Design Driven Innovation for Sustainability: An Analysis of 7 Cases

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Abstract. The current consumption and production pattern is unsustainable. How to make sustainable economy possible requires an influencing agent to promote. With the multi-stakeholder participation, design enhanced as a powerful driving force for the sustainable transformation and improving people's well-being.

Based on the literature review and 7 case studies, including ecosystem restoration camp, 100-mile food movement, world widely organic farms, collaborative chronic care network, participatory ground water management project, Chinese ancient cosmetics restoration project and a flax project, this paper aims to explore the role of design in promoting sustainable changes with an attempt to complete the theory of social innovation design.

"Design-driven innovation" taking the understanding of the evolution process of the social culture and put forward the new perspectives in regard to the persistence of the new vision. The design-driven innovation is the result of the research process of the social action network, which need to be achieved with joint efforts of the actors ranging from the institutions, enterprises, non-profit organizations, citizens, associations. This is conducted with special emphasis placed on stimulating the bottom-up actions to enable the sustainable economic model to become the mainstream.

Keywords: Design driven innovation · Sustainability · Cases study

1 Introduction

In 1992, the United Nations Conference on Environment and Development (UNCED) clearly put forward to change current consumption and production patterns. Schumacher E.F. questioned about the worthiness of yearning for the goal of the Western economy in his book "Small is Beautiful", by criticizing the use of economic growth as the standard for measuring the national progress. Since 2000, The concept of "Anthropocene" put forward by Paul J. Crutzen has made more and more people realize that human activities have in fact a tremendous impact on the Earth, which exceed even the limits of what the ecosystem itself can regulate. The economic growth requires that the stock of natural capital could be taken into consideration in the political decision-making process [1]. The central task facing mankind today is to find a sustainable alternative to complete the social transformation. It is really a hard work and the barriers

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are as follows: the deep-ingrained social awareness, the existing socio-economic system, the social infrastructure and the technological processes which have limited us strictly on the existing track, putting a curb on the sustainable alternatives. According to Schumpeter, the existing development model depends on creatively destroyed, thus stimulating and create an inlet for introducing and developing a brand-new model.

2 Three Dimensions of Sustainability

It was realized that there cannot be an overarching all-encompassing specific sustainability target to strive for [2, 3]. Sustainability is neither the state of the system nor is it a target to be achieved. Sustainability is an ideal to the system which inter-relates different aspects of economy, environment and society.

2.1 Environment Dimension: People, Planet and Profit

The origin of Sustainable Economy and its ideas can be traced back to Kenneth E Boulding, an American scholar, who put forward the concept of coming spaceship earth economics in 1969. He mentioned that human beings are just like on a small spaceship in the vast space. Sooner or later, the disorderly growth of population and economy will exhaust the limited resources in the ship, and the waste discharged during production and consumption will eventually lead to the pollution of the spacecraft. The concept of sustainability introduced the natural capital as a new constant into the accounting of development cost, this modification takes both efficiency and fairness into consideration [4].

Most climate change policies focus on long-term choices, such as the introduction of new low-carbon energy technology and the establishment of total carbon emissions control and trading systems. While the academia has introduced new tools from some more specific ways, such as “ecological footprint”, “carbon emissions” and “community marketing” [5–7], with attention to the impact of human beings on the environment from more specific aspects in terms of life behavior. For example, ecological footprint [5] visualizes the impact of resources needed by households, communities, regions and countries on the environment. Dietz [6] started with carbon emissions from family behavior to assess the plasticity of 17 kinds of family behaviors. He suggested that the policy should focus on family action and citizen action from the macro level.

2.2 Social Dimension: Well-Being and Welfare

Jackson [67] analyzed originally the relevance of the relationship between human development and economic growth, pointing out that human development and well-being do not depend exclusively on the economic growth, and holding that we should get rid of the obsession with economic growth, and that the concept of human well-being needs to be replaced by a new philosophical concept [8].

Sustainability, as a concept of the future, is defined as the environment, public health, social justice, and other options available for human beings and the biosphere [9]. It is also identified as a system-related human value [10] that improves the quality of human life within the affordability of ecosystems [11].

