

Designing for Sustainability: Challenges and Theoretical Considerations

Discussing theoretical considerations for framing strategic sustainable design approaches

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Abstract— Product demand and high consumption have been traditionally viewed as traits of successful business in the mass market. However, the environment is under immense strain to sustain hyper-consumption driven lifestyles fueled by conventional mass market business strategies. Sustainable services have started to emerge to disrupt such business practices and alter consumption driven processes to reduce the harmful impact on the environment. However, the adoption of such services has largely been limited to a niche environmentally conscious audience. Research has argued that for sustainable services to have a noticeable environmental impact, they need to be adopted in the mass market. In this paper, we discuss the challenges and outline the theoretical design considerations needed to frame desirable value propositions for sustainable services intended for the mass market. To do this, we review literature from the fields of strategic design, service design and Human Computer Interaction (HCI) and identify conceptual overlaps with broader discussions on sustainability and suggest that sustainability can potentially find a familiar voice in design due to their common interest in advocating an emphasis on people's needs and aspirations for a better present and future. Mutually, design and sustainability can discover new representations and opportunities for a better future beyond offerings designed to fuel incessant consumption of resources.

Keywords-Sustainability; Strategic Design; Service Design; Mass Market; Value Propositions.

I. INTRODUCTION

Mass-market businesses have traditionally functioned with a singular focus on generating profits. Consequently, their business strategies are carefully crafted for fast product absorption and long term consumer engagement with the brand. Product demand and high consumption have been traditionally viewed as traits of successful business [1]. This conclusion largely stems from a business perspective based on general desires and needs driven consumer behavior [1] [2]. Therefore, one of the key strategies employed by conventional businesses to promote their services is based not just on fulfillment of basic consumer needs but also capitalizing on the association of social status and exclusive ownership of the newest generation of products. Businesses use marketing strategies that aim to create and encourage consumer desires and aid higher product sales and increasing consumption.

While these consumption oriented market practices offer purchase options with attractive buying experiences to improve a consumer's quality of life, they have simultaneously become a threat to the very quality of consumer life that they advertise to improve. This can be illustrated by the purchase and short disposal cycles of smart phones, which are providing users with technology to simplify their day to day activities while negatively impacting the environment through harmful electronic waste [3]. The environment is under immense strain to sustain the lifestyles supported by both production and consumption of unsustainable products and services [3][4] and has also been conclusively established through research studies studying the adverse affects of over-consumption on the environment [5].

On the other hand, there has been a rise in the efforts by a few companies to capitalize on the increasing awareness of the effects of unsustainable services on the environment and society and bringing sustainable services into the mass market. Such efforts to make existing products sustainable are focusing on extending the product life cycle and building efficient after sales services [6]. Greenphones [7], for instance, provides an after-sale service where enterprises and consumers sell and buy smartphones and tablets. Greenphones [7] benefits from the dynamics of this market, and seeks to prolong the lifetime of these devices. However, such products and services are still largely limited to the niche and/or premium market segments stemming from environmentally conscious consumers [1]. Consumers share a long relationship with certain brands and their products despite having an awareness of their environmentally damaging effects. Sustainable replacements of such products are either not easily available or lack the same ease of use or brand recognition as their mass market counterparts. The buying patterns of consumers in the mass market are still primarily driven by a product's newness, cost, quality and brand [2], leading to a vicious circle of the demand and supply of unsustainable services [8].

Therefore, it is becoming increasingly difficult to ignore unsustainable patterns of production and consumption [8] and a growing need for disruptive innovation through the introduction of sustainable products and services [9]. These disruptive practices can be used to explore new and environmentally efficient value propositions framed around sustainable products and services positioned as desirable offerings in the mass market. In this paper, we discuss the

challenges and outline the theoretical design considerations needed to create sustainable products and services and frame desirable value propositions. Understanding the design considerations for the creation of sustainable products and services and how it can lead to sustainable business models is both timely and interesting. It is timely because of the the growing awareness of environmentally damaging effects of conventional products and services and efforts to introduce alternative sustainable value propositions in the mass market. Additionally, it is interesting because of the dilemma between making a sustainable solution a mass-market phenomenon and the consumption driven ethos of the mass market. We outline these design considerations and build our theoretical framework by reviewing literature from the fields of sustainability, strategic design, service design and HCI. Further, we juxtapose concepts from these fields to present a multi-disciplinary perspective on designing for sustainability.

