**Value-Driven Needfinding for Early Product-Service System Development**

**A Study in Collaboration with Volvo Construction Equipment in the Chinese Market**

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**Abstract:** Literature has shown that customers’ need last longer than any specific solutions, so understanding customer needs is a crucial factor in early Product-Service System (PSS) development. Recently, many western companies, especially manufacturing focused companies, have realized the difficulty of understanding market needs. In this thesis, a new Value-Driven Needfinding methodology for manufacturing companies to apply in the Chinese market was investigated. To further demonstrate the implementation of the proposed methodology, a case study with Volvo Construction Equipment explored value-oriented needs in Chinese market has been implemented. At the end, by providing the scenarios comparison, a PSS conceptual design is illustrated to show the utilization of customer needs, then opportunities for company future provision towards sustainability based on early PSS development will be discussed.

**Keywords:** Product-Service Systems (PSS), Early PSS Development, Value, Needs, Value-Driven Needfinding, Sustainability
Statement of Contribution

This thesis research was the result of the gathering effort of two team members, who are having the same interest in how to conduct a research on early PSS development for manufacturing company’s provision towards sustainability.

Both of Yan Zhang and Xi Chen are from Kunming, China. Yan has a bachelor degree of financial management and master student candidate of MBA in China, has owned working experience as project assistant in Railway Ministry of China, which raised his concern regarding system engineering, soft-product innovation and PSS design. Xi Chen is an exchange student who is a master student candidate of art and design in China as well and has a bachelor degree of industrial design, which drew her attentions on product design and product management.

One of the most interesting experiences was the co-creation with Volvo Construction Equipment. It gave the thesis group a great opportunity to apply some of the Product-Service System Innovation methods and skills learned throughout the studies at Blekinge Institute of Technology.

Each of the group members significantly and equally contributed to the final outcome. Yan mainly focused his work on thesis structure and theory establishment to analyze the white spot in early PSS development. He did great contribution to the methodology of Value-driven needfinding and built the interviews network by using his rich working experiences in the Chinese market. Xi focused on analyzing results gathered from needfinding activities, case study and scenarios deliberation as well. Her abilities in grammar checking and designing pictures were truly beneficial. At the end, each member cross-checked thesis writing and complemented each other’s parts in order to make sure everyone on the same page.

This thesis not only reflects the authors’ knowledge and learning but also presents the fruits of good collaboration and teamwork, enriched by differences in skills and backgrounds.

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Summary

Providing added value to standalone products by adding services is at the core of Product-Service Systems (PSS) offered in manufacturing companies. Providing PSS requires a change not only in the way products are sold, but also in the way they are designed and developed. The way of understanding and capturing customer needs often fall outside the early phase of designing integration solution in traditional manufacturing company. The aim of the thesis is to investigate the needfinding for early phase of PSS design, methods and tools proposed to improve the need collection and analysis process.

This academic work was performed through the close collaboration with Volvo Construction Equipment which is looking for opportunities to provide Product-Service System in the Chinese market. The thesis group firstly reviewed theory of needfinding, and then the importance of value was brought out. The methodology of Value-Driven Needfinding (VDN) was introduced to facilitate the early PSS development. By deriving needs from an adding value standpoint, this methodology is not only focused only on needs intended as “Voice of the customer” but rather as needs expressed as “Value Adding Activities”. Thus, these value-based needs can reveal some functions for potential system solution development. A case study involved with Chinese customers’ needs is described to demonstrate the application of VDN. Two scenarios comparison were presented to evaluate the sustainable influence between provision of current solutions and new PSS solution.

During discussion part, the application of VDN, the Chinese market preferences and the contribution of VDN for early PSS design from sustainable perspectives are discussed. At the end, three conclusions supported the contribution of VDN applied for manufacturing company to carry out PSS development at early stage was showed.
Glossary

*Total Solution:* By providing product and service for meeting and exceeding customer demands to build long-term relationships around total solutions in order to make customer’s job as efficiently as possible with maximum profitability and up-time.

*Product-Service System:* Products and services used in combination to provide utility to a customer

*Fleet Management:* Fleet Management is a function that allows companies that rely on transportation in their business to remove or minimize the risks associated with vehicle investment, improving efficiency, productivity and reducing their overall transportation and staff costs.

*Needfinding:* A qualitative research approach to studying people to identify their unmet needs.

*The Ownership Cycle:* It is a structure to show how customer interfaces with product and service during the use phase.

*Triple Win Strategy:* A structure of PSS development from Planet, People and Profits perspective.
Acronyms

**BTH**: Blekinge Institute of Technology

**BCDT**: Beijing Century Development Technology Co., Ltd

**DRM**: Design Research Methodology

**Enrich YN**: Kunming Enrich Construction Machinery Co., Ltd

**FPD**: Functional Product Development

**IPS2**: Industrial Product-Service Systems

**IUCN**: International Union for Conservation of Nature

**MEPSS**: Methodology development and Evaluation of PSS

**ODI**: Outcome-Driven Innovation

**PSS**: Product - Service System

**UNEP**: United Nations Environment Programme

**Volvo CE**: Volvo Construction Equipment

**VDN**: Value - Driven Needfinding

**VoC**: Voice of Customer

**WWF**: World Wide Fund for Nature

**YTH**: YunTianHua Group
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1 Introduction

In recent decades, the business competition in manufacturing industry is becoming more and more intensive. This increased competition has driven manufacturing companies to reconsider the traditional concept of the ways they do business nowadays, mainly hardware development. Many studies have outlined that the modern industrial economy emphasizes on manufacturing that is not sustainable (Mont 2002; Halen, Vezzoli and Wimmer 2005; Stahel 1997). Industrial product development focused company, such as construction equipment manufacturer, has started to recognize that it is not a long term solution to enhance market competitiveness and to increase their market share merely by tangible product development and purely hardware products selling. Rather, these manufacturing companies have started to become aware of the importance of customer value, customer needs, and intangible servicing products in aftermarket (Woodruff 1997).

The integration of product and service has been identified as a shift for manufacturing companies from hardware design to integrated solution design. By this way a sustainable economic performance could be achieved (UNEP 2001). This type of integration and the emphasis of service development pave the road of the development of the concept of Product-Service System (PSS).

1.1 What does Product-Service System mean?

A concept of Product-Service System (PSS) “suggests the need to link hard and soft issues such as technology and sociology, products and services, and to view existing environmental problems from a systematic perspective”(Mont 2006, 1). Meanwhile Mont described PSS as “as a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower
environmental impact than traditional business models” (Mont 2001, 9).

Similarly, Goedkoop (1999, 18) defined PSS as “a marketable set of products and services capable of jointly fulfilling a user’s need”. A concept of Product-Service System (PSS) has been summarized, and the key characteristics of PSS from the literature are shown as following:

- **A systematic integration of products and services** (Goedkoop et al. 1999; Mont 2002; Manzini and Vezzoli 2003; Tukker and Tischner 2006; Verkuijl et al. 2006).

- **A value proposition network** (Mont 2001; Chris 2002, Manzini and Vezzoli 2003; Baines et al. 2007; Tukker and Tischner 2006; Verkuijl et al. 2006).

- **Decreased environmental impact** (Goedkoop et al. 1999; Mont 2001; Mont 2002; Manzini and Vezzoli 2003).

- **A new competitive business and innovation strategy, fulfill specific client demands** (Mont 2001; Tukker, A. U. Tischner and M. Verkuijl 2006; Vezzolo 2002; Manzini 2003; Halen, Vezzoli and Wimmer 2005).

- **The network, infrastructure and governance structure** (Tukker, A. U. Tischner and M. Verkuijl 2006).

From literatures, PSS has been categorized into three different groups by product ownership and type of service provided (Cook 2001; Tukker and Tischner 2006). Different mechanisms can be used to create value systems in which product and service are linked. These categories are (see Figure 1.1):

- **Product-oriented PSS.** In this case, the provider not only sells a product but also offers services that are needed anyway during the use phase of the product. For example, warranties and a maintenance contracts.
- **Use-oriented PSS** In this case, the customer purchases the use of the product over a given period of time or units of service. For example, leasing contracts or product sharing.

- **Result-oriented PSS** In this case, the company sells a result instead of a product. The customer buys an expected outcome and not a “use of a product over a given period of time” (Cook 2006, 1456).

![Figure1.1: Categorization of Product-Service Systems (Tukker and Tischner 2006)](image)

Tukker and Tischner (2006) summarized the PSS categories by highlighting their differences in terms of value provided to the customers. From their view, “PSS covers the gap between pure products, whose value is mainly in product content (i.e., tangible), and pure services, whose value stems primarily from service content (i.e., intangible)”(Tukker and Tischner 2006, 20). PSS delivers integrated value from both product and service: thus, PSS can be seen as a value proposition network. Rather, from systematic perspective to understand serving products in aftermarket, customer value and customer needs are required.
1.2 Product-Service System-Opportunities for Sustainable Society

According to a UNEP report on PSS and Sustainability, “the PSS concept is a possible and promising business strategy potential capable of helping achieve the leap which is needed to move to a more sustainable society” (UNEP 2001, 3). PSS can contribute to sustainable development domains like living (e.g. intelligent heating), working (e.g. internetworking), recreation (e.g. base materials), healthcare (e.g. e-health) and food production (e.g. fast food) and distribution (e.g. express delivery). Changes in the product and service mix will have an impact on society at large and ultimately on the sustainability of our environment (Halen, Vezzoli and Wimmer 2005).

1.2.1 Definition of Sustainability

The Brundtland Commission Report defines sustainable development as “meeting the needs of the present without undermining the ability of future generations to meet their needs” (Brundtland 1987, 43). IUCN, UNEP and WWF define it as “improving the quality of human life while living within the carrying capacity of supporting ecosystems” (IUCN et al. 1991). “Sustainable development aims at ensuring a better quality of life for everyone, now and for generations to come”. Thus it combines environmental, social and economic concerns, and offers business opportunities for companies that can improve the lives of the world’s people (Halen, Vezzoli and Wimmer 2005; Tukker and Tischner 2006).

1.2.2 PSS and Sustainability

In 2000, UNEP hosted a PSS expert meeting, experts agreed that strategies to optimize the environmental loads of PSS have a great potential to “leap” to more sustainable production and consumption patterns (Halen, Vezzoli and Wimmer 2005, 47). Literature has shown PSS as a triple win strategy is
relating with people, planet and profit aspects of sustainability (Halen, Vezzoli and Wimmer 2005, 37; Tukker and Tischner 2006, 72).

- **People (Social)**- PSS may focus much more on the needs and values of customers (Mont 2001); PSS may integrate customers directly in the generation of the PSS and in this way increase the value of the offer and satisfaction of the customers by this participatory approach (Tukker and Tischner 2006). PSS also contributes to enhancing social coherence in the region. PSS development in principle should use a broader perspective on the system and related need fulfillment than product development. Meanwhile PSS is providing a value-added service (Halen, Vezzoli and Wimmer 2005).

- **Planet (Environment)**- Reducing the consumption of material and energy to manufacture new products by reuse, refurbishment, and remanufacturing (Mont 2001). Meanwhile PSS can reduce the impact (emissions and toxic substances) on nature; A shift in resource quality from finite fossil-fuels to renewable. Preserving or improving natural variety. Increased reuse of products and their elements decreases turnover of products and their elements through the production cycles and increases the lifetime of each element or a product (Halen, Vezzoli and Wimmer 2005).

- **Profit (Economic)**- The main benefit is that it creates economic incentives for the reuse of used products and components in order to minimize the cost of function provision to the customer (Tukker and Tischer 2006). PSS innovation can offer a practical route towards marketing sustainable development operational. Sustainability-driven PSS can offer clear benefits to society. In turn, these perceived benefits could act as drivers for continued business success.
In this thesis, the research relates PSS and sustainability. If customer perceived value and customer needs are considered in early development of PSS those findings can be related to the expectations of sustainability. Subsequently, the designed PSS will be likely to become a business success and contribute towards the achievement of a sustainable society.

1.3 Early PSS Development

By using PSS concept, the focus of design shifts from the creation of a new product or new service in use phase to the “re-organization of existing elements on the basis of new needs and values” in early design phase (Morelli 2003, 75). It requires the PSS designer using a holistic view to understand value, needs and requirements from the beginning of the design phase (see Figure1.2). Many studies have highlighted that the value of customer needs and the output from early phase provided new opportunities for PSS development (Ericson 2009; Tukker 2006). Since customer needs can be satisfied by products, services, or the combination of them, the product and service should be designed simultaneously at early phase development (Bertoni 2012).

![Figure 1.2: Early Design Phase of PSS Development](image)

In early phase of PSS development, two different research streams are focused. The characteristic of first research stream is by identifying value...
and customer needs as a driving force at the beginning of product and service design process, a new integrated solution for customer to maximize their value and to meet their needs will be provided. The value and customer needs is starting point to initiate a successful PSS development (Larsson 2006; Halen, Vezzoli and Wimmer 2005; Ericson 2008). The characteristic of second stream is by providing system solutions based on integrating the existing products and services (Maxwell 2003; Tukker and Tischner 2006; Mont 2001; Sakao 2007).

For instance, taking a car rental company that introduced a Blueprint renting system to the market as example, many unexpected problems might happen. The car is not available when the customers are going to use it (it was stolen), the car did not start (poor maintenance) and the payment could not be easily done. These problems could be avoided by understanding customers’ behaviour and expectations and for example the solution could have been to equip the cars with anti-theft systems, self-checking, wireless internet and an automatic payment system. Thus it can be claimed that PSS successful solutions in particular rely on understanding customer value and needs beyond the core physical product (Patnaik and Becker 1999; Ericson and Larsson 2007; Ulwick 2007).

1.3.1 Customer Needs for Early PSS Development

Needs are means to an end, i.e., a human goal, to understand the needs the goal has also to be understood (Kamenetzky 1992). Maslow presents the Needs Hierarchy in the theory of human motivation, “since needs are taken as the starting point for motivating people to change a situation” (Maslow 1987). In industry, most designers intuitively understand that needs are important, because they know that they can successfully design solutions to solve people’s problems only when they clearly understand what those problems are. The main functions of needs are: “Need last longer than any solution; Needs are opportunities waiting to be explored not guesses at the future; Needs provide a road map for development; Needs spur action and
needs are obvious after the fact, not before” (Patnaik and Becker 1999, 38).

One of the key success factors of the PSS concept is that it is capable to fulfill customer needs in a larger extent, which is due to on the establishment of long-term relationships with customers. Customers do not only create a demand for certain products, but can also contribute to relevant information to be used in the product-service design. PSS is designed for meeting customer needs in a more holistic perspective than standalone products or services (Mont 2001; Halen, Vezzoli and Wimmer 2005; Ericson, Bertoni and Larsson 2009).

Customers’ needs are widely acknowledged as a valid input in PSS development (Mont 2001; Halen, Vezzoli and Wimmer 2005; Maxwell 2003; Tukker and Tischner 2006). Although, there is no unified description of what constitutes a need. Maslow’s hierarchy of needs are meant to explain a view of a ‘complete human being’ and what is motivating people to change their situations, but it has been found by research not readily practical for product development (Ericson and Larsson 2007; Patnaik 1999). Rolf Faste believes that “a need is in itself a perceived lack of something, and such needs are difficult to express in terms of a potential solution” (Faste 1987, 419). Other researchers pointed out “Something is a dilemma when the actors realise that all choices lead to unsatisfactory solutions” (Löwgren and Stolterman 2004, 83). Thus, a relation between dilemmas and such difficult to articulate needs can be recognised here (Ericson 2007, 43).

1.3.2 Theory of Needfinding

Some researchers and practitioners have been dealing with the task on finding needs. The word needfinding implies the interplay between needs and recognition (Ericson 2007). The theory of needfinding derived from the research of Stanford University’s (CA, USA) product design programme. Robert McKim, the head of the product design programme,
was searching for a way to bring designer closer to the users (Patnaik and Becker 1999). Based on this, he hypothesized that designers have to be involved at the early stages of product development in order to have a greatest impact on the product definition (Patnaik and Becker 1999). As a respond, Mckim began to apply qualitative approaches to studying people to identify their unmet needs (Patnaik and Becker 1999). During the last three decades, Needfinding has been developed considerable. Patnaik and Becker have articulated and extended the Needfinding approach due to a growing understanding of qualitative methods in the product development (Ericson 2007). Needfinding also affects the whole product development process (Patnaik and Becker 1999) and PSS design (Ericson 2007; Halen, Vezzoli and Wimmer 2005).