The well-being of the developed countries has long been successfully decoupled from their economic growth, emphasizing other factors such as time well-being and autonomy than consumption. For example, the United States advocates "Recycling Your Time" to reduce the working hours, and achieve sustainability without any special emphasis on sustainable consumption. In addition, the discussion of well-being can also help people realize the limitations of material consumption on the promotion of human well-being.

Non-material factors are equally important for human well-being, such as: Security, Attribution, Social Cohesion, Equity and Social Relations [12]. Layard [68] emphasized the importance of fair distribution of wealth to happiness, Veenhoven [69] argued that autonomy is more important than distributive justice. In general, the better society is the more fair one described by Wilkinson and Pickett [70].

2.3 Economy Dimension: Reciprocity and Solidarity Relations

The assessment of another dimension of sustainability involves the economic dimension. After all, the solution of the social problems depends on the economic development. And this index of assessment does not lie in the growth of GDP, much less in the use of money to measure the value of people.

Reciprocity, as a social mechanism, has a close connection to people's daily life. When reciprocity finds economic expression to provide goods and services, the socio economy emerges [13]. Reciprocal economy utilizes virtue ethics, expands economic business, such as micro-credit, mobilizes local social networks, and creates opportunities for the poor [14], For example, Time Bank, employed as a community currency, rewards people for their work in the community [15].

The ecologists have been fully aware of the interconnectedness of life networks with their overall environment and provides us with theoretical tools to extend these relationships to the social systems and identify their common organizational patterns as the self-organizing networks [3]. The close cooperative partnership is established in the network platform with wide participation of multi-stakeholders (enterprises, universities, scientific research institutions, financial institutions). The economic subject interact with each other interdependently, and constantly carrying out the sharing of knowledge, value exchange, information transmission, and capital flow through material, energy, and financial institutions. The continuous transmission and circulation of information will execute self-regulation and feedback, thus maintaining the continuous existence and the evolution of the system, realizing the restructuring of the innovative elements, promoting more the new economic models, and completing the transformation of the sustainable development.

3 Design Driven Innovation

MIT Sloan Management Review describes innovation as the path to the next industrial revolution [71]. According to the analysis of global national competitiveness, our economy will face a major transformation from efficiency-driven to innovation-driven [72], which means the innovation-driven economy [73]. Social innovation serves as a

prerequisite for sustainable economy [74], innovation cluster will be an important tool for national competitiveness [75].

3.1 Design and Social Responsibility

The idea that designing and building the physical environment carries social and ethical responsibilities is not new, but since the building boom of the early 21st century and subsequent market crash, there has been a growing discussion of socially responsible design. Socially responsible design goes by a number of names (including Design Activism, Public Interest Design, Human-Centered Design, Social Impact Design, Social Design) and has not been formally defined, but it is generally characterized by attitudes that value justice, equality, participation, sharing, sustainability, and practices that intentionally engage social issues and recognize the consequences of decisions and actions.

3.2 Design as Approaches

Eco Design. Eco design is a product-based management system merging environment aspects into product development [16]. It used to be accepted by the electrical, electronics and domestic appliance sector. The challenge for eco-product developer is to provide a benefit to the customer at the lowest environmental cost [17]. It requires radical and creative thinking to reduce environmental impacts by a factor of between four and 20 times. Eu regulation on ecolabelling and energy labelling and a Dutch government Ecodesign programme aimed at Small and medium-sized enterprise [18].

Green Design. When we talk about a green product or service which include design for remanufacturing, design disassembly and for recycling [19]. Many green design studies have focused on complete disassembly of an end-of-life product to recover valuable components [20].

Cradle to Cradle Design. Cradle-to cradle design present an alternative design and production concept to the strategies of zero emission and eco-efficiency [21]. The concept of eco-effectiveness proposes to enable materials maintain their status as resources and accumulate intelligence over time and generates a synergistic relationship between ecological and economic systems. This closing resource loops strategy inspired business model for a circular economy [22]. Circular economy is a concept promoted by the EU [23]. While the current and traditional linear extract-produce-use-dump material and energy flow model of the modern economic system is unsustainable, Circular economy provides the economic system with an alternative flow model, one that is cyclical [24]. The ultimate goal of promoting CE is the decoupling of environmental pressure from economic growth [25].

Product-Service System Design. The product service (PSS) is described in the framework of the new type of stakeholder relationships and partnerships, producing a new convergence of economic interests and a potential concomitant systemic resources optimization [26].