This paper is structured as follows: Section II presents a condensed introduction to the key theoretical concepts that we use to ground our discussion followed by an overview of the different approaches to sustainable design in Section III. Section IV presents a discussion of the key design considerations needed for mass market sustainable design solutions followed by a conclusion in Section V.

II. THEORETICAL FRAMEWORK

This section presents a condensed description of the theoretical framework that acts as a conceptual anchor for our investigation into design considerations for sustainable products and services.

Sustainability

WCED [10] has strongly stressed the need for a balanced developmental paradigm that advocates equal importance to be given to social concerns of both present and future generations. It proposes that:

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” [10].

Most importantly, it can be observed that the definition of sustainability outlined by WCED shifts the focus from *“sustainability to save the environment”* to *“sustainability for the well being of human kind”*. This, as discussed in the introduction, is the perspective on sustainability that we work towards in this paper as well. This perspective views (see Figure 1) sustainability as the integration of environmental, social and economic as the three key dimensions of well being [11]. The paradigm proposed by WCED viewed environment preservation as one of the considerations for achieving well being and required the incorporation of social as well as economic considerations into sustainable solution. Further, the World Congress on Challenges of a Changing Earth proposes that:

“Common to the definitions, however, is an emphasis on the need to consolidate features from different knowledge systems into practical methods and tools that can be practically applied to promote sustainability on a worldwide scale.” [12]

Kieffer et al. [11] built on the key considerations defined in the World Congress and discussed the instrumental role of the widespread deployment of sustainable developmental paradigms to generate a measurable impact and proposed sustainability science as a potential framework to achieve the desired impact of this vision. With the significance of large scale deployment and a focus on holistic socio-economic sustainable innovation to support the pro-environmental willingness of consumers, we argue that sustainable entrepreneurship and sustainable design oriented towards the mass market can act as interdependent agents for achieving the holistic vision of sustainability outlined above. Further, we suggest that sustainability can potentially find a familiar voice in design due to their common interest in advocating an emphasis on people’s needs and aspirations for a better present and future. Mutually, design and sustainability can discover new representations and opportunities for a better future beyond offerings designed to fuel incessant consumption of resources.

A. Sustainable Entrepreneurship

In businesses, an increase in product consumption is traditionally viewed as a reflection of profits and market demand while environmental concerns have largely been centered on meeting environmental standards of product manufacture and responsible disposal and little to no attention to the negative consequences of increased consumption on the environment. However, studies on hyper consumption are presenting opportunities for companies to innovate and gain a competitive edge by challenging the traditional ethos of consumption led profits [1][13]. This has propelled several entrepreneurial initiatives aiming to disrupt mainstream markets by focusing on environmental and social value creation along with economic value.

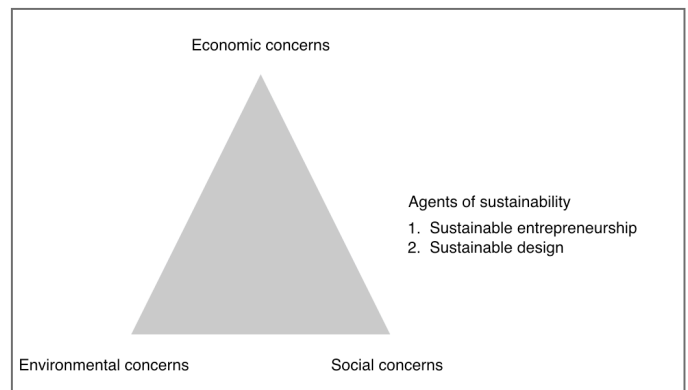


Figure 1. The three pillars of sustainable development

Building upon Schumpeter’s [14] constructs of entrepreneurship as a process of creating “market disequilibria” through innovation [15], Hockerts and Wüstenhagen [13] define sustainable entrepreneurship as:

“the discovery and exploitation of economic opportunities through the generation of market disequilibria that initiate the transformation of a sector towards an environmentally and socially more sustainable state.”

Sustainable entrepreneurship focuses on bridging environmental progress and market success by channeling innovative products and services [16]. Sustainable entrepreneurs operate with a profit motive as well but function with a framework of sustainability driven competitive solutions offering appealing value propositions to consumers. In contrast to having a sole orientation towards increasing the demand for products, sustainable entrepreneurship disrupts the market by shifting the paradigm from selling products to selling services and value along with manufacturing innovations for improving the eco-efficiency of tangible offerings as well. We argue that the mass market presents a powerful medium for sustainable entrepreneurs for reaching the most consumers for large scale impact. In this sense, sustainable entrepreneurship can be the realization of sustainability-centric innovations that provide benefits to a larger part of society by targeting the mass market [16].

