



Is the circular economy ambitious enough?

A look at incorporating PSS (product-service systems) into China's leapfrog development strategy

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Table of Contents

Acknowledgements.....	1
Abbreviations:.....	2
1 Introduction	3
1.1 Problem formulation.....	3
1.2 Research Questions	4
1.3 Stakeholders	5
1.4 Methodology	5
1.5 Limitations	6
1.6 Disposition	6
2 Case study: China.....	7
2.1 The historical perspective.....	7
2.2 The situation today	8
2.2.1 The growing trend of consumerism	9
2.3 Why has the situation been allowed to get so bad?	10
2.4 Traditional culture's role	10
2.5 Goals and policies towards a sustainable P&C system	12
2.6 The Circular Economy (CE).....	13
2.7 Summary	15
3 Key Concepts in Leapfrog Development	15
3.1 What is leapfrogging?	15
3.1.1 Different proposed methods of leapfrogging	15
3.1.2 Dematerialization as the basis of a leapfrog strategy	16
3.1.3 Dematerialization vs. other modes	17
3.2 Introduction to the functional-service economy and product-service systems.....	18
3.2.1 A closer look at the functional-service economy and dematerialization.....	18
3.2.2 Criteria for a functioning FSE.....	19
3.2.3 PSS as a concept	21
3.2.4 PSS in Practice	22
3.2.5 Infrastructure and logistical matters.....	24
3.3 Main drivers and barriers of PSS.....	24
3.3.1 Drivers.....	25
3.3.2 Barriers.....	27
3.4 Summary	29
4 Findings and analysis	29
4.1 CE and PSS in the context of the functional service economy	29
4.2 Stakeholder overview	31
4.2.1 Roles of stakeholders in the West	32
4.3 Chinese Consumers	32
4.3.1 Who are the consumers of China?	32
4.3.2 Opportunities for consumer acceptance of PSS	33
4.3.3 Obstacles to consumer acceptance of PSS	35

4.4 Producers of China	36
4.4.1 Role of producers	36
4.4.2 Opportunities for producer acceptance of PSS	36
4.4.3 Obstacles to producer acceptance of PSS	38
4.5 Chinese Government	39
4.5.1 The role of the government	39
4.5.2 Opportunities for government acceptance of PSS	39
4.5.3 Obstacles to government acceptance of PSS	41
4.6 Summary of drivers and barriers to stakeholder acceptance of PSS in China	41
5 Discussion	43
5.1 Discussion of concepts	43
5.2 Reflecting on research methods	43
6 Conclusion	44
6.1 Stakeholder analysis	44
6.2 Remaining barriers	45
6.3 Recommendations for further research	47
References	48
Appendix 1: Interview questions for CE experts	50
Appendix 2: Consumer expert interview questions	53
Appendix 3: Dematerialization and economic growth rate allowance	54
Table 1. Timeline of initiatives relevant to sustainable P&C	13
Table 2. Functional-service criteria, comparing CE and PSS	31
Table 3. Main Drivers of PSS in Chinese context	41
Table 4. Main general perceived barriers to PSS in Chinese context	42
Figure 1. Circular Economy Illustration	15
Figure 2. Linear vs. Functional-service economy	18

Abbreviations:

- B2B- Business to business
- B2C- Business to customer
- CCP- Chinese Communist Party
- CE- Circular Economy
- CP- Cleaner production
- CSR- Corporate social responsibility
- EOL- End-of-life
- EPR- Extended producer responsibility
- FSE- Functional-service economy
- IE- Industrial ecology
- LCA- Life-cycle analysis
- P&C- Production and consumption
- PRC- People's Republic of China (China)
- PSS- Product-service system
- R&D- Research and design (of a product)

*Map of China on title page is from: www.mybeijingchina.com

Abstract

At present, many nations-in-transition are following the example of the West's industrialization; developing material-intensive production-consumption systems that lead to economic growth, while incurring massive environmental and social costs. However, it is not necessary for emerging economies to follow these footsteps. Starting with the idea of leapfrog development, as a systemic solution to allow for a more eco-efficient means of development, this paper explores the notion of dematerializing the economy as a way of de-linking economic growth from environmental pressure. The functional-service economic model is proposed as a means of dematerialization. The concept of product-service systems (PSS) is then elaborated as a pragmatic way of achieving the functional-service economy.

In order to analyze the possibility of applying these concepts to an economy in transition, the case of China is probed. As a result of rapid industrial development, China is experiencing extreme environmental and social problems. In response, the government has stated its goal of leapfrog development. One of its main strategies is the Circular Economy (CE). The CE has the aim of de-linking economic growth from environmental destruction by changing the domestic production-consumption system. However, there are many gaps in the concept and its implementation. Using a set of criteria for the functional-service economy, this paper analyzes the CE concept, to find the gaps. It, then, shows where PSS applies and how it can fill in these gaps. A critical analysis of PSS is also performed. The analysis explores the drivers and barriers of the product-service systems concept, as per Western case studies. It, subsequently explores the opportunities and obstacles to the potential acceptance of the PSS concept by three main stakeholder groups (consumers, producers and the government) in the Chinese context. The conclusion is that China is currently at a tipping point with regards to the cultural, political and economic factors that are key to stakeholder acceptance and the institutionalization of product-service systems. It is possible that the functional-service economy could work in China, but it depends on which direction Chinese society and leaders decide to go from this tipping point.

Key words: Dematerialization, Leapfrog development, Product-service systems, Functional-service economy, Circular economy, China

1 Introduction

1.1 Problem formulation

The Industrial Revolution, experienced in North America and Western Europe, resulted in many things in addition to the accumulation of economic wealth. Pollution, excessive resource consumption and waste production were, unfortunately, seen as necessary costs to be paid for economic development and modernity (Hawken, 1993; Annandale et. al., 2005; Pan, 2006; Lovins, 2008). The legacy of the Industrial Revolution and the quest for modernity are riddled with such problems. Why would the emerging economies want to take on this same set of problems on an exponentially more massive scale, as waste and pollution become more of a threat to human wellbeing, and as resources become ever-more scarce? Business as usual would be a lose-lose situation for all. China, as one of the world's largest economies in transition, and with its very unique history and culture, is a place of great interest for the sustainable development discourse. The Chinese government has stated that leapfrog development is the direction they are pursuing (Wu, 2001; Wang, 2001; Bijian, 2005; Pan, 2006). Leapfrogging is the idea nations can "leap" over certain stages of development that industrialized nations underwent and reach a higher level of development without having to repeat all the steps of developed nations (Perkins, 2003; Wupertal Institute, 2006). A nation seeking leapfrog development creates its own path and goals, instead of simply following the status quo. Therefore,

the Chinese must focus on flexible and innovative thinking. Arnold Tukker, who manages the Sustainable Innovation Research Program asserts that in order to leapfrog, radical system innovations are necessary (Tukker, 2005). The current Chinese strategy is a step in the right direction, but is it a big enough step?

The environmental and social costs of the tremendous economic growth that China has been experiencing are so enormous that they can no longer be ignored. The Chinese leadership is well aware of these costs and that they are the result of the nation's current production and consumption trends, so they aim to change this system (Pan, 2006). The current strategy for making changes in the production-consumption (P&C) system in China is the circular economy (CE), which is based on cleaner production, the 3 Rs (reduce, reuse and recycle) and waste treatment. It is focused on cleaning up and making industrial production processes more eco-efficient. While this is a laudable effort, it seems to neglect one essential component of the P&C system; the consumer.

An economic model that is gaining more attention in the West is Walter Stahel's functional-service economy (FSE). The FSE seeks to de-link economic growth from environmental damage by means of dematerializing the economy. In other words, it seeks to drastically reduce the economy's dependency on material consumption. Product-service systems (PSS) are an on-the-ground, pragmatic way of shifting to the FSE model. A product-service system is defined as:

a system of products, services, networks of actors and supporting infrastructure that strives to be competitive, satisfy customer needs and has a lower environmental impact than traditional business models (Mont, 2006, 39).

PSSs usually take shape as leasing, renting, sharing and pooling schemes. Much research has been done to analyze what the main drivers and barriers are for a shift to the PSS mode of business among stakeholders in Western case studies (i.e.- North America and Europe) (Goedkoop et. al., 1999; Tukker & van Halen, 2003; Mont, 2004). Due to the unique set of cultural traits and the more state-controlled setting in China, product-service systems would take shape in a totally different way. With the extreme environmental plight and the resulting social and economic concerns, the incorporation of the PSS and FSE concepts into policy-making could be an effective means of leapfrogging China over the dirty industrialization stage and into an economy based on the exchange of money for environmentally friendly services. Essentially, the problem this research seeks to resolve is: can a business model that has been developed and is beginning to gain more attention in the West (product-service systems) work in China as a leapfrog strategy?

1.2 Research Questions

There were several questions that guided the research and writing of this paper. The main research question is, "Would the incorporation of product-service systems into the circular economy initiative be a possible way of helping China with its goal of leapfrog development by addressing the consumption-side of the economic system?" The sub-questions that help to break this large question into more manageable bits are as follows:

- "Where are the weaknesses of the current CE model?"
- "Does PSS fill in these gaps in the CE?"
- "Would it be feasible to implement PSS in coordination with the CE?"
- "How might the stakeholders react to PSS?"

1.3 Stakeholders

This paper will address three main stakeholder groups: producers, consumers and the government. The *producer stakeholder group* includes firms, companies, businesses, industries, factories and retailers that are responsible for and/or are paid for providing products and services. The *consumer stakeholder group* includes the individuals, families, groups, organizations, firms, companies and businesses that are receiving, paying for, and/or consuming products and services. It is important to note that, depending on the situation, a business, company, organization or firm can be in the producer or consumer stakeholder group. Interactions can be discussed in terms of B2B (business-to-business) or B2C (business-to-customer). The *government stakeholder group* includes policy-makers, state authorities, legislators, governmental organizations/branches, and government officials of all levels and rankings. In China's case, the main actors in the government stakeholder group will be the CCP (Chinese Communist Party), NPC (National People's Congress), SEPA (State Environmental Protection Agency), and the NDRC (National Development and Reform Commission), whereas the term PRC (People's Republic of China) is interchangeable with China. NGOs will not be discussed in this paper due to their extremely limited role in China (Croll, 2006).

1.4 Methodology

This is a case-study that is based primarily on qualitative data gathered from relevant literature. A trans-disciplinary approach has been used, so a wide array of fields was incorporated. Also, it has been acknowledged that using multiple sources of evidence can be important in revealing different perceptions of the same phenomena (Yin, 2003). Accordingly, the notion of triangulation was used (Ibid). Some data was specific to the Chinese context, while other material was used to give a deeper understanding of the concepts and theories. This literature review also involved the use of secondary sources of statistical data, in terms of China's demographics, consumer trends and environmental problems. Thus, quantitative data was used for background information and to gain a better understanding of the problem.

Empirical data often further substantiates or contests the claims put forth by the literature (Kvale, 1996; Yin, 2003). Empirical data for the stakeholder analysis of this paper was gathered in the form of semi-structured interviews with professionals and experts in a variety of pertinent fields. Because the interviews were used for qualitative purposes, the questions were specified and customized for each interviewee in order to maximize the knowledge and understanding that could be gained from each interviewee's unique experience with the subject (Kvale, 1996). Questions were aimed at getting a better understanding of the attitudes, opinions, experiences and interests of the three major stakeholder groups in relation to the circular economy as well as the production-consumption system, in general. Six experts

working with the circular economy initiative and/or the research thereof were asked questions pertaining to all three stakeholder groups. These interviewees are: Ren, Guo, Lowe, Coulter, Pinter and Wang (see Appendix 1 for more information). There were also many questions regarding CE experts' opinions about the circular economy initiative. These questions helped to find the weaknesses and to get a feel for whether or not the functional-service economy principles would be compatible with the circular economy. Three experts and researchers related to the field of consumption and consumer psychology and behavior in China were also interviewed. These are Zhang, Van Holde and Piron (see Appendix 2 for more information). The author felt the need to contact consumer experts because the CE experts did not have sufficient knowledge and/or experience in this area. These questions dealt solely with Chinese consumers, values, motivational factors and behavioral trends. There was no mention of the CE, PSS or any other field outside of consumer psychology and behavior.

Some interviews were carried out by phone, while other interviewees preferred to communicate via emails. Because the subject material is not very sensitive and the answers are not likely to change according to mood or emotional circumstances (Kvale, 1996), the author felt comfortable substituting a live, phone conversation with written communication (emails).

1.5 Limitations

Due to the complex nature and broad scope of this topic, it is necessary to clarify the limitations of this research, so as to set some boundaries.

This research will not discuss how a shift of the internal Chinese economy to a functional-service economic (FSE) model would interact with the global economy. Although this is very interesting, it is not within this scope of this paper. This study examines only the domestic Chinese market and the relevant stakeholders.

Due to time and length constraints, this paper will not discuss all possible alternative ways of leapfrogging or dematerialization, but will mention a few of the predominant ideas as a means of justifying the focus on the FSE and product-service systems.

The author did contact, via email and phone, five major producers, but was unable to receive timely responses. So the data representing the producers of China is based solely on literature and interviews with CE experts.

Another limitation, with regards to the interviews, is that it would require much more time and liaising to get a true understanding of how the government would see the idea of including PSS principles in their legislation. For this, the author had to rely on the CE expert focus group, which includes people who have worked closely with or in the relevant branches.

1.6 Disposition

In order to answer the research questions, this paper first explores the Chinese context. Subsequently, the functional-service economy (FSE) is identified as being a good leapfrog development strategy. The concept

of product-service systems (PSS) is, then, shown as a pragmatic way of implementing this economic model. This research analyzes the concepts of the circular economy and product-service systems according to criteria for shifting to a functional-service economy model. Additionally, the logistical concerns of PSS implementation are explored and discussed. The various opportunities and barriers for PSS implementation in Western case-studies are identified. Subsequently, in the stakeholder analysis, these opportunities and barriers are put into the Chinese context. After a discussion of the research design and outcome, the main conclusions are summarized and recommendations for further research are made.

2 Case study: China

2.1 The historical perspective

China has had an interesting history; a mixture of emperors, a people's revolution, a dictatorial communist regime, and now a unique system wherein the politics remain tightly controlled by the Chinese Communist Party while the market grows more and more neo-liberal all the time. After the infamous communist leader, Mao Zedong, died in 1976, the future of the communist regime was unknown. Deng Xiaoping succeeded Mao and saw the need for economic development to lift a poverty-stricken China out of the wake of the disastrous miscalculations of Mao's Cultural Revolution and Great Leap Forward (Bijian, 2005). The new Premier decided that the only way to achieve this would be to participate in the global market. In 1978, Deng began implementing economic policy reforms in order to open the country up for private and foreign investment (Ibid). He had a vision of China industrializing to a level at which not only were its people brought out of poverty, but also the nation would be competitive on the world market. His token slogan, "To get rich is glorious" reflects the way in which China's government and society have come to embrace a more capitalist mode of development (Roberts & Balfour, 2006). Deng's "opening-up" reforms were very effective in bringing economic growth; China has experienced an average of 9-12% GDP growth since 1978 (Bijian, 2005, 19-20; Ho, 2006, 10; Carter & Mol, 2007, 1).

These policy reforms had an enormous effect on more than just the economy. They encouraged material-intensive development, based on the production of goods, so more industrial processes began to take place. The fastest, cheapest, easiest means of production were adopted in the interest of cost-efficiency. Thus, non-renewable natural resources were being exploited at an ever-increasing rate for both energy supply and raw material input for production processes. (Croll, 2006; Ho, 2006)

Deng's policies, in addition to increasing global trade and China's comparative advantage of cheap labor and materials, were remarkably successful in attracting foreign investment. Along with foreign companies came Western products, advertisements, media and culture. These Western influences have disseminated and have had an incredible impact on Chinese society. In short, they have imported the American Dream (Bijian, 2005). This has, in turn, led to a dichotomy that can be seen everywhere in today's Chinese society; a dichotomy between old and new, traditional and modern, Chinese and foreign. In

some ways, this economic growth has been good for China, pulling millions out of poverty (Croll, 2006). Unfortunately, in other ways, it is having some extremely devastating effects.