Design for the Base of the Pyramid (BoP). More recently scholars have explored the importance of social innovation and social entrepreneurship in the context of BoP [27]. One of the promising approaches to tackle the wicked problem of poverty is business development combined with poverty alleviation [28]. With a particular emphasis on bottom-up approaches and on an active role for users as co-creators [29].

Design for Social Innovation. Design have mainly been part of the social and economic problems that we have to face. Social innovation is defined as "a new idea that works in meeting social goals" [30]. Especially when we found the wellbeing and ways of living is not sustainable, new conceptual and methodological tools need to be develop to exploring how to imagine and build a sustainable future [31]. Democratic innovation is an original look at the political future of democracy, exploring the latest ideas aimed at renewing popular power [32]. Democratic innovation practice with the original vision of participatory design, which is democratized through easy access to production tools and lead-users as the new experts driving innovation [33].

Design for System Innovation and Transitions. Design has expanded from product-centric focus towards large scale system level changes [34]. The idea of multilevel dynamic which is called Multilevel perspective (MLP) [35] play a crucial role in connection. System innovations and transitions central to understanding the mutually reinforcing transformation of structure and patterns action [36].

Observing the design approaches evolution that contribute to the economy, society and environment and make a rough statistical analysis based on the relevant literature numbers, it is found that the emerging system innovation and transformation design has great potential to development (Fig. 1).

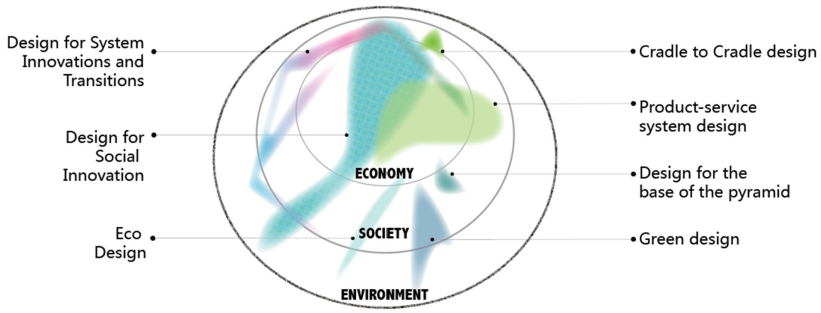

Fig. 1. Seven design driven approaches for system innovation and transitions

3.3 Design as Meaning Strategy

Norman and Verganti questioned the feasibility of user-centered design methods in promoting radical innovation [37]. Design-driven innovation, as a radical innovation, changes the rules of competition by using a meaning strategy [38]. The concept of "design is making sense of" originally proposed by Krippendorff [39–41], Meaning originates from the interaction between a person and an Artifact, whose form follows

its meaning rather than its function. Sensemaking process is associated with the belief system, Organizations use information to construct meaning, create knowledge and make decisions [42, 43].

The classical debate between function and form (functionalism and rationalism) mislead the understanding of forms as the beauty of the product's appearance and style. Beside the functional value, the emotional and symbolic value of the product-meaning - is the real important issue. Meaning proposes a value system to the user as a personality and identity that transcends formal style [44].

The concept of "meaningful interaction" (MI) was put forward by WG DE Medeiros who discussed three key ideas in current design: semantics, emotion and interaction. From the perspective of product semantics, He explored the understanding behavior of users in interactive behavior and stimulated people's emotion based on the whole interactive process [45]. Meaning, as the main conceptual building block of design-driven innovation, brings forward interpretative qualities and understanding that for radical change one needs to actively interact with the network of stakeholders in an ongoing discourse and meaning co-generation [46]. Innovation as the process of new value co-creation and resource recombination through meaningful value proposition Value co-creation and resource reorganization through meaningful value proposition [47, 48].

3.4 Design as an Actor Network Process

Design-Driven Innovation as a Networked Research Process, Spans widely outside the boundaries of the films, Co-create with several other actors [49–58]. The process of interaction transformed the way of power distribution and activated more innovators in the system. Co-creation became a broader method to attract community participation. Design-driven innovation can be seen as a manifestation of "reconstructivism" [59] or social-constructionist [60]. View of the market, where the market is not "given" a priori but is a result of an interaction between consumers and firms [61].

