

# **Business Model Innovation for Faecal Sludge Management: Collection and Transportation Services**

by

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## Abstract

This study investigated the business model innovation of collection and transport services in faecal sludge management. The three research objectives were to analyze the current business model and propose conceptual business model; to identify the business model components that affect service performance, and to identify the appropriate innovation solutions for Faecal sludge collection and transportation services.

Firstly, this research aimed to analyze business problems, business components with the financial structure and propose a new conceptual business model. Primary, secondary business data and financial statement reports of fifty-three service cases were collected and analyzed through field surveys, case investigations and questionnaires. The findings revealed the business problems, business components with the financial structure of FS C&T services. The operating cost structure (7.1 to 13.5 \$US\$/m<sup>3</sup>) and net profit (-65.8 to 11.1 US\$/m<sup>3</sup>) comparison results suggested that ownership status was related to business performance. A new conceptual business model for FS C&T was proposed, comprising Infrastructure, Service, Customer, Finance, Legislation, and Ownership. The proposed conceptual business model, qualitatively tested with cases in Finland, Thailand, and Vietnam, proved its applicability to improve the FS C&T service efficiency in municipalities of low and middle-income countries.

Within the conceptual business model, the relationships among business model component, service performance, and service innovation possibility were analyzed. The hypothesized relationships were quantitatively tested with data collected from 224 faecal sludge collection and transport services from 25 countries by Structural Equation Modeling method with the application of SPSS and AMOS software. The findings suggested that the Key Resource, Value Proposition, and Legislation platform are significantly related to the Service performance and then service performance significantly related to the service innovation solutions.

Lastly, the eight innovation solutions including Eco-friendly Branding, Customer Relationship Management, Cooperative Model, Technology Improvement, Transfer Station, Faecal Sludge Volume Pricing, Travel Distance Pricing and Truck With Treatment Function were further analyzed to conclude about the applicability of the innovative possibility. The applicability was measured with the Likert scale: 1 is minimum value and 7 is the maximum value of applicability. Among these eight solutions, the highest applicable solution was Environment-friendly branding (5.65) and the lowest applicable solution was improved truck (4.89). These solutions could be applied to optimize operating cost and generate revenue for better service performance. When the services are improved, the customer satisfaction levels are increased, the environment could be protected better.

The three findings of this study for business model innovation of collection and transportation services in Faecal sludge management are the conceptual business model, the key business model components significantly related to the service performance and the applicability of the service innovation solutions.

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## **List of Abbreviations**

AMOS	Analysis of a Moment Structures
BMGF	Bill and Melinda Gates Foundation
C&T	Collection and Transportation
CFI	Comparative Fit Index
CMIN/DF	Minimum Discrepancy
DEWATS	Decentralized Waste Water Treatment System
EAWAG	Swiss Federal Institute of Aquatic Science and Technology
FS	Faecal Sludge
FSM	Faecal Sludge Management
GFI	Goodness of Fit Index
LAO(s)	Local Administrative Organization
LGA(s)	Local Government Authorities
NGO	Non-governmental Organization
OSS	On-site Sanitation
PAO	Provincial Administrative Organization
PEST	Political Economical Social Technological
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Model
SPSS	Statistical Package for the Social Sciences
SRMR	Standardized Root Mean Square Residual
TDRI	Thailand Development Research Institute Foundation
UNESCO-IHE	The United Nations Educational, Scientific and Cultural Organization- Institute for Water Education

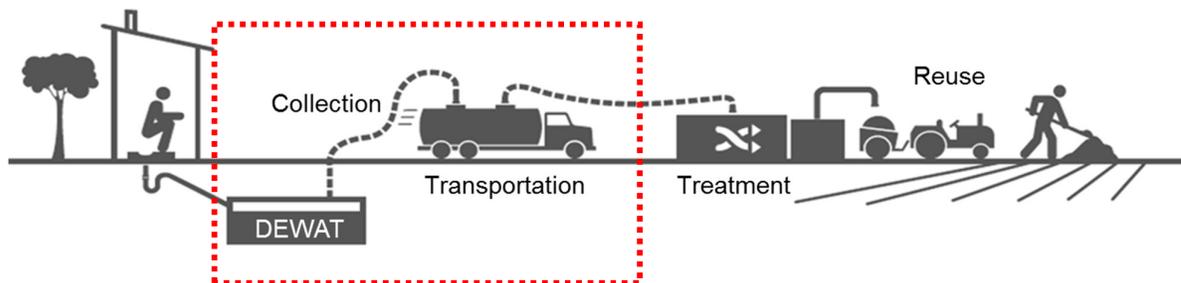
# Chapter 1

## Introduction

### 1.1 Problem Statement

In 2015, according to the United Nations Special Rapporteur on the human right to water and sanitation, more than 2.5 billion people in the world lack safely-managed sanitation. The Joint Monitoring Program of World Health Organization and The United Nations International Children's Emergency Fund published that 2.3 billion people (32% world population) using improved Onsite sanitation systems infrastructure, both in rural and urban areas (WHO & UNICEF, 2107) and this number is expectedly on growing up to 5 billions by 2030 (Strande et al., 2014). Onsite sanitation systems must base on Faecal Sludge Management (FSM) activities to handle the Faecal Sludge (FS). Faecal sludge is a mixture of human excreta, water and solid wastes contained in pits, tanks or vaults of onsite sanitation systems (Koottatep et al., 2001).

Both Sustainable Development Goals (SDGs) and Millennium Development Goal (MDG) emphasized that Excreta should be managed properly, stated in Goal 6 – Clean Water & Sanitation (UN, 2015, 2016 & 2018). If Excreta and FS are not managed properly, these waste products cause water pollution and waterborne diseases for human (Harada et al., 2016). There is the huge need of provision of sustainable FS Collection and Transportation (C&T) services for safe disposal while these services are not well controlled under regulatory frameworks or jurisdictions (Rao et al., 2016). The complete sanitation value chain is shown in Figure 1 with the FSM components including FS Containment, Collection, Transportation, Treatment and Reuse. The services of FS C&T play the main role in the FSM value chain to empty FS from the containment sources then bring it to the appropriate treatment plant to dispose or reuse. According to Strauss and Montangero (2002), the technical, institutional and financial problems of FSM practices led to the consequences for health hazards from openly dumped FS and through use of contaminated water. Particularly, the role o FS-related private entrepreneurs are not well recognized and legally secured.



**Figure 1.1 Faecal sludge collection and transportation in the sanitation value chain (BMGF, 2015)**

Within the FSM value chain, FS C&T services grow spontaneously without adequate business models, causing serious problems to human health and the environment. In low- and medium-income countries, especially in these smaller cities, FS C&T services are usually ignored by the users and government authorities in (BMGF, 2015). Service providers including municipalities and private operators are lacking the necessary service operating knowledge. Illegal FS discharge activities are harming the environment and human health. One of the illegal dumping reasons are: (1) no planned disposal places (Harada et al., 2016), (2) the

distance from the working site to the disposal place is too far, C&T trucks are not able to access narrow paths or lane connecting to the containment facilities (Strande et al., 2014) and (3) there is no rules to control the dumping activities (AIT, 2013). Currently, the available information and research dedicating for FS C&T service delivery are both limited and weak and FSM needs an integrated system approach incorporating technology, planning and management (Strande et al., 2014). The actual costs of transporting sludge and sources financing for these transport costs are not well understood (Balasubramanya et al., 2017). Consequently, “Business model innovation for FS C&T service” becomes one of the promising research topics to sustain these services and business prevent illegal FS dumping activities.

## **1.2 Background**

As residential areas usually stretch out, the haulage routes to disposal site tend to be long, leading to uncontrolled FS discharge, which seriously harms the human health and environment through the transmission of enteric diseases (Klingel et al., 2002 & Strauss et al., 2006). The causes of these serious problems are inadequate regulatory systems, loose cooperation among stakeholders and lack FS treatment plants, while private sectors are not well developed (Jeuland et al., 2004; Koné & Peter 2008). The profile, profitability and business model of FS C&T services are not yet well understood (Mbégué et al., 2010). When several studies aimed to find technological solutions to improve the FS collection activities and to optimize the transport routes (Chowdhry & Koné, 2012), research from the managerial point-of-view to analyze FS C&T services should be an alternative to add more theoretical knowledge to FSM field.

Recently, a business-model approach has been applied to study FS management services (Rao et al., 2016); however, the mechanism of FS C&T business components has not been addressed. By recognizing opportunities emerging outside the traditional business models, logistics firms must constantly seek new knowledge, “think for the customer”, anticipate and innovate services to meet customers’ evolving needs (Chapman et al., 2003). Business models perform two essential functions: value creation and value capture. Therefore, analyzing the business model explains how value is created and delivered to customers (Zott et al., 2011). Consequently, this research used a business component analysis approach to describe the operational and organizational service mechanisms, then to propose a conceptual business model with innovative solutions.

There were several available business model concepts such as the business model component (Alt & Zimmermann, 2001), the four-box business model (Johnson, 2010), the six-component business model (Chesbrough, 2003 & 2007) and the nine-component business model canvas (Osterwalder & Pigneur, 2010; Otoo & Drechsel, 2018). Among the theoretical business models, the nine-component business model was chosen for this study because it had the highest numbers of components which comprehensively explain all the compartments of a services business. Basically, the nine-component business model concept has studied for urban logistics services to which the FS C&T services belonged. And the nine business model components have been used to formulate the FS management services by Rao et al. (2016). For these reasons, adapting the nine-business component model, this paper demonstrates a comprehensive business component analysis of FS C&T services to explain how these services are developed and executed.

### **1.3 Objectives**

The overall objective of this dissertation is to study and explain the Business model innovation process of FSM, focusing on FS C&T services. The research results are expected to propose the conceptual business model, key business components and service innovation possibilities of FS C&T services for municipalities handling FSM based on onsite sanitation systems. Therefore, three specific objectives were:

1. To define business problems and financial structure of FS C&T services.
2. To identify the business components, the conceptual business model, business model performance indicators and business innovation of FS C&T services
3. To explore and confirm the Relationships among Business components, Service performance and Service innovation possibilities

### **1.4 Scope of Study**

The scope of this work is to undertake in assessing business models of FS C&T services within the FSM value chain. This research focuses on the current practices of the business FS C&T business as a service business in the urban areas within the low and middle-income countries, mainly in Vietnam and Thailand. Cross-country research aims to find out the similarities and differences of different indications on the business model innovation. This study aims to address and response to these key research questions:

1. What are the business problems and the financial structure of FS C&T services?
2. What are the business components and how is the business model conceptualized?
3. What are the business model innovations of FS C&T services?
4. How to assess the business model performance?
5. What are the Relationships among Business components, Service performance, and Service innovation possibilities?

### **1.5 Research Rationale**

This study aims to provide theoretical knowledge of how to innovate the business model of FS C&T. This research expects to add original, practical knowledge and insights for FS C&T and FSM by achieving three objectives and fill the current knowledge gaps mentioning in the problem statement including The systematic landscape study of FSM and FS C&T business, The FS C&T service business model and business model innovation and The key business model(s), the service performance and the service innovation possibilities. With the intensive review and analysis of the literature, these gaps would be elaborated at the end of the literature of Chapter 2.

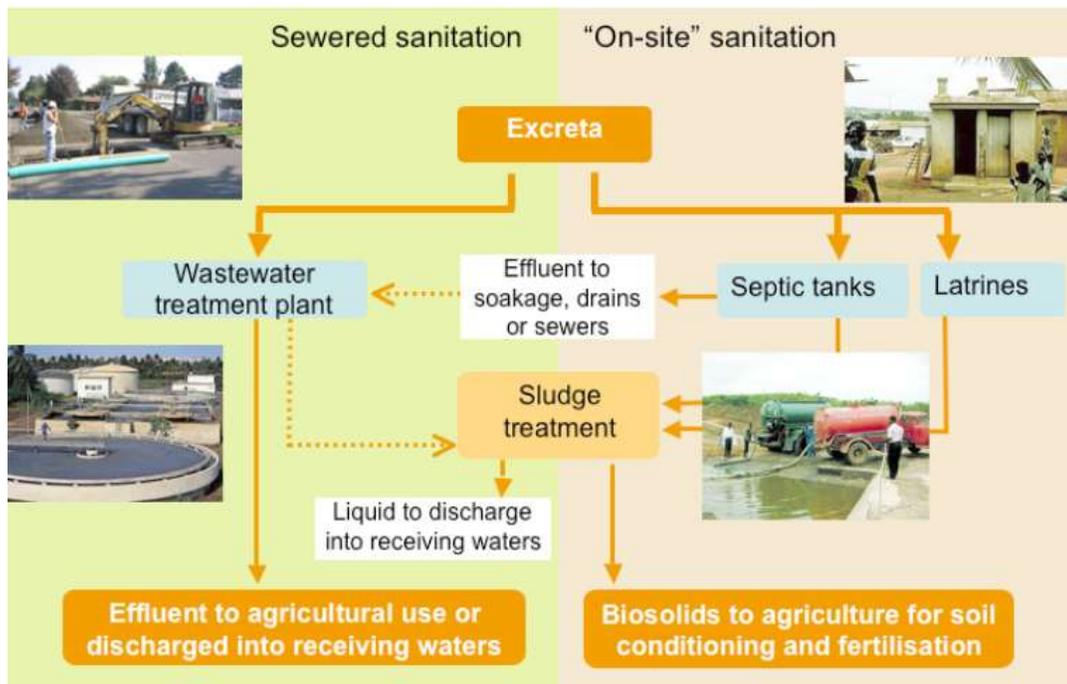
## Chapter 2

### Literature Review

Basing on secondary data from various peer-reviewed sources, this chapter reviews and elaborates the notions and information of the research topic title. Chapter 2 presents the definition and insights of Faecal Sludge Management, Faecal sludge Collection and transportation services, Business model and Business model innovation. Finally, the research gaps are defined to explain why this research has to be urgently and necessarily conducted.

