant LoT, as well as interviews with the providers, are still ongoing. The most relevant topics were identified and starting from there preliminary criteria for improvement of existing LoT were derived. In a further step these were transferred to entrepreneurial activities to show the potential for action. Finally it is shown that companies can contribute to establish LoT in the mainstream of societies if they consider the identified criteria when designing their offer.

Research Outcomes

Libraries of Things – the ongoing movement up to now

LoT function like a traditional library, except that, instead of borrowing books, members can borrow all kinds of items. Up until now LoT still represent a niche, which is expanding quickly as desk research has shown (especially in a reduced version of a Tool Library). The

expansion rate is shown in Fig.2. Before the year 2000 there were just 3 LoT worldwide: Columbus (OH): 1976, Seattle (WA): 1977, Berkeley (CA): 1979. Figure 3 visualizes that since 2000 the number has increased to approximately 100, showing a faster expansion rate after 2010 (see localtools.org).

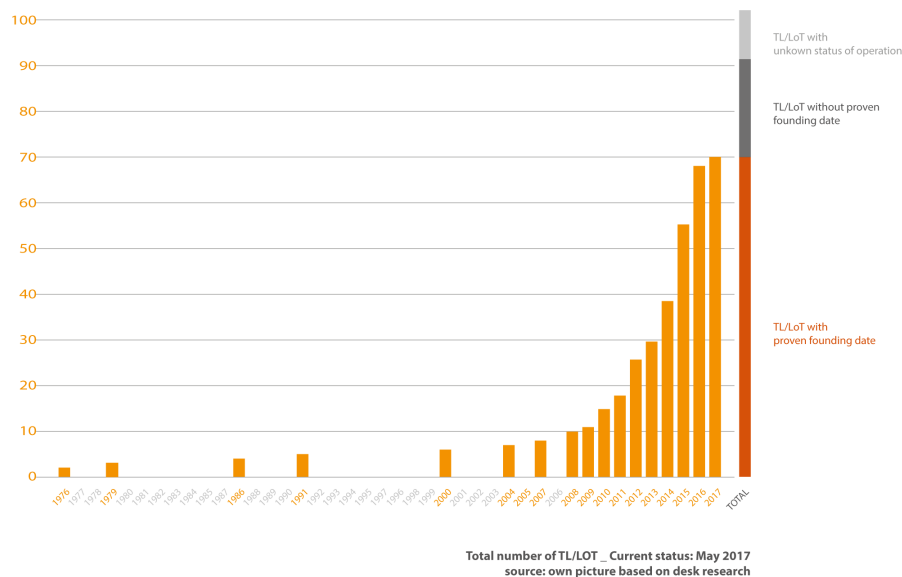


Figure 3. Total number of TL/LoT _ Current status: may 2017. Source: own picture based on desk research

The insights gained so far prove, that LoT have the potential to overcome the barriers of current sharing economy offers, because they are rooted in the neighbourhood.

Nevertheless, discrepancies between the offer of the LoT and the demand of the users can already be identified: They should guarantee better access (central location, frequent opening hours) and provide a wider range and a higher quality of items in the pool (Ameli 2017). This means that LoT can evolve faster from a niche-phenomenon to a mainstream offer, if they become more user-friendly.

As was shown, the user friendliness is getting better when a wide range of products is offered at an affordable price, which once again leads to the question of how to gather items for the LoT.

As mentioned at the beginning, they can either be donated or exclusively bought for the LoT. A first survey of the existing LoT has shown that gathering enough items by donations is no problem at all. Most libraries have way too many items and too little storage room. But at some point, this will not be an option any more.

In case of a new purchase it became obvious that many products are either of poor quality or far too expensive for the concept of a LoT, which wants to lend items for a small fee. Up until now there are no incentives for producers to change their production patterns. The market is asking for new products at an ever faster pace for falling prices. With the concept of a LoT, an alternative to individual consumption is offered. In this model the LoT can guarantee the purchase of high quality equipment, their maintenance and control of their professional disposal at the end of life. It can organize a recycling or upcycling process of their items.

Libraries of Things from now on

A) Criteria and their location within the bigger context

This study is part of a PhD project. Within this PhD the main research question is how the gap between the willingness to share and the actual lacking practice of sharing can be overcome with the help of a LoT.

Focussing on the aforementioned research question, the criteria described above were

derived. In the following, these criteria will be connected to the phases of a product life cycle, shown in Figure 4. All of these have to be considered while designing the product, although they might not come in effect until much later. Unlike an eco-design or green

design approach (e.g. Burall, 1991; Fiksel, 1996; Mackenzie, 1997; OECD, 1998; Tischner & Charter, 2001; Boks & McAloone, 2009; Pigosso et al. 2015) the usage and the sharing context have to be taken into account from the very beginning.