Today, although many industry projects have firmly established for capturing customer needs, it is still hard to find a practical needfinding method. As Ulwick had said: “Most companies nearly always fail to uncover all or even most of the customer’s needs” (Ulwick 2008, 1). Thus, customers have talent needs and these needs cannot be articulated. For early PSS development, there is a crucial problem on defining what types of customer needs are available for early PSS design (Ericson 2008). In most manufacturing companies, manager from different departments have different opinions on what kind of the customer needs they want to identify (Ulwick 2007). For example, it is very general for an automobile manufacturing company has a wide stakeholders’ network, long value-chain, and different customer categories. In this network, it is difficult for company to know where they should start to explore and what kind of customer needs they should focus.

Many existed methods were applied to capture needs such as: survey, focus groups, customer journey mapping, personal interviews, contextual analysis, observation approach and even the interviewing techniques like Voice of Customer (VoC), customer storytelling, experts workshop and lead user analysis, etc. But as Ulwick had pointed out that this dilemma on
searching customer needs: “Even many manufacturing companies assume that it is impossible to capture a complete set of customer need statements and that they have no choice but to execute the innovation process without knowing all of them” (Ulwick 2008, 4).

1.3.3 Value–The Driving Force for PSS Development

Different definitions of Value are presented in literature. Although the centrality of the value concept was recognized from both academic and industry, but in reality there have little knowledge exists about what value is, what its characteristics are, and how stakeholders determine it (Day 2000, 581). Among the others, one of the most common definition of customer value was defined as the perceived benefit relative to price (Monroe 1990). So, for research the customer trades continuously off the benefits she can get from a product-service with the costs to obtain such benefits. The equation can be expressed as following (Monroe 1990):

$$\text{Value} = \frac{\text{Benefits}}{\text{Cost}}$$

In manufacturing industry, Value was defined as the perceived trade-off between the positive and negative consequences of product use (Woodruff 1996). For instance, value as recognized as an emotional bond established between a customer and a producer (Butz 1996).

In the business market, value was defined as the “perceived worth in monetary units of the set of economic, technical, service, and social benefits received by a customer firm in exchange for the price paid for a product offering, taking into consideration the available alternative suppliers offerings and prices” (Anderson et al. 1993, 13). The value of a product is the mental estimation a consumer makes of it. “Generally it may be conceptualized as the relationship between the consumer’s perceived
benefits in relation to the perceived costs of receiving these benefits” (Monroe 1990, 22).

Research focused on value of PSS offerings has stated that value is subjective and can be shown as a function of consumers’ estimation. Meanwhile, value is relational, as both benefits and cost must be positive values (Bertoni 2012). This means that a product or service is generally considered to have good value if it has appropriate performance and a low cost. On the contrary, if a product or service has an inappropriate performance and a high cost, then the customer might consider it has a low value. In this case, performance and cost have become two main factors to assess the value of product or service. In ownership cycle of PSS, the customer-perceived value are not only generated from core product or pure service, but also more related to other activities like: maintains, upgrading, recycling and even build a long-term relationship with the customers (Zeithaml 1988; Ravald and Grönroos 1996).

Research has also tried to categorized value, among the others one can suit this thesis’ purposes because it focuses on customers of PSS offers (Kowalkowski and Kindström 2009, 34):

- **Product-based values**: such as quality, performance, and unit price;
- **Service-based values**: such as operation cost, customization benefits, and service consistency;
- **Relationship-based values**: based on the idea that a supplier and a customer maintain a relationship over time, thereby including value such as proactively, trust, long-term commitment, and shared norm and mindset.

Literature states that as a value proposition, PSS drives its value from a significant part from both the product and service element (Tukker and Tischner 2006). The essence of value propositions is at the heart of
business strategy and management, to define value provide scope to capture customer needs in a wide needs area.

1.4 Company Project - Needfinding in China

The overall purpose of this thesis has two distinctive perspectives. One is from academic view, by providing a deeper understanding of which methodologies can suit best in early PSS development. Another one is from industrial view, by carrying out a practical needfinding case for Volvo CE understanding customer needs in the Chinese market.

In this thesis, a company project has been carried out in close collaboration with the EmergingTechnology Department in Volvo CE. The result of this project will have influence on the new product and service provision of Volvo CE’s offering in the Chinese market. In the next session a background of the company will be provided. First, an introduction about Volvo CE’s total solution strategy will be brought into context, then the development of Volvo CE in the Chinese market will be discussed and finally an overview of how the company currently understands customer needs in the Chinese market will be presented.

1.4.1 Volvo Construction Equipment

Member of the Volvo Group, Volvo CE develops and manufactures equipment for construction related industries and is the second largest business unit within the Volvo Group. Volvo CE offers products and services globally by supplying more than 125 countries. Meanwhile, Volvo CE is starting to develop a new business philosophy that has been called ‘Total Solution’, in order to include in the term PSS liking value propositions (Volvo Construction Equipment 2012).

1.4.2 Total Solution Offering by Volvo CE

Total solution idea has been developed based on concept of Product-
Service System, thus total solution is different to traditional solutions with the overall vision of meeting and exceeding customer demands (Volvo CE Spirit 2009). The Volvo CE of total solution has two goals: one is building up long-term relationships around total solutions in order to let customer do their job as efficiently as possible with maximum profitability and uptime. Another is by offering services such as financing and insurance, various forms of service agreements, accessories and spare parts to support core products. The company’s increasingly broad range of these so-called ‘soft’ products has evolved into a distinct competitive advantage (Volvo CE Spirit 2009). Currently, Volvo CE is trying to apply its total solution strategy in what has become the the biggest market, the Chinese market, which represents still huge potential for the company’s development in the next years. However, the way of understanding local market value and customer needs for a Swedish based company is becoming a great challenge for the development of the “Total solution”.

1.4.3 The Development of Volvo CE in China

As one of the biggest economies in the world, China attracts and allocates most international companies to take advantage of the huge market in this country. For Volvo CE, China has already become its largest market by generate 46% of its net sales for Volvo CE’s global market in 2011 and the Company believes that this data is about to increase in the next year. During the past ten years’ development in China, Volvo CE has set down its local manufacturing sites, supply chain, distribution channels, stable dealership network and customers groups in China. For instance, in 2012, Volvo CE has established an R&D centre in China and more local designed products and services will be designed to meet the local customer needs. After running 10 years business in China, Volvo CE has recognized and stated that only rely on by selling its product couldn’t represent a long-term winning strategy in a fully competitive business environment. For further development in China, Volvo CE has the vision that the company
will not only limit itself to selling hardware product but also provide more services and integrated customer solutions for local customer in order to reach successful business goals on the Chinese market (Volvo Construction Equipment 2012).

**1.4.4 Understanding Customer Needs in China**

Today, Volvo CE has the belief that the local customers in the Chinese market are no longer fully satisfied with existing products or purely products provision. Meanwhile Volvo CE has realized that to stay competitive in the Chinese market in the long run they have to differentiate their machines from the competitors in a more unique way. This total solution would not only meet customers’ needs, but also add more value to them in order to maintain competitiveness of company in market. So the company has the necessity to understand better what the local needs are and how to meet them already since the early design phases.

Usually, customer needs and requirements are collected by marketing people, which means that during the customer needs acquisition stages, they may put more efforts on the cost and price perspective. Thus, the company would take the Chinese market as a low cost-oriented context for a long run. This way of understanding customer needs has become a main challenge for Volvo CE providing total solution in the Chinese market. The functional characteristic of manufactured products with a low quality is provided which was influenced by customer needs on low cost product. Consequently, many local customers complain about product’s quality problem during the use phase, the result from an inappropriate needfinding has caused a negative impact on Volvo brand in the Chinese market. If Volvo CE is going to become a total solution provider in the Chinese market, the challenge is to understand customers’ needs and values in-dept. A problem situation might be that the contemporary methods to capture customers’ needs are delimited to deal with new markets and organizational cultures.
2 Research Design

At the beginning of this thesis work, possible thesis topic, research questions have been investigated. After discussion with the company’s partners, literature review and interviews with research experts; the research scope and limitation have been defined as below.

Thesis topic: *Value-Driven Needfinding for Early Product-Service System development*

2.1 Research Questions

These two research questions were formulated to answer the thesis purpose:

1. *What specific needfinding methods can be used in early PSS development for company provision towards Sustainability?*

2. *How to conduct a practical needfinding for Volvo Construction Equipment to understand customer needs in the Chinese Market?*

2.2 Scope and Limitation

The scope of this thesis is both from academic research and company project perspective:

**Academic:** A methodology of value-Driven Needfinding was proposed for early PSS development. This methodology is composed by some methods already available for capturing customer needs. By applying this methodology, customer value can be defined and related needs can be captured. Then, how those findings can contribute to the conceptual PSS solution from sustainable perspectives has been discussed.

**Company Project:** This project started from January and ended at beginning of June in 2012. The project task was to identify stakeholders’ needs for Volvo CE in the Chinese market and particularly to focus on open
mining industry. Facing with only five months to complete the entire project, the project group members (Yan Zhang, Xi Chen) have chosen qualitative methods to gather the needs of the various Volvo CE stakeholders by conducting interviews and observations. Meanwhile quantitative method was used to analysis the result of needfinding. The interviews were conducted during two trips to Volvo CE in Eskilstuna, Sweden, and one-month “on the site” trip in Volvo CE’s branch in Shanghai and interviews with local dealers, customers and competitor in southwest of China. This company project has been focused later particularly on the open mining industry and a few customers within this industry. Some of the information used in this thesis are confidential and belong to the company partner, so some of them have not been included in this thesis.
3 Methodology

This section presents the phases performed through the whole thesis project, including the approaches adopted in order to solve the research question. Based on the working timeline and different purposes, there are three major research phases contained in this thesis and all approaches presented below will be categorized into the corresponding areas (see Figure 3.1). Within this scope, the best way to capture the distinctive data is by using some qualitative methods. Qualitative have been defined by research as what is defined by people’s experience in certain situations (Patton 2002). “Qualitative data are aimed at producing a ‘rich’ and ‘contextual’ understanding of experiences, rather than scientifically verifiable results.” (Patton 2002). Meanwhile thesis group also applied some quantitative ways to analysis data in order to present the importance and differences within data.

Figure 3.1: Structure of the Thesis
3.1 Preparation

The application of Design Research Methodology (DRM) and literature review were conducted in this section.

3.1.1 Design Research Methodology

As this thesis has gravitated towards the field of design research, it has been found helpful to adapt the Design Research Methodology (DRM; Blessing and Chakrabarti 2009). Usually a research methodology can be seen as a general framework to guide research project, and it helped the thesis thesis group to establish ways of approaching research questions. However there is a missing gap in research framework used especially for design research (Blessing and Chakrabarti 2009). How to address the importance of design research both from academic and practical perspective is what they want to accomplish in DRM and it is what thesis group wants to solve in this thesis. “A design research methodology is defined here as an approach and a set of supporting methods and guidelines to be used as a framework for doing design research.”(Blessing and Chakrabarti, 2009)

![DRM Framework](image)

*Figure 3.2: DRM framework (Blessing and Chakrabarti 2009)*
This framework consists of four stages: Research Clarification, Descriptive Study I, Prescriptive Study, and Descriptive Study II. The relationship between different stages can be seen from Figure 3.2.

During the first two stages, investigations including literature review, interviews, and company site visits were conducted to develop a description about the current situation. The shared vision and expectations of the company were studied and expressed. As the main purpose of doing this was to lead to research questions. During these stages, the network of influence factors was used to address the problem and lead to research questions. Then, the thesis activity moved to the next step which was about more into the prescriptive stage. The data and knowledge acquired from previous two stages was analyzed in order to reach the suggestions of improvements and modifications to the needfinding process.

This thesis mainly encompasses those first three stages of DRM (see Figure 3.3). The proposed improvements should be evaluated in stage 4 Descriptive Study II, but it is out of scope of the thesis based on time limitation. The outcome of solution and suggestions takes time to test in reality and need longer cooperation with the company, so solutions and suggestions even tools could be explored and evaluated in the future.

*Figure 3.3: Thesis Research Focus*
As mentioned at beginning of Method, there are three phases (Preparation, Into Practice and Evaluation) in thesis and methods applied will fill in certain phases. The application of DRM actually is designed for all phases. Three research stages in DRM correspond with three phases respectively. The thesis group takes DRM as a holistic means of thesis research planning to guarantee a successful process and promising results.

3.1.2 Literature Review

At the preparation phase, the literature review was executed for first two to three months at the beginning of thesis process. By doing this, the well understanding of research field was developed and the shared language within thesis team was established. Research topic area, research questions can be recognized. The types of literatures used in this step are book, journal, article, dissertation, conference paper, and document from internal company. It is expected to find evidence to address research questions and build theoretical foundation and benchmarking for next steps.

3.2 Data Collection and Analysis

The second section is to conduct fieldwork to test the methodology and obtain data that from the case in order to find out the possibilities for needfinding improvement. There are two main tasks in this phase, data collection and data analysis. The methodology, Value-driven needfinding used here is what the thesis group proposed for capturing needs is also introduced in 3.3. Interview and Observation as the complementary methodswere used in this section as well as in specific Value-Driven Needfinding methodology.

3.2.1 Interview and Observation

Face-to-face discussion and communication are relevant part of data collection. Informative communication in research team is very important
to build the shared language and common understanding on research topic (Kraut, Egido and Galagher, 1998). The interview and discussion were mainly held in forms of company site visits, phone meetings, formal meetings and informal occasions. Interview and observations were applied in second phase of thesis process, which is Into Practice. The reason is to get empirical data and first-hand experience from company, by doing this the current situation and rooms of improvements can be identified.

- **Interview Structure**

The structure of data collection is the degree of standardization that imposed on this data collection instrument (Churchill 1995). Usually, regarding the purpose and expectation of interviews, researcher will conduct highly structured, semi-structured form of interviews. For this thesis, the thesis group were mainly looking for influence factors that are qualitative data in order to distinct characteristics from different contexts. So highly structured interview was not applied and semi-structured interviews were used during whole interview process. All interviews were scheduled in advance and predetermined but with open-ended questions, which means by asking certain questions, researchers would not lead results into specific answers. More questions will come up regarding the interview objective environmental context and more communications were emerged during interviews. This method allows researchers to uncover more specific issues, but meanwhile it requires researchers have fully understood with their purpose and also with open mindset. It is very common, during interviews, that researchers would either to narrow communication scopes or expand topics because interview objectives will sometime interpreter in too detail or too general without clear restriction during semi-structured interviews.

- **Tools used in the interviews**

Generally, the interview has taken one to two hours of each on average. Video recording, audio recording and photographing are complementary
methods during interviews. The thesis group tried to take notes during conversation and validate them after working. Most of the time, one group member took the role as actual interviewer asking questions, and another one wrote down their answers as much as possible.

Besides interviews, the thesis group also have taken the form of observatory when doing site visit, for instance in the open mine in Haikou mine in southwest of China, in order to acquire some data: observing people’s behaviour and emotion in their own environment can gain much clearer understanding of their situation (Patnaik and Becker 1999). During observations, video recording and photoproduced evidenceto help the thesis group to capture people’s behaviour.