Design-driven innovation is based on a company's commitment to the vision. Understand the evolution of social and cultural patterns and propose new perspectives. New meanings are usually achieved through the joint efforts of external actors (institutions, enterprises, non-profit organizations, citizens, associations etc.).

This is conducted with special emphasis being placed on stimulating the bottom-up actions to enable the sustainable economic model to become the mainstream.

4 Case Studies

Small, local and spontaneous practice of social innovation emerging on a global scale provide us with valuable insights. Social actors including institutions, businesses, nonprofits, citizens, associations cooperate with each other demonstrated that, it is possible to explore the alternatives beyond the mainstream model. They created a new production system which rooted in local and connected with the global network.

4.1 Permaculture

The health of ecosystem is related to the well-being of human beings. The natural ecosystem provides products and services that support human survival and economic development. However, we used to dividing human and nature into two parts and ignoring that we are actually a whole. Permaculture is a series of system-centered design principles which simulate and directly utilize the patterns and elastic characteristics of natural ecosystems. Being used in regenerative agriculture, ecological restoration, community ecology, organizational design and other fields, it gradually develops into a sustainable design agriculture dominated by citizens and becomes a popular global network and a global social movement (Permaculture Movement). The culture of Permaculture design is a philosophy of cooperation with nature. It interacts with nature through long-term observation instead of regarding it as a resource pool of human.

The Ecological Restoration Cooperative includes a broad community of researchers, landscape designers, farmers, gardeners, engineers and many other professionals. People from more than 70 countries have joined the Cooperative as founding members including many of the top Permaculture designers and trainers in the world (Fig. 2).

Fig. 2. Ecosystem restoration camp.

4.2 100-Mile Food Movement

Another case is a 100-mile food movement which encourages people to eat only foods grown or produced within 100 miles away from home to gain insight into the source of food. Since the food does not need to be transported over long distance, it greatly reduced carbon footprint of individual. The 100-mile food movement aims to learn about the local agricultural communities, to maintain close ties with local farmers and to choose a sustainable diet, no matter in the farmer's market, attending CSA or meeting regularly with food cooperatives, so as to cause people's transition from a global food system to a more local thinking.

Locally produced foods are perceived by some consumers to provide important societal, environmental, and personal benefits (Fig. 3).

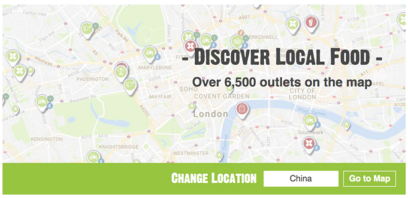

Fig. 3. Search for local food sites through website

4.3 World Wide Organic Farms (WWOOF)

The Law of Thermodynamics indicates that the closed system will gradually decay into chaos and tend to be maximum entropy. However, life systems are "open" and they constantly utilize external energy and maintain a stable low-entropy state away from thermodynamic equilibrium[1]. Open innovation, expressed in one sentence, is to purposefully use knowledge inflow and outflow to accelerate internal innovation and expand external market. WWOOF, an organic farm of global network and a network community open to the world with global thinking and local action (Think global - Act local). The Global Network Alliance not only focuses on the profound value of local wisdom and traditional knowledge, but also keeps a positive attitude to external changes. It lists organic farms, ranches and huts through its website and invites volunteers to help them work together in exchange for food and accommodation. WWOOF attracts 100,000 new members each year, bringing together 14,000 farms in more than 50 countries. Such travel platforms and farm projects are emerging, reflecting new life relationships, new stories of reciprocity and connections (Fig. 4).

Fig. 4. The organic farms spread in different countries

4.4 Collaborative Chronic Care Network

Collaborative chronic care network is a non-profit hospital, research center and innovative laboratory. It is also a learning-based social production system that gathers patients, medical staff and researchers to work together. It aims to reform the IBD system of chronic disease care. It provides an accessible and interactive learning database to create a more reliable medical service system of chronic gastrointestinal diseases for children and their families. Through an open source framework for data

[1] Schrodinger, E. What is Life? Dublin Institute for Advanced Studies: Dublin, 1943.

sharing, it overcomes the obstacles of intellectual property rights, privacy, medical legal liability and so on. It allows patients to upload data, which means mobile phones become a sensor for disease tracking. At the same time, it enhancing the education for patients and help raise questions and improve communication. The nursing teams with family members involved seek the best nursing methods through transparent cooperation, so as to provide the best results for children (Fig. 5).