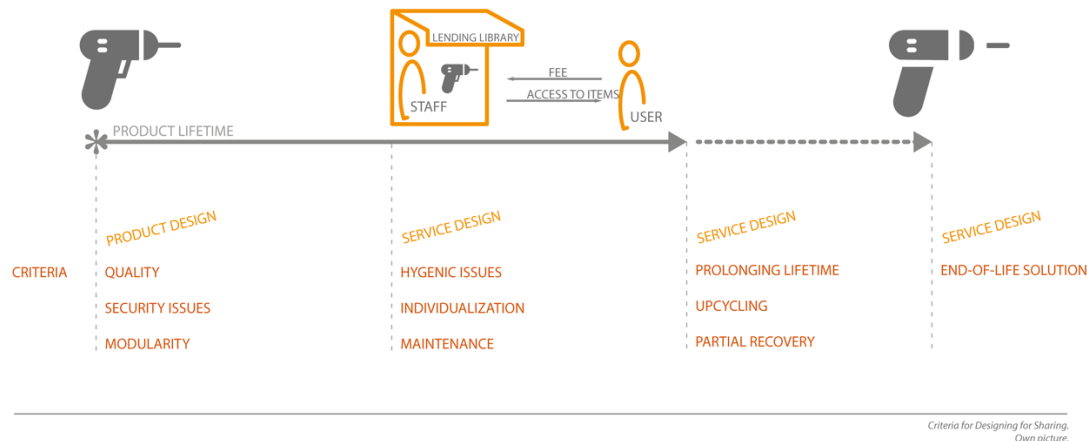


Figure 4. Criteria for Designing for Sharing. Source: own picture based on interviews, survey and desk research

Companies as provider of products AND services

It can be observed that the willingness of manufacturers to broaden their portfolio, including services (Deloitte Research, 2006; Visnjic, 2011), is increasing. Thus even well established companies, such as Otto Group or Media Markt, have started online lending services lately, which are at least theoretically enhancing collaborative consumption patterns (Otto Now, 2016; Media Markt, 2017). In both cases products can be borrowed directly from them on a monthly base. Once the customer does not need them anymore, they can be sent back and possibly be replaced by an up-to-date model or something completely different. These examples show, that even enterprises located in the nowadays mainstream do experiment with business models, which have up until now been part of the niche movement.

If the manufacturers look at a LoT as a partner to distribute the own product portfolio as part of an alternative ownership model, both sides can profit from it:

- The LoTs gain access to a high quality product range, which they can offer to their users. Thus the LoTs could react to the criteria identified.
- Manufacturers could still focus on their core activities and outsource the task of creating their own service infrastructure. The LoT is the partner, being a specialist in delivering a service model and having completely different channels to the users, since the LoT is a place for social interaction, networking, gathering information and counselling (Ameli, 2017).

Thus a LoT can be pushed out of the niche into the mainstream (Figure 5).

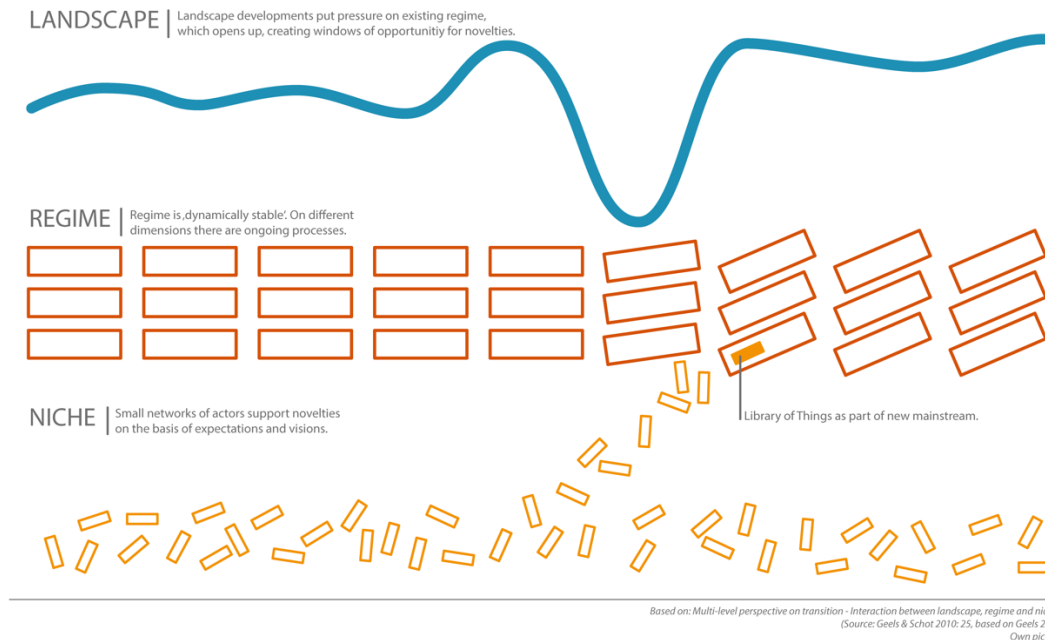


Figure 5. LoT as part of new mainstream. Source: own picture based on Geels & Schot 2010