B. Sustainable Design

Design as a discipline grew out of the industrial revolution in the late 19th and 20th century and has since been instrumental in creating aesthetically pleasing, useful and emotionally appealing objects. While these principles of good design remain relevant to this day, the rise of consumerism and the deteriorating effects on the environment is compelling designers to re-evaluate their offerings in terms of long term effects on the well being of consumers and communities. Campbell [17] argues that design will be fundamental to closing the gap between our behavior and our aspirations because of the particular resourcefulness that designers represent. Further, she suggests that:

“ready to improvise and prototype, brave in the face of disorder and complexity, holistic and people-centered in their approach to defining problems, designers have a vital role to play today in making society itself more resourceful” [17].

Sherwin writes about the designers training to be creative, challenging precedents and stereotypes and calls for greater involvement of designers given their inclination towards people centered and socio-cultural dimensions of sustainability [18].

In design processes, the exploration of sustainable outcomes is primarily conducted using one of the following three approaches:

- Designing for awareness and persuasion
- Designing for eco-efficiency at the product manufacturing level
- Designing at a systemic level

Even though eco-efficiency at product constitution level is essential, it cannot function in isolation. It requires the support of a system that enables seamless sustainable practices. Manzini and Vezzoli [19] caution that environmental risks still remain in spite of significant product improvement. They argue that:

“the practical and operational definition of this field (sustainable design) is outlined by two complementary strategies by their application in stages most agreeable to

companies: eco-efficient system research and the development of new solutions provide an instrument to confront, with a sustainable approach, some important problems emerging in contemporary society.” [19]

Similarly, efforts to promote reduced resource based lifestyles through awareness and persuasion fail to address the personal concerns of the individual, often driving them against sustainability related goals [20]. Therefore, all improvements in eco-efficiency and awareness seem to be offset by the steep increase in the volume of the products sold leading to a zero or even negative net effect [21]. Therefore, designing for sustainability requires systemic innovations by incorporating holistic perspectives at a product, service and individual level, in contrast to the solutions built primarily around technology or product innovation. In the following section, we discuss the sustainable design approaches mentioned above in greater detail by reviewing literature from strategic design, service design and HCI.

III. SUSTAINABLE DESIGN APPROACHES

A. Sustainability through persuasion and awareness

Extensive studies of harmful environmental impacts of consumption-mediated processes have succeeded in evoking awareness among consumers and companies [1] [8] [22]. Several international initiatives promoting sustainability have succeeded in generating substantial awareness amongst people and companies but have failed to translate into widespread proposals and adoption of sustainable products and services. While people are more than willing to adopt pro-environment practices, several factors such as lack of economic and social support structures enabling/assisting the willingness of the people has led to the failure of to translate this willingness into action. Sustainability centric campaigns driven by persuasive sustainability [23] and lifestyle rationalization [20] based on proactive consumers making sustainable choices has cracked under the pressure of daily priorities, cultural aspirations of people going about their daily routine. The limited influence of persuasiveness in the issues of sustainability has been highlighted by Brynjarsdottir et al[23]. who frame it in terms of sustainability, human behavior, and the relationship between them. They argue that:

“while this (awareness for pro-active action) may help make the problem of sustainability manageable as an engineering enterprise, it also makes designs susceptible to breakdown” [23].

B. Sustainability through eco-efficient market alternatives

Recognizing the issues with awareness based solutions, consistent efforts in the past decade have been directed towards developing a sustainable market space. This intent has driven businesses to explore sustainable avenues contributing to the well being of their consumers. Additionally, it has created a new segment of environment-focused businesses such as Fairphone [24][25] and Tesla [26] that are investing efforts in sustainable yet breakthrough processes. These processes perceive attaining environmental

sustainability and green consumption as one of the key performance indicators in the market. While this has initiated a positive trend towards a green consumption economy, these business models lack the appeal of unsustainable yet popular products in the mass market [1][5]. Every purchase related decision of a consumer continues to be driven primarily by easily quantifiable values that relate to fulfillment of basic needs, personal desires and buying power. Popular mass-market services present several alternatives tailored to these preferences, simplifying the decision to pick and choose. The purchase of these popular products requires minimum time and cognitive effort at the consumer's end. On the other hand, consumers willing to buy sustainable services have to evaluate the trade off in quality, cost and consistent availability leading to a more complex decision making for an activity that is a means to end and not the goal itself [1][5]. Therefore, while the general awareness about low-carbon consumption has gathered adequate appreciation among consumers and has led to the creation of a space in the economy for green products, it has been limited to a niche segment of actively environmentally conscious and premium buyer segments [1][5][27]. Csikszentmihalyi [5] in his theoretical account of consumption and its effects addresses this phenomenon by stating that:

"consumers report that they are concerned about the environmental issues but they are struggling to translate these concerns into purchases of sustainable products".