3.3 Methodology of Value-Driven Needfinding

The proposed needfinding methodology for early PSS development, called by the authors Value-Driven Needfinding (VDN), for PSS development is outlined in four main phases (see Figure 3.4). In phase1, stakeholders are analysed from holistic perspective. The second phase is to define the customers’ value definion in order to understand value creation process has to be carried out. In phase3, this phase integrates methods of Customer Job Mapping (introduced in 4.2.3) and Ownership Cycle Framework (introduced in 4.2.3) into needs collection phase and then to categorize customer needs into corresponding steps according to the two methods. During this process, value defined as benchmarking to allow needs collected around the process of value generation. Then, the categorized customer needs can be seen as value-based needs for PSS developer. In last phase, by using a quantitative method to assess the categorized needs.
Figure 3.4: Methodology of Value-driven Needfinding

3.3.1 Phase 1. Stakeholder Analysis

Stakeholder analysis can be seen as a process with the aim to identify people who are likely to affect or be affected by proposed action. It is strongly recommended that the co-creation with multiple stakeholders at early stage of PSS development, because it can lead to value exploration (Yip, Phaal and Probert. 2012). PSS development requires an initial stakeholder analysis (Halen, Vezzoli and Wimmer 2005). In this thesis, a stakeholder analysis was conducted to understand project background and to determine the needfinding scope.
3.3.2 Phase 2. Defining Value

After understanding the current situation of each stakeholder, a customer value identification is required to be conducted. Firstly, in the thesis work, the meaning of value in the specific industry where the customer are running their businesses was defined, such as product based, service based and relationship based value, etc. Secondly, by interviewes with customers, the meaning of value for them can be understood, such as: productivity of product, total revenue of production and satisfaction of customer service, etc. Thirdly, by observation and interviews, the process of how customer generates value from their business was captured. The specific customer needs can be found through these value creation process. Since the interviews did not focus only on the existing product or services, the true desired function from customers could be expressed. All in all, the defining value phase can be seen as a scope to filter various customer needs for next steps.

3.3.3 Phase 3. Needs Collection

Generally, traditional approaches to capture customer needs are carried out based on the problems of existing products or services. People will pay more attentions on these existing solutions and ignore the reason why they use this function of products or services and what exactly they want to accomplish by doing this. This functionality is very importance for PSS development since it usually requires the cooperation of product and service design. The process of how they accomplish their goal steps by steps can also picture a scenario for designers to fully understand those customer needs. In this phase, two methods for collecting needs were used and are introduced as following:
Method of Customer Job Mapping

The Customer Job Mapping has been recognized as a powerful method for mapping out customer needs in field of Outcome-Driven Innovation (ODI) during past 18 years (Ulwick 2007). Its main function is to separate business processes into process steps, and each process steps contains needs and requirements within it. Thus, many companies support the fact customers are buying products and services for a specific purpose: to get jobs done. From Ulwick 2007, “A job is defined as the fundamental goals customers are trying to accomplish or problems they are trying to solve in a given situation” (Ulwick 2007). Furthermore, how customers accomplish their goal can be defined as the business process, and the goal is the “job” that customers want to get done. Customer job is defined as the stable, long-term focal point around which value creation should be centred because the job’s perfect execution reflects the customer’s true definition of value (Ulwick 2007). A framework of this method is presented as all jobs can be categorized into eight fundamental steps (see Figure 3.5), and the description of the different customer needs in each step are described below:

Figure 3.5: The Method of Customer Job Mapping
**Define:** This step includes defining goal of task, determining objectives, planning the approach, selecting the resources and assessing which resources are necessary to complete the job.

**Locate:** In this step, customer has to know the inputs or items must locate to do the job, and inputs are both tangible and intangible.

**Prepare:** The meaning of this step shows that how customer prepares the inputs and environment to do the job. Generally all the customer jobs involve an element of setting up and organizing materials.

**Confirm:** After customer makes sure that materials and the working environment have been properly prepared; validates the quality and functional capacity of material and informational components; and confirms priorities when deciding among execution options.

**Execute:** In general, customer considers the execution step as the most important part of the job, products and services are mostly applied in this step in order to help customer to achieve the optimal result.

**Monitor:** In this step, customer must keep an eye on the result or outcome during execution, especially to determine whether they have to make adjustments to get the task back on track with problems.

**Modify:** Modify means when there are changes in inputs or in the environment, or if the execution is problematic, the customer may need help with updates, adjustments, or maintenance.

**Conclude:** Conclude may involve some concluding process steps. The customer has to record and assess the result of their job.

- **Ownership Cycle Framework**

  Literature shows that one of contribution of PSS is shifting the ownership from customers to producer, thus, customers with this kind of business model are mostly consuming product’s functions instead of owning
product (Mont 2001; Halen, Vezzoli and Wimmer2005; Maxwell2003). The Ownership Cycle Framework (Ulwick, 2008) provides a structure to show how customer interfaces with product and service during the use phase. This framework consists by 12 main steps relate to the use of the product and service in ownership cycle (see Figure 3.6):

![Ownership Cycle Framework](image)

*Figure 3.6: Ownership Cycle Framework*

The idea of the ownership cycle framework is to let designer can well understand the needs before actual design in order to optimize customer needs in each of job in this framework. Sometimes, a product does not work very well as it supposed to be, the reason behinds it could be the presence of this product during use phase is not represented during design. Common marketing people collect customer needs and brought back to the design department internally within the manufacturing company. However, those new products are designed based on desired needs would miss the target when they come to the market. This is mainly because market researchers tend to express those needs into some attributes, such as price, cost, whereas designers are working with specific product’s characteristics. Conflicts and misunderstanding will arise when they can’t share the same language. In this thesis, the ownership cycle framework is used for capturing needs from dealer perspective instead of from customer aspect.
3.3.4 Phase 4. Needs Analysis

Needs have been collected in phase 3. The categorization process has been carried out afterwards by both the methods of customer job mapping and ownership cycle framework. Through these two methods an operative organization of the identified needs into each specific step is possible. Two matrices can help to organize them (see Table 3.1 Matrix of Needs from Customer Job Mapping and Table 3.2 Matrix of Needs from Ownership Cycle). A need-based scenario, such as customer needs, problems, current solutions and Voice of Customer (VoC) can be categorized and expressed into four columns in horizontal and into certain steps from two methods in vertical, the result of needs matrix has shown in appendix. As an example, the brief expression of customer needs (A), which has been edited by thesis group. Then followed by the current problems (B) and current solution (C) of customer in working site are also listed. Original customer VoC expression (D) is at the end to help people to picture the scenario. The matrixes presented below is illustrative and not conclusive; hence, it is merely intended to give an instance of a possible operative matrix. The matrix is suggested to be used as a base for collection, assessment and evaluation of the collected customer needs.

Table 3.1: Matrix of Needs from Customer Job Mapping

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Define</td>
<td>A1</td>
<td>B1</td>
<td>C1</td>
<td>D1</td>
</tr>
<tr>
<td>Locate</td>
<td>A2</td>
<td>B2</td>
<td>C2</td>
<td>D2</td>
</tr>
<tr>
<td>Prepare</td>
<td>A3</td>
<td>B3</td>
<td>C3</td>
<td>D3</td>
</tr>
<tr>
<td>Confirm</td>
<td>A4</td>
<td>B4</td>
<td>C4</td>
<td>D4</td>
</tr>
<tr>
<td>Execute</td>
<td>A5</td>
<td>B5</td>
<td>C5</td>
<td>D5</td>
</tr>
<tr>
<td>Monitor</td>
<td>A6</td>
<td>B6</td>
<td>C6</td>
<td>D6</td>
</tr>
<tr>
<td>Modify</td>
<td>A7</td>
<td>B7</td>
<td>C7</td>
<td>D7</td>
</tr>
<tr>
<td>Conclude</td>
<td>A8</td>
<td>B8</td>
<td>C8</td>
<td>D8</td>
</tr>
</tbody>
</table>
The purpose of the presented framework can let PSS designer to easily understand user needs and their interaction with product-service attributes during product use phase. From the first step to the end, each of customer’s and dealer’s needs can be showed as a clearly scenario by the needs matrix table. The result of these two needs matrix tables are showed in Appendix A, Appendix B and Appendix C

Table 3.2: Matrix of Needs from Ownership Cycle Framework

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>E1</td>
<td>F1</td>
<td>G1</td>
<td>H1</td>
</tr>
<tr>
<td>Receive</td>
<td>E2</td>
<td>F2</td>
<td>G2</td>
<td>H2</td>
</tr>
<tr>
<td>Install</td>
<td>E3</td>
<td>F3</td>
<td>G3</td>
<td>H3</td>
</tr>
<tr>
<td>Set up</td>
<td>E4</td>
<td>F4</td>
<td>G4</td>
<td>H4</td>
</tr>
<tr>
<td>Learn to use</td>
<td>E5</td>
<td>F5</td>
<td>G5</td>
<td>H5</td>
</tr>
<tr>
<td>Interface with</td>
<td>E6</td>
<td>F6</td>
<td>G6</td>
<td>H6</td>
</tr>
<tr>
<td>Transport</td>
<td>E7</td>
<td>F7</td>
<td>G7</td>
<td>H7</td>
</tr>
<tr>
<td>Store</td>
<td>E8</td>
<td>F8</td>
<td>G8</td>
<td>H8</td>
</tr>
<tr>
<td>Maintain</td>
<td>E9</td>
<td>F9</td>
<td>G9</td>
<td>H9</td>
</tr>
<tr>
<td>Upgrade</td>
<td>E10</td>
<td>F10</td>
<td>G10</td>
<td>H10</td>
</tr>
<tr>
<td>Replace</td>
<td>E11</td>
<td>F11</td>
<td>G11</td>
<td>H11</td>
</tr>
<tr>
<td>Disposal</td>
<td>E12</td>
<td>F12</td>
<td>G12</td>
<td>H12</td>
</tr>
</tbody>
</table>

3.4 Value - Driven Needfinding: Into Practice

This section aims at evaluating the usefulness of the thesis results and the Value-driven needfinding methodology which thesis group proposed. The purpose of the section has been reached using two manners. Firstly, a detailed case study is presented in order to demonstrate how the Value-driven needfinding can be used in reality. This case study is elaborated in 5.1 Case Study. Secondly, by providing two Scenarios Comparison, a PSS conceptual design will be illustrated to show how the value driven needfinding can be used as a support tool in early PSS conceptual phase. The different impact from sustainability standpoint (People, Planet, and
Profit) from two different scenarios (one with the current traditional solution and one with a designed PSS from Value-Driven Needifinding) will be also assessed and evaluated. The comparison and the result of evaluation are presented in 5.2. Scenario Comparison.
4 Results of Value-Driven Needfinding

This chapter presents the result of an applied Value-Driven Needfinding process (framed trough the different phases of stakeholder analysis, customer value, customer need and needs analysis) by conducting an empirical study with Volvo CE in the Chinese market.

4.1 Stakeholders Analysis

The thesis group conducted many interviews with different stakeholders. In this thesis, four types of stakeholders were involved: Volvo CE (including Volvo CE in Eskilstuna, Volvo CE in Shanghai), Dealers, Customers, and Competitor were interviewed. The interviews with Volvo CE Eskilstuna and Volvo CE Shanghai were held to define the project scope and establish project network. So the details description of interviews with Volvo CE is not listed here since the outcome of these interviews could not so much relevant to answer research questions. Experts in Volvo CE interviewed with are listed in Appendix A.

The overall aim of needfinding is to bring customer needs to the designers. So customers are obviously the most important stakeholder group to conduct interviews. Dealers on one hand can be seen as the customer of Volvo CE; on the other hand, it can be seen as the extension of Volvo CE itself, due to the Business-to-Business model applied by Volvo CE. Dealer is the front desk contact with customers, and Volvo CE is actually supporting dealers in the process. The interviews with dealers can be helpful to understand the relationship among customer, dealers and Volvo CE.

Competitor is of course one important actor in every business and it directly or indirectly affects a company’s success. In this project, the thesis group had a chance to interview one of the dealers of Volvo CE’s biggest
competitor, Caterpillar. The main reason was to be aware of PSS development in construction machinery industry. Also the development and coverage of competitors in Yunnan were discussed. Other stakeholders such as suppliers, institutes, and media are excluded from this project due to the time constraints and project scope. Information and data regarding with legislation of the mining industry in China was investigated as background knowledge to learn about. The details about each interview object, interview processes were presented in Appendix D.

### 4.2 Defining Value for Stakeholders

By interviews and observations, different values for different customers and dealers were defined as below:

- **Key account (dealer):** keeping long-term relationship with big contractor customers; owning high customer satisfaction are key value for it. Such as signing the long-term service contract with big contractor customers like state-owned company, large scale private company who would like to pay on new products and services for a long run.

- **Sales channel (dealer):** the value for it is emphasized on high revenue of hard product selling, the increasing profit by selling parts and services to small customers. Such as sales revenue and number of new customer, etc.

- **Big contractors (customer):** high volum of mineral production, high quality and good performance of product, lower risk of accident happened, high safety of mining production process, effective mining management and high productivity of production process.

- **Small contractors (customer):** like private companies; the value for them is lower fuel consumption and high quality of product.
Increasing the volume of mineral production.

4.3 Needs Collection

This section shows the result of the captured market needs from dealers and mining customers. The detail about needs scenario for each customers, include with current problems, current solution and Voice of Customer can be found in Appendix B.

4.3.1 Dealers Needs

In China, there are more than 60 Volvo’s dealers located in 31 provinces. Usually, there are at least two dealers for each province. Due to time schedule (two weeks of work “on the site”) and the dimension of the Republic of China, this project only chooses dealers in one province of China. Two types of dealers in the Volvo CE’s dealership system, Key Account and Sales Channel. Dealer who takes care of big contractor customers is key account. Sales Channel often looks at the rest of customers, including relatively small contractors, private company, and individual rental company. The list of main interview objects within two companies and detail of each dealer are presented in Appendix D. The result of needs matrix from sales channel and key account dealer are presented in Appendix A and Appendix B separately. In this thesis, two dealers are chosen for conducting interview as below:

- **Key Account (dealer):** Beijing Century Development Technology (BCDT)Co., Ltd. Kunming Branch

- **Sales channel (dealer):** Kunming Enrich Construction Machinery (Enrich YN) Co., Ltd

Dealer’s needs are categorized by the ownership cycle perspective (see Table 4.1). Needs are gathered from the interaction among dealers and Volvo CE, the dealers and their customers. Here, the ownership covers all
provision including hard product, service and integrated solution from Volvo CE. The thesis group translated their detail description of customer needs into brief needs expression and listed those needs in each phase of mining customer daily production process as below.

**Table 4.1: Number of Dealer’s Needs in Ownership Cycle Category**
(Source: Dealer interviews in China, March, 2012)

<table>
<thead>
<tr>
<th>Needs Category</th>
<th>Number of Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>22</td>
</tr>
<tr>
<td>Receive</td>
<td>2</td>
</tr>
<tr>
<td>Install</td>
<td>2</td>
</tr>
<tr>
<td>Set up</td>
<td>0</td>
</tr>
<tr>
<td>Learn to use</td>
<td>8</td>
</tr>
<tr>
<td>Interface with</td>
<td>8</td>
</tr>
<tr>
<td>Transport</td>
<td>3</td>
</tr>
<tr>
<td>Store</td>
<td>1</td>
</tr>
<tr>
<td>Maintain</td>
<td>8</td>
</tr>
<tr>
<td>Upgrade</td>
<td>24</td>
</tr>
<tr>
<td>Replace and Disposal</td>
<td>3</td>
</tr>
</tbody>
</table>

**Purchase Phase:** In this phase, the authors mainly listed the needs from first step of how customers gain the ownership from company existing provision such as financial support, product, service, and system support, etc.

**Channel Sales**

- A stronger brand building from Volvo CE.
- Dealer needs more trust and support from Volvo CE.
- Dealer needs more trust and support from Volvo CE.
- Risk sharing and financial support to help dealer retain customers.
- To prolong account period of down payment.
- To share financial burden together with Dealer.
- Lower current down payment rate in order to attract more individual customers.
- To set up different standard of customer buying certification for different customers.
• To attract more customers by lowering the standard of current buying certification.
• Increasing the financial support in response to the promising future
• To enhance the financial support and strategy to reduce the risk on installment.
• Enhancement of brand competitiveness of Volvo CE.
• To set up marketing strategy for state-owned company.
• To prolong the receivable account period in order to reduce stress on dealer’s cash flow.
• More financial supports from Volvo CE are needed on parts purchasing and storing.
• Balancing the cost differences between internal and external markets,
• Eliminating smuggling from external markets (Korea)

**Key Account**

• Maintaining the good performance on fuel consumption of Volvo CE’s product.
• Reducing emission for next generation of new product.
• To enhance the competitiveness and cost-effective of Volvo product when facing with Chinese brands.
• To decreasing the expenditure of parts & replacement on hauler
• Dealers want to have a fair market, and hope that Volvo CE could cut off the illegal parts brought in from Korea

**Receive:** Needs in Receive phase indicate the ability of dealers and customers to obtain provision from Volvo CE.

**Channel Sales**

• Sufficient demo machines to attract more customers.