2.2 The situation today

The economic reforms of 1978 started a chain reaction entailing rapid industrialization, unprecedented rates of urbanization, and the spread of Western culture (Croll, 2006). At first, the production was mostly for export, as the consumer market was so small in China because most of the people lived in poor, rural areas and could not afford to buy more than sheer necessities (Ibid). More recently, though, an ever-growing portion of the products is being made for the domestic market (Kalish, 2005).

The negative environmental, social and economic ramifications of the commodity-driven, high-waste, modern production and consumption (P&C) system are enormous. Using a life-cycle perspective, which follows a product from the beginning of its "life" to the end, it is easier to see just how detrimental these P&C trends are. Main product life phases are raw material extraction, manufacturing (including energy, water and wastes), transportation (including emissions and fossil fuel usage), distribution & marketing, utilization & maintenance, and waste collection and treatment/disposal (Stahel, 2007b). Each phase has significant environmental and social impacts, directly and indirectly. For example, the production processes for consumer goods add to the atmospheric pollution and greenhouse gas emissions due to their high energy-intensity, as 70% of China's energy comes from the burning of coal (Ho et. al., 2006; Yusuf & Nabeshima, 2006). Thus, air pollution has become a major health concern. In 2002, air pollution in about 200 Chinese cities was over the World Health Organization's standards (Croll, 2006, 276; Flavin & Gardner, 2006, 7) and in some cities it is over 10 times worse than the WHO standards (Murray & Cook, 2002, 6).

In addition to being extremely energy-intensive, these industrial production processes are very water-intensive, which is negative in two ways. First, industries use water that is needed by households in a country wrought with water scarcity issues (Croll, 2006; World Bank, 2007a). Secondly, the industries use the immediate environment as a dumping ground for their byproducts and waste-water (Murray & Cook, 2002; Croll, 2006). This results in disturbing amounts of toxins in the rivers and other bodies of water upon which the Chinese population relies for its livelihood (Murray & Cook, 2002; Croll, 2006; World Bank, 2007a). The nation is experiencing extremely grave water problems such as the drying up of major rivers for many months per year, falling water tables, the shrinkage of lake areas and "severe water pollution, which renders almost 70% of the water unfit for use" (Yusuf & Nabeshima, 2006, 108), in fact, "studies of drinking water sources in some large cities found more than 20 different carcinogenic substances" (Murray & Cook, 2002, 3).

The problem has far reaching consequences for the Chinese people, in the form of illness and disease from the leaching of toxins from waste into their water and food sources as well as the air they breathe (Murray & Cook, 2002; Croll, 2006; Yusuf & Nabeshima, 2006). The consequences are also economically detrimental for the Chinese government, in the form of a solid waste management system that

is on the brink of economic collapse, overwhelmed by the sheer amounts of waste (World Bank, 2005), and a state-run health system burdened by the illness and disease wrought by this pollution. The government, itself, has identified China's environmental pollution and deterioration as a major factor influencing morbidity and mortality rates (Murray & Cook, 2002). In fact, "the economic costs associated with ecological destruction and environmental pollution (are) estimated as high as 14% of the gross national product" (Ibid, 8). There are environmental laws, regulations and restrictions in place; however, due to lack of enforcement and corruption, the existence of these laws is more symbolic than effective (Croll, 2006; Mol, 2006; Ohshita & Ortolano, 2006). Despite the consequences, these trends are only growing. It is a large problem that China (and the world) cannot afford to ignore.

2.2.1 *The growing trend of consumerism*

The combination of the new consumer classes having the ability to buy desired goods (non-necessities), the importation of the American Dream, and the fact that there are now more products available to Chinese consumers has led to the current state of affairs, in which increasingly intense P&C patterns are a real and growing problem (World Bank, 2005; Croll, 2006; Pan, 2006). It seems that consumption, and in fact over-consumption, have become equated with prosperity and status in the minds of many Chinese (Croll, 2006; Knight, 2006; O'Leary, 2007). However, there seems to be a growing issue of social justice tangled up with this consumerism. It is often noted that the middle and upper classes are consuming at an ever-increasing rate and the lower classes (the largest portion of the population) at the bottom of China's wealth pyramid, suffer the environmental consequences (Evans & Stevenson, 2001; Pan, 2006). These have been referred to as China's ecological refugees (Julienne, 2004; Pan, 2006). They are directly affected by pollution, while the rich are distanced and protected from it (e.g. - homes in the slums vs. the suburbs) (Ibid).

Therefore, it is also very important to point out that, although China has experienced amazing wealth accumulation in the last couple of decades, it has been very uneven. The GNI (Gross National Income) per capita (using the purchasing power parity) is \$4,660, ranking it at 133 on a list of 208 countries (World Bank, 2008). However, the money is concentrated in the big cities in the Eastern and Southern coastal regions of the country, while many people in the Central and Western rural areas, where there are far fewer natural resources, are still subsisting on the bare minimum (Croll, 2006; People's Daily, 2006; Yusuf & Nabeshima, 2006). This can be illustrated by the high Gini coefficient, an internationally accepted scale of measuring income inequality, which is 0.46; above the warning level of 0.4 (Croll, 2006; People's Daily, 2006; World Bank, 2007b). According to a World Bank report, 200 million people are still living below one dollar per day (World Bank, 2007a, xi). So, it is necessary for China to generate more wealth; however, it must be done in a way that it is more evenly distributed. Thus, more localized and regionalized development is a goal of the government (NDRC, 2006).

2.3 Why has the situation been allowed to get so bad?

Theoretically, the problem should have a balancing effect. The negative feedback of pollution and resource scarcity problems would cause the economy to react in such a way that production slows down and the ecosystems, people, and waste management system should recover. However, in reality, this is not what is happening because economic time horizons are much shorter-term than ecological time horizons. Also, there is the fact that environmental costs are still externalities, not properly reflected in daily economic activities (Hawken, 1993; UNEP, 2001). Therefore, the fast-paced economy, which generally functions with expected pay-back times and price changes within the span of five to ten years, does not account for the slower rate at which the ecological system recovers its resources, which takes several human generations (Hawken, 1993; Foster, 2000). Prices are based solely on the amount of the known (and sometimes assumed) resources, with no monetary accounting of their finiteness (Hawken, 1993; UNEP, 2001). Thus, proper signals are not sent to the market and there is no economic response to the resource and ecological crises at hand. Another major factor is that economic growth has been given supreme reign in China, according to government policies and the neo-liberal strategies of the current business model (Pan, 2006). Problems are swept under the rug, and their symptoms are treated with weak antidotes. Although there are environmental laws, there is a huge lack of monitoring and enforcement (Croll, 2006; Mol, 2006; Carter & Mol, 2007), and “(t)here is no routine, automatic and full inclusion of environmental considerations in the institutions that govern production and consumption practices...” (Mol 2006, 49).

2.4 Traditional culture's role

There are unique characteristics of Chinese culture that are important to the understanding of the current P&C system and its stakeholders. Daoism, Buddhism, Confucianism, Communism and, more recently, new-Confucianism have all had an enormous influence on China's culture, as it is today.

Daoism brought about the concept of *qi*, the energy that flows through everything and connects all; nature, human, animals, etc. In general, Chinese traditional culture has a very strong connection with the natural environment (Knight, 2006; Weller, 2006). Then, there is Buddhism, which rejects materialism and desire, seeking compassion for all things (Weller, 2006).

Traditional Confucianism has been one of the most highly influential belief systems in China. It is very critical of materialism, anthropocentrism, excess and wastefulness. Cooperation, harmony, moderation, eco-friendliness, frugality and self-discipline are stressed as very important traits to have. Filial piety is also a major value of Confucianism. It refers to having a great amount of loyalty and respect for one's parents and elders, and behaving appropriately according to one's place in the family, community and society. (Tu, 2001; Louie, 2005)

The communist propaganda emphasizes social cohesion, collectivism, frugality, a sense of community, and trust in the government. During Mao's rule, the vast majority of people lived in rural areas and, thus, felt a stronger connection to the land and nature (Croll, 2006).

All of these traditions had the theme of rejecting materialism, supporting a sense of community, encouraging frugality, and awareness of the human connection to nature. However, in the 20th century, new-Confucianism came along to resolve the tensions between the consumerism of an opening market and the Confucian tradition. New-Confucianism postulates that Confucius was the ultimate man of commerce and that Confucianism should not be interpreted as anti-materialism (Jensen, 2005). In this way, new-Confucianism also lost its tie to the natural world and ecology (Tu, 2001). Self-discipline, duty-consciousness, diligence, frugality, networking, cooperation, consensus-formation, and harmony are the features of Confucianism that are currently being emphasized and promoted by intellectuals and the government as nation-building values, favorable for economic growth (Ibid).

Nowadays, an interesting mixture of values and cultural attributes can be seen in China. Of course, the mixture varies from place to place and is different according to socio-economic status, as well. One characteristic that is useful for the purposes of this research is called *zongheliyong*, or “comprehensive utilization” (Zhou & Ren, 2005; Ren, 2007). This refers to the idea that things should be used in the most efficient and least wasteful manner possible (Ibid). There is also the idea of the *xiaokang society*. A *xiaokang* society can be described as a society that is socially harmonious, well-balanced, has even wealth distribution and takes only what it needs from nature, using moderation (Fan, 2000; Yusuf & Nabeshima, 2006; Ren, 2007). Chinese society¹ still also tends to have a stronger sense of communalism and collectivism compared to the fierce independence and individualism of North American and Western European cultures (Croll, 2006; Piron, 2006). Some scholars criticize this way of describing Chinese culture, because it uses such Western terms. These scholars say that *yi* and *li* are better terms, wherein *yi* refers to benevolence, morality and righteousness in human ties and *li* refers to profit and utilitarianism (Piron, 2006). Any way it is described, sharing within a community and doing things for the greater good, as benevolent, socialist morals/values, have been norms in Chinese society throughout many periods of its history and can still be felt today, but are much stronger in the less developed rural areas as compared to the cities (Croll, 2006; Piron, 2008). The continued use of Chinese traditional medicine, *fengshui*, and the practice of *qigong* all point towards a feeling of being tied to nature, despite China's ongoing modernization project (Tu, 2001).

However, these cultural traits are at a sort of crossroads. To some extent they are surely being replaced by materialism, greed and individual interest (Beng-Huat, 2000; Tu, 2001; Croll, 2006; Knight, 2006), but the literature is unable to solidify to what extent this has happened or as to what shape Chinese culture will be taking in the years to come. There is certainly no consensus to be found in the limited interviews nor the extensive review of literature conducted for this research. In fact, the one conclusion that can be made with some amount of confidence is that Chinese society is experiencing a cultural identity crisis

¹ In the context of a 50-page master's thesis, it is impossible to avoid generalizing; and though the author does acknowledge that this can take away some of the validity of the arguments, it is important to note that Chinese history and its cultural effects are still amazingly homogenous throughout society, aside from rural/urban and age group differences, which will be discussed in section 5.3.

(Knight, 2006) and may be at a cultural tipping point (Piron, 2008). This will be further explored in Chapters 4 and 5.

2.5 Goals and policies towards a sustainable P&C system

The stakeholders, their relationships and interactions with each other are very different in the Chinese context as compared to the Western context. So, it is important, first, to have a basic understanding of the power structure and roles of the pertinent stakeholders in China. Again, the three different groups are: consumers, producers and the government.

As this paper has previously stated, there has been a lot of foreign influence flooding into China in the form of media, people, products and services. However, this flood has been controlled and filtered by the government, to the best of its ability. Public demonstrations and protests are shut-down by the police if they do not align with government policy (Croll, 2006; Weller, 2006). The vast majority of the media is owned by the state and the rest is censored, or must be pre-approved (Latham, 2005). There is no right to association outside of state-approved events and organizations, and religion that is not state-affiliated is forbidden (Kindopp, 2005). Clearly, the Chinese government has astounding power over the people. Therefore, any significant change in society and/or the economy comes from the will of the PRC's leaders. In China, the relationship between the politicians and citizens is different from those seen in Western nations. Chinese rulers gain the right to the loyalty of their subjects by acting benevolently towards them (Carter & Mol, 2007); they are bound to each other by moral obligation and interdependence (Ma & Ortolano, 2000). As a result of this unique relationship, environmental institutionalization in China happens primarily through state and political structures (Mol, 2006).

The PRC government operates on the principles of the Five-Year Plans, formally known as the Five-Year Plans for National Economic and Social Development, put forth by the National People's Congress. These Five-Year Plans serve as guiding stars for progress and development. They outline priorities and general implementation strategies. Although they are more or less guidelines, as opposed to actual legislation, they have a great impact on policy-making.

The latest is the Eleventh Five-Year Plan designed for the period of 2006-2010. It states that the government aims to "adjust thoughts on promoting development, transform approaches to promoting development and specify policy orientations of promoting development" by: optimizing industrial structures, conserving resources and protecting the environment, strengthening the capability of independent innovation, deepening reform and opening-up, and using a people-centered approach (NDRC, 2006). The Outline of the Eleventh Five-Year Plan has chapters dedicated to the goals of *conserving resources, environmental protection, developing the service industry, tapping human resources, optimizing industry, and increasing science and education* (Ibid). Other literature and rhetoric about Chinese environmental governance points out that transforming the P&C patterns in an effort to become more sustainable is also an

intention of the PRC leaders (Lu & Liu, 2006; Pan, 2006; Ren, 2007). These goals are the cornerstones for the Chinese government's perception of sustainable development and, thus, drive any and all reforms, policies and legislation aimed at becoming more environmentally friendly and sustainable.

There have been many policies, legislature and reforms that seek to address sustainability issues. These have all had an iterative impact on the current vision of the Chinese leaders and the concept and framework of the circular economy (CE), their newest sustainable development strategy.

As Table 1 illustrates, since the early 1990s, there have been a number of initiatives that involve changing P&C trends to be more environmentally friendly.

Table 1. Timeline of initiatives relevant to sustainable P&C

Year	Name of Initiative	Description of Relevance
1994	Chinese Agenda 21 is published	Chap 7 focuses on sustainable consumption issues
1998	Circular economy (CE) is first proposed by scholars	Focuses on more sustainable production practices, based on German and Japanese ideas
1999	Eco-industrial parks are launched	Inter-linking factories, reusing wastes as inputs
2002	Cleaner Production Promotion Law and Environmental Impact Assessment Laws are passed	Encourages industries to use cleaner production technologies and methods and use EIA methods to evaluate/monitor progress
2004	NDRC is appointed the duty of promoting the CE principles	SEPA is no longer solely in charge, so the CE has become more of a priority
2005	Law on Pollution Prevention and Control of Solid Waste is passed	Holds producers more responsible for their wastes and products
2006	11 th Five-Year Plan is put forth Green public procurement is put into official guidelines	Outlines several goals related to increasing the sustainability of P&C patterns Encourages the government to be a good model of going green
2007	Draft of the Circular Economy Law is discussed by standing committee of the 10 th National People's Congress	Aimed at institutionalizing the principles of the CE and making them mandatory and, thus, violators of these principles will be punishable, by law
2008	Plastic Bag Ban (will be put into effect in June) Circular Economy Law (anticipated to be passed)	Supermarkets and sales outlets will be not give out free plastic bags Producers and industries will be legally obligated to use the CE principles

(UNEP, 2004; Yap, 2005; NDRC, 2006; Yuan & Moriguchi, 2006; Ren, 2007; Guo, 2008)

2.6 The Circular Economy (CE)

The CE is a part of China's leapfrog strategy. The rhetoric and research surrounding the circular economy show that it is intended to be part of an overarching plan of action; such as the mention of changing the P&C system and de-linking economic growth from environmental deterioration (Pan, 2006; Pinter, 2006; Ren, 2007).