#### 2.1 Faecal Sludge Management Overview

Figure 2.1 shows the structure of Sewered and Onsite Sanitation System (OSS) in which the latrines and septic tank stores the human excreta and urine. OSS comprises of non-sewered toilets with aqua privies and septic tanks. Faecal Sludge (FS) is the sludge collected from OSS systems. Faecal Sludge comprises semi-liquid and liquid particles from excreta (urine and faeces) and all additional input.



**Figure 2.1 Sewered and onsite sanitation systems (EAWAG/SANDEC, 2008)**

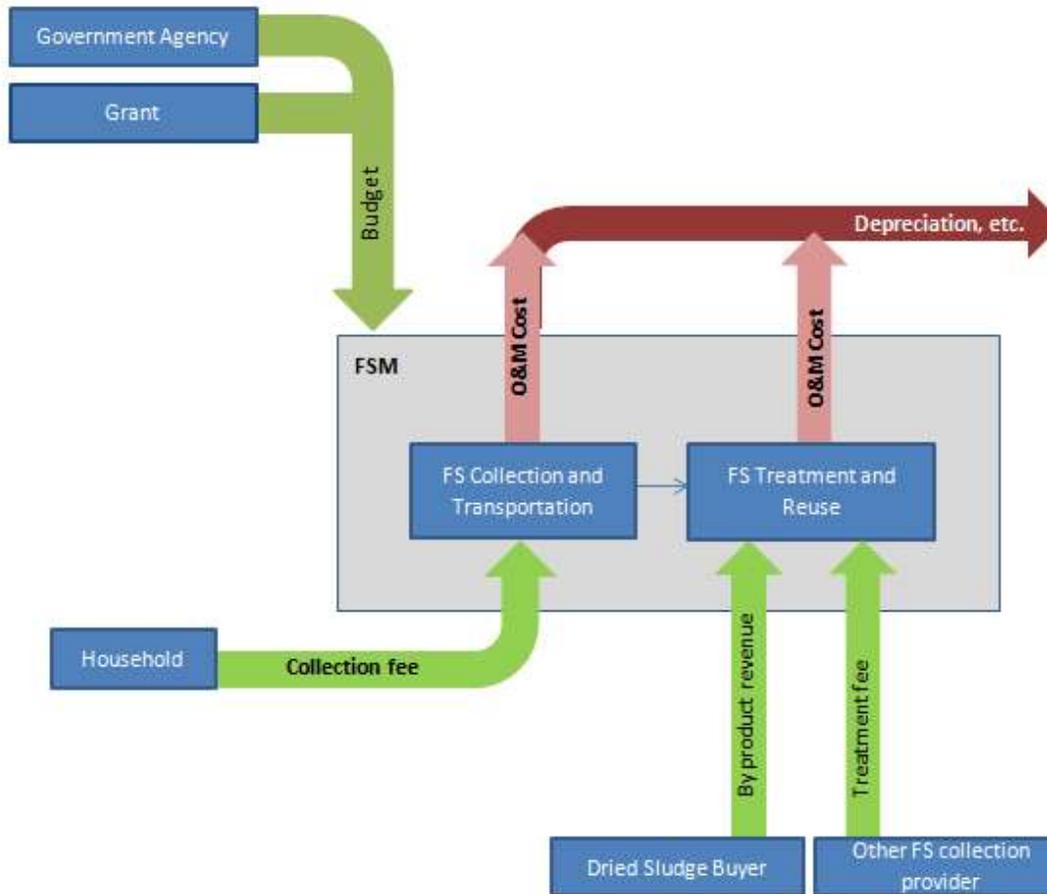
Factors influencing FS characteristics include the performance of septic tank, emptying technology, storage time, mixtures, climate temperature, and groundwater. Additionally, FS must be collected and disposed by a hygienic way to avoid pollution, contamination or diseases spreading.

Faecal Sludge Management (FSM) generally consists of FS collection and transportation (FS C&T), treatment and disposal. The main processing steps in FSM based on the FS processes of (1) FS collection, (2) FS emptying and haulage, (3) Treatment, (4) Reuse or storage. Key stakeholders in FSM are users, households, community, governmental, Community-based Organizations, Non-Government Organizations, authorities, public utilities, private sector

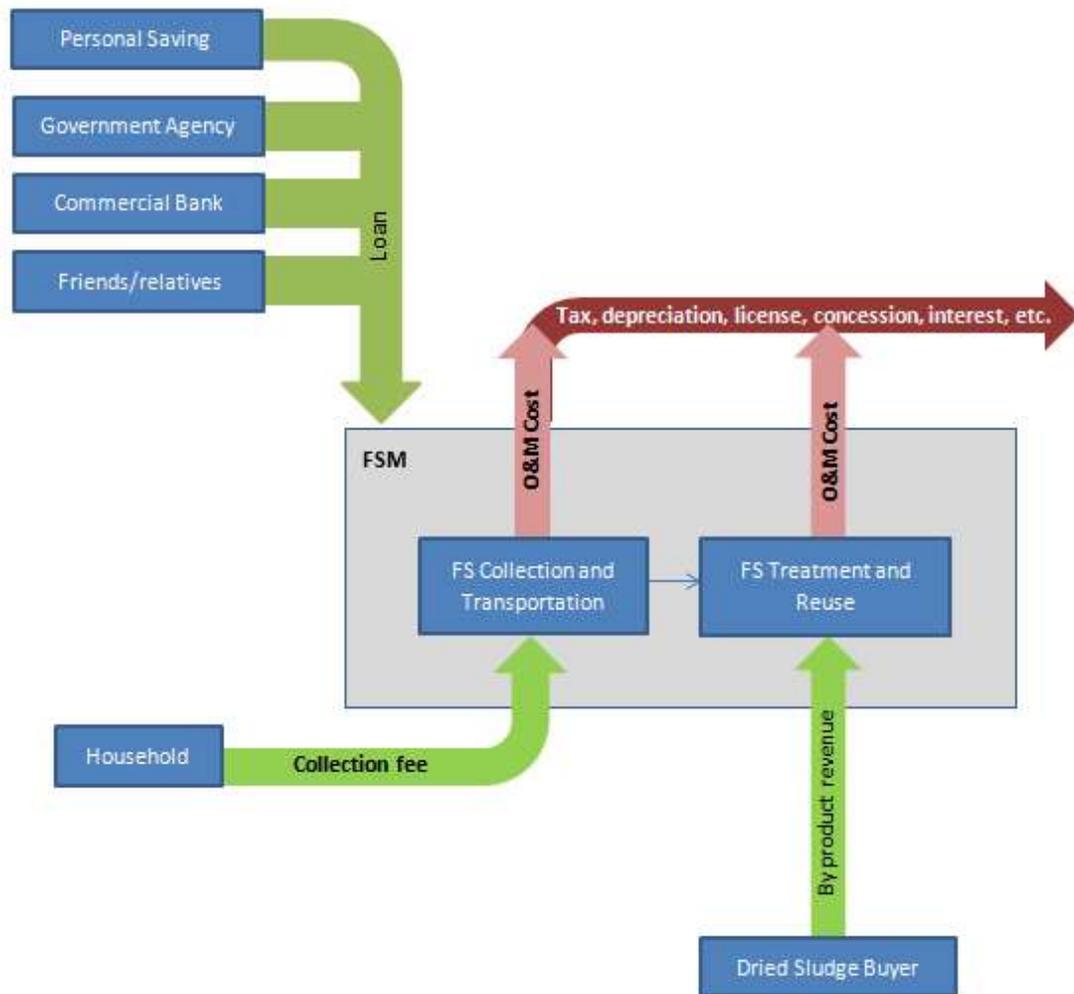
members and donors. As the rationale of this research is about business model innovation for FS C&T so the process of FSM, in general, should be clearly understood. FSM improvement process has three main activities: Advocacy, Capacity building, and Technical measurement.

### 2.1.1 FSM financial flow model

FSM financial flow models can be separated into two flow models: (i) public sector and (ii) private sector as shows Figure 2.2. They generally consist of costs and revenues of collection, transportation, treatment, disposal and reuse.



(A) Public sector



**(B) Private sectors**

**Figure 2.2 (A) & (B) FSM financial flow models (AIT, 2014)**

FSM costs can be divided into 2 types; (i) fixed costs and (ii) variable costs. The investment costs include truck investment, land and construction costs of the FS treatment plant. The variable costs consist of operation and maintenance (O&M) costs and other costs. The O&M costs comprise of personnel, fuel, materials, utilities, and maintenance. Others costs such as licensing, tax, depreciation, interest rate, inflation rate also needs to take into account in the financial flow.

FSM revenue comes mainly from FS collection fees. It is usually charged per cubic meter of collected FS. In Thailand, according to the Public Health Act 1992, the FS emptying service fee is 250 Baht/m<sup>3</sup> (8.33 US\$/m<sup>3</sup>). However, from the field observation, it was found that FS collection fee range from 50 - 350 Baht/m<sup>3</sup> (1.67-11.67 US\$/m<sup>3</sup>).

### 2.1.2 FS flow and financial flow

FSM improvement needs to optimize and develop the following activities: setting Institutional and regulatory measures, creating Legal framework coordination mechanisms between each stakeholder and process and defining sanctioning procedures. Issuing licenses to pit emptying service is to control and enforce regulations. In some countries such as Thailand and Vietnam, authorities applied the certification and licensing process for pit emptying enterprises, including procedures for control and enforcement (Klingel, 2001).

There is no single FSM model that has proven to be effective in all situations; indeed, service delivery models are constantly modified and restructured depending on the economic, legal, and environmental conditions. The following five financial flow models are extracted from the Faecal Sludge Management book (Strande et al., 2014) showing the connection flows among the stakeholders. Each stage of the FS flow is grouped together or separate in the same or different organization. In the FS flow, there are one model grouping Emptying, Transport and Treatment all together (Figure 2.3) and four models grouping Emptying & Transport together and Treatment separately (Figure 2.4, 2.5, 2.6 and 2.7). Thanks to the visualization the combination of FS flow and FS Financial Flow of Tilley & Dodane in Chapter 13 Financial Transfers and Responsibilities (Strande et al., 2014), the money flow and physical flow of FS were examined and understood.

**Emptying fee** is the fee the households pay for removing FS from containments of OSS including emptying and/or transport service fee. This fee is paid at household level which varies depending on the deal between householder and services operator.

**Discharge fee** is the fee charged for permission to discharge FS at the assigned places. The stakeholders receiving this fee should have the technical and legal ability to safely process the FS.

**Licensing fee** is the fee service operators pay for the municipality or authority department to have the right for FS service operation. This financial instrument used to control the number and quality of C&T enterprises that are allowed to discharge FS at properly designated treatment plants.

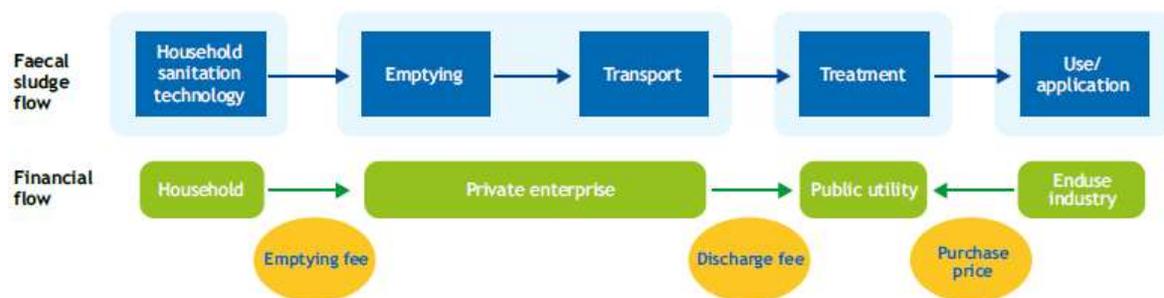
**Sanitation tax** is a fee collected either once, or at regular intervals, and which is paid in exchange for environmental services such as a water connection, a sewer connection/removal of FS, or any combination of these services. Flat-rate taxes based on a uniform per-capita FS generation rate or as a function of water consumption, would force those using more water to subsidise those using less water (Steiner et al., 2003). This model was applied in Hai Phong city of Vietnam (Nguyen et al., 2011)

**Budget support** is the name given to cash or money transfers between stakeholders to cover partly or fully one stakeholder's operating budget. The grantees are government authority, foreign governments or agencies. The receivers are could be any organizations involving in the FSM value chain which needs to have Subsidy to perform better FS service practices.

**Purchase price** is the price paid by one stakeholder to another in exchange for becoming the sole owner of a good. A purchase fee can be paid at any point or with any frequency, as opposed to capital costs, which are only paid at the beginning of a project. The purchase price is dependent on supply, demand, and any subsidies that may be available.