**Key Account**

• A quicker receiving time for product and parts

**Install:** Needs in Install phase indicate that the ability of dealers to help customers to install the provision they purchased and the ability of customers to install.
Channel Sales

• Increasing the existing service coverage

Key Account

• Increasing the existing service coverage

Set up: Needs in Set Up phase indicate that the ability of dealers to help customers to set up certain projects or activities to deliver better performance for customers and customers’ own ability to set up such projects. But in this project, the interviewed customer doesn’t show their needs on this step.

Learn to Use: Needs in Learn to Use phase indicate that the ability of dealers to educate customers to predominate some functions of provision and how customers can study those functions by themselves.

Channel Sales

• Volvo CE provides sufficient technical support on machine operating.
• More efficient and frequent training for dealers
• Practical user manual.
• Presenting machine’s functions and performance easily instead of falling into detail of mechanical information.
• Increase the number of operator training

Key Account

• Volvo could provide useful quarterly reports to dealer, especially on maintenance information.
• Dealer wants quarterly reports could be translated in Chinese.
• To apply the function of GPS in various areas, like navigation, monitoring, tracking and security etc.

Interface with: Needs here indicate that the current situation of interaction among Volvo, dealers and customers, such as communication and respond.

Channel Sales
• Providing more flexible supports and keep in good faith with the dealer
• A quick Information feedback loop in Volvo CE.
• Training activity for manager of customer’s company.
• Building up a close relationship with operators

**Key Account**

• Automatic alarming system on the maintenance parts.
• Automatic information system to predict the product lifetime.
• Quicker and efficient information feedback loop between VOLVO CE and Shanghai
• Easy and effective communication approach at mining working site between customer and maintenance people in sites

**Transport:** The current situation of provision transportation to dealers and customers is listed as below.

**Channel Sales**

• Reducing the time consuming on logistic the parts & replacements supply
• Easy assembling and disassembling machine on different working sites

**Key Account**

• Easy assemble and disassemble machine on different working sites

**Store:** The current requirements of product storage from dealers and customers are listed here.

**Key Account**

• The increasing demands on parts, storage capacity needs to be expanded.

**Maintain:** The ability of dealers maintaining skill and supports from Volvo CE to maintain product are translated into needs here.

**Channel Sales**

• Sufficient technical support from Volvo CE on thorny issues.
• Skillful Volvo CE expert on maintenance aspect.
• Back up Planning.
• Easy maintaining and easy replacing with the parts.

**Key Account**

• Volvo CE provides more effective technical supports on thorny problem.
• Adding the number of employee on technical support.
• To reduce the time spent on waiting problem
• Decrease the high expenditure spend on overhaul

**Upgrade:** Some complains and suggestions regarding existing provision from dealers and customers are provided here, those needs do not focus on small changes of provision but big improvements even new provision opportunities.

**Channel Sales**

• Changing marketing strategy in China with more aggressive approach
• Maintaining or improving the good performance of fuel consumption
• To adjust business model with dealers based on Chinese market situation.
• Flexible training schedule plan for operator training, timing is very important
• Solving the spilling problem on hose and enhance the quality of it
• To adjust current working time of maintenance people, set up more practical working hours
• To improve the structure of engine and heat exchanger
• To fix spilling problem on rubber key
• To enhance GPS system and provide new features about it
• Customers want more optional on small tonnages of product.
• Customers want more optional on a wide tonnages of product.
• Need to improve soft product application in a competitive market

**Key Account**

• Trade-off between product’s tonnage and labor cost.
• To enhance service capacity for the Gold CSA provision.
• More proactive service provision instead of the current passive way.
• Testing about friction plate in K3 Clutch on hauler-40E before sold it to market.
To solve spilling problem of rubber key.
To enhance the quality of E series hauler.
To test and verify product before product actually into market.
Redesigning the transmission/Gearbox on E series hauler.
Expend its life time and enhance quality.
To prolong the life time of the hauler.
To prepare a back-up plan for keeping constantly production.
Enhance the quality of hauler-40E.

Replace and Disposal: The current solution of dealers and customers taking care of used machines generate some needs that are listed s below.

Channel Sales
- Future assessment on second-hand market.

Key Account
- Company could provide recycling service initatively.
- After machine recycled, customers could get discount when they plan to purchase new product.

4.3.2 Customers Needs

Mining customers are main interview objects in this project. The Voice of Customer (VoC) obtained from mining industry needs to take many hierarchies then at last into Volvo CE. The list of main interview objects within big contractor customer and detail of its situation are presented in Appendix D. The needs matrix of customer is presented in Appendix A.

- **Big Contractor** (State-Owned Company): YUNTIANHUA Group Co., Ltd.

The thesis group applied value driven needfinding to find customers’ needs with Volvo’s big contractor-YTH which is a state –owned company. The needs, as stated from YTH of its general daily production process, were categorized with the method of customer job mapping and tallied in order to come up with distinctions (see Table 4.2).
Table 4.2: Number of Mining Customer Needs in Job Mapping Category  
(Source: Customer interviews in China, March, 2012)

<table>
<thead>
<tr>
<th>Needs Category</th>
<th>Number of Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define</td>
<td>1</td>
</tr>
<tr>
<td>Locate</td>
<td>1</td>
</tr>
<tr>
<td>Prepare</td>
<td>2</td>
</tr>
<tr>
<td>Confirm</td>
<td>1</td>
</tr>
<tr>
<td>Execute</td>
<td>4</td>
</tr>
<tr>
<td>Monitor</td>
<td>5</td>
</tr>
<tr>
<td>Modify</td>
<td>2</td>
</tr>
<tr>
<td>Conclude</td>
<td>4</td>
</tr>
</tbody>
</table>

**Define:** Needs in the Define step indicate that mining customer determine with their daily working objectives, making production plan, assessing the construction machines and people need to complete the daily job.

- Need to obtain environmental information such as working site condition for site manager sitting in offices.

**Locate:** Needs in Locate step indicate that customer needs to know the inputs need locate to put into working sites for production, and inputs are equipment, human resource and related information.

- Need to know real-time distance between changing mining points and dumping point in order to avoid inaccuracy during calculation.

**Prepare:** Needs in the Prepare step indicate that customer prepares both tangible and intangible products, services and environment to do their jobs in order to make sure the production will running well as they had planned.

- Need for early warning function on machines to inform people in offices.
- Need the automatic warming system to allow one person to take care of many machines and response quickly.
Confirm: Needs in Confirm step indicate that customer makes sure that materials and the working sites have been properly prepared; validates the capacity of machines, people and informational when deciding among execution options.

- Need for a production simulation to formulate the optimal daily production plan from alternatives.

Execute: Needs in Execute step indicate that the execution step as the most important part of the job for customer value generation. The main working processes that we focus on this step are includes: pre-strip, dirt dumping, striping, loading, transporting.

- Need a device for each operator to have conversation with managers directly. This device can provide clear dialogue and good quality.
- Need for an easy and direct way to dispatch and coordinate machines in offices. By this way, there is no need to have that many dispatching people on sites.
- Need a management solution to ensure the optimal performance of existing machines.
- Need to maintain or improve the fuel consumption performance.

Monitor: Needs in Monitor step from views of enhance production, productivity, safety on mining sites monitoring, fleet management, dispatching, communication. In order to achieve these views that customers must also monitor environmental factors to see whether and when adjustments are necessary.

- Needs to know the real-time production activities for managers sitting in offices.
- Needs to know the working condition of machines and operators for dispatching people sitting in the offices.
- Need for a device such as GPS which can be flexible enough to monitor changing working sites.
- Need for an easy and direct way or device to communicate with operators.
• Need to monitor individual operator’s performance for dispatching people works in the offices.

Modify: Needs in Modify Step indicate that problems and requirements on working sites need customer to updates, adjustments, or maintenance their machines and information.

• Need to improve the skill of technician from dealer.
• Need for backup plan for customers to keep working.

Conclude: Needs in Conclude step indicate that mining customer need to assess their production, productivity, cost and fuel consumption for daily production.

• Need to distinguish the number of loaded bucket rising and empty bucket rising.
• Need for dispatching people sitting in the offices to obtain the ore weight right after the truck loaded.
• Need for automatic recording about all data, and statistic department people can calculate on computer directly.
• Need for device to provide accurate measurement or calculation about production for managers.

4.4 Needs Analysis

In this section, the number of customer needs which are recorded in each phase in each of the needs matrices will be assessed by using a quantitatively. The bar charts (see Figure 4.1 and Figure 4.2) depict the the number of these needs in order to present a direct comparison among them. According to comparison, the decision maker could understand which steps have more customer needs to improve or provide new solutions.
Figure 4.1: Needs Assessment of Volvo’s Dealers in China

Figure 4.2: Needs Assessment of Mining Customer in China
5 Value-Driven Needfinding: Into Practice

In this section, a case study regarding the application of Value-driven needfinding is presented below. The detail sequence of needfinding activities in the Chinese market is described as well. After that, two scenarios comparison, one based on current solutions and one conceptual PSS solution to solve the problem of production monitoring are proposed in order to demonstrate how a Value Driven Needfinding can be used as support tool for PSS design, which might contribute towards sustainable development. To show the impact of the two solutions from a sustainability standpoint, the two authors have conducted a qualitative assessment of the impacts along the three dimensions of economy, environment and human society.

5.1 A Case Study in the Mining Industry

This section presents a case study in needfinding activities in the Chinese market for Volvo CE. One thing that needs to be addressed is the state-owned enterprise in China. In China 2008, the Second National Economic Census revealed that 63 trillion SEK— or 30 percent of total (208 trillion SEK) from industrial and service sectors was held by state-owned enterprises. ‘The state-owned enterprise controls a substantial part of total enterprise assets in China despite the fact that their total number is marginal’ (WorldBank, 2012). Those state-owned enterprises, to a large extent, have to rely on and be restricted by national policy. So when comes to the needfinding in the Chinese market, it is reasonable and understandable to include government as one of the major stakeholders and it is reasonable to take a state-owned company as main interview object in this thesis.
5.1.1 Customer Background

YTH Group, the state-owned company chosen for this case, owns the biggest phosphate mine in China. Right now, there are four main mines located in different places of the Yunnan province. The annual production of each mine is more than one million tons. Taking into account the limited time, this project has chosen one of the phosphate mines - Haikou mine in southwest of China (see Figure 5.1). It was built in 1966 and in 2005 YTH group took over the management of Haikou mine. There are four mining sites in Haikou mine. The average production is one million tons and traffic volume is 10 million tons (Baichuan 2011). There are more than 200 construction machines in Haikou mine, includes with 25 Volvo haulers, 3 Volvo EC700 excavators and other brands such as Caterpillar, Komatsu and domestic brands. In Haikou mine, features as mountain area located, ore scattered, soft soil, and continuous downhill terrain make the relatively low cost of production.

Figure 5.1: Haikou Mine Glimpse
5.1.2 Daily Production Process

In this case study, a daily production process has been put into focus since it is what customers are repeatedly doing everyday to obtain the production. This daily production process is then put into eight steps of customer job mapping: then a scenario of how customers obtain production is shown (see Figure 5.2) which are divided into three main phase as below:

![Diagram of Mining Production Customer Job Mapping]


Figure 5.2: Mining Production Customer Job Mapping

- **Define Daily Production Plan**

The daily working process is almost the same for every day. It starts with a morning meeting that is held to make the detailed production plan. Before everyone including site manager, dispatching team leader and operators get together, people from production department will drive around the whole mining site to observe and assess previous production schedule because the mine sites is changing all the time. During this process, daily working report from the day before will be looked through. Looking at all these
factors and at the distance calculations between different stripping sites and
dumping sites, the daily production plan can be defined. The allocation of
excavators and numbers of haulers and trucks can be fixed.

- **Daily Production Management and Monitoring**

After allocating tasks for different machines and people, the production
activities begin. Machines and people need to find their spot on sites. Usually as planned, certain number of haulers and trucks will serve one
specific site, and there is one people standing beside this site to monitor the
whole production and operators. The communication between him and
operators is by waving hands or making calls. Meanwhile site manager
needs to continually drive around those different sites (average 100km per
day) to manage and monitor. If the site manager realizes that the task
allocation for one site is not correct, for instance, (if too many haulers or
trucks serving one excavator), the site manager will call the monitoring
people who is on the site to inform him to adjust the machines tasks.

- **Daily Production Closure**

At the end of day, production department people need to assess daily
production. Currently, operator needs to take note for every day work. There is a daily operator sheet for them, in which operators will fill in
some data, such as daily working hours, daily mileage, number of turnover
time and etc. Then all operator sheets (more than 100) for one day will be
collected and people from production department will record them in the
daily report of duty turnover which helps them to evaluate daily production
in total. The information of total production is the determining factor for
the production department to arrange the production plan for the next day.

### 5.2 Scenario Comparison

This section gives two scenarios in order to compare a current solution and
a possible conceptual PSS design derived from the phase ‘conclude’ from
customer job mapping category in order to solve the current problem of the “production assessment” (see Figure 5.3). The main purpose is to investigate the impacts of the current solutions and the potential PSS solution from sustainable standpoint, and to show the strengths of the PSS concept to generate a more sustainable solution.

5.2.1 Scenario 1: Current Solutions for Production Assessment

Scenario 1, (see Figure 5.3), depicts the current solution and the process of how people obtain the production data. Volvo CE now only generates profits by producing and selling the hardware machines to customers. Thus the ownership of the product belongs to mining customer. In this scenario the customer assesses the daily production by itself and the process can be described as following:

*Figure 5.3: Scenario 1: Current Solution for Production Assessment*
- **Solution 1: Manual Sites Monitoring:**

There are two monitoring people on the site (number 1 in Figure 5.3). They are working 8 hours per day on each working site. Their job is to observe the hauler to load mineral (see Figure 5.3). After a hauler is filled with ore, the monitoring person gets a permission paper to allow the operator to drive to the weighbridge house. As the current solution, the weighbridge is a way for the mining company to get an accurate result of the weight of the hauler, but in general the weighbridge house (number 2 in Figure 5.3) always is far from mining sites. During the process of weighting, it takes one hour for the operator to go back and forth, it costs extra money to pay for weighting services and after that, the operator needs to bring the receipt of this weighing services back to a statistic department in the mining company to assess the daily production. Thus, high fuel consumption, fuel cost and emission are drawbacks of such a process in this solution.

![Dispatching on working site](image)

*Figure 5.4: Manual Sites Monitoring*

- **Solution 2 Manual Production Assessments**
In order to get the result of the weight, the operator (number 3 in Figure 5.3) needs to fill out a form in order to take record about the turnover time per day, every day once the operators finish the a day’s work (see Figure 5.5). This allows company to calculate the rough production per day per hauler by manual counting, but it is a huge task and really takes time for production department to summary each of sheet from two hundreds machines in every day.

Figure 5.5: Daily report of equipment production and durty turnover

- **Solution 3 Monthly Manual Measuring**

At the end of month, there are some measuring people (number 4, see Figure 5.3) that calculate the production with instruments observing and assessing production directly on the working sites (see Figure 5.6). However, there are usually big deviations between the number of calculation from the measuring people and the operators recording sheets. Thus, the problems become rather inefficient.
5.2.2 Scenario 2. New PSS Design - Automatic Production Assessment System

Scenario 2 (see Figure 5.7), designed by the thesis authors based on the PSS design studies and the Value-Driven Needfinding, there is an automatic weighting system incorporated into each hauler. Once the hauler is full loaded, the accurate number of weight will be shown to the operator. With the assistance of an information sensor (number 4), the number of the weight and other conditions of hauler will be sent to offices (number 5) where people can acquire information in a very convenient manner and easily from the computer in their offices. By showing the information about production of each of machine, the sites manager can understand the total production of each working sites and dispatch the machines in order to meet the different production requirements on the working sites.
Unlike in scenario 1 (Volvo CE only sell products), in scenario 2, Volvo CE could not only sell hardware products (for example, the haulers and the integrated soft product like weighing system), but also it offers a constant service fee from the use of the weighing system. In the future, the ownership of a PSS solution such as the tangible product (the hauler) and the intangible service like the soft product (weighting system) and the information provision system will belong to Volvo CE itself instead of the haulers being owned by customer, and the services was bought from the dealer. The application of PSS will change current ownership to a large extent. Meanwhile, the integrated solution and services (number 3) including automatic weighing and information transmission based on existed product are added to meet the need of customers to obtain production data. The new features of design on machines show the
potential of product and service provision for Volvo CE. By doing this, the system of a product and service can be established for Volvo CE providing more value to customers and allows Volvo CE’s solution provision to be more sustainable and competitive within the mining industry.