In addition to a need and desire oriented market strategy, the pace of technology also plays a significant role in the creation of unsustainable product advancements. Even though consumers are aware of the available environmentally friendly alternatives, they often choose to participate in a race to get the newest or latest product instead of replacing it with an environmentally friendly one [16]. Furthermore, the tech savvy consumers and early adopters of advanced technology wish to be at the cutting edge by buying the latest products, leading to frequent product disposal. Therefore, any effective disruption in this space to make sustainable innovation a preferred option should make environment-oriented consumers feel that they are still empowered with the newest technology.

C. Sustainability through strategic design

The pursuit of sustainable solutions is essential in questioning the long-established norms, processes and goals of mass market oriented businesses. As markets grow fiercely competitive, sustainability focused innovation can prove essential in reinventing and delivering new services to the consumers, driving innovation trends in the mass market landscape [27]. It is evident that even though the mass market and rapidly progressing technology are one of the primary propagators of over consumption, they also offer access to a larger consumer base and opportunities of greater involvement of consumers as equal stakeholders in the design of pro-environmental solutions utilizing new technological platforms. They could potentially offer the resources to disrupt existing unsustainable markets and value networks to innovative design and business models.

Systemic design integrates persuasion and awareness with desirability and ease of access to sustainable and eco-efficient service alternatives for mass market consumers. To effectively pursue the goal of making sustainable services have a greater impact on the mass market, a comprehensive study of the consumer's desires and preferences and traits of the existing popular products is a critical necessity. Given the existing niche market for eco-friendly products, an understanding of the customer's aspirations will play a pivotal role in bridging consumers' 'attitude-behavior' [2] gap and evaluating and better positioning sustainable processes in the mass market.

Building on the systemic perspectives outlined above, Manzini and Vezzoli [19] discuss the concept of '*strategic sustainable design*', which advocates a paradigm shift aimed at the buying and selling of a system of products and services in contrast to the traditional model of buying and disposal of products. It simultaneously addresses customer and service provider needs while promoting pro-environmental practices of production and consumption. Some of the common processes and tools under strategic sustainable design are 'product service systems' [11][19], 'peer to peer services' [28] and 'product life extension through repair and second hand ownership'. Due to the reliance of strategic sustainable design on the intangibility of products and efficiency of services in delivering value, the nature of the roles played by stakeholders also differs from traditional systems. With the dissemination of services being pivotal, the ownership of a product by the consumer no longer remains constant. In some cases, such as second hand or shared ownership, the consumer also plays the part of the service provider for new consumers. With this state of constant flux in the nature of engagement of the stakeholders, strategic sustainable design approaches transform linear provider to consumer models into a mesh of participants playing the role of provider, consumer or facilitator based on the context and requiring a more intensive inter-communication system amongst the stakeholders. Therefore, we argue that systemic design in general and strategic sustainable design in particular provides the most promising framework for positioning sustainable services in the mass market. Wolfson et al. [11] suggest that:

"The main incentive behind defining sustainability as a service enables the creation of an organized framework to facilitate the active implementation of sustainability. Such a framework should characterize the nature both of the value itself and of the roles played by the participants in the value co-creation process."

IV. IDENTIFYING DESIGN CONSIDERATIONS

Although strategic sustainability offers a highly integrated approach for sustainable offerings, it also creates fairly complex dynamics of key stakeholders and contexts for simultaneously addressing economic, social and environmental aspects of the issues requiring design interventions.

This section explores the considerations needed to effectively address the dynamics of strategic sustainable design. With respect to strategic sustainable design, these

theoretical constructs can be seen as four necessary facets that would need to be explored and addressed in order to design products and services for the mass market. These facets are: Design Thinking as a holistic approach, Sustainable Entrepreneurship as a mass market motivator, Product Service Systems as a potential space for disruptive innovation and User Experience as a mass market differentiator.

A. Approach: Design Thinking

Skoldberg et al. [29] describe design thinking as the:

“construction of the professional designer’s practice (practical skills and competence) and theoretical reflections around how to interpret and characterize this non-verbal competence of the designers.”