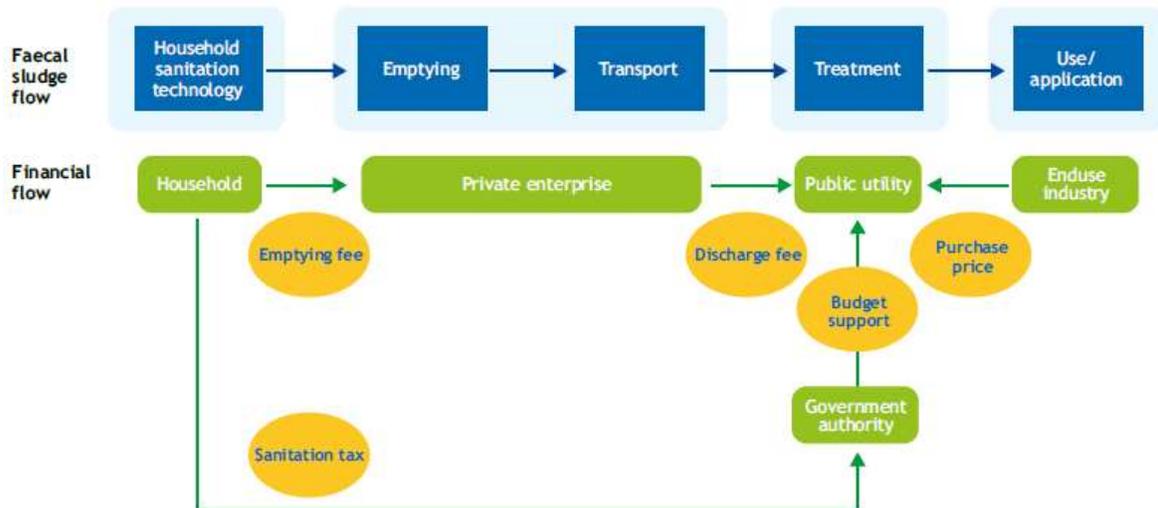


**Figure 2.3 Integrated FS C&T and treatment (Strande et al., 2014)**



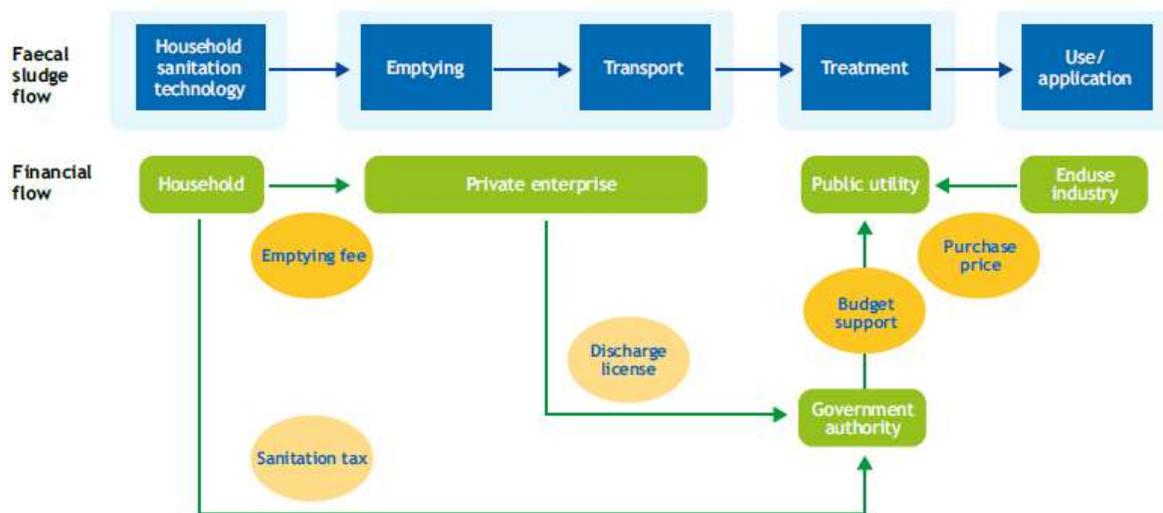
**Figure 2.4 Discrete FS C&T and treatment (Strande et al., 2014)**

Figure 2.3 shows the Integrated C&T and treatment model while Figure 2.4 shows the Discrete model of FS C&T separately with Treatment. In the model Integrated FS C&T and Treatment, a single private enterprise or non-governmental organisation (NGO) is responsible for the emptying, transport and treatment, thus eliminating the need for a discharge fee between the stakeholder responsible for C&T and the stakeholders responsible for the treatment.



**Figure 2.5 Using parallel tax & discharge fee (Strande et al., 2014)**

Figure 2.5 shows the flow in which the sanitation tax is paid directly to the government authority by the toilet user, either through water, sewer, or property taxes. The utility is given budget support from the government authority that collects the sanitation tax. C&T operators may benefit from lower discharge fees and collection and coverage increase.



**Figure 2.6 Using dual licensing and sanitation tax (Strande et al., 2014)**

In the dual licensing and sanitation tax model, as shown in Figure 2.6, the private entrepreneur who is responsible for C&T is not penalized with a discharge fee for each discharge at the treatment plant, but instead is granted unlimited (or semi-limited) access to dump through a discharge license, thus reducing illegal discharge by those C&T operators who may not be able to afford the discharge fee.

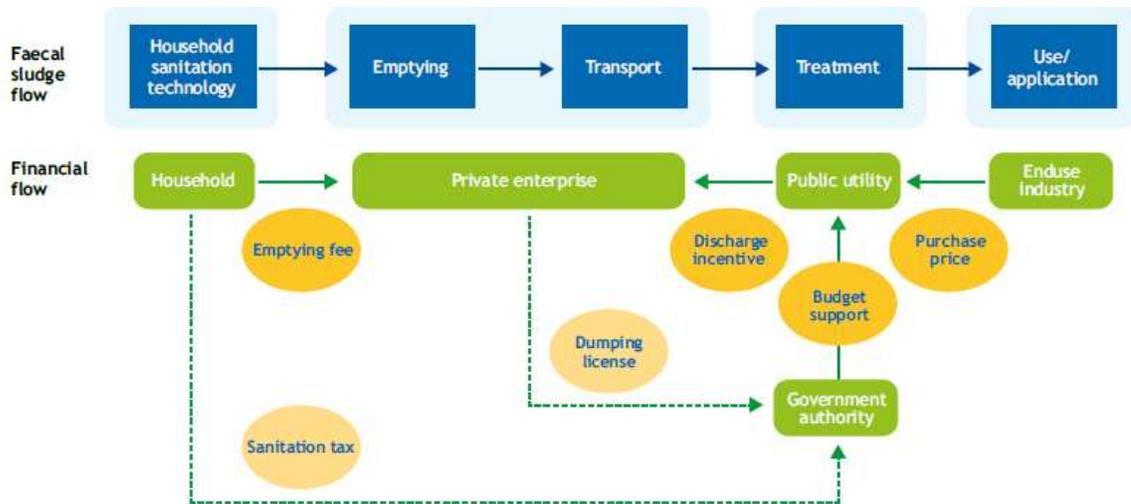


Figure 2.7 Incentive discharge (Strande et al., 2014)

An important feature of the model Incentive discharge shown in Figure 2.7 is the direction of the financial transfer from the public sectors to the private sectors. In this improved model, the FS treatment operator pays the stakeholder responsible for C&T a discharge incentive to dump sludge at the FS treatment plant. A financial model that includes discharge incentives could take a variety of forms that leading to the reduction of Emptying fees for households.

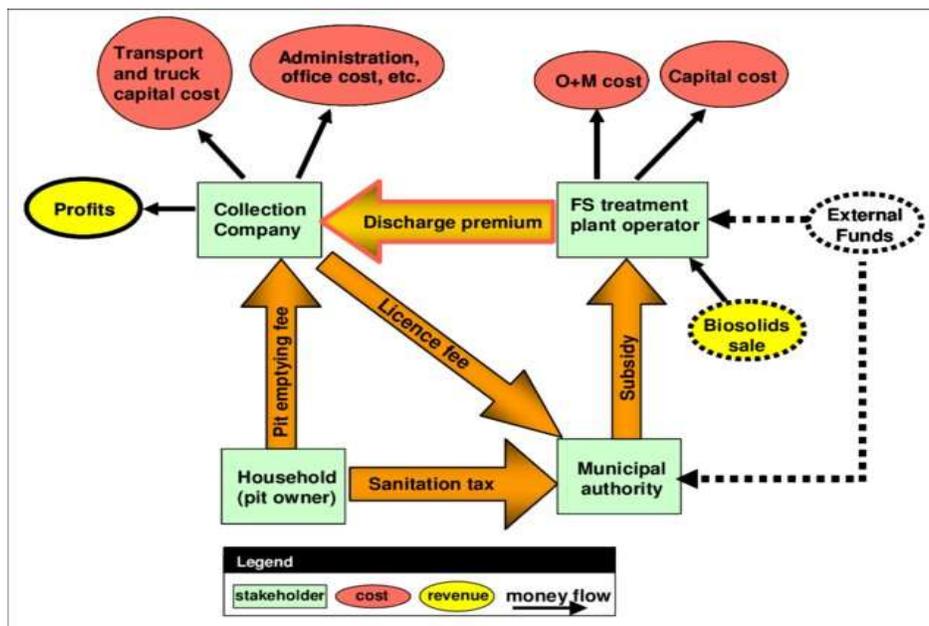


Figure 2.8 FSM money flow scheme (Strauss et al., 2006)

FSM private sectors have been emerging to lead the markets. Formal involvements of private sectors need to be recognized by authorities which can promote the benefits of reducing financial and administrative constraints for FSM services. This may, in turn, reduce fuel costs and motivate service providers to build up their own financial schemes, which may also motivate them to comply with legislation.

Figure 2.8 shows the relationship of four stakeholders within the FS flows including Household, Municipality, FS C&T and Treatment Plant Operator. Household users are responsible for the FS they produced, according to the regulations and rules of the Municipalities (Strande et al., 2014). In this Flow scheme, FS C&T company receives the emptying fee from household and receive incentive discharge premium from treatment operator.

The competent authority sets out a series of charges in which the operators are deemed to operate the FSM services. It has alerted truck drivers through letters and periodic meetings on the need for high environmental protection standards. (Strauss et al., 2002) To formalize the activities of mining enterprises, the idea of an emptier license was encouraged. This license determines the handling point, service quality and the number of trucks allowed to operate in a particular area. Details, awareness, and social/commercial marketing strategies are needed to introduce a new acceptable Money Flow scheme.

### **2.1.3 FSM financial measures**

Financial schemes & tariff structure should be designed so that the costs of treatment plants are covered; FS C&T services are encouraged to provide loan to the treatment plants and users can and will pay. The measures include the financial schemes and tariff structure, structure, loans, and Credit scheme for poor families which is every important solution in term of business and management approach for the solution of FSM improvement.

Subsidies and loans should be noted that for many low-income communities, especially with very low-income communities. The solution could be to subsidize the cost of cleaning facilities or arrangement for loans. Credit scheme for poor families: Septic tanks should be emptying on an annual basis. Empty fees are often too high for poor households who prefer smaller instalments throughout the year under the microcredit program. National or municipal governments should consider the provision of subsidies. The rationale for such a policy is to render FS C&T services affordable to all users to enable service provider operating FS services with adequate profit margins.

Financial sources of FSM can be from government budget/subsidy, loan, grant or personal saving. Public sector usually receives a budget or grant from the government to invest in FSM investment, and O&M. On the other hand, the private sector generally uses the budget from personal saving to start a FSM project. However, if personal budget is not available, capital financing from other sources is needed to be accessed such as government agency, commercial banks, NGOs and others. Therefore, the business plan and project document are required for the financial sources to consider and to offer the credit. According to Sangeeta and Kone (2012), most of the entrepreneurs of FS C&T business rely on personal saving or loan from informal sources such as friends and relatives. The reasons are that FSM services cannot meet bank loan criteria as it is typically required regular customers. Based on FSM financial flow models of the public sector and private sector, the differences in the financial components of each FSM structures are summarized in Table 2.1.

**Table 2.1 The Differences Of Financial Components of The Public Sector and Private Sector (AIT, 2014)**

Financial Component	FSM financial flow model	
	Public Sector	Private Sector
1. Financial Sources		
Government Agency budget	•	
Loan from commercial Bank	•	•
Loan/Borrow Friends/Relative		•
Personal Saving		•
Government/NGO project grant	•	•
2. Costs		
Fixed Costs		
Investment of truck, land cost, FS treatment plant construction cost	•	•
Varied Costs		
O&M i.e. personal cost, fuel cost, maintenance cost, utilities	•	•
Licensing and Concession		•
Others i.e. mobile phone, tax, depreciation	•	•
3. Revenues		
FS Collection fee	•	•
FS Product/by-product revenues sale	•	•

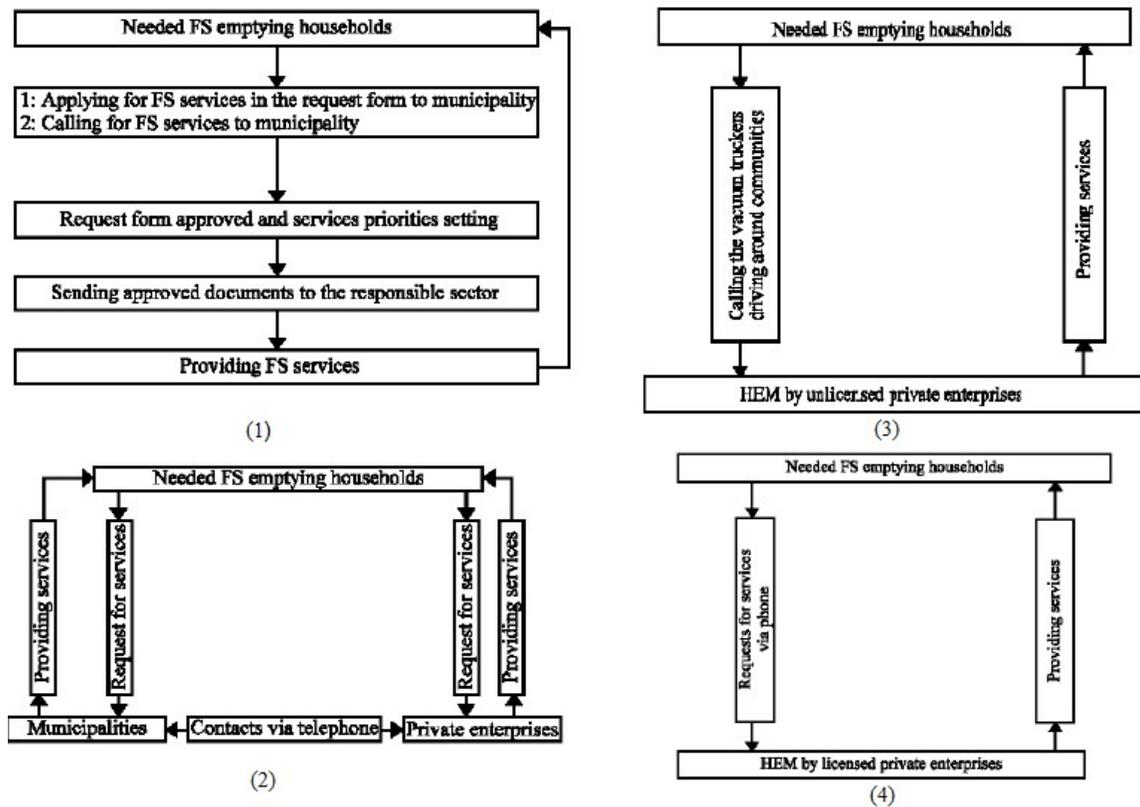
## 2.2 Faecal Sludge Collection And Transportation Services

### 2.2.1 FS collection

FS Collection is an important process of FSM to remove FS from toilet facilities. Manual emptying is still in practice in remote areas or low-income countries, mostly in Africa. This research focuses on FS Mechanical emptying services. The FS volume is defined by the Faecal Sludge Generation Rate is about 0.37 m<sup>3</sup>/capita/year while Sludge (Solids) generation rate is 0.13 m<sup>3</sup> (WHO & Strande, 2014).