### 5.2.3 Scenario Evaluation from a Sustainability Standpoint

In this thesis, the definition of sustainability covers three perspectives, people, planet and profit. The positive (+) and negative (−) impact on sustainability of the two scenarios are listed in the two tables below.
### Table 5.1: Current Solution Evaluation from Sustainable Perspective

#### Current Solutions of Production Assessment

<table>
<thead>
<tr>
<th>People</th>
<th>Planet</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>• It requires many people to collect data for one purpose about production. Duplication of effort; (-)</td>
<td>• Extra fuel consumption during the driving between long distance of working sites and weighbridge house; (-)</td>
<td>• Increase labor costs. It requires many people to work together to get job done; (-)</td>
</tr>
<tr>
<td>• Trust issue between operators and monitoring people; (-)</td>
<td>• Increase emissions and wastes during the driving between working sites and weighbridge house; (-)</td>
<td>• Extra costs on weighbridge service; (-)</td>
</tr>
<tr>
<td>• Safety issue. Too many people are working on dangerous mining sites; (-)</td>
<td>• Extra paper consumption on printing hundreds production sheet every day; (-)</td>
<td>• Inaccurate data may cause losses; (-)</td>
</tr>
<tr>
<td>• Unhealthy working environment. Monitoring people needs to work on the dusty working sites; (-)</td>
<td></td>
<td>• Complicated ways of production statistic cause errors and may cause looses; (-)</td>
</tr>
<tr>
<td>• Long working hour. Monitoring people needs to stand beside machines all day long; (-)</td>
<td></td>
<td>• The production management and fleet management were impacted by limited information about production; (-)</td>
</tr>
<tr>
<td>• Time-consuming on assessing the production for a fleet, Statistic by manual; (-)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5.2: PSS Solution Evaluation from Sustainable Perspective

<table>
<thead>
<tr>
<th>People</th>
<th>Planet</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Less people work on working sites; (+)</td>
<td>• Reduce energy consumption due to no need to drive to weighbridge house; (+)</td>
<td>• The Ownership of the customer solutions is owned by Volvo CE itself. (+)</td>
</tr>
<tr>
<td>• Automatic technology may eliminate the trust issue between different people on sites; (+)</td>
<td>• Reduce emissions and wastes due to no need to drive to weighbridge house; (+)</td>
<td>• Decrease labor cost to pay for people working on production evaluation; (+)</td>
</tr>
<tr>
<td>• Eliminate safety issue to some extent; (+)</td>
<td>• Reduce material consumption on weighbridge house establishment; (+)</td>
<td>• Decrease costs on weighbridge services per time; (+)</td>
</tr>
<tr>
<td>• Monitoring people can work in offices with relatively good working environment; (+)</td>
<td>• Reduce the paper consumption on printing production sheet; (+)</td>
<td>• Quick and accurate production information feedback may minimize deviation in order to enhance the production; (+)</td>
</tr>
<tr>
<td>• Automatic system can share part of work load from people, so they can finish jobs within normal working hours; (+)</td>
<td></td>
<td>• Automatic system can improve, production management and may further increase productivity; (+)</td>
</tr>
<tr>
<td>• Automatic system can speed up the calculation of production, decrease working hours on statistic; (+)</td>
<td></td>
<td>• Possible high initial cost on automatic system set up; (-)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Require more investment on technical support for applying this system; (-)</td>
</tr>
</tbody>
</table>
6 Discussion

This section begins with discussing the general application experiences of Value-driven needfinding in accordance with the sequence of phases. Meanwhile, the feasibility of Chinese customers’ and dealers’ needs turning into corresponding provisions is elaborated, as well as their preferences on types of provision (product, service and integrated solution). At the end, the influence on sustainability of the two scenario presented are discussed.

6.1 The Application of Value-Driven Needfinding

Four phases in this methodology (Stakeholders Analysis, Defining Value, Needs Collection and Needs Analysis) presents the detail sequence and methods in value-driven needfinding. First phase of the Value-driven Needfinding is to map out stakeholders around company in order to get a holistic view of the market. However, due to the project scope and time constraints, only the needs of big contractor customer and dealers were collected. Data and information from government stakeholder were not so abundant to fully understand the influence on the industry from a national level.

At the second phase, defining value allowed the thesis group to conduct interviews and ask questions within scope. The value scope was also commended by Volvo CE and facilitated one of its future system solution developments in soft product department in Chinese market. Nevertheless, there are no specific methods in this thesis for value identification other than face-to-face interviews and background study. Traditional survey is usually conducted by marketing people, so they may naturally take customer value as mainly a factor related to price, such as sales price and
cost for maintenance. The core values that the customer wants to receive is different in each industry and requires a deeper understanding. Future study that will deal with value identification and definition is definitely needed.

In the third phase, an actual daily production process was described by customers and then thesis group analyzed the actual “job” that customer wanted to accomplish in process. The result of customer needs was closely connected with productivity and production activities, which means that these needs are represented and restricted by customer value from the very beginning. Meanwhile, needs in these eight phases did not show specific solutions but functionalities which corresponds to the main characteristics of PSS in order to provide the functionality. The thesis group used to think that the future trend of Volvo CE is to sell product by itself instead of rely on dealer as current way. However in reality dealer takes care of many responsibilities for the company to satisfy customers, the future trend for company is to enhance the dealership, which further proved that the importance of conducting need finding at early PSS development.

At the phase- (needs analysis), the thesis group characterized the needs producing matrixes of needs. The clarity of presentation has been the main reasoning behind the choice. The needs assessment figure provides a comparison between needs in different steps. By going through this figure, designers can decide which step should be chose as first priority to develop with. But in reality, the result from need analysis couldn’t directly help the designer make the final decision due to PSS design has many processes such as: need translation, functional analysis, concept generation and prototyping etc. The implementation of a practical PSS solution requires more investigations and discussions at early phase of PSS development.

Although there are still many problems should be considered in this methodology. The authors also acknowledge that the approach needs further improvement. Methods and approaches used in this methodology have to
be further improved. For example, the application differences between methods of Customer Job Mapping and Customer Journey Map from whole product lifetime perspective should be further discussed. The specific approaches of defining value from customers and value evaluation have to be studied in the future. The methodology itself basically helped the thesis group to conduct successful customer needfinding activities in China.

6.2 The Chinese Market Calls for PSS Development

This section mainly discussed about the Chinese customers’ and dealers’ preference on future solution provision from PSS perspective. Needs are analyzed from the Product, Service, and Integrated Solution aspects. The percentage of the data shows here were assessed by thesis group based on categorizing amount of captured needs into these three aspects.

6.2.1 Customers’ Preference

![Pie chart showing customer needs in the Chinese market]

*Figure 6.1: Percentage of Mining Customer Needs in the Chinese Market*

From Figure 6.1, it shows that most of customer needs in the Chinese market are located in integrated solution instead of only on pure product or pure service aspect. Customers have huge demands on purchasing both
tangible and intangible provision, as the case study showed. The required integrated solutions are: mining production management, fleet management and mining sites monitoring, etc. Meanwhile, the figure shows that customer needs comes from existing construction equipment and service are limited. Moreover in mining industry in China today, customers are aware that many approaches could help them to achieve their goal instead of only relying on tangible provision like applying construction machines. Intangible provision such as information, management and service can also contribute to their production on a large extent. For this reason, market calls for more system solution to accomplish customer’s goal and add value for their business.

In a competitive market, only by enhancing functionality of hardware product and quality of service could not fulfi customer needs, it calls for manufacturing companies to provide more improvements on designing integrated solution in order to enhance its competitiveness. This type of needs can be seen as the new opportunity to motivate innovative provision in company. This innovative provision will not be restricted by specific product or service, possible innovative functionality that can bring about greater choice of alternatives for customers can be revealed.

6.2.2 Dealers’ Preference

![Figure 6.2: Percentage of Dealer’s Needs in the Chinese Market](image)

59
As can be seen from Figure 6.2, most needs from dealers are concentrated on service aspect. Dealers have huge demands on financial support, technical support and training from Volvo CE. Specific needs, such as to fix excavator spilling problem and hauler transmission problem, are categorized in product aspect. But from current situation of market, they do not have many needs on integrated solution aspect. The chart also sheds light on how the future integrated solution (total solution) would look like. If Volvo CE wants to achieve total solution provision for which is also customers are looking, the dealership needs to be enhanced. The tangible product provided by Volvo CE should possess physical and technical features to make sure part of total solution function can be shown. Moreover, the close connection with dealers should be improved in order to facilitate dealers to introduce and performance the integrated solutions to customers from intangible perspective. The future integrated solution (total solution) definitely calls for the tight combination of tangible and intangible provision and tight relationship between Volvo CE and dealers.

6.3 Towards Sustainability, the Contribution of Value-Driven Needfinding for Early PSS Development

The result from comparison between scenarios of current solution and PSS solution in part 5.2, the application of PSS solution might produce more positive influences from a sustainability perspective as well. From society’s standpoint, it provides safe, effective, comfortable, healthy and automatic functions that satisfy customer needs based on their specific requirements. For the environment, the new PSS solution shows more positive impacts on environmental, such as reduce gas emission and decrease material consumption to some extent. From the profitability point of view, it influences on both cost reduction and increasing volume of production. From the cost side, it doesn’t need to hire many people work on sites to assess the production, for that the high labour cost can be
reduced. At the same time, the cost that is paid for the weighbridge service can be saved also. Although the cost for initiating an automatic production assessment system might be high at the beginning, but in long run that the total operating cost will lower comparing with the current solution. From production side, the productivity can be increased by sites manager could well understanding the production of each machine timely. The machines can be dispatched based on timely production information in order to meet the requirements of whole production process. For instance, the fleet management and production management could be beneficial from the information of automatic weighting function to some extent.

The main point is that new PSS solution makes a shift in the product and service mix, moving existed mining customer from a resource–based production system to a knowledge-based system in which all commercial activities seek to fulfil customer’s needs.
7 Conclusion

In early design stages, manufacturing companies have the challenges of understanding and defining what to develop, what to provide in terms of products and services in order to remain profitable the competitiveness in intense competitive market.

This thesis has investigated how the early phase of Product-Service System development can be improved, by working of needfinding phase with a Swedish manufacturing company in order to capture and handle customer needs with the aim of designing competitive solutions.

Starting from the introduction of PSS development, this thesis has identified problems and challenges in early development phase. The thesis has further provided a methodology for capturing and analyzing customer needs, named by the authors Value-Driven Needfinding. A case study with the development of PSS solutions by Volvo Construction Equipment (Volvo CE) in the Chinese market, current situation and problems in mining industry was introduced and showed how to apply the value-driven needfinding methodology in reality. The authors have performed a potential PSS solution that solves the problem of production monitoring in a mining site. To show the higher potential of the PSS solution compared to the existing one, a qualitative comparison has been run by the authors. In the scenario comparsion, the influence of existing solutions and new PSS solution have been compared qualitative from a sustainability standpoint. Even though the comparison had the aim to assess the two solutions from a System level, so it will require further and more refined analysis, it shows the higher potential of a PSS solution to provide benefits for the Company’s profit, the environmental impact and society’s well-being.
The results of this thesis are discussed in the following section from methodology application, market needs and sustainable influence separately.

The thesis work has lead to the following conclusion:

**(1) Value is posed as the premise of early PSS development, by defining value as the driving force for needfinding.**

In early design phase, customer's value is defined by understanding customer’s business, observing the way of how customer generate profits from their working process and how they can get satisfied by hiring certain type of products or services, which is important for every designer. Value provides a scope for the needfinder to identify customer needs within the field where the customer’s value was generated. According to the scope, the captured needs can be more value-oriented than the result from general needfinding approach. As a result, the new PSS, which is designed based on those captured value-oriented needs, can meet more customer needs and add more value for the customer.

**(2) As a new integrated approach, the methodology of Value-Driven Needfinding provides a systematic structure to ensure all value-oriented needs are captured for development of a PSS in the early phase.**

The methodology proposed in this thesis has been called Value-driven needfinding, which aims to provide methods for manufacturing companies for conducting a structured research about customer needs at the early phase of PSS development. The traditional approach of customer needs investigation is mainly executed by marketing people, where focus is predominantly on the cost of existing products or services. When the company focus is a new type of business model, such as a PSS provision, this approach was revealed are unable to provide a systematic structure for PSS designers to understand customers’ needs. Generally speaking, the methodology of value-driven needfinding firstly poses the premise of PSS
development, which is the customer value. Then, needs obtained from market do not solely reveal drawbacks of existing provision from a customer’s value perspective, but more importantly they provide the desired functionality customers want to accomplish their goal.

(3) Through Value-Driven Needfinding, the opportunities for PSS solution provision towards sustainability might higher created if designed in early design phase.

PSS is recognized as a potential way for manufacturing company to move towards sustainability. By reasoning, thesis group has compared the sustainable influence existing solution that tries to solve the problem of monitoring the production of a mining site, and a PSS solution based on Value-Driven Needfinding designed by the authors. The comparison shows that the new PSS solution provides more positive influence on sustainable aspects such as, people, planet and profit. Although further validation needs to be done, since the comparison has been run qualitatively, and might naturally be affected by subjectivity, it still shows that the new PSS concept might bring into sustainable advantages for mining customer.

**Future Work**

It is believed that this thesis has taken a step for company’s provision towards sustainability at the early PSS development. The proposed methodology of value-driven needfinding provides sequential phases and specific methods to understand customer value and identify customer needs. However, future work should be carried out to further analyze the collected customer needs by closely cooperating with the manufacturing company partner and translating these needs into functional requirements by using tools, such House of Quality (QFD), in order to translate the collected needs into design requirements. Meanwhile, a value assessment

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approach should be developed to evaluate these needs in order to check whether they are value-oriented needs or not.