The CE was inspired by German and Japanese initiatives. The German eco-industrial parks were seen by Chinese scholars and government ministers as a feasible way to enhance the sustainability of industrialization (Yuan & Moriguchi, 2006; Lowe, 2008). Many of the principles of the German Recycling Economy were also incorporated into the CE (Yuan & Moriguchi, 2006; Ren, 2007; Lowe, 2008). From Japan, lessons were drawn about environmental legislation, for example, Japan's "Basic Law for Promotion of Circular Society Building" and the "Law for Promotion of Effective Consumption of Resources" (Guo, 2005).

The CE has several key elements and should be implemented on different levels. The foundation of the CE is based on the principles of the 3 Rs; reduce, reuse and recycle. Inline with these principles, Industrial Ecology (IE) is a main concept used in the development and practice of the CE in China (Yuan & Moriguchi, 2006; Ren, 2007). Ecosystems have no waste; outputs of one organism are used as the inputs for others. So, in its simplest form, IE proposes connecting industries and factories by means of reusing one industry's wastes (such as heat, water, solid materials and chemicals) as inputs for other industries. This requires infrastructure that facilitates the transport of wastes and inputs or, in some cases, allows the factories to be directly linked to one another. The ideal setting for this infrastructure is called an eco-industrial park. China currently has several pilot projects focusing on the development of eco-industrial parks (Pinter, 2006; Yuan & Moriguchi, 2006; Ren, 2007).

Another important component of the CE is Cleaner Production (CP). The requirement of industries to use CP was made legally mandatory in 2002 (Yap, 2005; Yuan & Moriguchi, 2006). However, CP is a vague term that can easily be manipulated to fit a multitude of circumstances. It has been defined as pollution prevention measures that often have "favorable rates of return and reasonably short payback periods" (Yap, 2005, 13). What effect does it have on producers and their means of production? Industries are encouraged to eliminate obsolete processes and technology, packaging must be safe and minimal, the service industry should use eco-efficient products and processes, green products are prioritized, industries should be restructured, recycling should be done where possible. It also encourages eco-labeling, tax incentives and environmental education for industries and society. However, it is a very weak piece of legislation that merely *encourages* industries to become more eco-efficient, but very little is legally required and non-compliance is rarely punishable. (Yap, 2005)

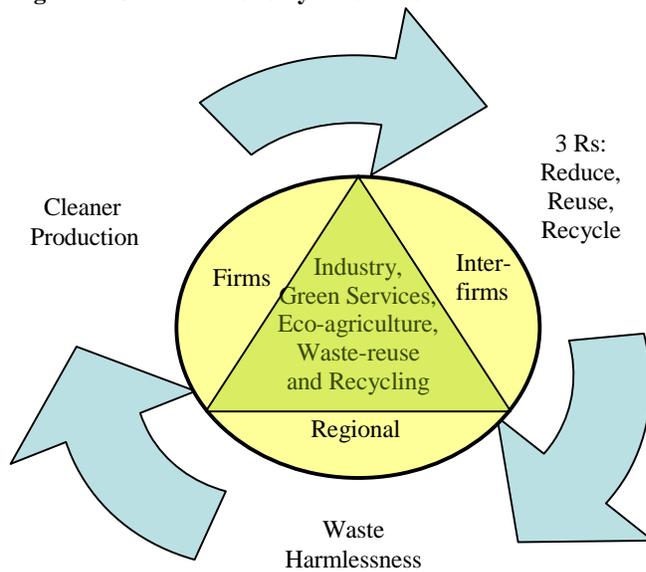
Another aspect of the CE mentioned throughout the literature is "waste harmlessness". This simply refers to proper waste treatment in a way that no toxic waste is released. It holds producers accountable for cleaning and treating their own waste, which is very important in a nation where toxic industrial pollution is a major health concern in many areas (Croll, 2006).

The CE should be carried out in several different areas and on two levels (Zhou & Ren, 2005; Ren, 2007). The main principles (the 3 Rs, CP and waste harmlessness) are a red thread that should be followed in every area of implementation. The first level consists of: the individual firms, "interfirms", and regional

interactions. The individual firm deals with what the company, internally, can do in terms of the guiding principles of the CE (i.e.- 3 Rs, CP and waste harmlessness). “Interfirms” deals with how firms can cooperate and collaborate in order to better adhere to the CE principles. The term regional refers to how eco-industrial parks, communities, cities, counties and provinces can collaborate in terms of using the guiding principles. The second level consists of the following areas: industry (heavy-polluting industries are the top priority), eco-agriculture, the green service industry, and the waste reusing and recycling industry. Again, the guiding principles of the CE are the red thread connecting all of these areas in their goals and

practices (see Figure 1). (Zhou & Ren, 2005; Yuan & Moriguichi, 2006; Ren, 2007)

Figure 1. Circular Economy Illustration



2.7 Summary

This chapter introduced the Chinese case and context. The sustainability issues related to the P&C system, some relevant cultural factors, and the relationship of Chinese society to the government were all described. Then, the goals and current strategies of the government were summarized. The next chapter will introduce the concepts of leapfrog development, dematerialization, the functional-service economy and product-service systems.

3 Key Concepts in Leapfrog Development

3.1 What is leapfrogging?

Leapfrog development is the concept of developing countries skipping over the transitional steps of the Western development model (Perkins, 2003; Tukker, 2005; Wupertal Institute, 2006). Rapidly emerging economy states (i.e. China, India and Brazil) have an amazing opportunity in front of them. There is no law stating that they must develop according to the same industrial economic model as the Western nations did. They have the opportunity to learn from the mistakes of these industrialized nations, to use new technologies and ways of thinking, and to innovatively design a path of development that meets their specific needs and, at the same time, leads to environmental, social and economic stability, in the long-term (for generations to come). After all, there is no one-size-fits-all method of development.

3.1.1 Different proposed methods of leapfrogging

Leapfrog development translates to a shift in the way of thinking about and acting out development. There are many different directions in which ideology and practice can shift as part of a leapfrog development

strategy. In much of the literature and websites that discuss leapfrogging, IT solutions are the focal point. According to the IT discourse, technology and communication seem to be the main components of the development strategy that will leapfrog transitioning nations into the realm of the developed countries (Oh-young, 2003; Dao, 2006). This is illustrated by mobile phone use in China. Very few Chinese ever had or will have land lines. They skipped over this stage experienced in Western countries and went straight on to mobile phones (Kalish, 2005). However, very few discussions about leapfrogging are centered around changing the underlying economic or business models upon which a society bases its accumulation of wealth. Many leapfrog articles and discussions seem to focus on the economy, social infrastructure (information and communications technology), physical infrastructure or environmental concerns (Oh-young, 2003; Dao, 2006). However, the best leapfrog development model, in terms of sustainability, would combine all of these focuses into one overarching strategy.

Arnold Tukker discusses the idea of societal/system transitions on three different levels: system optimization, system redesign and system innovation. He concludes that a complete system innovation is the most extreme and takes the longest to accomplish, but also has the highest factor of environmental efficiency improvement. He argues that small changes, such as market-based or regulatory instruments, are not enough to leapfrog. (Tukker, 2005)

Singular innovations that change elements of production-consumption chains... may lead to improvements of 50% or 75%... (b)ut only innovations at system level create such a large scope for change that really radical reductions of environmental pressure come into sight. (Tukker, 2005, 70)

In light of the statistics and trends of environmental destruction and social disruption referred to in the last chapter, what China needs is radical reductions, if the system can even hope to approach the point of being sustainable. As Tukker and others point out, the eco-efficiency (resource productivity) of our P&C systems needs to improve by a factor of at least 10 in order to reach a level that the planet's ecosystems can handle (Mont, 2002a; UNEP, 2002; Tukker, 2005; Lovins, 2008). That's a big leap and definitely requires the complete system overhaul that Tukker describes.

3.1.2 Dematerialization as the basis of a leapfrog strategy

There has been much written and spoken about the need to de-link economic growth from environmental destruction, to where wealth accumulation does not depend on depleting the natural environment (UNEP, 2002; Ayres & van den Bergh, 2005; World Bank, 2007; Stahel, 2007a). The most obvious way of doing this is to dematerialize. The concept of dematerializing the economy follows the idea that the economy should maximize resource productivity and eco-efficiency (Zaring, 2001; Ayres & van den Bergh, 2005). In other words, economic growth should become exponentially less dependent on resources and material inputs (and outputs) (Ibid). Ayres and van den Bergh propose that, in order to achieve a sustainable growth mechanism that accounts for resource scarcity, several factors must be taken into account. Resource

productivity and labor productivity must simultaneously increase. Such a growth mechanism “must add value to and extend the useful life of durable products” and “includes reuse, renovation, remanufacturing and recycling on various levels” (Ayres & van den Bergh, 2005, 101). It entails lighter products, miniaturization, new technology, accelerated technological innovation, sectoral shifts to services and lifestyle changes (Ibid). In a value creation (dematerialization) growth engine, the economy automatically focuses on the production of final services rather than materials (Ibid).

Granted, full dematerialization in one swift swoop is nearly impossible to imagine. However, incremental dematerialization is feasible (Zaring, 2001; Ayres & van den Bergh, 2005) and can be a guiding principle for a good, holistic leapfrog strategy; a wonderful fit for any nation facing widespread resource shortages and devastating environmental pollution, such as China. A researcher for the PRC State Council has even described the circular economy as having the aim of dematerialization (Zhou, 2006) although dematerialization is not yet a popular term in China (Wang, 2008).

3.1.3 *Dematerialization vs. other modes*

There are other ideas within the sustainable development discourse about what the paradigm shift should look like. Mills' steady state economy postulates a stable economy with no need for growth (Sandelin et al., 2002). Marxist ecology gives a framework for non-exploitation of the natural environment while enhancing social interactions through less alienation and rejecting modern materialism (Foster, 2000). Even more radical yet is deep ecology, which proposes that human kind should use the simplest modes of survival in small eco-communities, along with a massive decrease in population, in a quest to achieve a truly sustainable society that is in harmony with nature (Drengson & Inoue, 1995). However, these are all more of a vision of what's at the end of the rainbow. What we need now is a means to get there. None of these seem to be able to speak to and translate our current system's assumptions and premises. Whereas, eco-modernization (on its own) may not be radical enough (Tukker, 2005), these models might be too radical for the time being.

Dematerialization is a model that starts with the economy of the world today and proposes that it become exponentially more efficient, constantly adapting and changing with an ever-increasing rate of learning and technological innovation of products and systems (Ayres & van den Bergh, 2005). This means that economic growth is not sacrificed in the effort to become sustainable, because the increasing rate of efficiency of the system combined with the shifting of the focus from materials to function compensate for the fact that less goods are being produced (Ibid) (see Appendix 3 for details).

In fact, economic growth based on fossil-fuels and material-intensive production is that which cannot be sustained and is, thus, not an economically viable option (Zaring, 2001; Bell & Morse, 2003; Lovins, 2008).

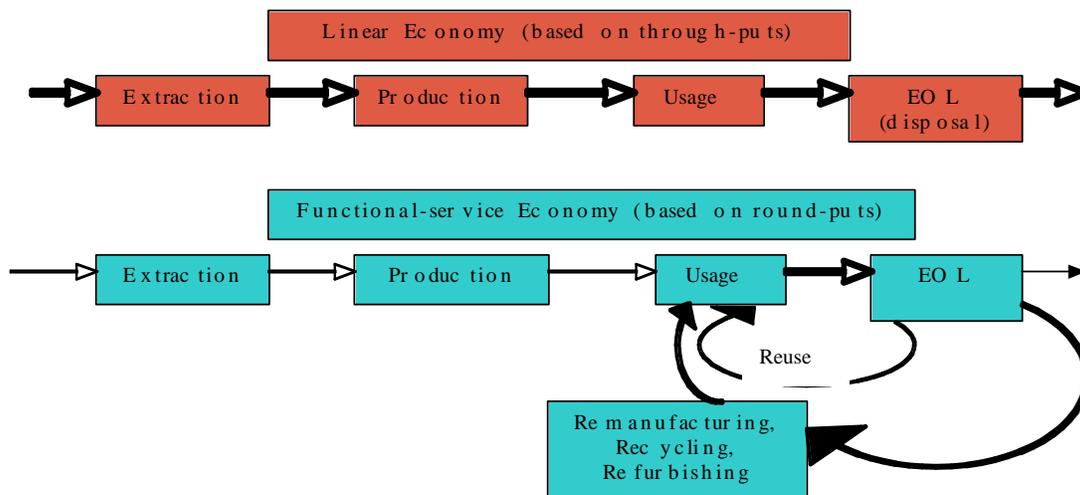
3.2 Introduction to the functional-service economy and product-service systems

3.2.1 A closer look at the functional-service economy and dematerialization

The current economic/ business model is based on a system of linear, one-way material throughputs. This is why there is such low production efficiency, causing the need for enormous amounts of inputs and resulting in excessive waste, both in the production phase (in the form of by-products) and in the End-of-Life (EOL) phase of products. The most efficient system that allows for economic growth would be based on loops that continuously feed into and fuel each other, in a network of synergies (Bell & Morse, 2003; Mont, 2004; Stahel, 2007a). The smaller the loops, the more efficient the system is, due to fewer losses in energy, materials and time (Stahel, 2007a).

An economist named Walter Stahel envisions a total economic shift. This economic shift is described in the idea of the functional-service economy (FSE). It is an economic model that is based on round-puts, rather than the throughput-based system of the current economy (see Figure 2). It is based on services, performance, utility and functionality. Services replace products in a way that radically reduces the raw material inputs. Products are owned by companies and the use or service of the products is what the consumers pay for. So, when a product breaks, it is replaced by the company and the used product's parts are reused and/or recycled into new products. The FSE necessarily induces dematerialization of the economy, as one of its aims (Stahel 2007b). By incorporating the concept of dematerialization, the functional-service economy is a great starting point for de-linking economic growth from environmental pressure. (Stahel, 2007b)

Figure 2. Linear vs. Functional-service economy



In order to make the loops as small as possible, Stahel insists that several changes must take place. The suggested changes are as follows:

1. Industrial structures must be regionalized (and/or localized) so that manufacturing and remanufacturing are close and convenient enough to be practical.

2. Products will have to be pre-designed in order that they may be easily maintained, disassembled, remanufactured and/or recycled.
 3. Components of products will also have to be pre-designed according to the commonality principle, which means that they should be interchangeable among different product lines, in order to further enhance efficiency.
 4. The development of new technologies that optimize resource efficiency and safety is essential; this includes life cycle data memory chips, function-monitoring systems, and spare-less repair methods.
 5. New professions and job qualifications will become very important (i.e. remanufacturing, operation and maintenance engineers, customer advisers, etc.).
 6. Users ("ex-consumers") must be educated about how to take care of the products as if they owned them in order to extend product life and make the entire system run more smoothly.
- (adapted from Stahel, 2007a, 493)

3.2.2 *Criteria for a functioning FSE*

For the purposes of this paper, the author has adapted a set of criteria from Stahel's abovementioned changes for transitioning to the FSE. Stahel discussed 6 changes. However, a set of 9 criteria has been adapted for the analytical framework of this paper. These criteria were chosen because they are more concisely phrased and they encompass Stahel's criteria, as well as three additional criteria, which take into account the social and political aspects of such an economic shift. These will all be explained in further detail below. The components of an FSE are:

1. Enhanced product design
2. Enhanced production processes
3. Product take-back systems
4. Supportive, eco-efficient infrastructure
5. Monitoring and evaluation of systems
6. Involvement of all stakeholders
7. Policies and supporting legislation
8. Education and awareness raising
9. New skilled labor

The first criterion, *enhanced product design*, refers to the R&D (research and design) of products being done in a way that eases recycling, remanufacturing and the interchangeability of product components at the end of life. R&D should also seek to minimize the negative environmental and social impacts and maximize the eco-efficiency of the product in all life-cycle stages. It encompasses Stahel's second and third changes.