Most septic tanks are emptied by vacuum trucks equipped with a pump and a tank. The pump is connected to a hose, lowered into a septic tank or pits, and the sludge is pumped into the tank. In general, the capacity of the vacuum tanker is between 4 and 6 m<sup>3</sup>. Depending on the system, sometimes the compacted garbage mixed in FS cannot be removed easily. In these situations, solids must be liquefied with water to flow more easily. Large trucks often have difficulty accessing septic tanks in areas where roads are narrow or inaccessible. The current issue of freeing FS is illegal dumping when private collectors, who pay a fee when delivering the FS to designated processing or processing locations, will discharge the illegal goods at Locations are not indicated at short distances to avoid paying such fees.

In Thailand, some FS collection services are slow service, no service in weekends, not feedback the schedule for emptying household which may be reflected in the following diagrams in Figure 2.9 (Suebsoh & Charerntanyarak, 2009).



**Figure 2.9 FS emptying services offered by (1) Municipalities (2) Municipalities and private enterprises (3) Private enterprises (4) Unlicensed private enterprise in Northeast of Thailand (Suebsoh & Charerntanyarak, 2009)**

### 2.2.2 FS transportation

The costs for FS emptying and transport depend on time-bound tasks and services, mechanical and personnel factors. The time-bound activities would include Pick-up, Hauling - Transport, At-site and Off-route (Tchobanagolous et al., 1993). Pick-up and Haul time task depends on collection system type. The on-site task is the unit of operation at the transfer station, or disposal place. Off-route includes the times spent on activities not directly connected to FS C&T activities. The main issue of FS transportation is indiscriminate disposal processing (Rao et al., 2016). When designated discharge sites or treatment programs are available, a fee is usually charged by the private collector for FS volume that is delivered to that location.

In Thailand, the Public Health Act BE 1992 authorizes local government or private sector licensing under the City's control to collect, transport and treat sludge. At the same time, the Ministry of Public Health has issued guidelines for the collection and management of appropriate FS for different levels of local government (LGAs). Although local regulations require FS to be collected and properly handled prior to disposal, most LGAs have not been able to provide the full FS collection or appropriate processing services. The level of enforcement authorities, in general, remains weak, leading to widespread unauthorized dumping in public areas (Ministry of Health, 2008). The choice of a second-hand truck has a significant impact on business profitability. Looking at the economy of the operator, the operating cost is about \$11,000 for a truck in Asia and three times more in Africa. The cost

division is much different, with African businesses spending 76% on various fees such as fuel and maintenance, while their Asian counterparts spend the bulk of their costs (62%) for fixed costs - mainly employee salaries. The largest component of operating costs in Africa is fuel, accounting for 40% of the cost. This is thought to be due to the use of large-capacity trucks that consume more fuel, older, less fuel-efficient trucks, and long hauls to landfill sites outside of the city.

Generally, municipal services and private companies spend about 10-30 minutes for FS collection. It includes truck parking, preparation, opening the manholes, emptying process, pipe cleaning and pipe collection as shown in Figure 2.10



Truck Parking

Pipe preparation

Opening the manholes/system and emptying process

Pipe cleaning

Pipe collection

**Figure 2.10 The steps of FS collection with truck and operator in Thailand (AIT, 2013)**

The collected FS will be disposed at FS treatment plant or other disposal areas. It was found that the FS treatment plant and disposal site are located within the service area. The one-way trip distance from the service area to the FS treatment plant or disposal site are about 2-40 kilometer (km) or 15-20 minutes' drive. Key resources in the C&T service is Truck, equipment, and human resources which are considered to be the key costly element which could be improved in the business perspective.

### 2.2.3 Truck and equipment

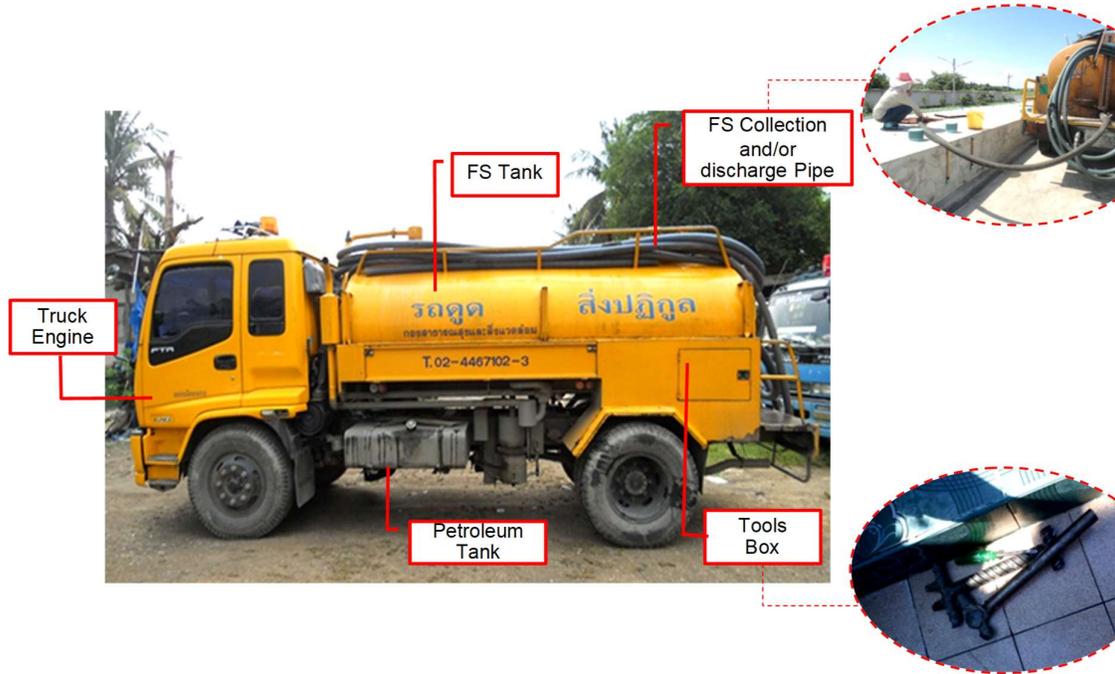
In Thailand and Vietnam, FS collection trucks capacities vary from 3, 4, 6, 8 and 12 cubic meters as shown in Figure 2.11. The field observation shows that 4 m<sup>3</sup> and 6 m<sup>3</sup> FS trucks are commonly used. The FS C&T trucks are equipped with vacuum pump and piping system.



**Figure 2.11 FS collecting truck (A) 3 m<sup>3</sup>, (B) 4 m<sup>3</sup> and (C) 6 m<sup>3</sup> in Thailand (AIT, 2013)**

A new truck is a truck which is complemented in a truck factory and ready to use. A second-hand truck is a used FS truck which may be ready to use or may need additional fixing

depending on its condition. An assembled truck is a truck of which the chassis and storage tank come separately. FS truck owner needs to assemble the tank, and pumping equipment before it can be used. Main equipment for FS C&T service are FS a vacuum truck and opening septic tank cap equipment such as hammer, chisel, ready mortar, and bucket.



(A) Right Side of FS Vacuum Truck



(B) Backside of FS Vacuum Truck

Figure 2.12 (A) & (B) FS collection truck: Compositions and other equipment in Thailand (AIT, 2013)

FS collection truck conditions can be divided into three groups; new, second-hand and assembled truck. It is also varied by its capacity as described in Table 2.2.

**Table 2.2 Truck and Equipment**

<b>FS truck condition</b>	<b>Description</b>	<b>Truck Capacity</b>
New trucks	A new truck is a truck which is complemented from a truck factory and is ready to use.	FS collection trucks capacities are varied from 03; 04, 06, 08 and 12 cubic meters (m <sup>3</sup> ). The field observation shows that 4 m <sup>3</sup> and 6 m <sup>3</sup> FS trucks are commonly used
Second-hand trucks	A second-hand truck is a used FS truck which may be ready to use or need additional fixing depending on its condition	
Assembled trucks	An assembled truck is a truck that chassis and storage tank come separately. FS truck owner needs to assemble the tank, and pumping equipment before it can be used.	

The route of service is usually decided by FS truck driver or municipality officer. Both will re-arrange the service priority based on job order information including name, address, contact information and amount of FS requesting households. Customers mainly contact the collection and transportation service provider by telephone, Other contact channels such as LGOs or private company's office, fax, or internet are rarely used.

#### **2.2.4 Human resources**

Human resources which are involved in FSM practice can be categorized into two groups: office staff and operating staff. The office staff is a person who is responsible for receiving the request and creating a job order for the operating staffs. Operating staff group consists of truck driver and assistant. Truck drivers' responsibilities are driving and pumping control. There are usually 1-2 assistants per truck to open the cover of DEWATS, control and clean the pipe. However, most private companies do not have office staffs because the same person receives the request and provides the services. Thus, the FS truck drivers or assistants have also received the requests as office staffs.

**Table 2.3 List of Staffs and their Responsibilities**

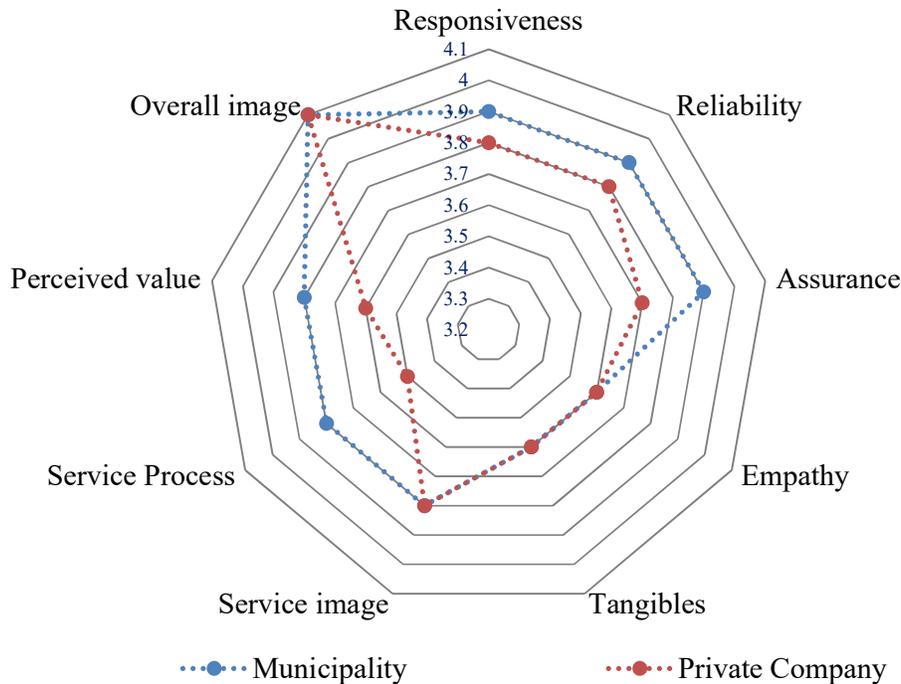
<b>Human Resources</b>	<b>Responsibility</b>
Office staff	A person who responds for receiving requests and create a job order for operating staffs. Most private companies do not have office staffs because an individual person provides the service. Thus, the FS truck driver or assistants have also received the requests as office staffs.
Operating staffs	
Truck driver	A person drives the vehicle and pumping control.
Assistants	There are usually 1 or 2 assistants per one truck to open the cover of DEWATS, control and clean the pipe.

The pre-survey results show that 90% of FS collected in Thailand (2013) was illegally dumped or discharged directly into agricultural areas or waterways due to shortage or distances of the plant. In addition, more than 90% of FS collected is water. Therefore, only 2-3 households can be served on one trip. That means that the time lost is due to the truck being on the way to or from the disposal site or processing plant. Therefore, it would be important to have a process or technology that can reduce the volume of treated FS and discharge water.

More efficient trucks (i.e., newer cars, more fuel-efficient), provided through lower import taxes, would significantly improve fuel consumption and help to reduce overall costs. More strategically positioned disposal facilities would reduce travel distances, and are important to the city, reducing the time and fuel wasted.

### 2.2.5 Customer satisfaction of FS C&T services

This section focuses on describing the level of service quality and satisfaction of household on FS collection and transportation service base. According to the survey in Thailand (AIT, 2012 & 2013), it was found that over half of the respondents were highly satisfied with FS service indicated 55.1% and 31.6% were moderately satisfied with FS services. And there was 2.1% of customers had the highest satisfied with FS services.



**Figure 2.13 Level of customer satisfaction of FS C&T services**

Figure 2.13 shows the level of satisfaction with FS C&T services by the public sector and the private sector. It indicates that service by the public sector enjoys a higher level of satisfaction. However, the following aspects are not different are similar:

- **Empathy** means that both providers had the ability to be approachable because they are well-known in their respective communities and service time depends on the convenient time of employees and customers.
- **Overall Image and Service image** are the images of organization which is in sight of the customer can influence customer satisfaction and can be created by credibility information and experience. In the study area, there was only one legal service provider, thus customers cannot choose which one was the best service. However, they still use this provider because it is legal and does not cheat.
- **Tangibles** refer to the appearance of the physical surroundings and facilities, equipment, personnel and the way of communication which were called the tangible was appropriate for both service providers. A customer can contact the service convenient and easy to access by telephone. However, the public service provider was contacted by writing a letter of request that can reach easily for the customer because the municipality location was closed to the community.