Preliminary Conclusions

The willingness to share items, skills and time can be noticed internationally (Nielsen, 2014). Nevertheless, so far this willingness did not necessarily lead to a collective shift of daily consumption practices (BMBF, 2016; GfK Verein, 2015; INGDiBa, 2015; UBA, 2015; Verbraucherzentrale, 2015). The sharing of everyday goods, however, is lagging behind its potential (Sundararjan 2016). This is partly due to the fact that currently offers that are focussing on sharing daily items are not user friendly enough (BMBF, 2016; Pelz, 2012): Nowadays offers are mainly online, the effort for arrangements between the users are mainly high, people want to borrow things but not to lend things and trust between strangers is an issue as well as liability in case of problems. LoT confront these issues as the offer is located offline (and online) within a neighbourhood,

opening times as well as borrowing conditions are organized and fixed, which reduces the organizational effort and the LoT as institution acts as person in charge which minimizes trust and liability issues (Ameli 2017).

If a LoT succeeds in overcoming these sharing-barriers, it can lead to changed consumer choices and enhance collective behavioural changes: fewer items will then be consumed individually but they are shared and used collaboratively.

To confront the global challenges mentioned in the very beginning, manufacturers should design up-to-date, long-lasting products that are supporting collaborative usage. LoT can be seen as a solution for the company goal of including services in their own portfolio. LoT can be cooperation partners for sustainable business models (Figure 6).

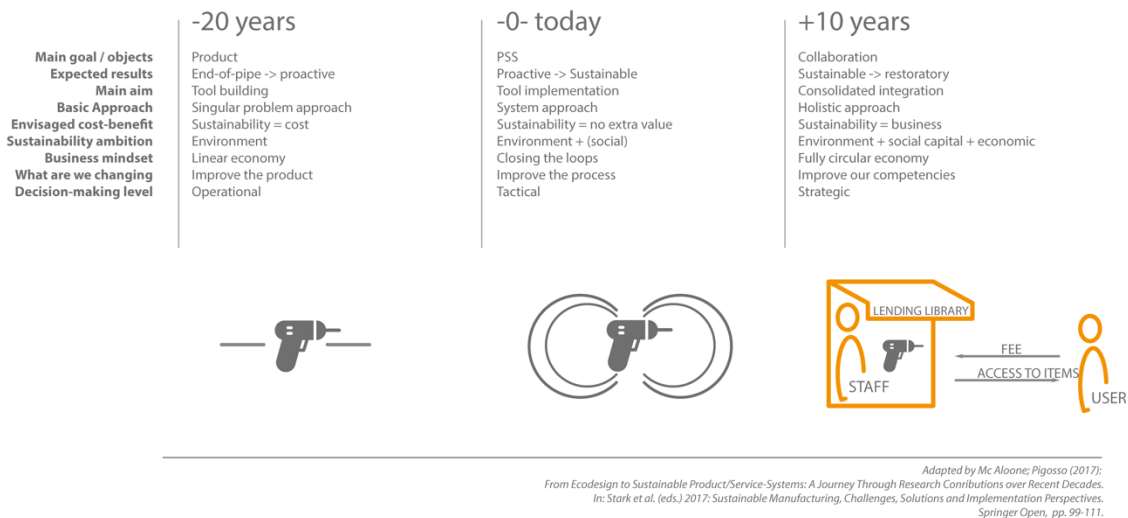


Figure 6. Designing for Sharing. Source: own picture based on McAloone & Pigosso 2017

These findings lead to the answer for research question 1 and 2:

As soon as companies look at LoT as distribution channel for their own products and use them as a hub for communication with users, there will be an opportunity to derive at a business model, which according to McAloone & Pigosso does not focus any more on products and also not only on PSS but on a collaboration with initiatives, such as LoT, and their user. With the help of the institution of a LoT it is possible to move from a linear economy towards a circular economy, since the LoT can take over strategic tasks, which so far have not been affordable for the companies themselves. If seen as a hub where the manufacturer connects with the user, the LoT can enhance the process of collaboration and lead to a holistic approach. LoTs can thus help to speed up the change.

Further Research

There is still no answer to the question of how to reach this form of cooperation. So far there are not enough LoTs out there yet. Thus the critical mass of items to attract the manufacturers' attention to adapt their products for this new model of sharing is not yet in demand. For a LoT the cooperation only makes sense if the items are affordable, in order to keep user fees low and to guarantee future access for everybody. But following the argumentation of the transition theory, the changing ecological and technological constraints will lead to the fact that this critical mass will be reached.

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