The feasibility and other details of PSS solution for mining industry in China such as fleet management, site monitoring system and weighting system needs to be discussed based on the future collaboration with Volvo CE in the future.
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## Appendix A: Needs Matrix of Big Contractor Customer

**YTH Group, YUNTIANHUA Group Co., Ltd.**

### Table A1: Needs Matrix of Mining Customer Job Mapping

<table>
<thead>
<tr>
<th>Phase</th>
<th>Customer Needs</th>
<th>Problem Statement</th>
<th>Current solution</th>
<th>Detail Description (VoC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Define</strong></td>
<td>Need to obtain environmental information such as working site condition for site manager sitting in offices.</td>
<td>It takes times for managers to drive to the actual working sites among different sites and offices, back and forth, for environment observation.</td>
<td>Site manager has to drive a car around whole working sites to observe and to collect information.</td>
<td>Every morning, site manager drives around on working site to observe and then drives back to office to submit information. Information including working environment, ore hardness, and soil condition is considered to further make daily production plan.</td>
</tr>
<tr>
<td><strong>Locate</strong></td>
<td>Need to know real-time distance between changing mining points and dumping point in order to avoid inaccuracy during calculation.</td>
<td>Site manager has to calculate all the time, since the mining points and dumping points change a lot. The accuracy of calculation could not be guaranteed.</td>
<td>Based on sites observation from previous phase, they calculate on paper map so the calculation is very rough.</td>
<td>Once the environmental condition from different working sites acquired, site Manager has to calculate the distance between mining (digging) point and dumping point in order to allocate excavators and trucks working on different points.</td>
</tr>
<tr>
<td><strong>Prepare</strong></td>
<td>Need for early warning function on machines to inform people in offices. Automatic warming system allows one people to take care of many machines and response quickly.</td>
<td>It takes time and spends a lot of manpower and resources to make sure everything is fine.</td>
<td>Taking lubricate as an example, one people needs to go through routine lubricate examination for all 75 haulers.</td>
<td>Information such as numbers of machines and operators, bucket capacity, working speed, and machines condition (diesel, lubricate) is considered. Site manager wants to make sure everything is fully prepared.</td>
</tr>
<tr>
<td>Confirm</td>
<td>Need for a production simulation to formulate the optimal daily production plan from alternatives.</td>
<td>The inaccuracy of information collected from previous phase makes hard for site manager to fully confirm daily production plan.</td>
<td>Site manager depends on his/her experiences to make plan and extra work to make sure production is going well.</td>
<td>Once all information mentioned above is collected, site manager has to make detail daily production plan. Allocating tasks for every operators and machines. Usually he/she formulates alternatives and determines one of them as priority. However, he/she can depends on nothing but his/her experience, which means there are uncertainty within daily plan and it may cause extra works and problems for next step.</td>
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</tr>
<tr>
<td><strong>Execute</strong></td>
<td>Need a device for each operator to have conversation with managers directly. This device can provides clear dialogue and good quality.</td>
<td>How to inform and communicate with each operator is a big problem. Too many dispatching people cost money and brings potential dangers on safety.</td>
<td>Dispatching people gets phone calls from managers and by waving hands to inform operators. They used interphone for a while, but too many people using it made chaos. The quality of interphone is not very good on mining site.</td>
<td>In order to make sure the production activities successful, the communication with people who works on sites is necessary. The adjustment of machines on sites happens sometime, so site manager needs to contact with operators to inform them off to another location. However there is no communication device on machines, there are one or two dispatching people always standing on each point to transmit orders from managers to operators. There are more than 20 dispatching people on whole mining sites. They usually by waving hands to attract operators’ attention.</td>
</tr>
<tr>
<td><strong>Execute</strong></td>
<td>Need for an easy and direct way to dispatch and coordinate machines in offices. By this way, there is no need to have that</td>
<td>It is impossible to dispatch and coordinate machines in offices, site managers need to remember all dispatching people’s phone number in order</td>
<td>Site manager calls dispatching people, and dispatching people talks to operators.</td>
<td>Dispatching People has to stand beside the machines to coordinate them. By waving hands to stop them and talking to operators face-to-face to coordinate.</td>
</tr>
<tr>
<td>Execute</td>
<td>many dispatching people on sites.</td>
<td>to contact with them.</td>
<td>Needs a management solution to ensure the optimal performance of existing machines.</td>
<td>The performance of existing machines sometimes are not so good, and the optimal efficiency of whole fleet is difficult to play, due to the coordination and cooperation among machines is hard to conduct.</td>
</tr>
<tr>
<td>Execute</td>
<td>Need to maintain or improve the fuel consumption performance.</td>
<td>It is an opportunity to maintain the good performance of fuel consumption on excavator.</td>
<td>People buy VOLVO CE excavators.</td>
<td>The Fuel consumption of excavator is around 0.14L per square meter on average. Compare with other brands, it is the lowest fuel consumption.</td>
</tr>
<tr>
<td>Monitor</td>
<td>Needs to know the real-time production activities for managers sitting in offices.</td>
<td>Managers can only by driving among all sites to be aware of production condition.</td>
<td>Managers drive among all sites.</td>
<td>During production activities, site manager has to drive around on sites to monitor overall production works (100km on average per day). Dispatching people also needed to monitor each machine and operator’s performance.</td>
</tr>
<tr>
<td>Monitor</td>
<td>Needs to know the working condition of machines and operators for dispatching people sitting in the offices.</td>
<td>Dispatching people has to stand beside machines to obtain the first-hand information from machines and operators, which cause potential</td>
<td>Dispatching people has to be aside the machines.</td>
<td></td>
</tr>
<tr>
<td>Monitor</td>
<td>Need for a device such as GPS which can be flexible enough to monitor changing working sites.</td>
<td>They could not find a better way to take record and transmit real-time information from working sites.</td>
<td>Manager drives around sites and dispatching people look after.</td>
<td>Site manager said that they considered about monitoring device such as camera to monitor working sites. But the sites are always changing. It is not practical to set cameras every time. And it requires very delicate and flexible angle of camera recording. They think the application of GPS may be a good idea, but till now nobody provide such technique to them.</td>
</tr>
<tr>
<td>Monitor</td>
<td>Need for an easy and direct way or device to communicate with operators.</td>
<td>It is hard for manager to deliver his/her ideas or to order with operators directly. Communication is still a problem during monitoring.</td>
<td>Site manager calls dispatching people, and dispatching people talks to operators.</td>
<td>During monitoring, any problems or adjustments about machines or operators, manager hast to call dispatching people to instruct and dispatching people needs to talk to operators face-to-face.</td>
</tr>
<tr>
<td>Monitor</td>
<td>Need to monitor individual operator’s performance for dispatching people works in the offices.</td>
<td>It is difficult to monitor operators’ performance during production activities.</td>
<td>Based on operators’ honesty to record their working load on sheets every day. Dispatching people has to stand beside to make sure they are working.</td>
<td>Site manager said that it is actually hard to monitor and assess operators’ performance during production activities. They can only evaluate them by the sheets recorded by operators. Information such as turnover times is fulfilled with by operators themselves. There are too many operators working on sites, managers can only pay the same amount of salary to them regardless of good or bad operation skills.</td>
</tr>
<tr>
<td>Modify</td>
<td>Need to improve the skill of technician from dealer. Need for backup plan</td>
<td>The sudden technical problems could not be solved timely; Sometimes need to shut</td>
<td>Customers work it out by themselves; hire skilled technician from other place</td>
<td>Technical support from dealers is very poor, they could not figure out what is the problem, no mention to fix it. Very small problems may cause shutdown.</td>
</tr>
<tr>
<td>Conclude</td>
<td>for customers to keep working.</td>
<td>down working because the problem couldn't be fixed by dealer.</td>
<td>Or they can be only waiting until problem solved.</td>
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<td>-------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
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<tr>
<td>Need to distinguish the number of loaded bucket rising and empty bucket rising.</td>
<td>The function of number of bucket rising on machines can be easily changed. It could not show the actual working load of operators.</td>
<td>Operators write down the number anyway based on his/her honesty.</td>
<td>After one day work, operators need to write down the number of bucket rising during production activities. The number of bucket rising is one of the most important factor to hauler operators' works. There are monitoring device on hauler to calculate the rising numbers and operators need to write down how many they did. But operators can also cheat by rising up the empty bucket in order to increase number of turnover.</td>
<td></td>
</tr>
<tr>
<td>Need for dispatching people sitting in the offices to obtain the ore weight right after the truck loaded</td>
<td>It takes time and cost extra money to get weighing services from weighbridge house at another place.</td>
<td>Get permission and drive to another place to weigh ores.</td>
<td>Besides operators take records of his/her working load. Dispatching people needs to give a paper permission to an operator every time, after one truck loaded with ores. Operators can only be allowed to drive to weighbridge house to weight the ores. It takes time and money to get weighing services there.</td>
<td></td>
</tr>
<tr>
<td>Need for automatic recording about all data, and statistic department people can calculate on computer directly.</td>
<td>Too many sheets and documents need to be organized and calculated every day for one people.</td>
<td>Statistic department people have to write down on another note, and make table into computer.</td>
<td>Every operator will submit working load sheets and weight number (all written on paper) got from weighbridge house to statistic department people. There are more than 200 sheets he/she needs to organize and calculation every day.</td>
<td></td>
</tr>
<tr>
<td>Need for device to provide accurate measurement or calculation</td>
<td>There is error in production calculation.</td>
<td>Production calculation by different means and people to verify, but still</td>
<td>After each month, there is a geological exploration team will go to sites to investigate and measure how many square meter has been removed during past month. They can</td>
<td></td>
</tr>
<tr>
<td>about production for managers.</td>
<td>inaccuracy exists.</td>
<td>calculate the monthly total production. However, this number sometimes could not match the number of calculation by daily production adding. activities.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table B: Needs Matrix of Ownership Cycle