Different aspects that people found more satisfied with the public service provider more than a private company provider are as follows.

- **Responsiveness** describes as a willingness to help customers from the public provider is more immediate than a private company. such as cleaning equipment/toilet after service finished, providing the knowledge and proficiency to fix problems; clogging, difficult to open a cover and odours.
- **Reliability** is the promised service dependably and accurately from the public providers under government agency has law enforcement directly. Staffs of public providers have been trained to working in hygienic condition whereas private companies are lacking attention in hygienic training.
- **Assurance** is the ability to ensure the service process correctly deployed. The Public service provider has the ability to convey trust and confidence which was called assurance issue because they and feel safe in their transactions. Hence, the services of the public provider are more trustworthy than FS services of a private company. For example, a service provider which is municipality have affordable service fee (some private companies have higher service fee), and there are the receipts to confirm which service is finished and completed.
- **Service process** is the procedure to request and operate the FS collection service which is appropriate to customers/users because there is a request letter to confirm when customer/users obtain FS services. However, most private companies contact and confirm FS services by telephone.
- **Perceived value** is the value customers have after using the services. The FS collection service is considered by quality more than by quantity because customers choose FS C&T services considering based on service quality.

## 2.3 Business Models

Recently, the Business-model concept has been applied to study FS services (Hawkins & Muxímpua, 2015; Rao et al., 2016; Otoo & Drechsel, 2018); however, the details behind the business model and business components have not been articulated. By recognizing opportunities emerging outside the conventional business models, logistics services must constantly seek new knowledge, focus customer, develop and innovate services to meet customers` needs (Chapman et al., 2003). The business model literature has expanded massively even faster than the related dynamic capabilities literature, which emerged at about the same time. The Scopus database lists 7,391 publications on the topic of “business model” and 349 (peer-reviewed article for business model innovation for the period 1980–2015 (Foss & Saebi, 2016). But very few articles related to Business model for FS such as from Hawkins & Muxímpua (2015), Nguyen et al. (2013). Particularly, as for as this research was started from 2012, there was no research on Business model innovation for FS C&T services. This is a huge research gap to be fulfilled in the FSM field. Recently The CGIAR Research Program on Water Land and Ecosystems and the International Water Management Institute, have recently released 18 business models and 44 cases on FSM, which propose solutions like turning waste into marketable fertilizer with can significantly reduce the cost of sanitation services while increasing agricultural yields (Rao et al., 2016).

The business model is emerging as a new analysis unit and research subject at the company level. The company's activities play a key role in the conceptualization of business models that have been proposed. Business models seek to explain how to create value, not just how it is captured. As a result, the FS C&T research with the business model approach is a trend in international sanitation research to contribute not only to sanitation research but to the Innovative solution to the problem of FSM.

Osterwalder and Pigneur (2009) were applied as a framework because it is a common and basic model which can be applied to a wild range of businesses. In this research, the business model is adapted from the business model of Osterwalder with nine components because it reflects the situation of sanitation as a service business that can be innovated.

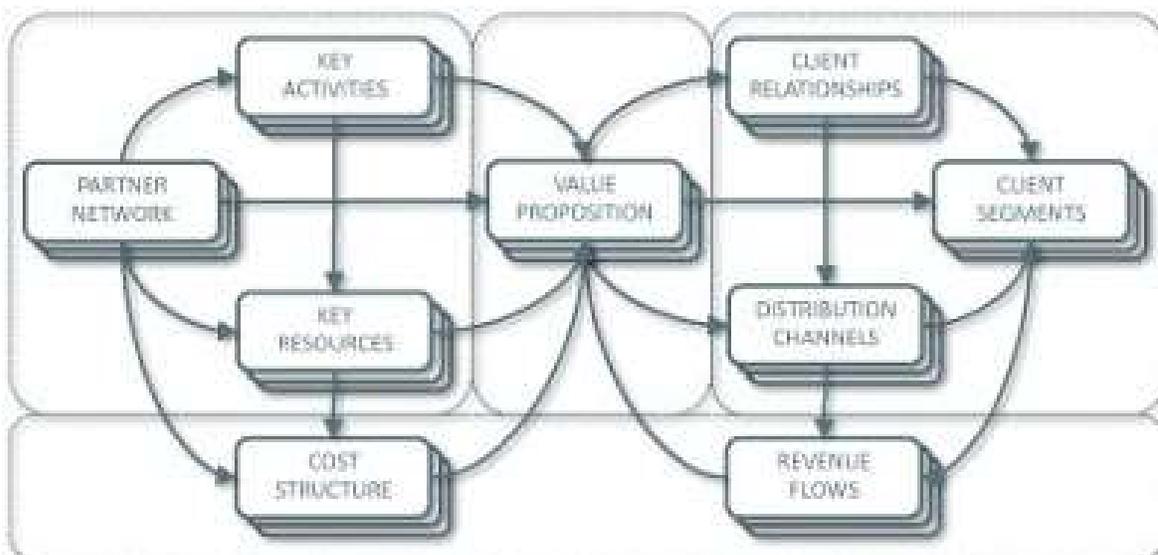
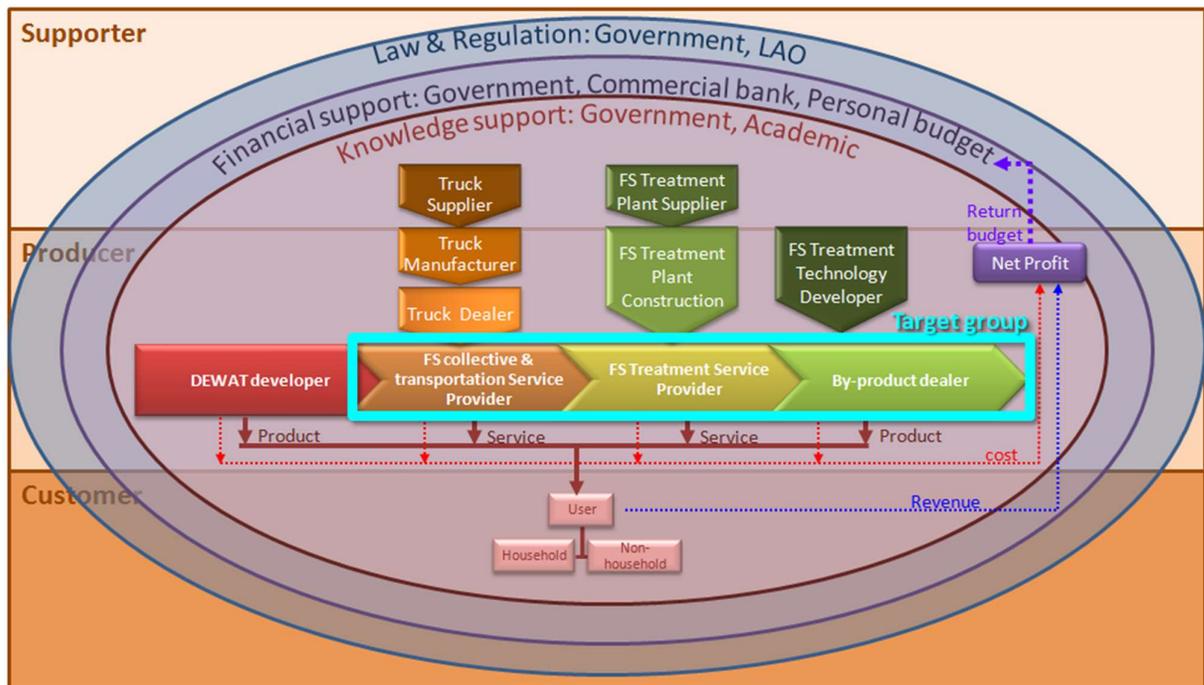


Figure 2.14 The nine-component business model canvas (Osterwalder, 2005)The key

stakeholders in the current situation of FSM Business model consists of DEWATS developer, Service Provider in collective and transportation include treatment and reuse or by-product dealer as producer of product or service to serve the user who is household or non-household, presented in Figure 2.15

For FS C&T services, there are truck suppliers, manufacturers and dealers to support and produce the vacuum truck that is the most important equipment for serving customers. In FS Treatment and reuse part, there are FS treatment plant supplier and Construction to build a treatment plant that is the main equipment. And the FS treatment technology of treatment plant will define by-product of they that can sell. In addition, the main supporters of the FSM chain are the Government, Commercial bank or Personal budget as financial support. All of the activities are controlled or supported by law and regulation that define by government or LAOs. The cost and revenues of FSM businesses are different depending on their activities.



**Figure 2.15 Conceptual framework of FSM and FS C&T service business model (AIT, 2014)**

Nutrition and organic matter recovery would be appropriate for Business model trend for FSM. Otoo, M. and Drechsel, P. (2018) have proposed two innovative business model for outsourcing FS treatment for on-farm use with the case Bangalore Honey Suckers in India. The second case is the business model on phosphorus recovery from excreta and wastewater, Case – Urine and faecal matter collection for reuse (Ouagadougou, Burkina Faso).

**Table 2.4 Business-Model Canvas - The Nine Business-Model Blocks (Osterwalder & Pigneur, 2010)**

<p><b>Key Partners</b> Who are our Key Partners? Who are our key suppliers? Which Key Resources are we acquiring from partners? Which Key Activities do partners perform?</p> <p><b>Motivations for partnerships:</b> Optimization and economy Reduction of risk and uncertainty Acquisition of particular resources and activities</p>	<p><b>Key Activities</b> What Key Activities do our Value Propositions require? Our Distribution Channels? Customer Relationships? Revenue streams?</p> <p><b>Categories</b> Production Problem Solving Platform/Network</p> <p><b>Key Resources</b> What Key Resources do our Value Propositions require? Our Distribution Channels? Customer Relationships? Revenue Streams?</p> <p><b>Types of resources</b> Physical Intellectual (brand patents, copyrights, data) Human Financial</p>	<p><b>Value Propositions</b> What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? What bundles of products and services are we offering to each Customer Segment? Which customer needs are we satisfying?</p> <p><b>Characteristics</b> Newness Performance Customization "Getting the Job Done" Design Brand/Status Price Cost Reduction Risk Reduction Accessibility Convenience/Usability</p>	<p><b>Customer Relationships</b> What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? How are they integrated with the rest of our business model? How costly are they?</p> <p><b>Examples</b> Personal assistance Dedicated Personal Assistance Self-Service Automated Services Communities Co-creation</p> <p><b>Channels</b> Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How are our Channels integrated? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?</p> <p><b>Channel phases:</b> 1. Awareness: How do we raise awareness about our company's products and services? 2. Evaluation: How do we help customers evaluate our organization's Value Proposition? 3. Purchase: How do we allow customers to purchase specific products and services? 4. Delivery: How do we deliver a Value Proposition to customers? 5. After sales: How do we provide post-purchase customer support?</p>	<p><b>Customer Segments</b> For whom are we creating value? Who are our most important customers?</p> <p>Mass Market Niche Market Segmented Diversified Multi-sided Platform</p>																								
<p><b>Cost Structure</b> What are the most important costs inherent in our business model? Which Key Resources are most expensive? Which Key Activities are most expensive?</p> <p><b>Is your business more:</b> Cost Driven (leanest cost structure, low price value proposition, maximum automation, extensive outsourcing) Value Driven (focused on value creation, premium value proposition)</p> <p><b>Sample characteristics:</b> Fixed Costs (salaries, rents, utilities) Variable costs Economies of scale Economies of scope</p>		<p><b>Revenue Streams</b> For what value are our customers really willing to pay? For what do they currently pay? How are they currently paying? How would they prefer to pay? How much does each Revenue Stream contribute to overall revenues?</p> <table border="0"> <tr> <td><b>Types:</b></td> <td><b>Fixed pricing</b></td> <td><b>Dynamic pricing</b></td> </tr> <tr> <td>Asset sale</td> <td>List Price</td> <td>Negotiation (bargaining)</td> </tr> <tr> <td>Usage fee</td> <td>Product feature dependent</td> <td>Yield Management</td> </tr> <tr> <td>Subscription Fees</td> <td>Customer segment dependent</td> <td>Real-time-Market</td> </tr> <tr> <td>Lending/Renting/Leasing</td> <td>Volume dependent</td> <td></td> </tr> <tr> <td>Licensing</td> <td></td> <td></td> </tr> <tr> <td>Brokerage fees</td> <td></td> <td></td> </tr> <tr> <td>Advertising</td> <td></td> <td></td> </tr> </table>			<b>Types:</b>	<b>Fixed pricing</b>	<b>Dynamic pricing</b>	Asset sale	List Price	Negotiation (bargaining)	Usage fee	Product feature dependent	Yield Management	Subscription Fees	Customer segment dependent	Real-time-Market	Lending/Renting/Leasing	Volume dependent		Licensing			Brokerage fees			Advertising		
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## **2.4 Business Model Innovation**

Business Model Innovation (BMI) is about transforming the key elements of the business or inventing completely new ways of doing business. To drive Business Model Innovation in established companies a concrete process is needed with clear tasks and a dedicated team driving the efforts. Fallahi (2017) proposed two approaches to BMI is purposeful and unintentional and BMI processes unfold in the two distinct spaces of ‘new Business Model design’ and ‘existing Business Model transformation’.

To drive Business Model Innovation, a five-step process of setting the stage, discovery, development, conceptualization, and commercialization can be used. Most organizations will need to identify internal leaders to change the business model, to manage the results of these processes and to provide a better and new business model for the company. At the same time, the organization's culture must seek to embrace the new paradigm while maintaining the effectiveness of its current business model until the new model is ready to take over. Only in this way, innovative new business models can help companies get rid of the 'traps' of their previous business models, growth and profitability. According to Osterwalder, Pigneur (2010) Business model innovation results from one of four objectives: (1) to satisfy existing but unanswered market needs, (2) to bring new technologies, products, or services to market, (3) to improve, disrupt, or transform an existing market with a better business model, or (4) to create an entirely new market.

As it was stated by Chesbrough (2007), Business model innovation: It's not just about technology anymore but including management and planning. There are several approaches to innovating business models such as Establishing new business models in the old industry, Solving unsolicited customer needs and Building new business models around them. Business model innovation should start with optimization and development. In FSM, applying the concept of Resource recovery from waste could be the strategic step to innovate the business model (Otoo & Drechsel, 2018).