Design thinking has found applicability in a wide variety of domains like social innovation [30], healthcare services [31], organizational strategy [32] and organizational studies [33]. It is also being used for enabling resourcefulness in user groups and actively engaging them in co-design and co-creation activities through tailored tools and methods. We argue that sustainable solutions grounded in a deep understanding of the needs and context of the participants in the stakeholder network aligns with a designer’s ability to translate opportunities into offerings by closely working with users.

Buchanan’s seminal work [34] describing professional designer’s thought process as an approach for solving ‘wicked problems’ (a class of social systems problems with a fundamental indeterminacy without a single solution and where much creativity is needed to find solutions [35] and is one of the foundational references for design in general. Buchanan [34] argued against the prevalent linear design process of his time with specific steps of “problem definition” and “problem solution” and instead proposed a model where problem formulation and solution continuously feed into each other and solutions are considered as “working hypothesis for exploration”. This is typically facilitated through a co-design process where all participants collaboratively cycle through the process of refining the problem formulation and narrowing down the solution-space. Further, Schön [36], in his theoretical construct of ‘a reflective practitioner’ outlines a practice based construct of the design process that describes “creation and reflection upon the creation” as two symbiotic processes working in tandem to “allow constantly improved competence”. Schön [36] stresses that reflection on creation does not happen after the fact but is an integral part of the whole design work and hence a part of the practice.

We argue that strategic sustainable design solutions should have a dual focus on identifying specific opportunities for interventions and innovation along with reflective and corrective measures that guide the design of future innovations. Therefore, we suggest that an approach for designing mass market strategic sustainable solutions would be best informed by a juxtaposition of the design frameworks outlined by Buchanan [34] and Schön [36], i.e. by using co-design methods and tools for framing problem areas and solutions and using the reflexive practice as an

outline to guide the definition and refinement of future innovations.

B. Motivation: Sustainable Entrepreneurship

Sustainable entrepreneurship represents a departure from the usual focus on large firms in earlier work on corporate sustainability. It builds upon the concept that new entrants are more likely to pursue radical change than larger firms and usually lead the charge in an industry’s transformation by creating ‘market disequilibria’ and making larger bodies react to raising market expectations.

Further, it has been stressed [13] that disruptive innovation [37] (as opposed to incremental innovation) is an integral characteristic of sustainable entrepreneurship. ‘Disruptive innovation’ describes new products or services, which are presented as simpler, more convenient and inexpensive alternatives to new or less demanding customers and eventually replace the established yet more complex competitors [37]. Hence, reach and impact play a significant role in qualifying an innovation as truly disruptive. For e.g., innovation by entrepreneurs in a social niche, without a strategy or intent to broaden its reach/impact would not qualify as disruptive innovation and hence should not be categorized as sustainable entrepreneurship. Additionally, literature points us to the fact that sustainable entrepreneurs are driven by a strong motivation for industrial transformation and hence aim for mass-market transformation beyond the eco-niche [13]. Since there is growing interest in the opportunities and the business case for sustainable innovation [38] and ‘green growth’ [39] it makes a strong case for sustainable entrepreneurship being treated as a motivating strategy for an approach for designing mass market strategic sustainable solutions.

C. Opportunity: Product Service Systems

The first formal definition of Product Service Systems (PSS) was given by Goedkoop, et al. [40] who suggested that:

“A product service-system is a system of products, services, networks of “players” and supporting infrastructure that continuously strives to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models.”

It builds on the management concepts of ‘servitization’ [41], which highlights the shift in manufacturing towards the inclusion of a service component in products. Baines et al. [42] describe the shift in emphasis advocated by PSS as a move towards the “sale of use” as opposed to the “sale of product” and outlined its key elements as:

- Product: a tangible commodity manufactured to be sold.
- Service: an activity (work) done for others with an economic value.
- System: a collection of elements including their relations.

The relations between these elements and their impact on each other considered collectively represents a ‘service ecology’ [43]. Additionally, a lot of research on PSS highlights the concept of ‘dematerialization’ and

sustainability and the current move to a ‘dematerialized economy’ [19][44]. Tim Jackson, describes this as the ‘new service economy’ where profitability does not depend on greater material consumption and production but from the “provision of services” that meet the essential human needs like communication, mobility etc.