The second, *enhanced production processes*, means that all production processes should be as eco-efficient as possible, in a way that maximizes resource productivity. In other words, the principles of cleaner production should be used; maximizing the efficiency of use of water, heat and raw materials. This criterion reflects Stahel's fourth change.

The third, *product take-back systems*, refers to producers being responsible for the EOL of their products; which can also be referred to as EPR (extended producer responsibility). The most cost-efficient way to do this is to reuse and remanufacture the products, which also happens to be the most eco-efficient way, as it keeps the round-put of materials going. So, this criterion has a strong connection to the first,

enhanced product design. Either of these criteria could be useless (or at least sub-par) without the other. It also encompasses Stahel's second and third changes.

The fourth, *supportive, eco-efficient infrastructure*, is essential. It means that the infrastructure is constructed in a way that facilitates the use and function of product-service systems (ie- product take-back areas, conveniently located servicing centers, etc), while minimizing transport. The infrastructure must be designed in a way that it is practical and convenient for consumers and producers, alike, and allows for maximum eco-efficiency. This incorporates Stahel's first change.

The fifth, *monitoring and evaluation of systems*, embraces Stahel's fourth change in which "new technologies aimed at optimizing the resource efficiency and safety of products and components over long periods of time will have to be developed" (Stahel, 2007a, 493). This refers to the life-cycle analysis (LCA) dimension, described earlier, in which all stages of a product's "life", from cradle to grave (or in this case, cradle-to-cradle), are monitored and analyzed in terms of the direct and indirect environmental impacts that the product has. This includes the pre-production, production, transport, retail, use and end-of-life (EOL) phases. The constant and consistent use of LCA indicators, monitoring and evaluation is the only way to keep track of the progress being made in the FSE and to see where improvements are needed. The aim of the functional-service economy is to be constantly improving the eco-efficiency of the system.

The sixth, *involvement of all stakeholders*, is fairly straight-forward. All stakeholder groups, the producers, consumers and government, should be involved, enabled, and empowered to participate in the FSE. Stakeholders should not be left in the dark for any reason. Cohesion and cooperation between stakeholder groups is vital. Stahel writes about stakeholder engagement as being an essential component of the FSE (Stahel, 2007a).

The seventh, *policies and supporting legislation*, creates a legal and regulatory incentive for stakeholders to participate. It also ensures that everyone is on the same page. Also, a leapfrog strategy must take into account the important role of policies; especially in light of China's power structure, where a more radical leapfrog strategy will require greater state intervention (Perkins, 2003). Policies and legislation that support the functional-service economy and product-service systems include regulatory measures that require product take-back systems, for instance. This criterion also includes creating financial incentives and disincentives. One important recommendation that is described in the literature is decreasing the taxation of labor and increasing taxation of natural resources; which would create an incentive to use manpower (ie- refurbishing, remanufacturing and servicing) and a disincentive to use natural resources (Mont, 2004; Stahel, 2007a).

The eighth, *education and awareness-raising*, deals with Stahel's sixth change. In order for the FSE to run smoothly, all of the stakeholder groups must be informed and educated as to what the purpose and goals of the new economic model are, what their respective roles are and how to fulfill those roles. For example, all of the supportive infrastructure, best design and cleanest production processes could be cancelled out by irresponsible actions of consumers (i.e.- the "rebound effect"). To get them aboard the PSS

concept, they must be informed and educated. With proper information, policies and infrastructure, the consumers and companies, alike, will be empowered to act in a more eco-efficient way, themselves. Also, this education and awareness raising might help avoid some of the corruption that can be a major obstacle for policy enforcement (especially in China).

The last criterion is *new skilled labor*. It means that the labor force must be flexible enough to adapt to a new job market. This requires training and educational programs to be in place to teach the new skills that the functional-service economy will require. Stahel gives the examples of operation and maintenance engineers, service advisors and Chief Risk Officers (Stahel, 2007a).

If any of these criteria are missing, the possibility of experiencing rebound effects (when all positive gains are negated by irresponsible actions) is high. All of these are tightly interconnected and are part of realizing the FSE. These criteria will be revisited in the first part of the analysis (Chapter 4).

3.2.3 *PSS as a concept*

There are many ways in which Stahel's concepts can be interpreted and implemented, one of which is product-service systems (PSS). However, it seems that the term "product-service system" can easily be misinterpreted and misused. Without good guidance and guidelines, PSS could be completely useless when it comes to reducing the stress that the economy puts on the environment (UNEP, 2002; Mont, 2004). So, this paper will use the term PSS as it is defined by Mont's doctoral dissertation; as

a system of products, services, networks of actors and supporting infrastructure that strives to be competitive, satisfy customer needs and has a lower environmental impact than traditional business models (Mont, 2006, 39).

It is a way of helping to dematerialize the economy by reducing raw material inputs and changing high-waste P&C patterns, while maintaining economic efficiency through the exchange of money for the use-value, performance and functionality provided by products and services.

PSS, as Mont has defined it, is a concept that aligns very nicely with the principles of the FSE. In fact, much of the concept was inspired by Stahel's early ideas of remanufacturing, upgrading and maintenance (Mont, 2004). It focuses on dematerializing, as well (Ibid). The idea and practice of PSS focuses more on the specific systems through which the functional-service economic principles can be achieved and maintained.

Mont says that the "paramount goals" of PSSs should be:

- closing material cycles;
- reducing consumption through alternative scenarios of product use;
- increasing overall resource productivity and dematerialization of PSSs;
- providing system solutions seeking the perfection in integrating system elements along with improving resource and functional efficiency of each element.

(Mont, 2002a, 239)

The product-service systems concept takes a life-cycle approach, meaning that it relies on the LCA (life cycle analysis) of products to show the need for a PSS, to guide the design of a PSS and to evaluate its effectiveness. An LCA reveals exactly where the most environmentally detrimental phases are in a product's life, as well as how and why these negative impacts happen. Using the life-cycle approach in a consistent way gives continual feedback about the efficiencies and flaws of the system. Dematerialization, in the context of product-service systems, is "changing a user's need fulfillment in such a way that material flows and energy flow of this need fulfillment decreases significantly" (Goedkoop et. al. 1999, 18).

The concept of PSS uses a systems approach. This means that it seeks to find systems solutions (changes throughout the entire system) as opposed to small solutions to small problems (Mont, 2004). The PSS concept posits that there are fundamental flaws in the current P&C system and that finding solutions to the individual problems created by these flaws will not be sufficient because it is the system itself that is problematic. In other words, we should treat the root cause of the illness, not just the symptoms.

Mont's framework for analyzing PSSs illustrates that the cultural context has an effect on all aspects (Mont, 2004). It encompasses everything else. This is especially important when looking at using product-service systems in China, because the weight and shape of all the other factors in the feasibility and institutional framework will vary greatly in the Chinese setting compared to Western settings.

3.2.4 *PSS in Practice*

Product-service systems, as a concept, may seem a bit impractical or too abstract in some ways. Therefore, it may be quite helpful to illustrate its functionality, flexibility and the forms it can take. One of the most appealing things about the idea of product-service systems is that it is very flexible and can be adapted to almost any product or need. PSSs can take the form of leasing, pooling, renting or sharing. Because the function/service is being paid for, rather than a product, a new metrics for pricing must be established. This is called the functional unit. Functional units vary from one PSS to another due to the disparities in services provided. (Mont, 2004)

There is the very obvious example of car sharing, which is becoming ever-more popular in the US, Canada and Europe (Shaheen & Barth, 2003; Mont, 2004; Belk, 2007). In this PSS, the car is owned by a co-operative or a company and customers pay for the service that the car provides; mobility. The functional unit paid for, in this case, can be measured in hours used or kilometers driven.

Another PS system that is quite common is that of laundromats, in which people in a community pay for the service of machine-washing their clothes at a common place, as opposed to purchasing individual laundry machines for each household. The functional unit is usually measured by number of washes; pay-per-load. This example illustrates how product-service systems are often easily motivated by saving money and avoiding large capital investments.

Another great example for smaller consumer products is that of the mobile phone. In this case, a leasing system makes more sense. The phone is leased, while the service is paid for. There can be a wide array of services and service products provided by the producer/leasing company, while the ownership of the phone, itself, is retained by the producer or leasing company. The customer pays a deposit, as an incentive to bring the phone back, and is put on a payment program as part of the contract for the phone service. The major difference between the current mainstream system and this PSS is that in the PSS, the customer never owns the phone. So, the company is responsible for the phone, its maintenance, hardware and software upgrades, and the EOL of the product. It is an excellent opportunity to reach new heights of customer service and satisfaction. This type of leasing program can be applied to most electronics, tools and white goods (major household appliances). Like the aforementioned example, such leasing PSSs can also be motivated by the desire of consumers to cut costs and avoid making large initial investments in products, as well as the provision of increased and enhanced customer service.

Product-service systems can even be incorporated into grocery stores and other shopping experiences. Of course, the act of buying food can never be completely dematerialized. One cannot simply pay for the service of nourishment without consuming food. However, the ways in which the food is packaged can be addressed in a PSS. For instance, breakfast cereals can be stored in large barrels and the customer can go to the store with a reusable container to refill from the barrel every time s/he runs out of cereal. This could save a lot of trees and oil that go into the production of plastic and cardboard in traditional breakfast cereal packaging. The same thing can be done with shampoo, milk, juices, nuts, dish detergents, etc. Dirty containers can be left at the grocery store for them to be washed and put back into circulation and the cost of washing them is added to the price of the products, thus internalizing this cost. The grey water used for washing the containers en masse can be filtered/cleaned and reused in this cycle. This is true system efficiency optimization, in both economic and environmental terms. It drastically reduces disposable packaging while giving the customer more service and interaction. It is a big step away from our modern throw-away habits and mentality.

PSSs can be seen as B2B (business to business) systems or B2C (business to customer) systems (Mont, 2004). A good example of a B2B product-service system is equipment leasing to businesses. Many companies have started leasing office equipment and furniture, including Xerox (photocopiers), Interface (carpets), IBM (computers), and Wilkhahn (furniture) (Cooper and Evans, 2000). Xerox is often paid for the service of providing the photocopies rather than being paid for the machine and it is becoming more common for businesses to lease their office furniture and computers, cutting down on large expenditures and avoiding the responsibility of maintenance and disposal (Mont, 2004). There are also many examples of B2B chemical leasing and chemical management PSSs, including Haas, DuPont, Quaker, Castrol Industrial, Ashland Chemical Co. and Safechem (Mont, 2004). Chemical leasing is even being done in Egypt, Russia and Mexico, as examples from economies in transition (Jakl and Schwager, 2008).

Examples of B2C product-service systems include car-sharing (Honda Motor Co., GreenWheels, StattAuto, CITYgogo), carpet leasing (Interface), pay-per-use tool leasing (Atlas Copco Tools AB), and professional attire leasing (Mont, 2004). More and more mobile phone service providers are starting to do PSSs, as well (Cooper and Evans, 2000). So, PSS is not just an abstract idea, but rather something that can be and, indeed, is being implemented.

3.2.5 *Infrastructure and logistical matters*

It is not always easy to imagine what kind of infrastructure might be needed in order to create PSSs in various markets, as each product-service system can be so uniquely adapted to the needs of the producers and consumers. Some types of businesses need to make only slight changes while others have to completely redesign and rebuild their infrastructure and the way they do business. This can require a lot of time, money and energy. Changing to PSSs also requires company policies that support this change. It is helpful if there are supporting governmental policies, as well as economic incentives and disincentives. In order to fulfill the environmental soundness requisite of PSS, companies and producers have to be localized in order to be near the point of service, avoiding the extensive environmental impacts of transporting goods and services long distances (ex- repair/maintenance engineers should also be close enough to be conveniently accessible for customers, incurring minimal transportation). (Mont, 2004)

PSSs mandate that the organizational structure of producers and their interactions between each other and with customers facilitates repairing, remanufacturing and refurbishing. This means that many companies have to reorganize, expand and/or form new networks with companies that provide these services. The connections and collaborations between companies in these types of networks have to be very tight, nearly seamless, in order to be competitive and efficient. In other words, a whole new system of cooperation and contracts has to be created on many different levels between all stakeholders and actors. (Mont 2002b; Mont, 2004)

Another important aspect of having a functional, efficient scheme of PSSs is that consumers should be informed and educated about environmental problems and how they are connected with consumer behavior. This helps encourage the effective use of PSSs. Producers and government agents should be informed and educated along these lines as well. (Mont, 2002a; Mont, 2003; Mont, 2004)

3.3 Main drivers and barriers of PSS

Mont and other researchers have written about case-studies and the experiences of PSSs in Europe, the US and Canada. In addition to exploring how the PSSs were initiated and how they work, these case-studies have identified why the involved actors have gone the PSS route and the complications and challenges they encountered along the way. These drivers and barriers are summarized in this section. It is easy to see how they connect with the functional-service economy criteria/components discussed in the first half of this chapter.

They can be categorized and analyzed along many different lines. This paper looks at the drivers and barriers with regards to the stakeholder groups that are directly influenced; the producers, consumers, the government, or non-specific (all groups). The drivers and barriers are also categorized as environmental, economic or social. These categories were chosen as they are acknowledged as the main areas of sustainable development (Harris et. al., 2001; Bell & Morse, 2003; Annandale et. al., 2005). Environmental drivers are motivated by concerns about impacts of the production-consumption system on the natural environment and ecosystems. Environmental barriers are those that are related to unknown environmental impacts or outcomes. Economic drivers are motivated by financial gains for the stakeholder. Economic barriers are those that have a negative impact on the financial situation of the stakeholder. Social drivers are those related to meeting psychological and social needs or enhancing social relations and interactions (including legally-related issues). Social barriers are those that have a negative or ambiguous impact on psychological wellbeing, social relations, and interactions between people (including legal impacts). This way of categorizing them will help to clarify the roles of the stakeholders in relation to PSS implementation, as well as locate the drivers and barriers within the context of sustainability. Many overlap and apply to multiple stakeholders and two or more aspects of sustainability.