## **2.5 Literature Gaps of Business Model Innovation in Faecal Sludge Management**

By intensively reviewing the literature of two main research fields BMI and FSM, this study figure of the three main gaps for FS C&T services innovation as follows:

### **1. The lacking of systematic landscape study of FS C&T business integrated into the FSM Value Chain**

The environmental problems and issues are traditionally addressed and proposed to be solved by technical tools or technology while the management tools are considered a very powerful solution. The research gap in the sanitation management is considering FS C&T as a service business to be well-researched and defined and the lacking the systematic landscape of FS C&T business integrated into the FSM value chain.

### **2. The well-defined FS C&T service business models**

In term of considering FS C&T as a service, the well-defined FS C&T business model as a service based business model is a gap should be further explored. As some researches are conducted in African countries are mentioned about sanitation “business model” for C&T service but the model of Osterwalder’ s 9 point decomposition should be a new approach to

formulate the current state of the business model. The Osterwalder' s model is applied in retail, IT, manufacturing business... but rarely applied for sanitation business especially for C&T service. This model is promising to be applied for a FS C&T service business is one of the environmental-related and transportation services which could be modelled and innovated. Basing on Business-Model Canvas Nine business-model blocks (Osterwalder & Pigneur, 2010) shown in Table 2.3, The business model of FS C&T will be developed and innovated.

### **3. The innovative business models to be applied in different business contexts**

The most significant and origin gap is the Gap in research and proposing the innovative service-business model Some business model about FS C&T focuses in financial aspect or regulatory (Sangeeta & Kone, 2012) but lacking the research perspective of innovation business to support the private sector and/or Public-private-cooperation to enhance both advantages of each sector. So the gap “The innovative service-business model to be applied in an appropriated business context” is proposed to be the key research gap for find out the suitable solution and innovative tools a creative business model aims for long-term profitability to sustain the business and contribute for the environment protection.

## Chapter 3

### Methodology

The research topic addresses both Environmental science of FSM and FS C&T and Business management science about Business model innovation. To explore this interdisciplinary research and fulfil the three objectives stated in Chapter 1, Combined methods have applied and utilized all the functions. The comprehensive research framework was designed then to achieve each objective, relevant methods were used to achieve the relevant results. Qualitative methods were used for exploratory results and quantitative methods were carried out for confirmatory findings.

#### 3.1 Research Design and Framework

This study was designed following the ethical guidelines of the Finnish Advisory Board on Research Integrity (TENK, 2009) to study on 53 cases in which all the informants understood and consented about the purely scientific purpose. Data on FS C&T services were collected from employers and employees of total 52 service cases in Thailand & Vietnam and one case in Finland, in which interviews and questionnaire surveys were conducted separately to cross-check data validity. The case in Finland was chosen to represent a successful FS C&T service with a well-defined business model. By random data sampling method to collect total 53 cases, 6 cases were used only for qualitative analysis; 38 cases were used only for quantitative analysis and 9 cases were used for both qualitative and quantitative analysis.

**Table 3.1 Detailed Research Framework**

Research objectives	Methods	Detail of works	Outcomes
1. To define business problems and Financial structure of FS C&T services.	Situational analysis Financial structure analysis and comparison	Reviewing Institutional framework, legislation practice in National and Local Level for FS C&T service	Business problem matrix
	Secondary data analysis	Case-study analysis: FS C&T services of Public and Private cases	Financial structure
2. To identify the Business components, Conceptual business model, Business model performance indicators and Business innovation of FS C&T services	Qualitative methods Benchmarking assessment	Field investigation, field observation, in-depth interview, content analysis	Conceptual business model  Business model performance indicators  Innovation solutions

3. To confirm the Relationships of Business components, Service performance and Service innovation possibilities	Quantitative methods Structural Equation Modeling, Questionnaire	Descriptive analysis Correlation analysis Reliability analysis Confirmatory Factor Analysis (CFA) Hypotheses testing	Relationship model of Business components, Service performance & service innovation possibilities
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To adhere and achieve the research objectives, the research framework was designed with four flows accordingly with methods, detail of works and expected outcomes, shown in Table 3.1. The methods are considered and chosen by the author are resources and the appropriateness to have the optimum results. This research aimed to explain and describe the Business model innovation process dedicated to FS C&T service. Then, this research aims to assess the innovative solutions and make recommendations on how to apply the findings to innovate the service performances.

### 3.2 Qualitative Method

The data for the empirical study was collected both in developing and developed countries, examined fifteen representative cases chosen based on service location base, type of ownership and business size (number and size of trucks). Within 2013 and 2014, This study included by the author with eight cases in five provinces in Thailand, six cases in Ho Chi Minh City, the biggest metropolitan of Vietnam, and one case in Finland as a representative for transnational waste management companies. Qualitative data were collected through semi-structured interviews with various service stakeholders including owners, operators, truck drivers and authorities from 15 service cases consisting (shown in the appendix) of 4 municipality cases, 2 public companies, 8 private companies with licenses and 1 private operator without a license. The interview questions addressed mainly on what the service problems were, how services were planned, deployed and how the business performed. PEST analysis (Gupta, 2013) were used to classify the service problems into business problems. The nine-component business model (Osterwalder & Pigneur, 2010) was applied as a framework to classify business activities into business components. Each business component was described and explained with the comparison among 3 clusters of services scales.

#### 3.2.1 Site selection

The qualitative survey and interviews with service providers were conducted face-to-face in Finland, Thailand, and Vietnam. There were one city in Finland, eight provinces in Thailand and one city in Vietnam were visited by the authors. The service cases were chosen by the convenient random sampling to meet the criteria of ownership, service size, location and the willingness to respond from the key informants.

#### 3.2.2 The unit of analysis

The public organization (Municipality, Public Company, One member Ltd. Company) and Private sector (Service provider, Private Ltd. Company) which are currently the two main organizations conducting the FS C&T services. Based on Case Study (Yin, 2014), the unit of analysis of this study is the business model of FS C&T organization.

### **3.2.3 The key informants**

The key informants were the key people involving in business planning, process and development such as the business owner, the director and the operators of the business. The key informants are employers and employees of each organization, in which interviews were conducted separately to cross-check the validity of given data. Data and information were recorded from in-depth interviews with several service stakeholders including owners, operators and truck drivers.

### **3.2.4 Secondary data analysis**

Reports, peer-reviewed journals and Institutional framework and Policy & Regulation of representative countries were reviewed and synthesized to develop background information from both existing research results and governmental documents about FS C&T services in each of the three countries. Literature reviews were conducted to develop background information from existing research results and governmental documents about FS collection and transport services in each of the three countries.

### **3.2.5 Field investigation & observation**

The service cases are chosen based on the key criteria: cross-countries to show the impact of external factors on the business model (Thailand and Vietnam), location (urban area), Type of service (In order to investigate FSM practice, a set of structured questionnaires were used to with the target groups. Moreover, to understand the FSM practice process, this study also observed the FS trucks service from the beginning of the day until they finished the first trips. The author of this research travelled to Finland, Thailand, Vietnam to select the cases. Two research groups had been working both in Vietnam and Thailand on the field directly with the service operators to observe the FS C&T services in four main locations: truck parking lots, service station, households and discharge, and treatment sites. Photos, video clips, voice clips were recorded to analysis the activities and monitor the whole services process to distinguish the services based on country contexts.

### **3.2.6 Semi-structured in-depth interview**

After both municipalities and private companies had answered the questionnaires, the selected municipalities and private companies were chosen based on random convenience sampling for interview. The key informants who were aware and agreed to engage in the interview. The questions are mainly focusing on FSM business i.e. investment, expenses, and revenues. Interview questions addressed how services were planned, deployed and how business performance was defined with the confirmation of the reported annual financial profit or loss. Data were voice recorded, analyzed and translated into information and integrated into the adapted nine-component business model canvas and two external components. Each component was explained and described and financial performance data were compared in the Results and Discussion section. The FSM expert's opinion research was conducted in India, Netherlands and South Africa to interview and discuss with FSM experts to figure out the innovative solutions and applications in the annual workshops of the project Stimulating Local Innovation on Sanitation for the Urban Poor in Sub-Saharan Africa and South-East Asia (SaniUP project).

In-depth interview questions have been developed based on the literature and field observation to address how services were planned, deployed and how business performance was defined with the confirmation of annual financial profit or loss. Data were recorded, cleaned then translated into information and integrated into the adapted nine-component business model canvas and two external components. Each component was explained and described clearly detailed in the conceptual business model in the results and discussion. Standardized interview question sets were constructed basing on Dialogues with 20 service providers, five experts, five researchers and five authorities.

### **3.2.7 Benchmarking assessment**

Benchmarking is comparing one's service processes and performance metrics to best perceived FS C&T service from other service cases. Benchmarking is used to measure performance using specific indicators. Business model performance indicators and Service performance indicators are proposed. The model service cases will be used as a role model case to compare with other cases. This Finnish case would be elaborated in Chapter 4.

## **3.3 Quantitative Method**

In the current study, quantitative methods have two main aims including Financial structure analysis and Structural Equation Modelling for FS C&T services. The financial data were collected from financial statement survey in Vietnam and Thailand in 2013, 2014 by the author and NATS research team (AIT, 2013, 2014). The Structural Equation Modelling was surveyed internationally by online and post mailing questionnaire survey by the author in 2015 & 2016.

### **3.3.1 Financial structure analysis**

Financial analysis is a tool to identify the financial situation and structure of FS C&T services of the representative cases in Thailand and Vietnam. Costs and income statements of 28 service cases in Thailand were collected through questionnaires and 19 service cases in Vietnam were extracted from the report *Landscape Analysis & Business Model Assessment in FSM: Extraction & Transport models in Vietnam* (Nguyen et al. 2012). Financial performance data were compared based on the financial net profit, annual collected FS volume and operating cost structure. These financial indicators from 28 cases were calculated from the survey income statement. There are several input parameters involved in financial analysis. Those parameters were conducted by applying income statement questionnaires and in-depth interviews. They were grouped into the following: **(1) Service parameter** includes general information on service area, resources and working condition of FSM activities. And **(2) Financial parameter** includes cost and revenues at the different activities shown in Table 3.2. The detailed of the parameter is later presented in Appendix 4. The challenge of this data survey is to ensure data validity and reliability. As the author and research team (AIT, 2013, 2014) has both send the questionnaires by post and interview face to face with the Staff/Manager in charge of Financial statement for the case we can schedule the interview. The financial data were double checked with the value logic and compare with the reasonable value range of the parameters.

**Table 3.2 Input and Output Parameters for Financial Analysis**

Activity	Input		Output	
	parameters	Unit	parameters	Unit
<b>FS Collection and transportation</b>	No of Truck	Truck		
	Truck Capacity	m <sup>3</sup>		
	Number of Trips	Trip/day		
	Working day	Day/year		
	Amount of collected FS	m <sup>3</sup> /year		
	No. of served household (per year)	Household/year		
	Age of trucks (Optional)	Year		
	Travelling Distance (Optional)	km/day		
	Truck investment	US\$	Investment	US\$
	Equipment cost	US\$		
Year of truck invest	Year			
Number of staff	Persons	Operating cost	US\$/year *It can be US\$/day	
Salary rate	US\$/month*			
Fuel consumption	Liter/day			
Fuel cost	US\$/liter			
License	US\$/year			
Tires	US\$/year	Maintenance cost	US\$/year	
Annual maintenance	US\$/year			
Other	US\$/year			
Truck Estimate useful life	Years	Other costs	US\$/year	
Truck Depreciation cost	US\$/year			
Other Cost	US\$/year			
FS collection fee rate	US\$/m <sup>3</sup>	Revenues	US\$/year	
Raw sludge selling rate	US\$/ton			
Amount of Raw FS selling	m <sup>3</sup>			
Other Revenue	US\$/year			

Operating cost components consist of personnel cost, fuel costs, maintenance costs, licensing, material, utilities and others. Personnel cost is calculated based on the number of staff and wage rate. The fuel cost is multiplied of fuel consumption and fuel price which may be different due to logistic conditions, service area, and travelling distance, the amount of collected FS, etc.). Maintenance cost is the cost to maintain the equipment and facilities in good condition. Utilities included water and electricity supply. Licensing is calculated from licensing fee rate and a number of the area they were licensed. Other costs vary such as treatment fee, discharge fee, administrative, and/or telephone.

### 3.3.2 Structural equation modelling for FS C&T services

Structural Equation Modeling (SEM) was applied to analyze the data set for relations among observed and latent variables (Hoyle, 1995). To test the proposed hypotheses, this study conducted an international survey through the online survey tool Survey monkey and the sending mail post to the respondents. The respondents are the FS C&T service providers and experts. The questionnaire was made based on the business model theory. The empirical study

was collected in both developing and developed countries, examined chosen based on service local, type of ownership and business size (number and size of transportation truck). Data were compared in the Results and Discussion section.

Based on the literature review, in-depth interview data, the questionnaire content was designed English then translated into Vietnamese and Thai. The questionnaire in English was pre-tested by three service experts to ensure content validity. The pilot survey was conducted among eight service providers in Vietnam and Thailand. With the final version, the English questionnaire was surveyed online international, the Thai and Vietnamese questionnaires were mailed by post to the respondents in Thailand and Vietnam respectively. Instrument items are measured on a seven-point (1-7) Liker scales, in which 1 indicates that the respondent strongly agrees with the statement and 7 indicates that the respondent strongly disagrees with the statement respectively

The questionnaire was used to collect the opinion about business components and business performance. The analysis factors were 12 business model components, the law-regulation system and the ownership status. Detailed quantitative survey shown in Table 3.3 and Questionnaire were attached in Appendix 1, 2 &3.