From the perspective of strategic sustainable design, the concept of sustainable product service systems and the market opportunity linked to them is especially interesting. First, Sustainable PSS pushes the concept of sustainability beyond environmental optimization of products and processes, which has been shown to be an ineffective strategy for long term sustainability. Second, sustainable PSS represents a competitive proposition that outlines a viable market opportunity for sustainable entrepreneurship and disruptive innovation by “*considering alternate socio-technical systems (and ecologies) that can provide the essential end-use function, such as warmth or mobility, that an existing product offers*” [19].

D. Differentiator: User Experience

As technology has progressed, products in general and interactive products in particular have matured in terms of their usability and effectiveness in performing tasks and hence users have started looking at them as more than just tools, but rather objects to be desired [46]. Consequently, the concept of user experience has been evolving over time in Interaction Design and HCI literature from an initial focus on user behaviors and traditional usability to more expansive notions of aesthetics, effectiveness and hedonic qualities in product and technology usage [46]. Hassenzahl & Tractinsky [46] reason that this is because focusing on products and services as mere tools is insufficient to capture the variety and engaging aspects of the actual use of technology. Building upon the focus on aesthetic, emotional and hedonic qualities required to define a user experience, Hassenzahl [47] describes user experience as the consideration of:

“the pragmatic aspects of interactive products (i.e. its fit to behavioral goals) as well as about hedonic aspect, such as stimulation (i.e. personal growth, an increase of knowledge and skills), identification (i.e. self-expression, interaction with relevant others) and evocation (i.e. self-maintenance, memories).”

Hassenzahl & Tractinsky [46] also argue that since user experience considers technology from more than a simplistic and limited instrumental needs perspective the design motivations behind it would be better informed by focusing on pleasure, positivity and empowerment than on ‘the absence of pain’ [46]. Hassenzahl [47] builds upon this notion by suggesting that positive experiences cannot be traditionally manufactured and acquired but rather needs to be co-created by consumers and providers together.

Moreover, from a business value standpoint, literature [48], also points to the fact that the increasing commoditization of goods and services would lead to experiences emerging as key differentiators in the ‘progression of economic value’. Pine and Gilmore [49] also suggest that experiences should be considered as distinct economic offerings, just like products or services. It follows

that experiences should also be explicitly considered as a tangible and marketable outcome of a design process and not just an ‘amorphous goal’ [48] that is built around products or services and therefore can act as a viable differentiator for strategic sustainable solutions

V. CONCLUSION

The paper presented the challenges and outline the theoretical design considerations needed to frame desirable value propositions for sustainable services focusing on positioning services for adoption in the mass market. Building on literature from the fields of strategic design, service design and HCI, current theoretical discussions on sustainability and entrepreneurship with its key problematics and challenges are introduced.

We argue that sustainability can potentially find a familiar voice in design due to their common interest in advocating an emphasis on people’s needs and aspirations for a better present and future. Mutually, design and sustainability can discover new representations and opportunities for a better future beyond offerings designed to fuel incessant consumption of resources. From the literature discussed, three primary design approaches are highlighted and discussed in detail: designing for awareness and persuasion, designing for eco-efficiency in product manufacturing and systemic design.

We propose that systemic design in general and strategic sustainable design in particular provides the most promising framework for positioning sustainable services in the mass market. As a framework, it integrates persuasion and awareness with desirability and ease of access to sustainable and eco-efficient service alternatives for mass market consumers. Further, we have highlighted four theoretical considerations needed for framing design approaches within this framework, which are ‘*design thinking*’ for holistic and reflective problem solving, ‘*sustainable entrepreneurship*’ to identify disruptive value propositions, ‘*product service systems*’ for framing value propositions and design concepts as real world sustainable services and ‘*user experience*’ as a differentiator in the mass market.

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REFERENCES

- [1] J. N. Sheth, N. K. Sethia and S. Srinivas, “Mindful consumption: a customer-centric approach to sustainability,” *Journal of the Academy of Marketing Science*, vol. 39, no. 1, Aug. 2010, pp. 21–39.
- [2] A. A. Marylyn Carrigan, “The myth of the ethical consumer – do ethics matter in purchase behaviour?,” *Journal of Consumer Marketing*, vol. 18, no. 7, 2001, pp. 560–578.
- [3] X. Li, et al., *Smartphone Evolution and Reuse: Establishing a more Sustainable Model (Invited Paper)*.
- [4] A. K. Bhuie, O. A. Ogunseitan, J.-D. M. Saphores and A. A. Shapiro, “Environmental and Economic Trade-offs in Consumer Electronic Products Recycling: A Case Study of Cell Phones and