Fig. 5. Collaborative chronic care network for children

4.5 Participatory Groundwater Management Project

Take the Participatory Groundwater Management Project in Andhra Pradesh, India as an example: Due to the scarcity of water resources, illegal drilling can not be prevented. With no effective management obtained, more than 600 villages take the local waters as common resources to manage. Groundwater can be quantified and managed through data collectors of splay mark units (monitor daily rainfall, water level, outflow of wellbore, daily stream flow) to enable communities and stakeholders to monitor and manage groundwater as a public resource itself (Fig. 6).

Fig. 6. Participatory groundwater management

4.6 Ancient Chinese Cosmetics Restoration Project

The modern lady imbued in the consumerist culture are inevitably tired of the industrial aesthetics of "crystal texture". They have a Utopia space in the imagination of distant time and space from themselves. A young entrepreneur, Wang Yi Fan deductive people's ideal space makes it into a vivid story.

When she was young, She has always been obsessed with "Yanzhi" and "Meidai" which is the makeup suite used by Chinese ancient women. Drawing inspiration from Chinese ancient paintings, books and museums, she has already systematically restored 32 kinds of ancient women's cosmetics from Qin dynasty (213BC) to Qing dynasty (1644–1912). Her passion for traditional Chinese culture in the forms of stories infected

a large number of fans who all hope that Chinese traditional culture can be well inherited.

These restoration cosmetics abstracted from pure natural plant, such as soybeans, madder root as a pure natural way of skin care without any chemicals. However, in contrast to functional improvements, the semantic and emotional meanings that the packaging deliver are more thought-provoking (Fig. 7).

Fig. 7. Restoration of Chinese ancient cosmetics by Young entrepreneur wang yi fan

4.7 A Flax Project

Sustainable economic is not driven by users' needs, but by companies' persistence in vision, and possible implications of new products. Companies need to understand the evolution of social and cultural patterns, propose new perspectives and meanings, understand and predict new meanings of products.

Christien Meindertsma, a Dutch designer, has launched a very interesting project and named it: A Flax Project. It aims to produce local products with reasonable price, scalability and environmental protection while exploring new production processes. Recording the production process is an important part of the flax project. Christien cooperated with film maker Roel van Tour to record all the steps of flax production. The film shows different scenes of flax producers, processors and users, such as seed sowing, spinning in Hungary, horses eating flax chaff in flax village and flax dust that used for providing energy for bio-fermentation (Fig. 8).

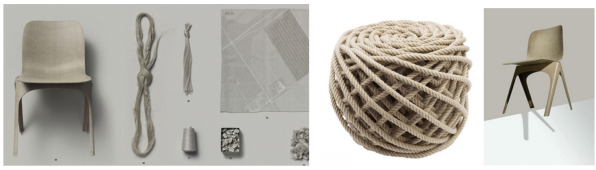

Fig. 8. Flax material products exhibition

5 Discussion and Concluding Remarks

The role of design evolved from products design, product service system design to collaborative organization transition design. Design-driven innovation processing a self-presentation stage for human and non-human beings. The problem is how to create a common problem situation to coordinate all participants [62]. Cultural material is

involved in the design process which is based on participation, communication, and negotiation.

Participatory design thinks that design has a voice in the design process, and tends to develop effective project participation strategies for the resource-disadvantaged groups. And in a broader sense, engaging in design involves people expressing themselves creatively and engaging in meaningful activities.

Design-driven social innovation is not required to completely change social and cultural patterns, but to observe these social phenomena from a broader perspective, and influence it in a long term. It is driven by the enterprise's vision for possible product languages and breakthrough meanings in the future [38].

User participation is very beneficial to the innovation process [33, 62–64], Especially for radical innovation [65, 66].

In general, a supporting social innovation context such as legal protections, open media and network is vital to accelerating the social innovation process.

But we think a lot of ideas fail not because of inherent flaws, but because of the lack of sufficient mechanisms for them expand to scale. it requires good innovative businesses driven by technology support, public subsidies, private investment, venture capital, market competition, adapting to market conditions.

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