3.3.1 Drivers

There are numerous benefits that can be gained from shifting to the functional-service model and PSSs. These perceived benefits act as drivers that motivate the various actors to change their ways of doing business, writing policies, and participating in economic activities. Many drivers discussed in the literature relate to why **producers** would be motivated to adopt a product-service systems mode of doing business. The main drivers for producers are mostly economically motivated. One such driver is that of finding new markets and niches. This includes the “first mover advantage”, or the advantage that businesses have when trying something new in a market. Often it can catch on as a trend and the “first mover” is directly associated with the trend (Mont, 2004; Frynas et. al., 2006). Also, new niches in a saturated market can be found or created when trying something different, like a PSS, thus, expanding the market. Another incentive is to have a greener image. Being a “green” business is becoming more and more profitable as environmental problems worsen and consumers become more educated and worried about these issues. There is also improved eco-efficiency of the P&C system, which results in economic savings and often helps to adhere to environmental legislation (or anticipate policies). For some producers, corporate responsibility/accountability can be a driver, whether it is to improve their image or out of ethical concerns. There is also the idea that the service contracts have built-in customer loyalty. (Goedkoop et. al., 1999; Mont, 2002b; UNEP, 2002; Mont, 2004)

Other incentives relate to why **consumers** would be interested in using PSSs. One economic and social driver is the higher level of producer responsibility/accountability, which means that the producer is responsible for the maintenance, repair, replacement and EOL of the product. This can add a lot of

convenience for the customer, who no longer has to try to fix it him/herself or to pay to get it fixed professionally. Service-based systems can also be considerably cheaper than the current product-based system by avoiding large capital investments, especially regarding white goods (such as refrigerators, washing machines, etc.). The PSS concept requires that products are made to last longer, because producers will not want to waste their resources on avoidable reparations, maintenance and replacement of products. Increasing the durability and quality of goods obviously benefits consumers. The inherent contracts create a sense of dependability for the customer. The customization of products and services is also especially beneficial for consumers. This aspect of PSSs caters to the customers' specific needs. Another aspect that could motivate some consumers is that more localized development will occur, as part of reaching the eco-efficiency and environmental goals of the FSE (the fourth criteria discussed earlier). Many consumers translate localized development to mean more social and economic benefits for their community in the form of increased employment opportunities and cultural preservation. (Ibid)

Yet other drivers address why **governments** and policy-makers would be interested in encouraging PSSs. One driver that applies to all aspects of sustainability is that PSSs can help in the creation of and adherence to environmental legislation. More regionalized/localized development is also a social and economic driver for governments. Local and regional economic growth and increased employment are good for political and social stability. (Goedkoop et. al., 1999; Mont, 2002b; Mont 2004)

Non-specific drivers are those that apply to the system, as a whole, and can motivate all stakeholders. One such environmental driver is that of eco-friendliness. Many producers, consumers and government actors would be interested in PSSs for the fact that they aim to be more environmentally benign than traditional systems. PSSs can also be good drivers of innovative thinking and new technology solutions. This innovation in system organization, interactions, networks and technology is an incentive for everyone, as it helps society progress while enhancing economic growth. Closing the material cycles is a driver for all stakeholders, as well, because it internalizes the externalities and closes material loops, greatly alleviating environmental pressures while maintaining a healthy economy (Mont, 2004). All stakeholders that are driven by environmental and social concerns will be motivated by the increase in awareness and education about problems related to the P&C system and the increased monitoring of the environmental effects of the P&C system, which product-service systems necessitate and reinforce. (Goedkoop et. al., 1999; Mont, 2002b; Mont 2004)

Some drivers directly motivate actors to start PSSs, but others are just added benefits that may or may not help motivate. These bonuses include diversification of the job market, the increased flexibility and adaptability of the P&C system, the innovation in the R&D of products, and the fact that there will be more human interaction in the P&C system (Mont, 2004).

3.3.2 *Barriers*

The previous discussion highlighted the strengths of the PSS and functional-service economy concepts. However, no idea is flawless or perfect and, of course, these concepts have weaknesses, too. Although there seems to be a plethora of drivers for all stakeholders to create and participate in PSSs, there are also plenty of barriers and deterrents. Some barriers can be described as more of a lack of incentive while others are truly a disincentive.

For **producers**, it can be a risky move regarding market acceptance, since it is a relatively new way of doing business and is, thus, still quite marginalized. So, the newness of the concept, itself, can be intimidating enough to keep companies from switching to a PSS mode of business. It can necessitate a lot of restructuring, both in terms of organizational management and internal infrastructure (including manufacturing and remanufacturing plants). It may also require that a company out-sources, which can create a feeling of less independence and lead to more complicated inter-business transactions. Therefore, the new physical infrastructure and reorganization of B2B and B2C interactions and social structures that PSSs may require can be quite a challenge. In the case that they do not out-source, producers might have to expand their areas of service and expertise; thus, spreading themselves too thin (trying to do too much) and undermining their core areas of expertise. (Goedkoop et. al., 1999; Mont, 2002b; Mont 2004)

In some cases, a driver can also be a barrier. Such is the case with customization. For some companies and nearly all customers, customization and improved customer service is a positive thing. However, it might be a barrier for other companies to get aboard the PSS train of thought as it will require more innovative thinking, time and energy on their part, while the payback time is unknown. R&D in a PS system might take more time, lengthening the time to the market, as well. This can be a major deterrent for companies and producers. The fact that the producer retains the ownership of the products is often quite convenient for the consumers, while it can be a burden for producers to have so much more responsibility. It means that they would have to reformat the way they do business (which links to other barriers) as well as extend their responsibilities, duties and range of services provided. It can be seen as far more convenient for producers to sell a product and never have to see that product or its owner again. Having the responsibility of maintaining, repairing, recycling and remanufacturing might deter companies from wanting to get involved. However, this might be overcome by two factors. The first is the customer loyalty that is inherent in a functional PSS, due to the closer relations between producer and customer. The second is the fact that resources are becoming more scarce and costly, so it might soon be more economically viable for a company to recycle, repair, reuse and remanufacture than to sell products once and never see them again. (Goedkoop et. al., 1999; Mont, 2002b; Mont 2004)

It might also be quite difficult for some producers to start marketing services if they are well-known for certain products. Additionally, a major economic barrier for PSSs right now is the low price of natural resources and raw materials, because, as previously discussed, environmental degradation is still not accounted for in these prices (i.e.- they are externalities). This combined with the high cost of labor can

make the PSS concept unappealing or even economically nonviable. Also, in some cases, it could be very difficult to balance customer needs and environmental goals as priorities. This is because these are sometimes at odds with each other. For example, this is the case when customers demand disposability and convenience in packaging, however, such packaging is extremely detrimental to the environment. There might also be uncertainty about the return of products that have reached their end-of-life. This was mentioned by some of the companies in the case-studies as a concern because if they spend the money to create product take-back programs, they want to be assured that the products will come back. However, the latter can be less of an obstacle with a good take-back system that incorporates monetary deposits as incentives for customers to bring EOL products back. (Goedkoop et. al., 1999; Mont, 2002b; Mont 2004)

For **consumers**, a big deterrent is the lack of ownership, which is one of the basic elements of the PSS concept. Often, customers buy products, in part, to identify themselves as belonging to a certain group or as a status symbol (Jackson, 2008). However, if the producers retain ownership of the products, it may feel as if the products are no longer helping them to identify themselves within the larger social context. As Mont puts it, "(p)roduct ownership not only provides function to private users,, but also status, image and a sense of control" (Mont, 2002b, 94). Reorganizing B2C interactions and social structures is also a barrier for consumers. They have norms for how they expect market transactions to happen and how they expect to interact with producers/retailers. These norms are hard to change. (Mont 2004)

For **governments**, the main barrier would be provision and/or help in the financing of infrastructure for mass PS systems. The government might have to provide financial and/or logistical help with building new physical infrastructure. There is also the question of who should do the life-cycle analysis (LCA), monitoring and evaluations. Should the producers or government be responsible for this? Also, there is the inherent difficulty in life-cycle monitoring (monitoring the impacts of products via LCA) and evaluation of products and services, because it requires a lot of time and effort to carry out LCAs and create adequate LCA techniques (Hertwich, 2005). (Goedkoop et. al., 1999; Mont, 2002b; Mont, 2004)

One barrier that does not apply to any specific stakeholder (**non-specific**) is the fact that a product/service system is often perceived as a more complex way of doing business than the traditional business model. This is partly because it involves a shift in the mind-set of all economic actors. This issue relates to the newness of the concept and the ambiguities of PSS implementation. Although the fact that PSSs are so adaptable and there is no set methodology for how to set up a PSS can be an appealing aspect, it can also be a barrier in that it leaves a lot of ambiguities about implementation. The lack of supporting policies and legislation is also a significant obstacle. Actors that decide to undertake a PSS have often felt that they became disadvantaged compared to traditional business actors. In essence, even if they had changed their way of playing, the rules of the game had not been changed. (Goedkoop et. al., 1999; Mont, 2002b; Mont 2004)

Some barriers impede the implementation of PSSs, while others keep stakeholders from ever even considering the concept as a viable path to follow. For instance, short-term thinking and lack of awareness about environmental and sustainability issues are major barriers that can play a role among all stakeholders (Cooper and Evans, 2000). Other aspects that fit into this category include: the high price of labor, the lack of understanding life-cycle costs of P&C patterns, and the lack of understanding the goals of the functional-service economy and the PSS concept. Also, the literature mentions the lack of green public procurement. If the governmental agencies aren't going green, why should producers and consumers consider it? (Goedkoop et. al., 1999; Mont, 2002b; Mont 2004)

3.4 Summary

As one can see, there are many factors involved with shifting from the current economic model to an FSE. Stahel outlined some main changes that should take place, from which the author developed a set of nine criteria that should be met when aiming for a successful economic shift and also in designing a sustainable product-service system. There are plenty of drivers and barriers involved in the implementation of PSSs and shifting to a functional-service economic model. The drivers and barriers discussed in this last section will be used as a basis for comparison and a means of assessing the potential willingness/acceptance factor of the Chinese stakeholders in the next chapter.

4 Findings and analysis

This research has a two-part analysis. The first part is performed using the framework of FSE criteria presented in the previous chapter. This framework is used to analyze the circular economy and the product-service systems concept in order to answer the first two sub-questions, "Where are the weaknesses of the current CE model?" and "Does PSS fill in these gaps in the CE?" It also identifies the main similarities and areas of overlap between the CE and PSS concepts, in order to help answer the third sub-question, "Would it be feasible to implement PSS in coordination with the CE?"

The second part of the analysis investigates the three main stakeholder groups in the Chinese context and seeks to answer the last sub-question, "How might the stakeholders react to PSS?" The framework for this second part was also developed in the previous chapter, when the drivers and barriers for PSS were identified. It probes the potential feasibility of PSS implementation by breaking down what the main drivers and barriers might be in China, according to the literature and interviews.

4.1 CE and PSS in the context of the functional service economy

There are some of the nine FSE criteria, mentioned earlier, to which the CE obviously does apply. The core goal of the CE is to have enhanced production processes. As part of having the enhanced production processes, the CE necessarily includes the provision and construction of supportive, eco-efficient infrastructure; although it is incomplete, according to the standards of the FSE because it does not provide for the consumer's convenient use of services and product take-back systems. The circular economy is also

heavily based on creating policies and supporting legislation (Pinter, 2008). From the literature, it is clear that new skilled labor is expected to increase in order to meet the requirements of the new job markets that the recycling and waste management industries will create in response to the circular economy initiative (Ren, 2007). This is not complete according to Stahel's vision either, as it does not include the new service advisors, maintenance engineers, etc., that are mentioned in his literature (Stahel, 2007a).

This means that, according to the functional-service criteria, there are definitely gaps in the circular economy. The criteria that are not met by the CE are: enhanced product design, product take-back systems, monitoring/evaluation of systems, involvement of all stakeholders, and education/awareness-raising. Enhanced product design and product take-back systems are not at all part of the CE (Ren, 2008). However, some other criteria can be a bit more controversial and should, thus, be discussed.

As far as the monitoring and evaluation of systems goes, the government is working with the World Bank and other researchers to come up with a set of indicators to enable setting up a way of monitoring and evaluating the success of the CE (Pinter, 2008). However, this is still in the very first stages of development, and is far from implementation at this time (Ibid). The involvement of all stakeholders might be debatable. Consumers are not addressed as a main stakeholder or actor in the context of the CE (Ren, 2008). Some of the interviews revealed different understandings of the consumers' role in the CE, but all acknowledged that lack of consumer engagement and education are major weaknesses of the CE. Education is being provided by the government to the companies and local officials in the CE pilot projects (Gao et. al., 2006; Ren, 2008). However, these are just two of the three stakeholder groups in light of the functional-service economy. It is essential to inform and educate the consumers as to their roles and the importance of fulfilling those roles and having an FSE. So, if taken solely in the context of the CE, it does actively involve all the stakeholders: producers and the government. However, in light of the FSE, it neglects the consumer group.

The CE definitely adheres to environmental economics and the ecological modernization paradigm. It suggests that technical innovations in addition to economic incentives, education of producers, and policy approaches will have a dramatic impact on changing the current, unsustainable production patterns. In this sense, it is part of China's leapfrog strategy. However, Tukker mentions ecological modernization as a "system-compliant" solution, which is not a radical enough change to make sufficient increases in eco-efficiency (Tukker, 2005, 69). As Mont points out,

although improving efficiency of products and processes makes environmental sense, it is not enough in order to combat the scale of the problems we face... (s)pecial attention should be given to current consumption levels and patterns (Mont, 2004, 2).

As discussed earlier, PSS fits perfectly within the framework of the FSE. So, it comes as no surprise that the concept of PSS meets all of the criteria. Table 2 illustrates the relation of the CE and PSS to the criteria. It seems that PSS schemes, if properly coordinated, would help the circular economy meet the

standards of the more ambitious FSE. Product-service systems can be adapted to enhance the aspects of the circular economy that already fulfill the FSE criteria. For instance, since the eco-industrial parks of the CE pilot projects are being constructed in a way that links the industries to recycle and reuse energy and by-products, PSSs would complement this in that they would add remanufacturing plants, which could also be linked to the eco-industrial chain of factories, using wastes as inputs. Or, in the case of new skilled labor, the CE is anticipated to create a new job market in the recycling and waste industries. PSSs and the FSE will also require more employment in these sectors as well as the remanufacturing, product maintenance and service sectors. So, where the CE is already making strides in the direction of sustainability, the incorporation of product-service systems, in an effort to shift to a functional-service economic model, could take those strides even further.

Table 2. Functional-service criteria, comparing CE and PSS

Enhanced product design	Enhanced production processes	Product take-back systems	Supportive, eco-efficient infrastructure	Monitoring/evaluation of systems	Involvement of all stakeholders	Policies and supporting legislation	Education and awareness-raising	New skilled labor
PSS	CE & PSS	PSS	CE & PSS	PSS	PSS	CE & PSS	PSS	CE & PSS

The government does have the ultimate authority over what goes on in China. However, they will not be willing to incorporate into policy the FSE model and PSS principles unless they see that it is feasible and that it would be accepted by the other stakeholders. If it seems completely unfeasible with a stakeholder analysis, then, of course the leaders would not want to waste time, energy and resources on trying to force the consumers and corporations in China to do something that does not mesh with the culture and business climate. The next few sections will explore the stakeholders and their potential acceptance of the PSS and FSE principles according to the drivers and barriers presented earlier.

4.2 Stakeholder overview

As discussed earlier, China's setting allows for a totally different interplay between stakeholders in PSSs and due to the unique power structure in Chinese society, the stakeholders will play different roles than their Western counterparts when it comes to setting up a functional-service economy and PSSs.

As Mont points out, producers (ideas), consumers (market) and financial institutions (investment) are the key actors in the development and acceptance of PSSs (Mont, 2003). The case-studies discussed in the literature were PSSs that were started voluntarily by producers, companies and/or co-operations. This is a social organizational factor that depends highly on the cultural context. In China, the picture would be painted in a very different way. In the current Chinese context, the government is a key actor in every situation (Ma & Ortolano, 2000; Croll, 2006). Therefore, its role must be added to this simple triangulation.

4.2.1 *Roles of stakeholders in the West*

In the past experiences of PSS implementation, the role of companies has been the most involved. They build the necessary infrastructure (product take-back systems, etc.), think innovatively in terms of R&D (“precycling”) and market their PSS effectively (Mont, 2004).

The role of consumers has been to use the infrastructure and methods made available by the companies/retailers. They have a lot of choices available to them on the market, so their decision to use PSSs is usually motivated by environmental concerns, friendly interaction, less alienation (feeling of participating in the community), good customer service, and cost-efficiency (Ibid).

The main stakeholders in any PSS system are the producers and the consumers. In the Western experience of PSS, the government can play a small role by giving tax incentives. In essence, they can help create an economic environment conducive to the success of PSSs. Also, acknowledging successful PSSs can be helpful in encouraging others to implement PSS schemes. To date, though, the governments in the West have been relatively uninvolved (Ibid).

4.3 Chinese Consumers

4.3.1 *Who are the consumers of China?*

The role of the consumers within the context of PSS in China is an interesting one to explore. This role is not easily defined, as the consumers in China have just recently begun to see themselves as consumers (Croll, 2006). Another characteristic of China that makes the consumer role difficult to describe/define is the sheer size and numbers. With a population of nearly 1.4 billion people spread over more than 9,500,000 km², one cannot simply refer to a group as “consumers” without exploring what this insinuates.