<table>
<thead>
<tr>
<th>Phase</th>
<th>Needs</th>
<th>Problems</th>
<th>Current solutions</th>
<th>Voice of Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>A stronger brand building from Volvo CE. Dealer needs more trust and support from Volvo CE.</td>
<td>Customers are concerning about the lineage of Volvo's excavator due to negative information separates from other competitors.</td>
<td>Dealers explained to customer about the history of Volvo's product. Rely on Volvo's customer support.</td>
<td>Customer concerns most of Volvo products like excavator BC700 is not 100% original from Sweden, assemble product. Customer concerns about Credibility.</td>
</tr>
<tr>
<td>Purchase</td>
<td>Dealer needs more trust and support from Volvo CE.</td>
<td>It is hard for dealer to attract new customers, and Volvo CE may doubt dealer's ability.</td>
<td>Dealers explained to customer about the history of Volvo's product.</td>
<td>“I don’t know where is my excavator coming from? Sweden or Korean or assembling in China?”</td>
</tr>
<tr>
<td>Purchase</td>
<td>Risk sharing and financial support to help dealer retain customers</td>
<td>For channel sale, dealer takes more risk to help customer to pay part of down payment.</td>
<td>Dealers have to pay part of spent in advance for customers in order to retain customers.</td>
<td>Customers sometimes failed to pay down payment, even it is only 25% of whole cost. Under this circumstance, dealers have to pay part of spent in advance for customers in order to retain customers.</td>
</tr>
<tr>
<td>Purchase</td>
<td>To prolong account period of down payment. To share financial burden together with Dealer.</td>
<td>Dealers need to provide more money and account period to help customers to prepay down payment</td>
<td>Dealer pay by itself without help from Volvo CE.</td>
<td>For this part of money, dealers can only provide by themselves without VOLVO CE support. Meanwhile, since the account period is short, customers still cannot pay all cost, dealers have to pay in advance all money by themselves to VOLVO CE. Sometimes, those customers were failed to pay back money to dealers, so dealers have</td>
</tr>
<tr>
<td>Purchase</td>
<td>Lower current down payment rate in order to attract more individual customers</td>
<td>Compare with other brands (Caterpillar and Komatsu), the actual rate of down payment is very high.</td>
<td>Dealer shares part of down payment for customers by themselves.</td>
<td>The rate of down payment in Volvo is 20%, but in fact, it conclude: 20% (down payment) + 2.5% (security deposit) + buying commission 2.5% (VFS) + insurance 5% = 30%~35% down payment in actually. So customers need to pay a lot for down payment which poses a big pressure on them. E.g. Cat and Komatsu only asks for 18% down payment.</td>
</tr>
<tr>
<td>Purchase</td>
<td>To set up different standard of customer buying certification for different customers. To attract more customers by lowering the standard of current buying certification.</td>
<td>Many financially unqualified customers want to buy Volvo products. Same buying certification was applied for certifying different customers.</td>
<td>Dealer help those customers by paying part of their down payment to qualify these customers to apply for VFS.</td>
<td>VFS in China: to get the support from VFS, dealers need to collect customers materials (including repaying ability) then give to VFS, VFS will evaluate and consider about financial service. However, in order to retain customers and attract more customers, dealers will help some unqualified customers (who could not pay all down payments at once) to make them qualified. Dealers prepay to VFS for their customers.</td>
</tr>
<tr>
<td>Purchase</td>
<td>Increasing the financial support in response to the promising future.</td>
<td>Dealers are not sure that VOLVO CE can provide sufficient financial support when facing with</td>
<td>Dealers try their best and by all means to attract potential customers.</td>
<td>Industry prospect: China Grand Western Development Program will boost mining industry, even bank credit crunch, prospect is still</td>
</tr>
<tr>
<td>Purchase</td>
<td>promising market trend</td>
<td>promising.</td>
<td></td>
<td></td>
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<tr>
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<td></td>
</tr>
<tr>
<td><strong>Purchase</strong></td>
<td>To enhance the financial support and strategy to reduce the risk on instalment.</td>
<td>Not only small individual customer but even big contractors prefer to choose the instalment, which makes dealers stressful on their financial risk.</td>
<td>If necessary, dealers will help customers to prepay part of payment.</td>
<td>Customer type: big contractor (focus on scale of company, not necessary on number of machines.) Dealers think highly of customers’ potential. This type of customers used to pay all money at once, but now they prefer to pay by instalments.</td>
</tr>
<tr>
<td><strong>Purchase</strong></td>
<td>Enhancement of brand competitiveness of Volvo CE. To set up marketing strategy for state-owned company.</td>
<td>It is hard to persuade state-owned customers to only chose and apply one brand machines.</td>
<td>Dealer tries their best to sell machine by different approaches. Even bribe manager and officer in state-owned company.</td>
<td>Does state-owned customer just buy one brand product? State-owned customer owns more than one brand on the site. Because decision makers need to consider about money and quality, and multi-brands can balance what looks like on working site. If only one brand used on site, people will connect this with bribery. Multiple brands can be also beneficial in competition to increase the quality of service provided by each brand.</td>
</tr>
<tr>
<td><strong>Purchase</strong></td>
<td>To prolong the receivable account period in order to reduce stress on dealer’s cash flow.</td>
<td>The account period is too short for both dealers and customers.</td>
<td>Dealers need to take risk to prepay for customers within account period</td>
<td>The receivable account period decided by VOLVO CE is three months, after that dealers need to pay all money to VOLVO CE, but usually customers can only pay all money after one year. Risk control department in company takes care of this part. Competitor: Komatsu account period is ONE YEAR.</td>
</tr>
<tr>
<td><strong>Purchase</strong></td>
<td>More financial supports from</td>
<td>Dealers need to prepay a lot to</td>
<td>Dealers need to prepay almost</td>
<td>After customers get replacements or parts</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Purchase</th>
<th>Volvo CE are needed on parts purchasing and storing.</th>
<th>purchase parts &amp; replacements for customers</th>
<th>15 to 18 million RMB per year for parts purchasing.</th>
<th>then they will pay for them. So in this way, dealers need to prepay the payment of parts and replacements to Volvo CE: 30 (thousands) X 500 or 600 (20level excavators) = 15,000,000 or 18,000,00 (15-18 millions SEK per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>Balancing the cost differences between internal and external markets, Eliminating the smuggling from external markets (Korea)</td>
<td>Cheaper parts from external markets disrupt the internal markets</td>
<td>Dealers try to persuade customers to buy parts from them.</td>
<td>Some spare parts and replacements from external market (Korea) are very cheap, these parts are mainly smuggled from Korea and transported to Yantai, Guangzhou city in China. They have the same quality as original ones but 50% cheaper. Some people used to work for Volvo after they left; they found a way to sell external parts to customers.</td>
</tr>
<tr>
<td>Receive</td>
<td>Sufficient demo machines to attract more customers.</td>
<td>There are not enough available demo machines</td>
<td>Dealers can do nothing but ask for more supports from VOLVO CE Shanghai</td>
<td>Business adjustment for dealers is always falling behind. One of the reasons is lack of demo machine.</td>
</tr>
<tr>
<td>Install</td>
<td>Increasing the existing service coverage</td>
<td>The coverage of service is insufficient for current business. Service people are busy in running among different areas.</td>
<td>Dispatching service people working around working sites.</td>
<td>Current technical people couldn’t solve customers’ problems due to the number of technician and their skills.</td>
</tr>
<tr>
<td>Learn to use</td>
<td>Volvo CE provides sufficient technical support on machine operating.</td>
<td>Dealers could not get enough technical support from VOLVO CE</td>
<td>Dealer asks for helps (both from parts or financial assistance.) among dealers to exchange</td>
<td>Since VOLVO CE technical support is insufficient, dealers help each other. They share one a domestic communication software QQ group to discuss about problems</td>
</tr>
<tr>
<td>Learn to use</td>
<td>More efficient and frequent training for dealers</td>
<td>The efficiency and frequency of training from VOLVO CE is not enough for increasing demands from dealers</td>
<td>Dealers help each other, but the outcome is far from satisfactory</td>
<td>The request for more training is increasing. The number of staff is increasing, but the efficiency and frequency of training is very limited.</td>
</tr>
<tr>
<td>Learn to use</td>
<td>Practical user manual. Presenting machine’s functions and performance easily instead of falling into detail of mechanical information.</td>
<td>Volvo product manual is not practical and less useful for customer.</td>
<td>They seldom use it.</td>
<td>Volvo product manual gives lots of description on product detail functionality, but somehow it is not what customer wants.</td>
</tr>
<tr>
<td>Learn to use</td>
<td>Increase the number of operator training</td>
<td>Training for local customers is not enough</td>
<td>There are no trainings for customers</td>
<td>Training to customers is very important. If customers are not familiar with machines, they may mis-operate it, the best machine efficiency could not be delivered, and in this case, they will report to decision maker level that machine is not good, then Volvo will lose the faith from this customer.</td>
</tr>
<tr>
<td>Interface with</td>
<td>Providing more flexible supports and keep in faith with dealer</td>
<td>Confronting with unreasonable customers, dealers need to try hard to retain and attract customers</td>
<td>Dealers need to retain customers anyway</td>
<td>In China, customers breach of contract or change their mind all at sudden is common, legal restriction is weak, so to some extent, contract is just a wastepaper. So dealers call for VOLVO CE’s confidence in them, help dealers to get through hard time and help them to grow up.</td>
</tr>
<tr>
<td>Interface with</td>
<td>A quick Information feedback loop in</td>
<td>There are only a few people in VOLVO</td>
<td>Dealers can do nothing but waiting.</td>
<td>Feedback loop takes too longer. There are only a few people work for</td>
</tr>
<tr>
<td><strong>Interface with</strong></td>
<td><strong>Volvo CE.</strong></td>
<td><strong>CEShanghai to take care of information feedback</strong></td>
<td><strong>giving feedbacks to dealers. One people need to take care of dealers from many provinces, usually it means more than 8 dealers at same time.</strong></td>
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</tr>
<tr>
<td><strong>Interface with</strong></td>
<td><strong>Training activity for manager of customer company.</strong></td>
<td><strong>Manager does not pay attention on operator training.</strong></td>
<td><strong>Dealers need to persuade and educate them by all means, but more passive.</strong> Also, Volvo needs to put impact on decision level of a customer, then will have influence on their production, productivity and maintenance of machines. The more Volvo can be understood, the more customer relationship can be enhanced.</td>
<td></td>
</tr>
<tr>
<td><strong>Interface with</strong></td>
<td><strong>Building up a close relationship with operators</strong></td>
<td><strong>Unskilled operators will blame for product performance and customers may not apply Volvo product any more.</strong></td>
<td><strong>Dealers need to bribe operators not to report to customers.</strong> Usually, operators in China have low educational level. They are hired for short time for specific project. So customer would not pay the training fee for operators. When dealing with big customer, dealer will bribe operators to report machine problem directly to dealers, rather than customers.</td>
<td></td>
</tr>
<tr>
<td><strong>Transport</strong></td>
<td><strong>Reducing the time consuming on logistic the parts &amp; replacements supply</strong></td>
<td><strong>Products and parts are always out of stock, it causes customers need to shutdown work.</strong></td>
<td><strong>Dealers disassemble demo machines to help customers keep working</strong> VOLVO CE factory is always out of stock, and logistics take too long. Usually within 10-12 days. Customers did not happy with that, and dealers can only disassemble the demo machine in shop and give parts to customers.</td>
<td></td>
</tr>
<tr>
<td><strong>Transport</strong></td>
<td><strong>Easy assembling and disassembling machine on different working sites</strong></td>
<td><strong>Transport machine in mountain areas is really inconvenient. Hard to move big</strong></td>
<td><strong>Customers will hire trucks and other equipments to transport and assemble</strong> It is inconvenient to transport big tonnage machine in mountain areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Action</td>
<td>Issue</td>
<td>Recommendation</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Maintain</td>
<td>Sufficient technical support from VOLVO CE on thorny issues. Skillful VOLVO CE expert on maintenance aspect.</td>
<td>Customers need to shutdown work because of poor technical skills on thorny issues. Dealers try to fix it by their experiences.</td>
<td>Technical support is insufficient. So dealers will fix problem by themselves (groping forward). No matter what, keeping customer production activity going well is most important thing.</td>
<td></td>
</tr>
<tr>
<td>Maintain</td>
<td>Backup Planning. Easy maintaining and easy replacing with the parts.</td>
<td>Lack of backup plan to support customer when their production has shutdown. Dealers try to fix it by their experiences.</td>
<td>Volvo marketing style is very “gentle” compare with other competitors. Maybe sometime it needs to put Gentle away and start to be fierce to grab customers from other brand. E.g. CAT is arrogant; they can let customers waiting for them. Komatsu is “immoral”, they defamed Volvo machines.</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>Changing marketing strategy in China with more aggressive approach</td>
<td>Volvo was caught in so Swedish gentle among many competitors, it needs to try hard to grab customers Dealers need to try harder to retain customers in competitive market</td>
<td>In one hour, 20t level excavator can save 6liter fuel compare with Caterpillar and Komatsu’s product on similar level. For Volvo, average hour fuel consumption: 16-17liter/hour The hour fuel consumption under hard working environment is 21liter/hour, but other brand like caterpillar will reach to 30liter/hour.</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>Maintaining and even improving the good performance of fuel consumption</td>
<td>How to maintain the good performance of fuel efficiency right now but also to reduce fuel consumption in future is a challenge. Selling point rely on fuel consumption, but will no longer depend on it due to increasing technical competitiveness from competitors</td>
<td>In one hour, 20t level excavator can save 6liter fuel compare with Caterpillar and Komatsu’s product on similar level. For Volvo, average hour fuel consumption: 16-17liter/hour The hour fuel consumption under hard working environment is 21liter/hour, but other brand like caterpillar will reach to 30liter/hour.</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>To adjust business model</td>
<td>Other competitors has Still using existed service</td>
<td>In overall, VOLVO CE in China, relationship with</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>with dealers based on Chinese market situation.</td>
<td>provided different business model for Chinese market. Volvo has been fallen behind.</td>
<td>policy</td>
<td>dealers has already passed the run-in period, but adjustment of business model/type was very slow. E.g VOLVO CE provides parts maintenance service within 8000 hours; Komatsu already presented two years overall maintenance.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>Flexible training schedule plan for operator training, timing is very important</td>
<td>It is hard to persuade operators to get trained.</td>
<td>Dealers continuous to find a win-win solution for operators training but most times they failed.</td>
<td>Operators usually only have few months to rest with their family during rainy season, other than getting trained.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>Solving the spilling problem on hose and enhance the quality of it</td>
<td>Spilling problem in excavator bothers a lot (expect BC700).</td>
<td>Dealers need to fix it frequently.</td>
<td>Bigger bucket compare with same tonnage level excavator, but causing spilling problem.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>To adjust current working time of maintenance people, set up more practical working hours</td>
<td>The Fixed working hour payment is not practical for dealer</td>
<td>Dealers need to pay extra money (more than 12 hours) to maintenance people.</td>
<td>Maintenance people will get same standard payment no matter working in workshop or site. Usually working on site takes more time and money, but Volvo only has one financial standard which is 12 working hours for each person. E.g working on site may take three days. So this standard is very irrational.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>To improve the structure of engine and heat exchanger</td>
<td>There are many problems on type 50BC and 60BC excavators'engine.</td>
<td>Dealers tried to fix it and concluded some suggestions to Volvo, but Volvo did not consider about it.</td>
<td>In Puer town, 55/60 excavators occupy 72% market share. But high temperature problem on engine has not been solved for almost two years. Factory does not response dealers suggestion.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>To fix spilling problem on rubber key</td>
<td>Spilling problem has occurred in each type of excavator (except 700C)</td>
<td>Dealers can do nothing.</td>
<td>210B, 240B excavators have very serious spilling problem, only 700BC survived.</td>
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<tr>
<td>Upgrade</td>
<td>To enhance GPS system and provide new features about it</td>
<td>GPS system was not good as promised. Customer couldn't get benefits from function of GPS</td>
<td>Dealers do not recommend GPS system to customers</td>
<td>GPS system of Volvo is not very good, can be demolished and not good at shutting down machines as promised. Right now Komatsu has GPS system used on market.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>Customers want more optional on small tonnages of product.</td>
<td>Not many people have realized the arising market for small tonnage excavators</td>
<td>Dealers can do nothing about it. But this problem had solved by other competitors.</td>
<td>Excavator : Small tonnage: 5t, 6t ; Future trend, small tonnage and big tonnage are demanding. In some regions of Yunnan province, small tonnage excavator is very popular. They are used for agriculture and forestry. E.g in Puer, small excavators are used in rubber plantation and coffee plantation. Government encourages people to start New Rural Construction such as Building houses and fish ponds digging.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>Customers want more optional on a wide tonnages of product.</td>
<td>There are huge demands for 33t excavators in China markets, but Volvo doesn't provide it in Chinese market.</td>
<td>Dealers can do nothing about it. But this problem had solved by other competitors.</td>
<td>Excavator : Small tonnage: 5t, 6t ; Middle tonnage: 29-38t (missing 33t, 35t, there are 20% market share for this type of machine) 38t (there are 33t in Korea, why not in China) In Yunnan, biggest demand is about 6 square meter bucket. (but Volvo only has 4.5) Currently, 20t tonnage level market has already saturated.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>Need to improve soft product application in a competitive market</td>
<td>The features of hard product could not help Volvo to attract more opportunities.</td>
<td>Dealers will attract customers by all means.</td>
<td>Product capacity is not so much different from other brands; Komatsu and Caterpillar.</td>
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<tr>
<td>Replace and Disposal</td>
<td>Future assessment on second-hand market</td>
<td>The demand of second-hand market is increasing, but there is no mature second-hand market exists yet</td>
<td>Right now, they have ability to refurbish, but cost too much.</td>
<td>Second hand market: private customer will disposal to second market. But in Yunnan market retention is very high, so not many people will go to second hand market. As Volvo required, in the future, dealers will set up second hand department.</td>
</tr>
</tbody>
</table>
# Appendix C: Needs Matrix of Key Account Dealer

**BCDT, Beijing Century Development Technology Co., Ltd**

*Table C: Needs Matrix of Ownership Cycle*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Needs</th>
<th>Problems</th>
<th>Current Solutions</th>
<th>Detail Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase</td>
<td>Maintaining the good performance on fuel consumption of VOLVO CE’s product. Reducing emission for next generation of new product.</td>
<td>To maintain the good fuel consumption and be competitive in Chinese market. How to be prepared for future policy.</td>
<td>Decision maker in company would consider purchasing the new machine with low fuel consumption and also has a good working performance.</td>
<td>The main reason for state-owned company choosing VOLVO CE excavator is its good performance on fuel consumption. Because Chinese Sustainable development policy calls for fuel efficiency, but not particularly focus on emission reduction.</td>
</tr>
<tr>
<td>Purchase</td>
<td>To enhance the competitiveness and cost-effective of Volvo product when facing with Chinese brands.</td>
<td>Chinese brands are much cheaper than Volvo’s products. Big contractors tend to look for other brands.</td>
<td>State owned customer is using rental machines on light job. Dirt dumping and transportation are using Chinese brands.</td>
<td>Overall, the impact of country’s macro-control is small, so state-owned customer will also apply some equipments from individual/private rental company, but these kind of equipments used for taking care of small works. Domestic brands such as Hongyan, which has 10t capacity but it always be five times overloaded. Hongyan truck only costs 500 thousands SEK.</td>
</tr>
<tr>
<td>Purchase</td>
<td>To decreasing the expenditure of parts &amp; replacement on hauler</td>
<td>The expenditure on parts and replacement gives much economical pressure on big contractors.</td>
<td>Buying some parts from external market, like smuggling product.</td>
<td>One of a state-owned company are using 25 VOLVO CE’s haulers, and they needs to pay 13 million SEK on total of maintenance cost in one year; thus 40 thousands SEK/hauler per year on Parts &amp; Replacements (Jining Mine as an</td>
</tr>
<tr>
<td>Purchase</td>
<td>Dealer wants to have a fair market, hopping VOLVO CE could cut off the illegal parts smuggled from Korea</td>
<td>The difference of parts price between dealer and external market is significant. Those cheaper parts are smuggling products.</td>
<td>Customer buys those cheaper parts from external market.</td>
<td>There is a big difference of spare part cost, (internal and external). Even there is contract restriction between dealers and customers, customers prefer to buy parts from external markets. Some parts sellers can get those parts and replacements from illegal channels. Customers considered that dealers raise prices in purpose in order to get higher profits, and ignore customers’ feeling. If the difference of cost within 10-20% which customers could bear, but in fact the difference is already higher than 30%</td>
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</tr>
<tr>
<td>Receive</td>
<td>A quicker receiving time for product and parts</td>
<td>It always takes long time to wait machine during delivery</td>
<td>Waiting</td>
<td>It is very common waiting import type of machine for a long time.</td>
</tr>
<tr>
<td>Install</td>
<td>To increasing the service coverage</td>
<td>The coverage of service is insufficient for current business.</td>
<td>Dispatching service people working around working sites.</td>
<td>Technical support service coverage: Excavator: 1 people/15 excavators; Hauler: no specific, 1 person/2-3 haulers Aftermarket, 30 employees are working in this area. Almost half amounts of them are working at overhaul workshop.</td>
</tr>
<tr>
<td>Learn to Use</td>
<td>Volvo could provide useful quarterly reports to dealer, especially on maintenance information.</td>
<td>Dealers could not get enough data from quarterly report. Most quarterly</td>
<td>Sending English vision quarterly report to dealer directly. The translation version made by BCDT in Beijing is inaccurate.</td>
<td>Dealers could not get enough data from quarterly report, not many quarterly reports are available. And they are usually written in English. The translation version made by BCDT in Beijing is inaccurate.</td>
</tr>
<tr>
<td>Learn to use</td>
<td>Dealer wants quarterly reports could be translated in Chinese.</td>
<td>reports are English vision.</td>
<td>GPS was not used as the primary functions.</td>
<td>Using GPS to monitor the customer who arrears money. By GPS to turn-off power of engine</td>
</tr>
<tr>
<td>Interface with</td>
<td>To apply the function of GPS in various area, like navigation, monitoring, tracking and security etc.</td>
<td>Automatic alarming system on the maintenance parts. Automatic information system to predict the product life.</td>
<td>Due to busy production job, customer always forget to maintain or change the maintenance parts</td>
<td>To maintenance parts based on customer’s experience and observation. State-owned company has specific employees to check parts every day.</td>
</tr>
<tr>
<td>Interface with</td>
<td>Automatic alarming system on the maintenance parts. Automatic information system to predict the product life time.</td>
<td>Quicker and efficient information feedback loop between VOLVO CE and Shanghai</td>
<td>Current information feedback loop takes too long.</td>
<td>Waiting responds from VOLVO CE Shanghai</td>
</tr>
<tr>
<td>Interface with</td>
<td>Easy and effective communication approach at mining working site between customer and maintenance people in sites</td>
<td>The communication signal at mining working site is always bad. It takes time for dealer to get to know which machine has broken.</td>
<td>Making a phone call to maintenance man on worksite.</td>
<td>Customers will contact with service people who is working at mine site by phone calls.</td>
</tr>
<tr>
<td>Transport</td>
<td>To easy assemble and disassemble</td>
<td>Transporting machine in mountain areas</td>
<td>Customers hire trucks and other equipments to</td>
<td>It is inconvenient to transfer big tonnage machine in mountain</td>
</tr>
<tr>
<td></td>
<td>machine on different working sites</td>
<td>is really inconvenient. It is hard to move big excavator between different working sits.</td>
<td>transport and to assemble machine in mining sites.</td>
<td>areas</td>
</tr>
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</tr>
<tr>
<td>Store</td>
<td>The increasing demands on parts, storage capacity needs to be expanded.</td>
<td>Dealer’s storage capacity is always insufficient due to limited parts supply from VOLVO CE Shanghai</td>
<td>Both dealer and customer only could wait and do nothing anymore.</td>
<td>The spare parts and replacements of haulers are always out of stock. They always are told to wait from Volvo CE.</td>
</tr>
<tr>
<td>Maintain</td>
<td>VOLVO CE provide more effective technical supports on thorny problem. Adding the number of employee on technical support.</td>
<td>The technical support from VOLVO CE Shanghai couldn’t solve complex problem The number of technical stuffs in Shanghai is very limited</td>
<td>Waiting answer from Shanghai</td>
<td>The technical support of haulers from Shanghai is very limited. The working experiences and numbers of technical staff is problem.</td>
</tr>
<tr>
<td>Maintain</td>
<td>To reduce the time spent on waiting problem</td>
<td>It takes time for maintenance man to fix complex problem due to insufficient skill.</td>
<td>Waiting and using extra machines to keep production at same time.</td>
<td>Usually it takes three days to fix transmission problem thoroughly. In this case, customer can do nothing but only wait. (Usually, there are three working teams shift, 20hour/day).</td>
</tr>
<tr>
<td>Maintain</td>
<td>Decrease the high expenditure spend on overhaul</td>
<td>The expenditure on overhaul is very high</td>
<td>Making decision on disposal machine or not. In mostly will give up overhaul.</td>
<td>Purchase cost of one hauler is three million, and cost of overhauling is one million. The expenditure of overhauling has occupied one third of total purchasing cost.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>To prepare a back-up plan for keeping</td>
<td>It caused terrible losses on production</td>
<td>Waiting dealer to fix it.</td>
<td>Customers complain that four to five haulers will break simultaneously</td>
</tr>
<tr>
<td>Upgrade</td>
<td>constantly production. Enhance the quality of hauler-40E.</td>
<td>when four or five haulers are broken at same time. But both customer and dealer couldn’t provide a back-up plan.</td>
<td>Small tonnage restricts the production. In this way customer will hire more people to do the work, which will raise the cost.</td>
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</tr>
<tr>
<td>Upgrade</td>
<td>Trade-off between product’s tonnage and labour cost.</td>
<td>Existing VOLVO CE’s equipment couldn’t meet the needs of increasing production.</td>
<td>State-owned customers have their own maintenance team, but they still rely on dealer instead of maintain machine. Right now, they provide Silver CSA to its customers. In the future, there is a possibility for customers to apply Gold CSA. Customer still has their own maintenance personnel, and with time goes by, they will not recruit new maintenance employees, but maintenance problems will exist.</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>To enhance service capacity for the Gold CSA provision</td>
<td>Dealer’s existing technical skill on maintenance couldn’t meet the requirement of Gold CSA.</td>
<td>State-owned customers have their own maintenance team, but they still rely on dealer instead of maintain machine. Right now, they provide Silver CSA to its customers. In the future, there is a possibility for customers to apply Gold CSA. Customer still has their own maintenance personnel, and with time goes by, they will not recruit new maintenance employees, but maintenance problems will exist.</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>More proactive service provision instead of the current passive way.</td>
<td>There is lack of a proactive way for dealers to predict or notice the machine’s problems before customer reported.</td>
<td>When problem has happened, customer call dealer. Any problems happened are being reported by customers. The service provide by dealers is passive, not proactive.</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>Testing about friction plate in K3 Clutch on hauler-40E before sold it to market</td>
<td>There is a problem happened on hauler-40E with its K3 clutch.</td>
<td>Customers always complain this problem to dealer. The application of K3 is not realistic, friction plate is easily broken.</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>To solve spilling</td>
<td>For most type of replace a new</td>
<td>After 8000 hours</td>
<td></td>
</tr>
<tr>
<td>Upgrade</td>
<td>problem of rubber key</td>
<td>excavator, hoses have very serious spilling problem after 8000 hours (except).</td>
<td>one.</td>
<td>working, hoses have very serious spilling problem with its rubber keys (except 700BC).</td>
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<tr>
<td>Upgrade</td>
<td>To enhance the quality of E series hauler</td>
<td>The parts quality of hauler 40E has decreased a lot comparing with 40D.</td>
<td>Maintenance, and again</td>
<td>Hauler is upgrading too fast but quality could not maintain. Generally speaking, quality of haulers is getting worse</td>
</tr>
<tr>
<td>Upgrade</td>
<td>To test and verify product before product actually into market</td>
<td>40E has a very poor quality.</td>
<td>Maintenance</td>
<td>40D has the best quality in whole series of Volvo articulated trucks. 40E has a very poor quality. The reason behind this is because after improvement, the 40E series hauler did not verified in long time market test.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>Redesigning the transmission/Gearbox on E series hauler.</td>
<td>The quality of 40E hauler parts is very poor. Gearbox of E series always causes problem.</td>
<td>Repair or replace a new gearbox.</td>
<td>The problem of 40E hauler’s transmission (gearbox) will show up after 100 hours working. The average working hour should be 2000 hours.</td>
</tr>
<tr>
<td>Upgrade</td>
<td>To prolong the life time of hauler</td>
<td>After 6-7 years, hauler needs to overhaul or otherwise disposal</td>
<td>Due to high cost to overhaul, they can only disposal it.</td>
<td>Customer felt that the life time of hauler is short, just within 6-7 years, hauler needs to overhaul and the expenditure for overhaul is huge.</td>
</tr>
<tr>
<td>Replace and Disposal</td>
<td>Company could provide recycling service initiative. After recycled, customers could get discount when they plan to purchase new product.</td>
<td>Customer needs to dispose used scraped machine by themselves.</td>
<td>Sell used machine as scrap metal</td>
<td>State-owned company wants a recycling service to deal with their used machine as a sustainable way.</td>
</tr>
</tbody>
</table>
Appendix D: Project Stakeholder Interview