- Computers,” in Proceedings of the International Symposium on Electronics and the Environment, Washington, DC, USA, 2004, pp. 74–79.
- [5] M. Csikszentmihalyi, “The Costs and Benefits of Consuming,” *Journal of Consumer Research*, vol. 27, no. 2, Sep. 2000, pp. 267–272.
- [6] C. C. M. I. of Technology and 1977-2015 All rights reserved, “Sustainability Through Servicizing,” MIT Sloan Management Review. .
- [7] “GreenPhones (In Norwegian).” [Online]. Available: <http://www.greenphones.no/>. [Accessed: 12-Jan-2016].
- [8] D. A. L. C. Esty, “The Sustainability Imperative,” *Harvard Business Review*. [Online]. Available: <https://hbr.org/2010/05/the-sustainability-imperative>. [Accessed: 19-Mar-2016].
- [9] D. Yu and C. C. Hang, “A Reflective Review of Disruptive Innovation Theory: A Reflective Review of Disruptive Innovation Theory,” *International Journal of Management Reviews*, vol. 12, no. 4, Dec. 2010, pp. 435–452.
- [10] Brundtland Commission, “Our common future: Report of the World Commission on Environment and Development,” UN Documents Gatheringa Body of Global Agreements, 1987.
- [11] A. Wolfson, S. Mark, P. M. Martin and D. Tavor, *Sustainability through Service*. Cham: Springer International Publishing, 2015.
- [12] R. Kates, et al., “Sustainability science,” 2000.
- [13] K. Hockerts and R. Wüstenhagen, “Greening Goliaths versus emerging Davids — Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship,” *Journal of Business Venturing*, vol. 25, no. 5, Sep. 2010, pp. 481–492.
- [14] K. Śledzik, “Schumpeter’s view on innovation and entrepreneurship,” *Management Trends in Theory and Practice*, (ed.) Stefan Hittmar, Faculty of Management Science and Informatics, University of Zilina & Institute of Management by University of Zilina, 2013.
- [15] J. T. Eckhardt and S. A. Shane, “Opportunities and Entrepreneurship,” *Journal of Management*, vol. 29, no. 3, Jun. 2003, pp. 333–349.
- [16] S. Schaltegger and M. Wagner, “Sustainable entrepreneurship and sustainability innovation: categories and interactions,” *Business Strategy and the Environment*, vol. 20, no. 4, May 2011, pp. 222–237.
- [17] E. Campbell, “You know more than you think you do: design as resourcefulness & self-reliance,” *RSA Design & Society*, 2009.
- [18] C. Sherwin, “Design and sustainability,” *The Journal of Sustainable Product Design*, vol. 4, no. 1–4, Jan. 2004, pp. 21–31.
- [19] E. Manzini and C. Vezzoli, “A strategic design approach to develop sustainable product service systems: examples taken from the ‘environmentally friendly innovation’ Italian prize,” *Journal of Cleaner Production*, vol. 11, no. 8, Dec. 2003, pp. 851–857.
- [20] K. Hobson, “Competing Discourses of Sustainable Consumption: Does the ‘Rationalisation of Lifestyles’ Make Sense?,” *Environmental Politics*, vol. 11, no. 2, Jun. 2002, pp. 95–120.
- [21] *Design for Environmental Sustainability*. London: Springer London, 2008.
- [22] W. Young, K. Hwang, S. McDonald and C. J. Oates, “Sustainable consumption: green consumer behaviour when purchasing products,” *Sustainable Development*, vol. 18, no. 1, Jan. 2010, pp. 20–31.
- [23] H. Brynjarsdottir, M. H’a akansson, J. Pierce, E. Baumer, C. DiSalvo and P. Sengers, “Sustainably Unpersuaded: How Persuasion Narrows Our Vision of Sustainability,” in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, New York, NY, USA, 2012, pp. 947–956.
- [24] M. van der Velden, “Re-politicising Participatory Design: What can we learn from Fairphone,” presented at the Ninth International Conference on Culture and Technology and Communication (CaTaC), 2014.
- [25] T. Wernink and C. Strahl, “Fairphone: Sustainability from the Inside-Out and Outside-In,” in *Sustainable Value Chain Management*, M. D’heur, Ed. Springer International Publishing, 2015, pp. 123–139.
- [26] S. Reinecke, “On the Way to Sustainable Transportation,” *Marketing Review St. Gallen*, vol. 31, no. 5, Oct. 2014, pp. 84–88.