China’s consumers can be categorized along several different lines. Authors, researchers and marketing firms have spent great amounts of time and energy just trying to find the optimum method for segmenting Chinese consumers. It can be done according to socio-economic class, region (east, west, central, north or south), urban vs. rural, according to age, coastal vs. inland, men vs. women, etc. The demographics are daunting and, due to the time and space constraints of this paper, the author has chosen to define consumers in a very broad sense. For the purposes of this research, the term “consumers” is used to denote the group of people who can afford to buy more than the bare essentials; those who have disposable income. Some specific groups will be discussed in more detail, as they seem to have more influence on the market. These groups are the elites, the middle class, the urbanites, the “tweens”² and the children.

So, how might this diverse set of consumers react to PSS and the FSE? In order to make a worthwhile assessment, the drivers and barriers of Chapter 3 will now be used to analyze the consumer stakeholder group of China.

² The “tweens”, as Croll refers to them, are the teenagers and people in their early twenties who are part of the urban work force, are single, living with their parents and, thus, have time and money to shop for non-essential items. This group often is very brand-savvy and seeks to be part of the “international generation”. (Croll, 2006)

4.3.2 *Opportunities for consumer acceptance of PSS*

There are opportunities and drivers in all three categories: environmental, economic and social. However, the most relevant opportunities for consumer acceptance seem to be social and economic. For instance, the traditional values of conservation, reusing and sharing affect consumer behavior patterns in China to a great extent (Zhang, 2008). People in China are well-known for being thrifty and this is reflected in their daily behaviors; “they tend to make good use of an item and frown upon any behavior that is deemed waste(ful)” (Ibid). Durability and quality (which are always among the top purchasing criteria) of products are also highly valued (Kalish, 2005; Zhang, 2008). Consumers do not value the disposability of products very much at this stage, which goes with the cultural values of conservation (Zhang 2008). These cultural attributes coincide with some previously mentioned drivers: increased quality and durability of goods; improved eco-efficiency of the P&C system; and closing the material cycles.

Also, many consumers, especially the aforementioned “tweens”, are interested in trying new things; be it new items and services on the market or new ways of doing things (Croll, 2006; Zhang, 2008). They are curious and eager to see what the market has to offer and they like the idea of feeling “ahead of time” (Ibid). So, this applies to the drivers: innovation in system organization, interactions, networks and technology as well as the customization of products and services (as both of these drivers deal with innovation and newness). It also helps to greatly reduce the significance of the barriers: newness of the concept and reorganizing B2B and B2C interactions and social structures, as these both apply to how new the PSS concept is in the Western context.

The quality of professional services is still catching up to those of most developed nations and so Chinese consumers very much value that they are treated well (Piron, 2008; Zhang, 2008) and research shows that quality service is highly valued (Kalish, 2005). This value of Chinese consumers might be seen as a good opening for acceptance of product-service system schemes because competition in the market will depend on providing a high quality of service and interaction. It applies to a couple of the drivers from the previous chapter; the customization of products and services and a higher level of producer responsibility/accountability. It also helps to overcome the barrier of the producer retaining ownership of products. It seems that ownership of the product is not always the end goal for Chinese consumers and “it is very important for them to feel good about the entire purchase experience and after-purchase consumption” (Ibid).

Unique consumer spending trends is also an indication of how the consumers might accept PSSs. Market research shows that most of consumer spending goes to food and services, rather than material possessions like clothes and household goods. The percentage of expenditures going to services increased from 1997 to 2003 (from 23-30%) and the percentage going to purchasing consumer goods decreased (from

21-19%) (Kalish, 2005, 2)³. If people are already spending more money on services than possessions, it is not as big of a shift in the consumer mindset to go to PSSs.

Also, Chinese consumers have a tendency to save money, rather than spend it, as their Western counterparts do (Garner, 2005; Croll, 2006; Van Holde, 2008). This is due to many factors. Partly, it is an outward expression of the comprehensive utilization value described earlier in this chapter. This cultural value of saving, combined with the fact that health care costs have gone up and pensions are no longer guaranteed for the elderly, explains the fact that China's savings rate is the highest in the world (Croll, 2006). Frugality and saving money are main motivators for consumer engagement in product-service systems.

There is also the collectivist aspect of Chinese culture, which is directly related to the Confucian and communist heritages of China, in which socialist morals and values are highly important. According to these values, people should care for the well-being of their family (filial piety), peers and the entire community more than for their individual interests. There is a strong sense of group identification (Hui, 2005; Piron, 2008) and consumers in China place immense value on community involvement (Kalish, 2005). This cultural climate could be highly conducive to the acceptance and success of sharing-based PSSs. In this sense, more regionalized/local development might also be an aspect of PSSs and the functional-service economy that appeals to Chinese consumers.

These could all be seen as promoting factors for the acceptance of PSS schemes. If the cultural mindset of the Chinese is already tuned into saving, sharing (Confucianism), high levels of community interaction and conserving (comprehensive utilization), then it seems that some of the biggest obstacles to consumer acceptance of PSS in the West would not be major challenges in China.

Chinese consumers appear to be more concerned about their economic circumstances, social fulfillment and personal wellbeing than about environmental problems (Croll, 2006; Coulter, 2008; Piron, 2008; Van Holde, 2008). However, this does not mean that environmental factors do not play a part. The environmental drivers that might serve as opportunities for the acceptance of PSSs are secondary to social and economic concerns, but are not obsolete. This goes back to the idea that the Chinese culture regards nature as being highly valuable in an intrinsic sense. This high regard for nature and the environment could mean that the drivers of eco-friendliness; increased monitoring of the environmental effects of production and consumption; increased awareness and education about problems related to P&C system; improved eco-efficiency of the P&C system; closing the material cycles (i.e.- less waste) could all play a vital role in the acceptance of PSSs among Chinese consumers. Chinese consumers have a low level of awareness and education about environmental issues (Gao et. al., 2006; Piron, 2008; Ren, 2008; Van Holde, 2008), so if the

³ Services include: healthcare, transport, communications, education, entertainment & other services; and consumer goods include: clothing, footwear and durable goods.

consumers become more aware of the connection between their consumption and behavior and environmental problems, the opportunity for acceptance of environmentally friendly initiatives, policies and ways of doing business (like PSS) might be expected to improve (Carter & Mol, 2007; Lowe, 2008; Ren, 2008; Van Holde, 2008).

However, because it is not a black and white issue, and nothing is cut and clear in the realm of Chinese consumer culture right now, it is not completely sure that the traditional, collectivist values and socialist morals have a strong enough presence to be an opportunity for PSS acceptance. This is because, in recent years, there has also been a turn away from traditional, collectivist values (Knight, 2006; Piron, 2008).

4.3.3 *Obstacles to consumer acceptance of PSS*

When doing an analysis of qualitative data, there is not always a clear line that divides opportunities and obstacles. This is very obvious when analyzing the potential stakeholder perceptions of PSS in China. Many factors that are opportunities according to some attributes of Chinese consumers may also be considered obstacles in light of other attributes. Therefore, some factors spill into both categories.

The first social obstacle is that, as was previously discussed, Chinese consumers like new technology and the feeling of keeping up with the times or “being ahead” (Croll, 2006; Zhang, 2008). While this could be an opportunity for them to accept the newness of the PSS concept, it could be a hindrance in the respect that R&D takes more time and energy- lengthening time to the market, especially for the tweens that want to be part of the global generation (Ibid). For them, it is quite important to keep up with the current and new technology (Ibid).

Although the newness of the concept might be appealing for some segments of Chinese consumers, like the tweens and middle-aged shoppers in urban areas or even the rural consumers, it might be an obstacle for the super-rich and elite consumers. These are the consumers that are more likely to have formed norms regarding their consumption styles and the way they expect the market to respond to their demands (Croll, 2006). In some ways, these are the most Westernized consumers (Roberts & Balfour, 2006, Van Holde, 2008), and so they would experience almost the same mental blocks as consumers in North America and Europe. For the same reasons, reorganizing B2B and B2C interactions and social structures and the fact that the producer retains ownership of products might be significant obstacles for this group.

Additionally, Western concepts of shopping for fun and defining oneself by one's possessions are becoming more and more imbedded in China's social norms. The idea that possessions and clothes are signs of status and one's worth in society is becoming more pervasive (Croll, 2006; O'Leary, 2007) which can definitely be a barrier for PSS implementation. The “Little Emperor” mentality⁴ of material entitlement

⁴ The children of China are a group of only children, due to the one-child policy that the government put in place over 20 years ago. This policy, combined with the effects of globalization, has created a very interesting, non-conventional childhood for a great

might also serve as an obstacle, though the literature and interviews show that this is not such a major concern, since most families cannot yet really afford to spoil their children in over-the-top ways (Croll, 2006; O'Leary, 2007; Zhang, 2008). In fact, research and interviews have shown that the values of conserving, moderation and saving money are still shown in behavior and are being passed on from older generations (Van Holde, 2008; Zhang, 2008). Still, this could be a significant obstacle that relates to the fact that, in PSSs, the producer retains ownership of products.

Another obstacle for consumers, one that was not mentioned in the Western case-study barriers, might be poverty. In many instances, not only can a consumer or family not afford a product, but they may not even be able to afford leasing that product.

4.4 Producers of China

4.4.1 Role of producers

As Chapter 3 showed, almost any kind of company can initiate a PSS. PSSs can be designed in a way that accommodates different types of business sectors and individual firms/companies. In China, the producer stakeholder group is comprised of a variety of firms and companies, nearly as heterogeneous in attitudes and values as the consumers. However, it has been shown in studies about PSSs, that the producers who are most likely to implement a PSS scheme are those who stand to economically benefit, those who are environmentally and socially conscious in their business practices, trend-starters, and/or those who want to improve the quality of their image in an innovative way (Mont, 2004; Frynas et. al., 2006). In this section, the opportunities and obstacles for producers in China (those producing for the domestic market) will be analyzed.

4.4.2 Opportunities for producer acceptance of PSS

There are many opportunities in all three categories for producer acceptance of PSS in China. All of the producer-relevant drivers mentioned in Chapter 3 would also apply to producers in China: higher level of producer responsibility/accountability; green image; increased quality and durability of goods; innovation in system organization, interactions, networks and technology; new markets/niches; improved eco-efficiency of the P&C system; closing material cycles; eco-friendliness; increased awareness and education about problems related to the P&C system; and increased monitoring of environmental effects of production and consumption.

The size of companies in China seems to play a significant role with regards to these motivating factors. Larger companies in China are motivated by being able to improve their market image as a green company, whereas smaller and medium-sized enterprises would not care as much (Ren, 2008). This is to appeal to the elite consumers, who are more environmentally aware, as well as to take advantage of

portion of today's Chinese children. This is especially apparent in the cities. It is here where the "Little Emperors" are most abundant; where the "six pockets, one child" syndrome seems to have become a norm. (Fan, 2005; Croll, 2006)

subsidies and financing that are available to “green” firms (Van Holde, 2008). These large firms are also the ones who are more likely to be motivated by eco-efficiency (for the sake of cost-efficiency) (Ren, 2008).

Lessons can be learned from the experience of the circular economy pilot projects. Some of the interviews helped to uncover the main drivers for companies who are involved in the pilot projects, which are based on voluntary participation (Ren, 2008). The government seems to have the largest impact. The government helps to “create the framework conditions within which the private sector finds it advantageous to act” (Pinter, 2008). Subsidies have played a big part (Coulter, 2008). The main drivers for CE pilot project participation are “the involvement of the government at different levels, as well as the chance to improve the production level and efficiency” (Wang, 2008). However, most producers have been motivated by legislation, while fewer have been driven by efficiency (Guo, 2008). Aside from the pilot projects, there have also been easier financing and loans for greener companies, as a collaboration between SEPA and the banks (Van Holde, 2008).

Some of the big barriers experienced by producers and companies in the West are less of an issue in China. These include: the lack of market demand; the newness of the concept; the fact that the producer retains ownership of products; reorganizing B2B and B2C interactions and social structure; and marketing services instead of products. All of these are less of an issue because they are tied to the previous section in which it was stated that there are no thoroughly defined norms for the P&C system in China. The consumer market is quite flexible and diverse, with the exception of the elites and super-rich (Kalish, 2005; Croll, 2006) and, therefore, it should be much easier to overcome the market restrictions that the Western PSSs have experienced due to the more rigid expectations of the consumers in settings like Western Europe.

Another advantage that producers in China have that producers elsewhere might not have is the fact that the government has so much control. Often this has been a big barrier for companies (lack of supporting policies/legislation); however, in the case of incorporating PSS principles into legislation, this can actually be a good thing in that it takes a lot of the pressure off of the companies. The government can help create a more even playing field by requiring compliance of all companies. Having supporting legislation and better education (provided by the government) also makes balancing environmental goals and customer needs easier.

Also, the government can also help finance and construct the new infrastructure needed. The need for new physical infrastructure might be less of a challenge to PSS acceptance and implementation in China than in the West, because China is already in the midst of creating new industrial and urban infrastructure (Kalish, 2005). The actors (both private and public) will be spending time and money on infrastructure anyways, so that's not nearly as much of a barrier in China as it might be elsewhere. The challenge for China is to incorporate the principles of the FSE into the construction and design of the infrastructure that it

already intends to build. Yet, China's consumer goods distribution system is still very localized; a national distribution system is still in the very early stages (Kalish, 2005), so this is also a positive factor for the incorporation of the functional-service economic principles. Additionally, in some of the CE pilot projects, infrastructure is already being built in a way that facilitates recycling and the take-back of products (Coulter, 2008; Guo, 2008; Wang, 2008).

The low price of natural resources and raw materials is becoming less and less of a barrier as prices continue to rise at an ever-increasing rate, though it is still an issue (Wang, 2008). In the case of China, one of the largest motivating factors for introducing the CE initiative is the fact that the nation is relying too heavily on importing natural resources and raw materials (Ren, 2007). So, as this awareness of increasing resource scarcity continues to rise, it could also serve as an opportunity for producer acceptance of the product-service systems concept and the principles of the FSE. It should also be mentioned that because labor is still cheap in China (Kalish, 2005), this would not be a barrier as it has been in some Western cases (Mont, 2004). Another barrier overcome by the Chinese context is green public procurement, because the government put green public procurement into the official guidelines in 2006 (Ren, 2008).

It should also be mentioned that there are several companies with CSR policies in China. Some companies have even implemented product take-back systems (Pinter, 2008). So, regarding the uncertainty about the return of EOL products; this is not so much of a barrier in China, as is shown by these companies. For instance, there are many electronics companies (e.g.- China Mobile, Motorola, Nokia, Panasonic) that are doing a Green Box take-back program, in which owners of mobile phones bring back their used phones to the producers' stores and receive phone credits, in return (Coulter, 2008; Pinter, 2008). These have been moderately successful, so far.

There are a few companies, who, of course, do have leasing systems in place (Ren, 2008). These companies are doing PSSs and this is a sign that is very much in favor of and shows the opportunity for producer acceptance of PSS. However, this is still very rare in China. Renting and leasing are almost unheard of at this point (Piron, 2008; Ren, 2008); yet, they can be expected to become a new trend (Ren, 2008).

4.4.3 *Obstacles to producer acceptance of PSS*

As discussed above, the obstacles that are less relevant to Chinese producer acceptance/willingness of PSS would be: the uncertainty about the return of EOL products; reorganizing B2B and B2C interactions and social structure; the lack of market demand; the newness of the concept; marketing services instead of products; the low price of natural resources and raw materials; the producer retaining ownership of the product; and difficulties in balancing customer needs and environmental goals.

The barriers that remain are: uncertain time horizons for payback for switch-over costs; undermining core strengths while trying to address all parts of a PSS; and the fact that R&D takes more time and energy-lengthening time to the market.

Lessons about barriers can also be taken from the experience of producers in the circular economy pilot projects. In general, the levels of compliance and willingness are still low among companies, as far as following the principles of the CE goes (Guo, 2008). One aspect is that small and medium companies are not really motivated by efficiency. They see eco-efficiency improvements as more of a burden than as a profit (Ren 2008). Also, international competition can make the costs associated with becoming more eco-efficient seem like a race to the bottom (Coulter, 2008).