This appendix contains the interview notes of each of the stakeholders that were interviewed as part of this project. They are presented in the following order:

Volvo CE
- Volvo CE in Eskilstuna
- Volvo CE in Shanghai

Dealer
- Key Account Dealer
- Sales Channel Dealer

Customer
- Big Contractor
- Individual Rental Company

Competitor
- Caterpillar’s Dealer
Volvo CE in Eskilstuna

Volvo Construction Equipment in Eskilstuna owns the headquarter office of region international and the headquarter office of customer support area. It is consisted of around 1000 employees. Important office branches such as customer center, customer support training and technical center are located in Eskilstuna.

• Interview Objects

Some key decision makers have been interviewed in Volvo CE in late February and April. Authors conducted eight times face-to-face interviews and one phone meeting.

• Interview Process

Interviews with Volvo CE people in Eskilstuna were firstly determined by emails in which interview purpose, project goal, expectation, and meeting participants were discussed. Once the detail schedule defined, authors prepared a PPT slides for meetings. It took one to three hours to carry out interview meetings. As mentioned before, authors applied the semi-structured interviews, so time schedule was varied with different interview objects.

The aim for conducting those interviews with people in Volvo CE Eskilstuna was to help author to get a big picture of company and be prepared to narrow down project scope. Company history, product management, product planning and other industry strategy were shared during meetings. The outcome was beyond authors’ expectation. In each meeting, authors firstly presented our findings on product-service system, and the importance of needfinding and early phase of PSS design, then our focus about needfinding in China was proposed. Detail needfinding plan and needfinding methods were also elaborated. By doing this, interview objects were usually inspired by authors’ inputs from academic perspective, and they brought out their understanding and insights on PSS in practical
industry perspective. Many suggestions about product-service system provision and needfinding activities were posed and authors could get closer and closer to the practical aspect of PSS. The next step about how to continually narrow down scope in China market was discussed, and the connection with specific interview objects for next step was built.

**Volvo CE, China**

Volvo CE Shanghai, as the head quarter of Volvo CE in China, was founded in 2002. In order to satisfy the increasing demand of the Chinese market, Volvo CE has established an excavator Plant in Shanghai. The capacity of the Shanghai Plant has been doubled after 2004. Right now, this is the Volvo’s largest plant for Volvo excavator in China and second largest in Global.

- **Interview Object**

Many interviews conducted cover almost every department. Thanks to the help from Volvo CE Eskilstuna and cooperation with Volvo CE Shanghai, almost every interview was went well. The interviews were carried out in March, in total two weeks. Interview Process

The same step as previous step with Volvo CE Eskilstuna. Interview objects and schedule were determined by emails, and slides were prepared to present our thesis purpose and project goal. However, almost every meeting was controlled in no more than one and a half hour. So the context of each meeting was not varied greatly with different objects.

The aim of conducting meetings with people in Volvo CE Shanghai was to further narrow down our scope in China market. Authors followed the routine as previous step in Volvo CE Eskilstuna, firstly introduced our findings on PSS, and the importance of early phase of PSS design. Unlike interview objects in Volvo CE Eskilstuna, most objects in Shanghai would like to go directly to practical industry application, rather than spending time on academic discussion. The overall picture of mining industry in China Market, construction machinery industry in China, and Volvo CE in
China were shared mainly by decision maker level. Information about production capacity, customer support situation, soft product provision, trainings and etc were provided by different departments. After two weeks, authors could defined the research scope as mining industry in southwest of China, and big contractors such as state-owned company. The network with specific contact person in two types of dealers was established which means all preparations for next actual needfinding activities were ready.

**Key Account Dealer**

**BCDT, Beijing Century Development Technology Co., Ltd**  
_Caiqin Long_, CST Director & Branch Manager BCDT (Yunnan Region),  
_Chenli Zhang_, Customer Support Director (Yunnan Region)

Kunming Branch specializes in the agent of Volvo CE. It signed the agreement as Volvo CE dealer with Volvo group in China in 2002. There are five branch offices located in five cities. BCDT provides products and services such as machine selling, renting, parts supply, used machines and other services on Volvo CE’s behalf. The one authors conducted interviews was in Kunming, Yunnan. BCDT Kunming branch mainly takes care of big contractor (YTH group) in Yunnan province. Right now, there are 150 employees working in BCDT Kunming branch.

**Channel Sale Dealer**

**Enrich YN Kunming Enrich Construction Machinery Co., Ltd**  
_Rongtao Sha_, Sales Director  
_Lin Zhang_, Customer Support Director

Enrich YN also signed dealership agreement with Volvo group in 2002. It provides almost same product and service range as BCTD Kunming Branch. Its service covers the whole Yunnan provinces. There are more than nine sub offices scattered in Yunnan. Unlike BCDT Kunming branch,
Enrich YN mainly takes care of private companies and individual rental companies.

- **Interview Process**

The interviews process with dealers in China was totally different. Thanks to the introduction from Volvo CE Shanghai, authors can get the chance to interview them. In China, it is not a good strategy to claim us as students. Otherwise dealers would not take us seriously. In all meetings with dealers, authors claimed that we are from Volvo CE in Eskilstuna not from BTH.

All schedules were determined by phone calls. Interviews with dealers usually did not have very clear time limit, authors conducted a meeting with one dealer often would spent one or two days largely in accordance with dealers’ wishes. Firstly authors introduced the purpose of needfinding project, which is to help dealers to deliver Volvo provision and meanwhile to gain more profit for dealers. Then dealers would present their current situation, and problems following with the ownership cycle which used as the structure of interview. During this process, needs and requirements from two dimensions were collected. One part was related to the interaction between dealers and Volvo CE, another perspective mainly focused on the interaction between dealers and their customers. Basically, there were not many differences in interview structure between key account dealer and Sales Channel dealer. Regarding the different features of two dealers, their focuses were somehow different which could be uncovered during their expression. Key account dealer was concerned more about the product quality and supply system, Sales Channel then complained about financial support from Volvo CE. In general, the outcome of interviews from both of dealers were very rich, all needs were categorized by ownership cycle and were presented in Appendix B. Matrix of need in ownership cycle in appendix. Besides those important and useful data, dealers also helped authors to build connection with specific customers which allow us to carry out next step of customer interview.
Big Contractor Customer

YTH Group, YUNTIANHUA Group Co., Ltd.

Hua Wang, Equipment Management Director
Ma Shengli, Equipment Maintaining Manager
Wu Jun, Production Manager
Xiang Ming, Sites Dispatching Manager

YTH is a state-owned company which is one of 13 largest fertilizer enterprises built in the 1970’s. It has good reputation on production management by technical innovation, capital operation, new project construction and industry integration, which has led to the group success in building the industry platforms of phosphate & compound fertilizer, phosphate mining and processing and etc (YTH net http://www.yth.cn/yth/aboutus/intro/). Its operating revenue has been more than 4.6 billion dollar in 2008. Till 2009, YTH group was ranked as the 194th of top 500 enterprises, the 97th of manufacturing company, the first of chemical and fertilizer enterprises in China. YTH group owns the largest phosphate mine in Yunnan province in which four main mining sites scattered including Jinning mine, Haikou mine, Jianshan Mine, and Kunyang mine. The total production of these mines are the biggest in China. The Group up to now has bought 75 Volvo haulers and Volvo 10 excavators, the number of Volvo machines is continually increasing.

Taking into account the limited time, authors have chosen one of the phosphate mines - Haikou mine in order to conduct the interviews. Haikou mine located at the junction of Jining, Anning, and Xishan. It was built in 1966 and in 2005 YTH group took over the Haikou mine management (http://www.baiinfo.com/article/lingkuangshi/754/5310897.html). There are four mining areas in Haikou mine. The annual production is 20 million tons and traffic volume is 10 million tons. There are 25 Volvo haulers and
three Volvo EC700 e excavators, including other brands such as Caterpillar, Komatsu and domestic brands there are more than 200 machines in Haikou mine. In Haikou mine, features as ore scattered, soft soil, and continuous downhill terrain make the relatively low cost of production.

Since the scope of the project is about big contractor, this state-owned company has been the most important object to be interviewed. Many actors in the Corporation have been interviewed in this company, such as the owner of the mine, director of production, director of equipment, dispatching manager, site manager, maintenance people, statistic department, and operators.

- Interview Process

Connection with customers was set up by dealers on one side, and by authors’ own network on the other side. But all interviews were firstly confirmed by phone calls and SMSs. Interviews with state-owned company and private company started with our introduction of project purpose and goals which is mean to understand customers’ current situation and identify their existing requirements and potential needs.

Haikou Mine, Authors spent almost two days to interview owner of mine, equipment department and production department to gather the first hand materials about Haikou mine production. When talked to dispatching manager and site manager, authors followed customer job mapping to fully understand current production process and customer’s job in each phase. Authors also put most emphasis on how to help customer increasing productivity. Any jobs or process and problems related to productivity were written down carefully and needs were categorized. Meanwhile authors spent days on actual working sites to observe the procedure of mining. Many interviews with employees on sites to get details about problems during management and monitoring process were conducted. Product and parts quality problems are gathered during the interviews with
maintenance people and equipment department. Services efficiency problems from dealers were shared with production department.

**Small Contractor Customer:**

**Individual Rental Market**

Individual Equipment Rental Company.

Individual Rental Company. There are many individual construction equipment rental markets located around Kunming city. Most of these markets were built spontaneously, which means they are usually gathered illegally. These individual rental companies were founded by one or two people, who usually own no more than three machines. This type of customers is often short of money and people who has small projects would like to rent from them.

- **Interview Process**

Connection with customers was set up by dealers on one side, and by authors’ own network on the other side. But all interviews were firstly confirmed by phone calls and SMSs. Interviews with private company started with our introduction of project purpose and goals which is mean to understand customers’ current situation and identify their existing requirements and potential needs. Authors went to one of the excavator rental markets to interview and observe. There are more than two hundreds of excavators but only with two Volvo excavators, and more than 50 individual rental companies in markets. It was impossible for authors to conduct semi-structured interviews because of the disordered environment, and authors can only be pretended as buyers in order to get some rental company information. The whole interview lasted three hours. Many pictures and video were taken during process. At the end, authors particularly talked with owner of the Volvo excavators, the reason of buying Volvo was discussed. He admitted the very good performance of fuel consumption was his primary factor to buy Volvo excavator, and
meanwhile high purchasing cost of the machines was the reason that not many individual rental companies would like to recommend Volvo.

**Competitor**

Caterpillar, ECI-Metro  
Kinix Xue, General Manager, Yunnan Province

- **Interview Process**

Authors contacted manager of ECI-Metro by personal network and meeting determined by phone calls. It spent three hours to interview manager (see Figure 4.6). During the whole process, authors firstly presented their studying about PSS, and then discussed about potential future of PSS development in construction machinery industry. ECI-Metro manager gave some insight about PSS, and in CAT, PSS was considered as IS (Integrated Service). However, since he is manager from CAT, authors could not ask too much about it.