**Table 3.3 Quantitative Survey Detail and Output**

<b>Methods</b>	<b>Detail of works</b>	<b>Output</b>
Quantitative survey	224 questionnaires internationally distributed	The structural equation model of Business components and service performance and innovative possibility
Questionnaire	Mailing survey and feedback: 470 Vietnam mails, 140 Thailand mails,  Online Survey: internationally email through Online survey monkey on Sustainable Sanitation Alliance forum and 2300 email addresses. The email addresses were collected from Pollution control Department in Thailand, Department of Solid Waste in Vietnam and Sanitation and FSM directory books.	

This study first undertakes the CFA to confirm the factor loadings of 12 variables shown in Table 3.4 (i.e., key resource, key partner, key activity, value proposition, customer relationship, distribution channel, customer segment, cost, revenue, law & regulation platform and ownership) and to assess the model fit. The model adequacy was assessed by the fit indices suggested by Hair et al., 1998. Convergent validity of CFA results has been supported by item construct reliability and extracted average variance.

Using the business model canvas with The nine-component business model (Osterwalder & Pigneur 2010) this study develop 38 observed variables of business components 5 latent variables of Service performance. Base on the assessment statement in page 217, 289 and 219, in the book Business model generation, 1st edition, (Osterwalder, & Pigneur, 2010), the nine latent variables were measured by the measurable statements. The two new factors were assigned the statement based on in-depth interview data. Service performance was set with five measurable variables which later were explained in Chapter 4.

**Table 3.4 Variable and Construct of FS C&T Services Business Components**

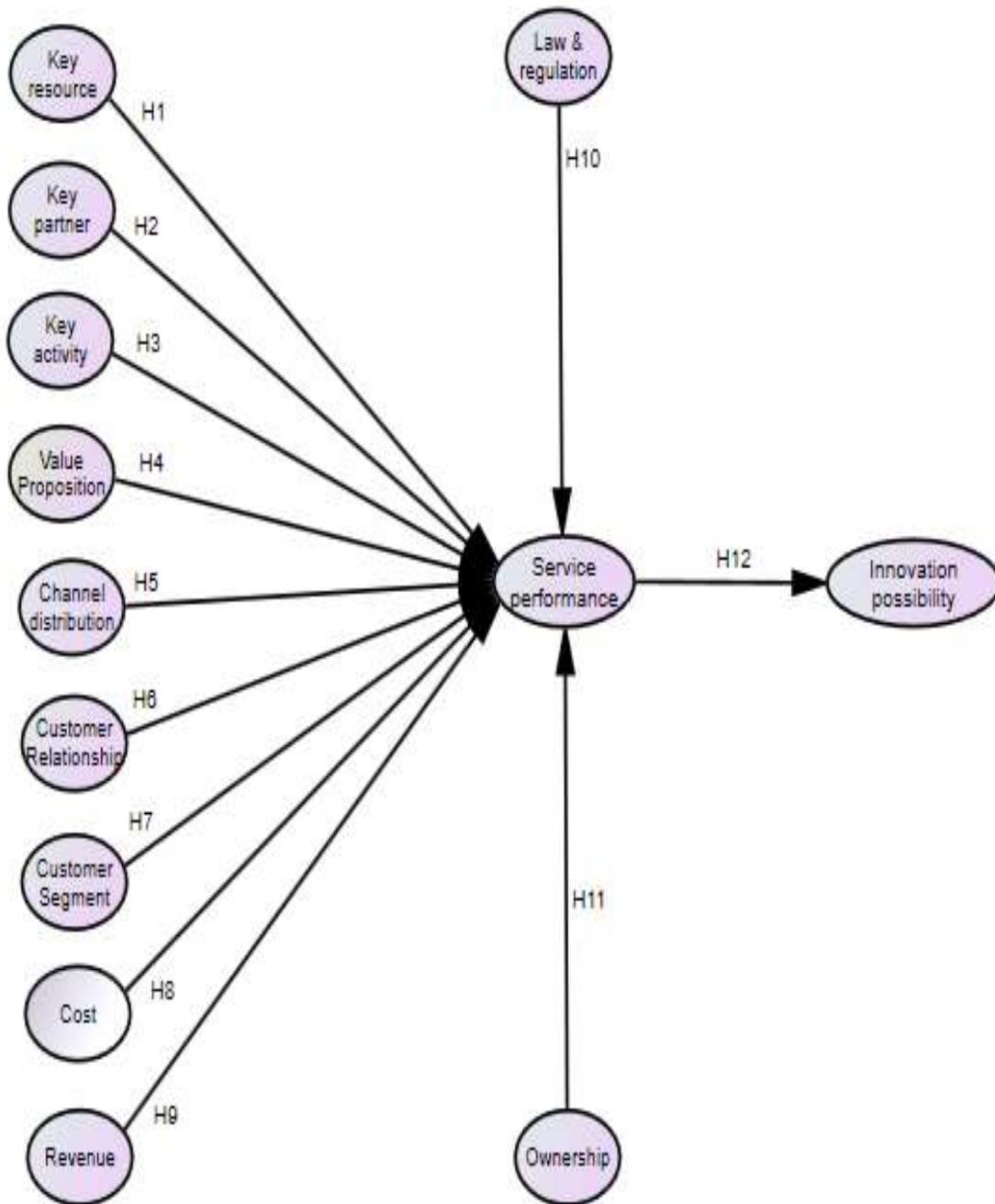
<b>Latent variable construct</b>	<b>Measurable Variables</b>
1. Key resource	KR1. Key resource replication KR2. Key resource prediction KR3. Key resource deployment
2. Key partner	KP1. Key partner necessary KP2. Key partner relationship KP3. Key partner contribution
3. Key activity	KA1. Key activity efficiency KA2. Key activity uniqueness KA3. Key activity balance
4. Value proposition	VP1. Value proposition customer alignment VP2. Value proposition for value chain VP3. Value proposition customer satisfaction
5. Customer relationship	CR1. Customer relationship strength CR2. Customer relationship matching segment CR3. Customer relationship binding customer CR4. Customer relationship - Brand
6. Channel distribution	CH1. Channel visibility CH2. Channel efficiency and effectiveness CH3. Channel matching segment CH4. Channel economies of scope
7. Customer segment	CS1. Customer segment churn rate CS2. Customer segment appropriateness CS3. Customer segment new customer
8. Cost	C1. Cost prediction C2. Cost matching service model C3. Cost efficiency C4. Cost economies of scale
9. Revenue	R1. Revenue frequency R2. Revenue diversity R3. Revenue willingness to pay R4. Revenue Pricing mechanism R5. Revenue Margin
10. Legislation	L1. Legislation availability L2. Legislation monitoring L3. Legislation obey
11. Ownership	O1. Ownership determination O2. Ownership - Service improvement O3. Ownership income affection
12 Service performance	S1. Finance success S2. Customer satisfaction S3. Corporate Social responsibility S4. Environmental code-of-conduct S5. Service efficiency

Service performance is referred to Business performance or Business Service. Service performance is a matter of meeting key performance and agility indicators. The key performance included Inputs, Outputs, Outcomes, Efficiency Indicators and Effectiveness Indicators (Coste & Tudor, 2013). In his research, service performance indicators were proposed based on the performance criteria of 5 business groups. The service innovation possibilities will later be elaborated in chapter 4. To identify the relationship and associate among variables, this study proposes the 12 hypotheses including 11 hypotheses among business components and 1 hypothesis between service performance and service innovation possibilities shown in Table 3.5 and Figure 3.1. The following Hypotheses were formed with by relation between the business component and service performance.

**Table 3.5 Research Hypotheses**

<b>Hypothesis</b>	<b>Description</b>
H1	Key resource will be positively associated with service performance
H2	Key partner will be positively associated with service performance
H3	Key activity will be positively associated with service performance
H4	Value proposition will be positively associated with service performance
H5	Customer segment will be positively associated with service performance
H6	Distribution Channel will be positively associated with service performance
H7	Customer Relationship will be positively associated with service performance
H8	Cost will be positively associated with service performance
H9	Revenue will be positively associated with service performance
H10	Ownership will be positively associated with service performance
H11	Legislation will be positively associated with service performance
H12	Service performance will be positively associated with service innovation possibility

Figure 3.1 illustrated the conceptual structural model between variables which will be tested and fit in chapter 4. Thirteen variables were presented. Latent variables are drawn as circles and measured variables will be shown as squares



**Figure 3.1 Conceptual structure equation model of business component, service performance and innovation possibility**

## Chapter 4

### Results and Discussion

According to the three research objectives, the research results are presented in three main parts. Part 4.1. Business problem and Financial structure of FS C&T services; Part 4.2. Business components, Conceptual business model, Business model performance indicators and Business model innovation of FS C&T services and Part 3. Relationships of Business components, Service performance and Service innovation possibilities.

#### 4.1 Business Problems and Financial Structure of FS C&T Services

##### 4.1.1 Business problems of FS C&T services

Regarding FS C&T services, several environmental and technical problems have been studied (Koné & Peter, 2008) but service problems were not well articulated with a business approach. To identify the business problems, this research applied PEST analysis (Gupta, 2013) to classify the service problems into Political, Economic, Socio-cultural and Technological issues. The business problems are presented in Table 4.1 in the order of the impact level, from more to less crucial, on service performance. This synthesized results based on the secondary data (Strauss, 2002) and the results from qualitative data of in-depth interviews.

**Table 4.1 Business Problems of FS C&T Services in Low- and Medium-income Countries**

Political issues	Economic issues
<p>(P1) Lacking national laws, local regulations and overlapping policies lead to ineffective FS collection, transport and disposal activities.</p> <p>(P2) Some authorities allow private companies to operate these services even when their municipalities do not offer proper FS treatment plants.</p> <p>(P3) Without local monitoring guidelines, several unlicensed service operators disturb the market.</p>	<p>(E1) The low investment cost for trucks and high energy costs increase the operating cost.</p> <p>(E2) Revenue decreases due to limited numbers of customers, price-dumping from competitors and the increasing FS discharge fee.</p> <p>(E3) Cost-revenue imbalances make the service unprofitable.</p>
Socio-cultural issues	Technological issues
<p>(S1) Society perceives the services dealing with FS as dirty and “low-level” business.</p> <p>(S2) Since FS C&amp;T services are considered as unclean and hazardous jobs, the service providers tend not to commit to</p>	<p>(T1) Internal factors include broken equipment, poor transport vehicle condition and lack of operators` skill that lead to unhygienic practices and occupational hazards.</p> <p>(T2) External factors include poor accessibility to pit or tank; poor domestic</p>

<p>long-term working and do not concern the Corporate social responsibility.</p> <p>(S3) FS by-products are not widely marketed and used; therefore, FS C&amp;T services are not well-developed to engage with FS treatment and reuse business.</p>	<p>sanitation facilities; long distance to disposal plants and traffic jams.</p> <p>(T3) Appropriate FS C&amp;T logistics technologies are not available or well-implemented.</p>
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While political and socio-cultural issues come from the external business environment, economic and technological issues are internal business problems of the services. As a part of the sanitation chain, which remained as a taboo subject in most cultures (Hutton et al., 2014), FS C&T services are either not well-paid attention by the policy-makers, leading to the low level of service privatization.

Cultural factors inhibit service development with improper social awareness since human naturally perceives business dealing with faecal sludge is a dirty and low-level business. This perception challenges business model to develop professionally. Unless customers could be aware that every single human obviously needs FS-related services the same as they are the consumers of the food and beverage industries. Once customers value the indeed role of FS collection and transport services, the entrepreneurs can conceptualize the FS collection and transport services by a business model is a fundamental step towards the more professional services.

**Table 4.2 Key knowledge Gap and Area for Improvement of FS C&T Service**

Aspect	Knowledge Gap	Area for improvement
Politics	Increase authority awareness	Understanding on FSM
	Reduce the number of illegal private companies or illegal dumping	Add up monitoring and punishment issue
Economic	How to increase revenues with reasonable FS collection fees	Business model
	How to reduce the operating costs	
Socio-culture	No-brand company	Advertisement
	Unrecognized services	Advocacy
Technology	How to optimize the numbers of truck	Transport and logistics model

When the public sectors in both countries neglected to offer the service for customers, Thailand government had set the ceiling fee tariff for the FS services about 8 US\$/m<sup>3</sup> (2014) and based these services on the municipalities while Vietnam did not set the fee tariff ceiling for these services and based these services on private sectors. Using Table 4.1 and 4.2, the other FS C&T service providers can systematically diagnose their business problems while seeking for the appropriate solutions outlined in the Business component analysis, as shown in the following section.