4.5 Chinese Government

4.5.1 The role of the government

As was mentioned in Chapter 2, the role of the government in China is vital. The amount of power and influence that the Chinese government has over society, by means of legislation, policies, media and education, is tremendous. The state is described as the strongest driver for change in China, by far (Ho& Vermeer, 2006) and “the government clearly has more levers than governments in a classical economy” (Pinter, 2008). Therefore, the government’s role in the implementation of product-service system schemes and/or a functional-service mode of development would be extremely important and necessary. The tasks of the government could include: creating supportive legislation; educating consumers and companies about problems of high-intensity consumption patterns and about how to participate in the functional-service economy effectively; helping to build supporting infrastructure; internalizing externalities; creating economic incentives and disincentives; and making ambitious environmental goals.

4.5.2 Opportunities for government acceptance of PSS

One social opportunity for the Chinese government’s willingness to help initiate PSSs and incorporate the FSE principles into legislation is the increased awareness and education about problems related to the production-consumption system. The PRC government is constantly seeking to encourage and improve the education of its citizens (Croll, 2006; NDRC, 2006; Yusuf & Nabeshima, 2006). Due to the growing concerns about waste management, water and air pollution, scarce natural resources, eco-toxic threats to human health, and other environmental concerns, the government is seeking to raise awareness and education about how to prevent and help ease these problems (Gao et. al., 2006; NDRC, 2006). Therefore, the necessity of the functional-service economy’s principles and PSSs to educate all stakeholders aligns very nicely with this goal of the PRC leaders.

Another aspect that coincides with the goals put forth by the Chinese government is innovation in system organization, interactions, networks and technology. Throughout Chinese rhetoric, it is mentioned that China should become more innovative in all respects (Wang, 2001;Wu, 2001; NDRC, 2006; Yusuf &

Nabeshima, 2006) and they seek to be on the cutting edge. It is obvious that China does not want to feel left behind anymore and implementing product service system schemes and the FSE model could launch them into a new era of eco-efficiency and market innovations. This government goal also helps to overcome the newness of the concept.

The improved eco-efficiency of the P&C system and closing the material cycles are aspects of PSSs and the functional-service economy that align well with the government's goals to de-link economic growth from environmental destruction (Pinter, 2008), to optimize industry, to conserve resources and protect the environment (NDRC, 2006). So, this is an opportunity that is socially and environmentally-oriented, but can also be motivated by indirect economic impacts, in that the government would not have to be as concerned about increasing dependency on the importation of natural resources or the increasing costs of the waste management and health care systems (due to environmentally-related health issues). Also, the increased monitoring of environmental effects of production and consumption and the eco-friendliness of the PSS concept are in line with the abovementioned goals (NDRC, 2006; Pan, 2006; Pinter, 2008).

The driver of legislation (anticipated or existing) is an interesting one to mention here. This is because the government is already working on new environmental legislation that would require producers to adhere to the principles of the CE (Guo, 2008; Ren, 2008). So, if the PRC government is willing to pass the circular economy law, it could be expected that the government would also pass or add a piece of legislation regarding the FSE principles. (That is, of course, only if it seems like a worthwhile endeavor and is deemed the appropriate way forward for China.) This, then, would also overcome the lack of supporting policies/legislation that many Western PSS case-studies have encountered, a barrier that affects all stakeholder groups.

There are tensions between the socialist, collectivist society and the competition-fueled economic growth, both of which are goals of the government and it is one of the government's priorities to preserve China's unique culture and heritage, in the midst of globalizing forces (Bijian, 2005; Knight, 2006; Piron, 2008). PSS and the necessity for local and regional development and also the required increase in human interaction (ie- the purchasing process, maintenance, customer service, etc) could be quite effective in helping to preserve communities' sense of culture and social wellbeing.

One advantage that the Chinese government has over actors looking to implement PSSs in other countries is that they are currently in the midst of developing their infrastructure. In most cases in China, the new infrastructure that is needed is not really an issue. In many of the circular economy pilot projects and other instances, the government is already financing the building of recycling infrastructure (Pinter, 2008).

Another major driver that may not apply to Western cases but is very important in China is that of relieving unemployment. China's unemployment rate is a huge concern for the government (Croll, 2006; Yusuf & Nabeshima, 2006). According to interviews, recycling, remanufacturing and disassembling

industries have the capability to significantly reduce unemployment rates in China (Coulter, 2008; Lowe, 2008). So, the functional-service economy and PSSs will help alleviate this unemployment plight. Also, developing the service industry and tapping human resources are goals mentioned in the Five-Year Plan (NDRC, 2006), and these are most certainly essential aspects of product-service systems and the FSE.

Additionally, there are already some targets and goals that have relevance for the circular economy (Pinter, 2008) and the FSE (e.g.- emissions targets). The idea of a *xiaokang* society is philosophically linked to dematerialization, both of which are motivations behind implementing the CE (Coulter, 2008; Pinter, 2008), so these same motivating factors can apply to the legal embodiment of the product-service system principles.

4.5.3 Obstacles to government acceptance of PSS

The barriers for the Chinese government could be expected to be the same as those experienced in the Western case-studies. These are: ambiguities of PSS implementation; life-cycle monitoring; and ambiguities of PSS outcomes. Barriers that do not apply to the Chinese case include: the concerns about building new infrastructure and the lack of supporting legislation (as they are already in the midst of creating new legislation along these lines). Also, the newness of the concept is a barrier that is not as big of an issue in the Chinese case.

4.6 Summary of drivers and barriers to stakeholder acceptance of PSS in China

Having discussed the opportunities and obstacles for PSS to take hold among the stakeholders in China, some general conclusions can be made about which drivers are still relevant and those that are highlighted or are even more important in the Chinese context, as compared to Western case-studies. As this stakeholder analysis shows, all of the factors that acted as drivers in the Western case-studies would also be opportunities for stakeholder acceptance in China. Table 3 shows the drivers categorized according to stakeholder and type (environmental, economic and/or social), highlighting the drivers that align with the PRC's government's goals.

Table 3. Main Drivers of PSS in Chinese context

PSS Driver	Relevant Stakeholder(s)	Type(s) of Driver	Aligns with NDRC* goals
Improved eco-efficiency of P&C system	non-specific	environmental and economic	yes
Innovation in system organization, interactions, networks and technology	non-specific	economic, social and environmental	yes
Increased monitoring of environmental effects of P&C	non-specific	environmental and social	yes
More regionalized/local development	government and consumers (sometimes producers)	economic, social and environmental	yes
Eco-friendliness	non-specific	environmental and social	yes
Increased awareness and education about problems related to P&C system	non-specific	environmental and social	yes
Legislation (anticipated or existing)	producers and government	environmental, economic and	yes

		social	
Closing the material cycles	non-specific	environmental and economic	yes
Development of service industry	government	social and economic	yes
Tapping human resources	government	social and economic	yes
Green image	producers	economic	no
Customization of products and services	consumers (sometimes producers)	social (sometimes economic)	no
Higher level of producer responsibility/accountability	consumers (sometimes producers)	social, environmental and economic	no
Increased quality and durability of goods	consumers (sometimes producers)	economic, social and environmental	no
New markets/niches	producers	economic	no

*National Development and Reform Commission (i.e. Five-Year Plan goals)

Whereas many barriers can be expected to be overcome or weakened by the Chinese context, there are also barriers that remain steadfast as obstacles to acceptance, regardless of the cultural or political context. These are: the ambiguity of PSS implementation, the difficulty in life-cycle monitoring, and the ambiguity of PSS outcomes. Only through more research and experimentation will these three obstacles/barriers be resolved. Yet, there are eight barriers that become less significant and three barriers that do not apply to the Chinese context. One obstacle that came up, which applies to consumers in China but not in the West, is poverty. In analyzing the producer and government stakeholder groups, no unique obstacles were encountered.

Table 4 shows the barriers categorized according to stakeholder and type, highlighting those that become less important in the Chinese context and those that become obsolete.

Table 4. Main perceived barriers to PSS in Chinese context

PSS Barrier	Relevant Stakeholder(s)	Type(s) of barrier	Relevance to Chinese case
New physical infrastructure needed	producers and government	economic and social	not relevant
Lack of supporting policies/legislation	non-specific	social	not relevant
Lack of green public procurement	non-specific	social	not relevant
Producer retains ownership of products	consumers and producers	social and economic	not as relevant
Uncertainty about the return of EOL products	producers	economic and environmental	not as relevant
Lack of market demand	producers	economic and social	not as relevant
Newness of the concept	non-specific	social and economic	not as relevant
Reorganizing B2B and B2C interactions and social structures	producers and consumers	social and economic	not as relevant
Marketing services instead of products	producers	social	not as relevant
Low price of natural resources and raw materials	Producers	economic	not as relevant
Difficulties in balancing customer needs and environmental goals (as priorities)	producers	economic and social	not as relevant
Uncertain time horizons for payback for switch-over costs	producers	economic	relevant
Undermining core strengths while trying to address all parts of a PSS	producers	social and economic	relevant

R&D takes more time and energy-lengthening time to the market	producers (and some consumers)	economic and social	relevant
Ambiguity of PSS implementation	non-specific	economic and social	relevant
Difficulty in life-cycle monitoring	producers and/or government	economic and social	relevant
Ambiguity of PSS outcomes	non-specific	environmental, economic and social	relevant

* "Not as relevant" in relation to Western cases.

5 Discussion

5.1 Discussion of concepts

There are some issues that apply to both the CE and PSS concepts that should be discussed, as conceptual challenges that are faced when trying to make any sort of economic shift. One issue is the scale of the economy. This is tied to the necessity for economic development and growth to happen on a more regional and local level; even so, "environmental measures and technological innovations (can be) offset by the sheer increase in the scale of production and consumption" (Ho, 2006, 8). The interviews pointed this out as one of the most problematic factors with the CE concept in China (Pinter, 2008). Therefore, this is something that must be intentionally avoided by all stakeholders, if the circular economy, functional-service economy, product-service systems or any other such endeavors are undertaken.

The ambiguity of PSS outcomes includes the ubiquitous issue of the rebound effect. The rebound effect, as mentioned earlier, is the idea that when actors/stakeholders feel that something they are doing is being done in a way that is environmentally friendly or eco-efficient, they tend to do it more (because they feel good about it), thus negating any positive effects that the improved eco-efficiency would have had. For example, when a person knows that her/his waste is being recycled, s/he might feel fine about generating more waste than normal. Such a shift in habits could cancel out all of the environmental pros of the CE or PSSs.

Also, there is the argument of quality versus quantity. Economic growth (making the economy bigger) does not necessarily equate to economic development (making it better) (Gardner & Prugh, 2008). The quality depends on how social, environmental, economic and institutional issues are all addressed and the extent to which all stakeholders are considered within the context of the economy. This also ties to the discourse of how we measure wealth, development and happiness. Special attention must be paid to these issues as they relate to functional-service economy; it should not be manipulated or seen as an alternative means to simply gain wealth in an eco-efficient way (Lovins, 2008).

5.2 Reflecting on research methods

In any research project, there is always the issue of trying to balance breadth and depth. If one's research scope is too broad, one cannot go deeply enough into the analysis when working with tight time and space

constraints. For the author, the challenge of striking a balance between breadth and depth was a hard one. These are relatively new concepts and therefore there is not much literature, information and case studies available to reference. However, it is the author's opinion that new concepts should be given more attention and warrant research, adding to the creativity and innovation of the solutions to our most pressing problems. One huge obstacle for this particular research was that a large part of the case study is theoretical. Yet, the qualities of PSS and the FSE are a good match for helping China in its goal of developing more sustainable P&C patterns, due to the many unique cultural and political attributes.

Some aspects of the research could have benefited greatly from more empirical data. It would have been interesting to conduct surveys and/or questionnaires for the purposes of collecting quantitative data for the stakeholder analysis; however, due to the enormity of the stakeholder groups, and the time and space limitations, this was not a practical option.

The intent of this research was not to conduct a full feasibility study or to come to conclusions as to whether or not PSS is the supreme solution for China. Rather, the point of this research was to look at a dominantly Western concept and apply it to the Chinese setting to see if it warrants further interest, research and consideration. This paper has succeeded in meeting this goal. Applying the concepts and principles of PSS and the FSE model to China is an area that deserves more attention and should be further investigated in research.

6 Conclusion

6.1 Stakeholder analysis

After having reviewed the literature on PSS and having made an analysis of stakeholders in China, some general conclusions can be made about the potential willingness of these groups with regards to PSS implementation in China. Chapter 4 sought to answer one of the very important sub-questions listed in Chapter 1, "How might the stakeholders react to PSS?" Chinese consumers will probably be willing to accept product-service systems, if the supportive infrastructure and policies are in place and they are informed and educated about how to actively and effectively participate. The producers in China will probably accept their role, if there are legal obligations and economic incentives to drive them. They will also need to be informed and educated as to how to effectively contribute to a sustainable PSS scheme.

So, as has been a recurrent theme in this paper, the deciding factor is the willingness of the PRC's leadership. It is not a black and white issue and most certainly justifies further investigation. However, a conjecture can be made based on the above analyses. The government would probably be interested in incorporating the functional-service economy and product-service systems into their policies and development strategy, as long as economic growth is not compromised and it seems feasible and effective in

helping them reach their goals related to achieving a *xiaokang*, “resource-saving” society. However, it is important to note that the Chinese government decides whether or not to implement policies and legislation of this sort based on the success or failure of pilot projects (Coulter, 2008). Therefore, the likelihood of the government incorporating the functional-service economy principles into the circular economy legislation is highly improbable, as the CE law will be promulgated this year (Coulter, 2008; Guo, 2008). However, the Chinese leaders are becoming more aware of Stahel’s economic model (Coulter, 2008). So, it is possible that they will consider going for a functional-service economy in the future, as they begin to see that the circular economy is not holistic or systemic enough of a change to truly leapfrog, as this paper has shown.

From all of the literature reviews and interviews done for this research, it can be concluded that the Chinese state and society are at a sort of tipping point; a point from which drastic changes may follow any one of several trajectories. The available information, data and research about Chinese culture, norms, values and society shows a rather diverse China that is changing at a neck-breaking pace, on many different levels. It is becoming ever-more fragmented, as economic and social inequalities increase and as the dichotomy between traditional and modern values grows. So, one has to be very careful when making generalizations or speculations. One thing is sure, though; the government has the power to steer society into a more sustainable direction (Tu, 2001). Rather than embracing the individualist, materialist values of the West, the state can promote more traditional values as part of its nationalist campaign (Van Holde, 2008). This, along with education and awareness-raising about environmental issues (especially in relation to P&C patterns), could play a vital role in the acceptance of an FSE business model.

6.2 Remaining barriers

The other sub-questions are, “Where are the weaknesses of the current CE model?”, “Does PSS fill in these gaps in the CE?”, and, “Would it be feasible to implement PSS in coordination with the CE?” This paper illustrated that the most obvious and detrimental gap in the circular economy initiative is that consumers and the consumption side of the P&C system are not addressed. All of the interviews with CE experts indicated this. Also, none of the Chinese consumer experts had ever heard of the circular economy. This points to a huge gap if the CE truly seeks to change the production-consumption system and patterns in China. This is where product-service systems can work with the CE in order to fulfill the criteria for shifting to a functional-service economy as a means of dematerializing and, thus, leapfrogging China over the dirty phases of the classical industrialization model. The first part of the analysis also showed that the PSS and CE concepts are quite compatible, and even overlap in certain ways, and that incorporating the principle of product-service systems and the FSE would take the CE further, in terms of environmental, economic and social sustainability.