- [27] J. Olson, P. M. Clay and P. Pinto da Silva, “Putting the seafood in sustainable food systems,” *Marine Policy*, vol. 43, Jan. 2014, pp. 104–111.
- [28] “What’s Mine is Yours (Botsman & Rogers, 2010),” John A. McArthur, Ph.D. .
- [29] U. Johansson-Sköldberg, J. Woodilla and M. Çetinkaya, “Design Thinking: Past, Present and Possible Futures,” *Creativity and Innovation Management*, vol. 22, no. 2, Jun. 2013, pp. 121–146.
- [30] T. Brown and J. Wyatt, “Design Thinking for Social Innovation,” *Stanford Social Innovation Review*, 2010. [Online]. Available: http://www.ssireview.org/articles/entry/design_thinking_for_social_innovation. [Accessed: 22-Mar-2015].
- [31] V. Kumar, A. K. Duncan and M. A. Breslin, “Innovating health care delivery: the design of health services,” *Journal of Business Strategy*, vol. 30, no. 2/3, 2009, pp. 13–20.
- [32] D. Dunne and R. Martin, “Design thinking and how it will change management education: An interview and discussion,” *Academy of Management Learning & Education*, vol. 5, no. 4, 2006, pp. 512–523.
- [33] A. G. L. Romme, “Making a Difference: Organization as Design,” *Organization Science*, vol. 14, no. 5, Oct. 2003, pp. 558–573.
- [34] R. Buchanan, “Wicked Problems in Design Thinking,” *Design Issues*, vol. 8, no. 2, Apr. 1992, pp. 5–21.
- [35] H. W. J. Rittel and M. M. Webber, “Dilemmas in a general theory of planning,” *Policy Sciences*, vol. 4, no. 2, Jun. 1973, pp. 155–169.
- [36] D. A. Schon, *The Reflective Practitioner: How Professionals Think In Action*, 1 edition. New York: Basic Books, 1984.
- [37] C. M. Christensen, C. W. Johnson and M. B. Horn, *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns*, 1st ed. McGraw-Hill, 2008.
- [38] M. B. M. S. L. Hart, “Global Sustainability and the Creative Destruction of Industries,” *Sloan Management Review*, vol. 41, 1999.
- [39] B. Ki-moon and A. Gore, “Green growth is essential to any stimulus,” *Financial Times*, 16-Feb-2009.
- [40] M. J. Goedkoop, “Product service systems, ecological and economic basics,” Ministry of Housing, Spatial Planning and the Environment, Communications Directorate, 1999.
- [41] S. Vandermerwe and J. Rada, “Servitization of business: Adding value by adding services,” *European Management Journal*, vol. 6, no. 4, 1988, pp. 314–324.
- [42] T. S. Baines, et al., “State-of-the-art in product-service systems,” *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, vol. 221, no. 10, Oct. 2007, pp. 1543–1552.
- [43] A. Polaine, L. Løvlie and B. Reason, *Service Design: From Insight to Implementation*, 1st edition. Brooklyn, NY: Rosenfeld Media, 2013.
- [44] R. Roy, “Sustainable product-service systems,” *Futures*, vol. 32, no. 3–4, Apr. 2000, pp. 289–299.
- [45] P. Glavič and R. Lukman, “Review of sustainability terms and their definitions,” *Journal of Cleaner Production*, vol. 15, no. 18, Dec. 2007, pp. 1875–1885.
- [46] C. Sanne, “Are we chasing our tail in the pursuit of sustainability?,” *International Journal of Sustainable Development*, vol. 4, no. 1, Jan. 2001, pp. 120–133.
- [47] M. Hassenzahl and N. Tractinsky, “User experience - a research agenda,” *Behaviour & Information Technology*, vol. 25, no. 2, Mar. 2006, pp. 91–97.

- [48] M. Hassenzahl, "Experiences Before Things: A Primer for the (Yet) Unconvinced," in CHI '13 Extended Abstracts on Human Factors in Computing Systems, New York, NY, USA, 2013, pp. 2059–2068.
- [49] B. J. P. Iij. H. Gilmore, "Welcome to the Experience Economy," Harvard Business Review. [Online]. Available: <https://hbr.org/1998/07/welcome-to-the-experience-economy>. [Accessed: 18-Mar-2016].
- [50] W. J. Orlikowski and J. J. Baroudi, "Studying Information Technology in Organizations: Research Approaches and Assumptions," Information Systems Research, vol. 2, no. 1, Mar. 1991, pp. 1–28.