In answering these questions, it is also important to note that there are weaknesses in the CE other than the lack of addressing consumers and consumption. The CE interviewees revealed many problems with implementation. These problems would also serve as barriers to proper implementation of product-service systems. These are: shifting the mindset of the public and policy-makers; rebound effects; lack of a proper understanding of the concepts on behalf of the stakeholders; the idea that the terms regional and local development are not defined; the lack of specific, ambitious goals; the lack of indicators; the lack of monitoring and evaluation; issues with compliance; the lack of enforcement of environmental laws; corruption; bureaucratization; and the fact that there not enough economic incentives. Most of these issues relate to the cohesion and organization of governmental agents. The Chinese leaders are fully aware of these problems and are working to resolve them. This does not mean that they should not try to get things going along the functional-service economy track, though. With increased attention paid to education, creating proper incentives and disincentives, organization and making ambitious goals, most of these problems would not pose much of a threat.

However, corruption and law enforcement have been major problems with the implementation and undertaking of many other environmental initiatives (Croll, 2006; Mol, 2006; Lowe, 2008; Wang, 2008), so in the case that China promulgates PSS-promoting legislation, there must be factors other than the regulations and economic incentives motivating companies to abide by the principles of the FSE; or else corruption will be a large threat to the success of the functional-service economy.

To get it started in China, the functional-service economy will need the backing of enforced environmental laws, a shift in taxation, as well as economic incentives and disincentives. Also, the bureaucratization of even the smallest tasks in China is an aspect that can drastically reduce the efficiency of environmental initiatives and occasionally even leads to the indefinite stagnation of projects (Mol, 2006; Ohshita & Ortolano, 2006; Lowe, 2008). So, proper organization is key.

Would the incorporation of product-service systems into the circular economy initiative be a possible way of helping China with its goal of leapfrog development by addressing the consumption-side of the economic system? The answer is that product-service systems will most likely not be a part of the CE legislation. Yet, under the right set of circumstances, with proper education and understanding of the goals and path to be followed, the functional service economy and, likewise, product-service systems could work with the circular economy as a systems solution in order to truly de-link economic growth from environmental devastation in China. Although considerable barriers remain, it is an interesting proposition that should be further explored.

6.3 Recommendations for further research

Of course, this research, being so broad, has led to many questions that should be further analyzed. For instance, it would be interesting to take a closer look at the infrastructural and other logistical needs for implementing PSSs and the FSE model in China. Another area that deserves more attention is a deeper analysis of the consumers' role in China and the domestic market. Also, it would be interesting to find and research specific cases of existing leasing, sharing and renting systems in order to see how these function in China and how much of a factor culture plays in these systems, versus Western case-studies. Also, it would be interesting to analyze what the drivers and barriers are that companies have faced in the "Green Box" product take-back schemes in China. Of course, the most pressing questions have to do with how the government would see the functional-service economy in light of their goals.

Product-service systems, the circular economy and the functional service economy are not the end goal. They are rather the first steps in the right direction. There is no way of knowing what kind of system will constitute a feasible sustainable society because we are currently so far away from that point. What we need is to start to shift the entire system, but it must be done incrementally, in stages and steps. Perhaps we will end up with the society that deep ecology proposes, or the steady state economy or eco-communalism. However, those are too far away from the present paradigm to shift to without having transitional steps. Product-service systems and the functional-service economy constitute feasible steps.

Other issues that nations-in-transition need to tackle, alongside the P&C system include: transportation, energy, water and food consumption issues. For even if the P&C system is successfully transformed into a more sustainable model, the positive outcomes of this transformation could be completely cancelled out (negated) by lack of progress in other areas. The Chinese have a massive project in front of them. Sustainable development, however one defines it, is no easy task.

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Appendix 1: Interview questions for CE experts

(in chronological order of correspondence)

Respondent: Ren Yong, Employee of SEPA and policy researcher specializing in the Circular Economy (phone conversation) (China)

Do you know when the government plans to pass the circular economy law?

How effective do you think the circular economy pilot projects (like Guiyang) are in reducing the causes of negative environmental impacts, like excessive waste, resource exploitation and pollution?

What are a few of the main weaknesses of the circular economy initiative?

What role do Chinese consumers play in the context of the circular economy?

What role does educating consumers play in the circular economy initiative?

And the special articles include education of consumers?

What is the level of compliance/willingness among the companies to follow the principles of the circular economy?

What kinds of companies are participating in the pilot projects?

In the pilot projects, are products being designed in a way that facilitates reusing and recycling?

Have there been any noticeable rebound effects (ie- companies and/or consumers using more resources/energy/products because they feel better about how eco-efficient the production processes are)?

What is regional and local development in the context of the circular economy?

How big is a region?

To your knowledge, has the idea of a service-based economic model (in which the focus is shifted from products to services) been considered by policy makers?

How willing do you think the government would be to incorporate a service-based business/economic model into the circular economy initiative?

Respondant: Pibin Guo, Researcher from North China University with field experience in the CE pilot projects (written communication via email) (China)

Do you know when the government plans to pass the circular economy law?

How effective do you think the circular economy pilot projects (like Guiyang) are in reducing the causes of negative environmental impacts, like excessive waste, resource exploitation and pollution?

Are there any readily available data on results with figures and numbers, compared to goals?

What are a few of the main weaknesses of the circular economy initiative?

How do you see the relation between consumption and the circular economy?

What role do Chinese consumers play in the context of the circular economy?

What role does educating consumers play in the circular economy initiative?

From your experience, what is the level of awareness of Chinese consumers about environmental issues and the connection between their consumption behaviors and these issues?

What is the level of compliance/willingness among the companies to follow the principles of the circular economy?

Regarding the pilot projects, is the legislation of the circular economy the main driver or do the companies seem to want to be more efficient out of their own interests?

What kinds of companies are participating in the pilot projects?

In the pilot projects, are products being designed in a way that facilitates reusing and recycling?

Have there been any noticeable rebound effects (ie- companies and/or consumers using more resources/energy/products because they feel better about how eco-efficient the production processes are)?

To what extent is regional and local development being accomplished by the circular economy pilot projects?

To your knowledge, has the idea of a service-based economic model (in which the focus is shifted from products to services) been considered by policy makers?
How willing do you think the government would be to incorporate a service-based business/economic model into the circular economy initiative?

Respondent: Ernie Lowe, researcher for the Indigo Development Group with excellent knowledge of the CE concept (phone conversation) (USA)

How effective do you think the circular economy pilot projects (like Guiyang) are in reducing the causes of negative environmental impacts, like excessive waste, resource exploitation and pollution?
Do you know of any readily available data on results with figures and numbers, compared to goals?
In your opinion, what are the main weaknesses of the circular economy initiative?
How do you see the relation between consumption and the circular economy?
What role do Chinese consumers play in the context of the circular economy?
What role does consumer education play in the circular economy initiative?
In the pilot projects, are products being designed in a way that facilitates reusing and recycling?
Have there been any noticeable rebound effects (ie- companies and/or consumers using more resources/energy/products because they feel better about how eco-efficient the production processes are)?
What is regional and local development in the context of the circular economy?
In your opinion, is the circular economy initiative compatible with Stahel's functional-service economy?
If so, how do you see the relation between the circular economy and the functional service economy?
How willing do you think the Chinese government would be to incorporate a service-based business/economic model (such as Stahel's) into the circular economy initiative?

Respondent: Laszlo Pinter, researcher and analyst working with the World Bank on issues of indicators related to the CE (phone conversation) (Canada)

Have you seen any specific quantified goals for the CE, either on a national level or for the pilot projects?
To your knowledge, has the government established a set of indicators and/or a monitoring and evaluation system for assessing the effectiveness of the CE?
In your opinion, what are the main weaknesses of the CE initiative?
How do you see the relation between consumption and the circular economy?
What kinds of companies are participating in the pilot projects?
Follow-up question: In these projects that aren't labeled CE projects, do you know if they are just being implemented by the companies or are they being encouraged by the government in the municipalities, or?
And in this position, is the government helping to finance the infrastructure for a lot of these projects?
Do you have the name of the companies that were doing this?
Have there been any noticeable rebound effects (ie- companies and/or consumers using more resources/energy/products because they feel better about how eco-efficient the production processes are)?
Can the use of indicators, monitoring and evaluating systems like the CE help reduce or prevent rebound effects?
Does the CE relate to the concept of dematerialization?
If so, how do you see this relation?
In any part of studying the circular economy, have you run into anything explicitly saying that they want to dematerialize the economy, or have you only run into these xiaokang type things?
In some of the literature about the CE, I've noticed that the Chinese government seems to be counting on the waste and recycling industries to grow substantially enough to offer new job markets. Do you think that the CE has the potential to ease unemployment rates in China?

Respondent: John Coulter, independent researcher and consultant who has excellent experience working with Chinese state agencies at the pilot project level (written communication via email) (China/Australia)

How effective do you think the circular economy pilot projects (like Guiyang) are in reducing the causes of negative environmental impacts, like excessive waste, resource exploitation and pollution?

Have you seen any specific quantified goals for the CE, either on a national level or for the pilot projects?

If so, have you seen any actual data in relation to these goals?

To your knowledge, has the government established a set of indicators and/or a monitoring and evaluation system for assessing the effectiveness of the CE?

In your opinion, what are the main weaknesses of the circular economy initiative?

How do you see the relation between consumption and the circular economy?

What role do Chinese consumers play in the context of the circular economy?

What role does consumer education play in the circular economy initiative?

From your experience, what is the level of awareness of Chinese consumers about environmental issues and the connection between their consumption behaviors and these issues?

What is the level of compliance/willingness among the companies to follow the principles of the circular economy?

Regarding the pilot projects, what seem to be the main drivers motivating the companies to participate?

What kinds of companies are participating in the pilot projects (ie- chemical factories, consumer goods producers, textile manufacturers, etc.) ?

In the pilot projects, are products being designed in a way that facilitates reusing and recycling?

Do you think that the infrastructure is being developed in a way that allows for product life extension and product take-back schemes?

Have there been any noticeable rebound effects (ie- companies and/or consumers using more resources/energy/products because they feel better about how eco-efficient the production processes are)?

Do you think the use of indicators, monitoring and evaluating could help reduce or prevent rebound effects in the CE?

What is regional and local development in the context of the circular economy?

To what extent is regional and local development being accomplished by the circular economy pilot projects?

Does the CE relate to the concept of dematerialization?

If so, how do you see this relation?

To your knowledge, has the idea of dematerializing the economy been considered by policy makers?

In some of the literature about the CE, I've noticed that the Chinese government seems to be counting on the waste and recycling industries to grow substantially enough to offer new job markets. Do you think that the CE has the potential to ease unemployment rates in China?

In your opinion, is the circular economy initiative compatible with Stahel's functional-service economy?

If so, how do you see the relation between the circular economy and the functional service economy?

How willing do you think the Chinese government would be to incorporate a functional-service business/economic model into the circular economy initiative?

Respondent: Wang Xuejun, Professor at the College of Environment at the Beijing University with great knowledge of the CE and EPR initiatives in China (written communication via email) (China)

Have you seen any specific quantified goals for the CE, either on a national level or for the pilot projects?

If so, have you seen any actual data in relation to these goals?

In your opinion, what are the main weaknesses of the circular economy initiative?

How do you see the relation between consumption and the circular economy?

What role do Chinese consumers play in the context of the circular economy?

What role does consumer education play in the circular economy initiative?

From your experience, what is the level of awareness of Chinese consumers about environmental issues and the connection between their consumption behaviors and these issues?

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In the pilot projects, are products being designed in a way that facilitates reusing and recycling?

Do you think that the infrastructure is being developed in a way that allows for product life extension and product take-back schemes?

Have there been any noticeable rebound effects (ie- companies and/or consumers using more resources/energy/products because they feel better about how eco-efficient the production processes are)?

Do you think the use of indicators, monitoring and evaluating could help reduce or prevent rebound effects in the CE?

Does the CE relate to the concept of dematerialization of the economy?

If so, how do you see this relation?

To your knowledge, has the idea of dematerializing the economy been considered by policy makers?

In some of the literature about the CE, I've noticed that the Chinese government seems to be counting on the waste and recycling industries to grow substantially enough to offer new job markets. Do you think that the CE has the potential to ease unemployment rates in China?

To what extent are Chinese scholars and intellectuals writing and researching about things like EPR, industrial ecology and environmental economics?

Appendix 2: Consumer expert interview questions⁵

(in chronological order of correspondence)

Respondent: Jing Zhang, A PhD in consumer psychology related to Chinese cultural values (written communication via email) (China/USA)

To what extent do the traditional values of conservation, reusing and sharing affect consumer behavior patterns in China?

How much is Chinese consumption of non-essential goods increasing?

To what extent do most Chinese consumers value disposability of products?

To what extent do they value durability of products?

To what extent do they value quality service and human interaction when shopping?

Would you say that middle-aged and older Chinese consumers reflect the values of sharing, conserving, and reusing in their consumption patterns?

Have these values of sharing, conserving, and reusing been passed on to the Little Emperor generations?

Are environmental issues and environmental awareness having an impact on Chinese consumer behavior?

How open are average Chinese consumers to trying new things (ie- new products, new services and new methods of purchasing)?

In general, do consumption patterns show that consumers seem to embrace Western culture and/or products?

Do you think that as rural areas experience more economic development, their consumption patterns begin to emulate those of urban areas?

Respondent: Steve Van Holde, Professor at Kenyon College with extensive experience in China and recent consumption trends (phone conversation) (USA)

What are the main values that seem to be motivating consumer behavior in China?

⁵ Note that not all of the original questions asked are not presented here because they were not answered by the respondent(s).

What would you say are traditional Chinese values that relate to consumption?
What other factors (aside from consumer values) have a major impact on Chinese consumption?
How do you see the relation between the government and consumption in China?
How do you see the relation between Chinese consumers and environmental problems?
How informed are Chinese consumers about environmental problems?

To what extent do consumers seem to value the environment?
Do environmental values play a role in purchasing decisions?
What do you think are the major factors that motivate companies producing in China for the domestic market to become "greener"?
Do you know of any companies/producers in China that have initiated product take-back systems (extended producer responsibility), in order to recover their products after consumer usage and reuse or recycle the parts?
In your research, have you dealt with the circular economy initiative in China?

Respondent: Francis Piron, PhD with extensive experience in marketing and consumer values and behavior in China (phone conversation) (France/China/ USA/Malaysia)

From your experience, what are the main values that seem to be motivating consumer behavior in China (both urban and rural)?
Do you know of any data that ranks the values that consumers use when they're buying?
Are the older age groups still buying with these traditional values and the younger groups aren't or what would you say about that?
I've also been exploring the idea of China being at a sort of cultural tipping point, where it could go any of several different directions. Would you say that it's at that tipping point?
Which consumer group(s) would you say has/have the most influence and/or purchasing power on the domestic market in China today?
How do you see the relation between the government and consumption in China?
Do you know where the government seems to stand on the issue of consumption and materialism? I've read a lot about the government saying that materialism is spiritual pollution. Have you seen a lot of that, while you were in China?
How informed are Chinese consumers about environmental problems?
Do environmental values seem to play a role in purchasing decisions?
To what extent do they value quality service and human interaction when shopping?
How do you think Chinese consumers feel about sharing and/or leasing products?
In your opinion, is there more of a tendency to accept or reject Western culture and products among Chinese consumers nowadays?
Do you think it's more fueled by cheaper prices or nationalism?
Do you think that, as rural areas experience more economic development, their consumption patterns begin to emulate those of urban areas?
In researching Chinese consumers, have you heard of the circular economy initiative?

Appendix 3: Dematerialization and economic growth rate allowance

Ayres & van den Bergh's dematerialization mathematical model shows that 6% and higher growth rate per annum of the economy can actually enhance dematerialization. This is based on many assumptions, but mainly, it assumes that, in a dematerialization paradigm, higher capital accumulation will lead to more eco-efficient technology and knowledge accumulation, which is exponentially increasing. So, higher growth rates actually increase the de-linking of economic growth and natural resource depletion. So, if the cultural and societal mindset of China can take large steps into the dematerialization paradigm, and the nation uses its capital to invest in eco-efficiency and more knowledge creation, it can sustain high growth rates. (Ayres & van den Bergh, 2005)