#### 4.1.2 Financial data analysis of FS C&T services

To sustain the business profit, Cost and Revenue needed to be optimized. So financial analysis was applied and demonstrated afterwards to identify which components mainly impacted on service efficiency. Net profit and operating-cost structure are two financial performance indicators of FS C&T services. Collected income statement data of 28 cases in Thailand and 19 cases in Vietnam were calculated by the equation 1 to 4, to compare net profits and annual collected FS amounts among cases according to ownership charted in Figure 4.1 & 4.2.

$$\text{Net Profit} = \text{Revenues} - \text{Costs} \quad (1)$$

$$\text{Revenues} = \text{FS volume} * \text{FS collection fee rate} \quad (2)$$

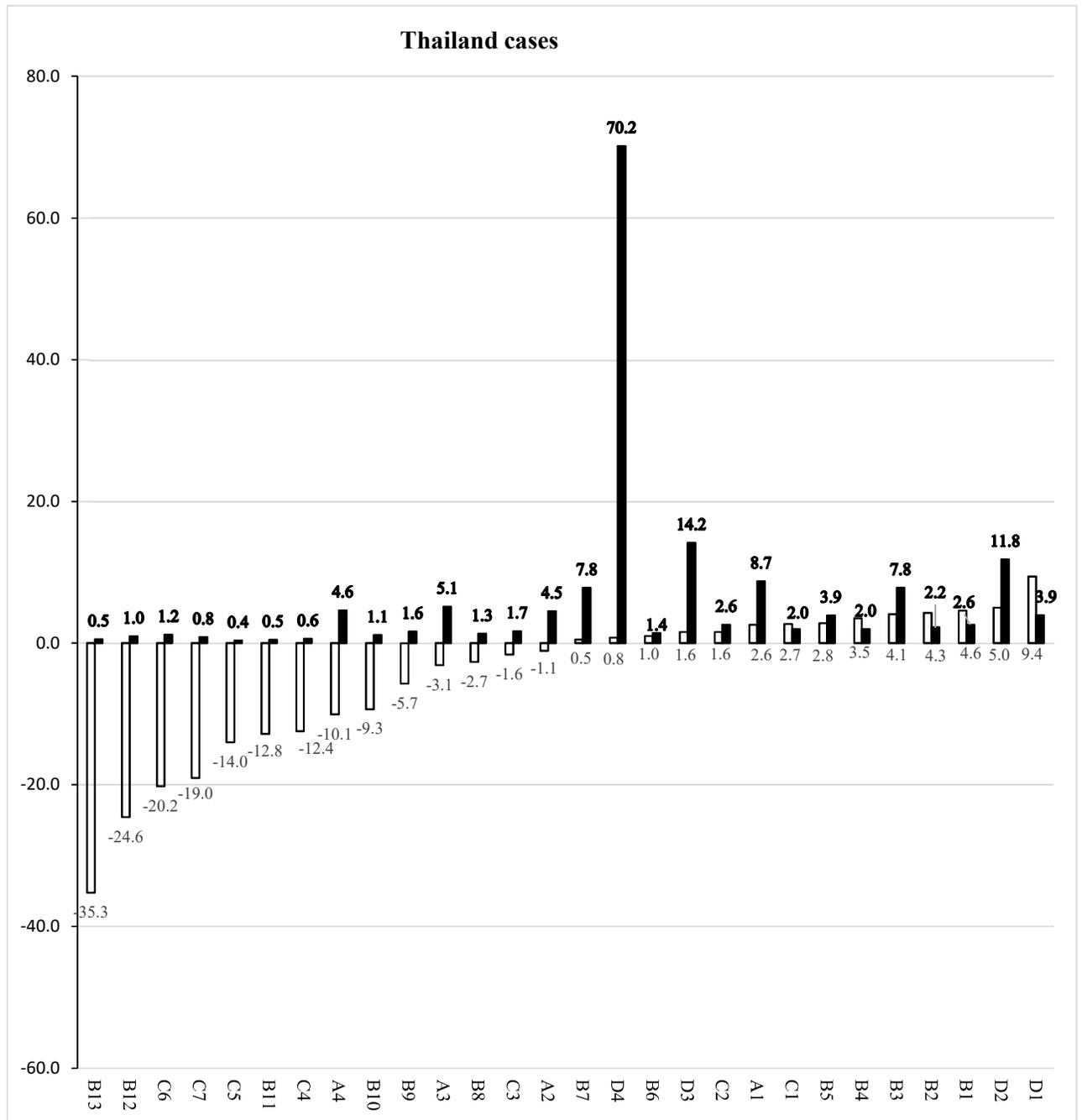
$$\text{Costs} = \text{Truck cost} + \text{Operating costs} \quad (3)$$

*Truck cost = approximately 20,000 US\$/truck with 10% annual depreciation  
(Steiner et al., 2002)*

$$\text{Operating Costs} = \text{Personal cost} + \text{Fuel cost} + \text{Maintenance Cost} + \text{Licensing Fee} \\ + \text{Other costs} \quad (4)$$

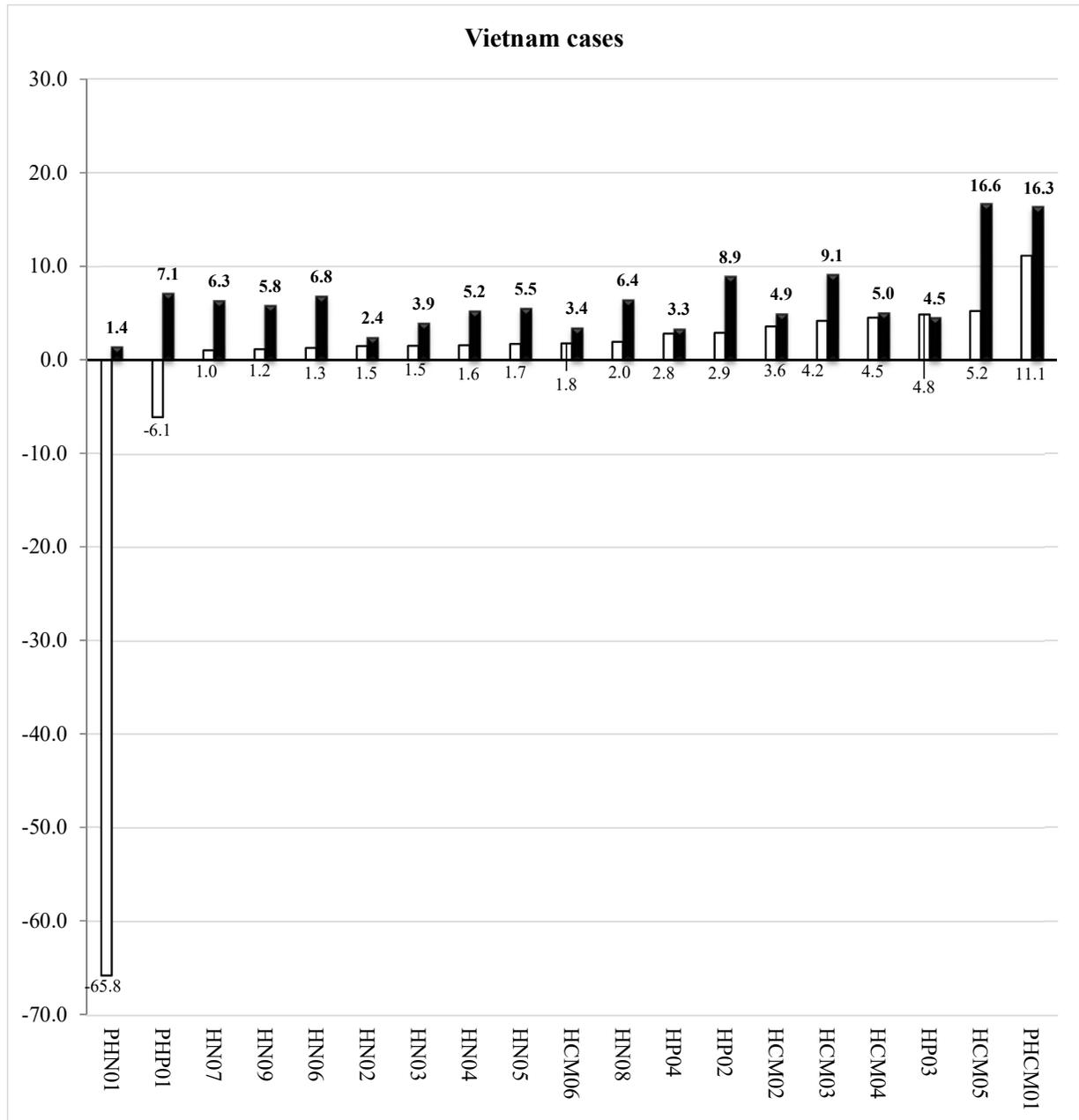
- *Personal costs = Number of truck \* [(No. of truck driver \* wage \* working day) + (No. of truck assistant \* wage \* working day)] + (No. of officer \* Salary)  
(From the field surveys, in general, each truck was operated by one truck driver and one assistant.)*
- *Fuel cost = (Traveling distance \* Fuel consumption) \* Fuel Rate*
- *Maintenance = 1.08 \* Fuel cost (This maintenance cost is based on Thailand Development Research Institute (AIT, 2014)*
- *Other costs = Mobile phone, Advertising, etc...*

Within each country, the net profit per cubic meter and the annual amount of collected FS were charted and arranged from negative to positive profit order to compare the financial performance among the service cases according to their ownership status. The names of cases were coded based on ownership status: the cases with the prefix A, B, C and P had public ownership and the cases with the prefix D, H had private ownership. The profitability and the annual collected amount were together in the same chart aiming to illustrate the correlation between these two indicators.



□ Net profit per 1 m<sup>3</sup> FS collected (US\$) ■ Annual collected FS volume (1,000 m<sup>3</sup>)  
*A: City municipals, B: Town Municipals, C: Sub-district municipals and D: Private companies*

**Figure 4.1 Net profit per 1 m<sup>3</sup> collected FS (US\$/m<sup>3</sup>), the annual amount of collected FS (1,000 m<sup>3</sup>) and ownership of FS C&T cases in Thailand (Ta et al., 2018)**



□ Net profit per 1 m<sup>3</sup> FS collected (US\$) ■ Annual collected FS volume (1,000 m<sup>3</sup>)

\* Prefix cases start with "P" are public firms, the other cases are private firms.  
 HN: Hanoi city, HP: Hai Phong city, HCM: Ho Chi Minh City.

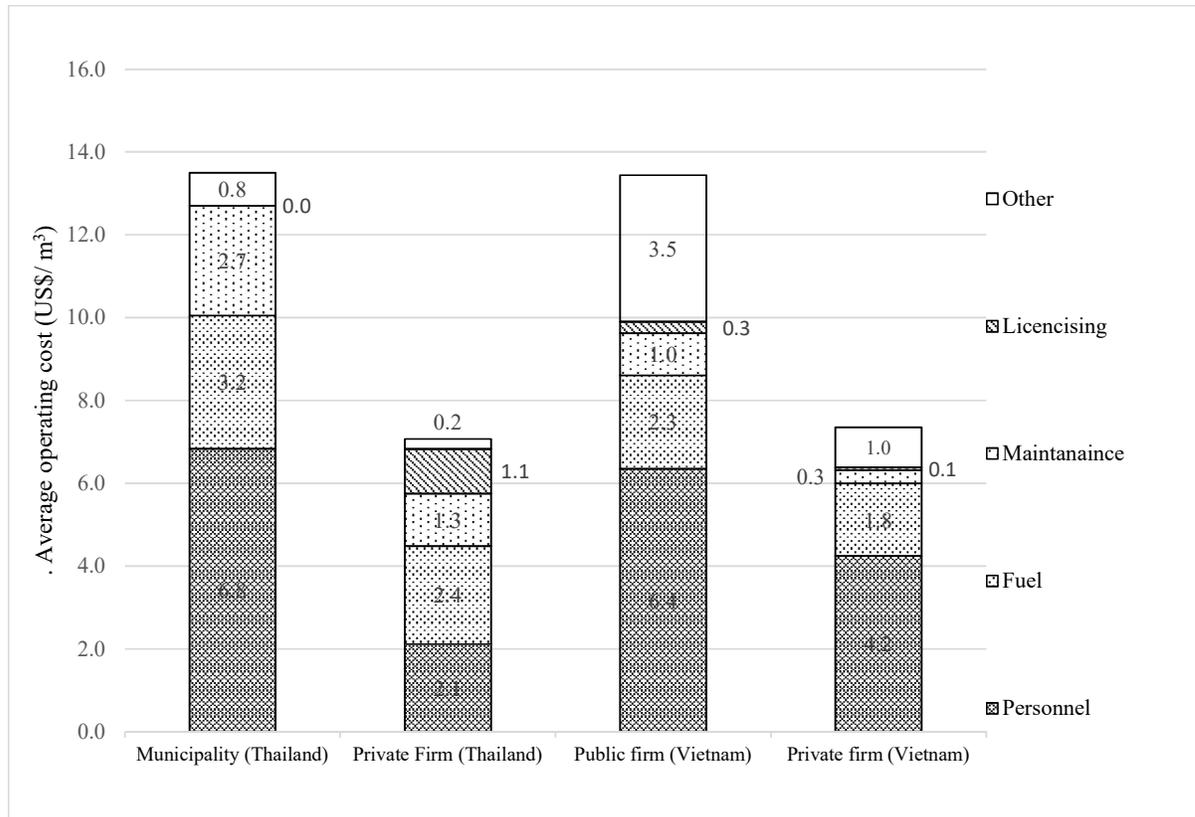
**Figure 4.2 Net profit per 1 m<sup>3</sup> collected FS (US\$/m<sup>3</sup>), the annual amount of collected FS (1,000 m<sup>3</sup>) and ownership of FS C&T cases in Vietnam (Ta et al., 2018)**

The primary data of Figure 4.1 was extracted from the report “Landscape analysis & Business-model Assessment in FSM: Extract & Transport models in Vietnam” (Nguyen et al., 2011). The primary data of Figure 4.2 was collected by the financial statement questionnaire sent and received the feedback from Thailand cases from 2013 to 2014. Regarding net profit and ownership status, all negative profit cases were administrated by public sectors while all positive profit cases had private ownership. The normalized net profit per collected FS cubic meter was from US\$ -35.3 to 9.4 and from US\$ -65.8 to 11.1 in Thailand and Vietnam respectively. This tremendous profit difference was due to the service operation efficiency according to the ownership status which then explained in Figure 4.3. While public sectors operated their services as their compulsory utility duty for their municipalities, the private cases run their businesses to serve customers for profitability.

The negative net profits occurred significantly at the public cases in both Thailand (Municipal services) and Vietnam (Public firms) due to the business components 5 and 6 (Table 4.3) in which the Distribution channels and Customer relationships were less developed. In the field investigations, most public services showed their fewer interests in developing the Distribution channels and Customer relationship with their customers. On the contrary, the private cases received positive net profits because they were more efficient in the business component 3 (Key Activities) with a higher amount of collected FS. None of the private cases has negative profits even without subsidization budgets from the governments.

In terms of net profit and annually collected FS amount relationship, Figure 4.1 & 4.2 showed that the cases that had higher FS collected amounts tended to have higher profit such as D1, D2 HCM05 and PHCM01. Only the case D4 with extremely high annual collected FS amount (70,200 m<sup>3</sup>) has a moderate net profit (US\$ 0.8/m<sup>3</sup>). Meanwhile, both cases with the highest negative profit in Thailand and Vietnam (B13 and PHN01) had collected the lowest annual FS amount. It could be confirmed that the sufficient collected FS amount could be lead to positive net profit and an insufficient amount is the cause of profit loss.

Meanwhile, there was no clear relation between annual collected FS amount and ownership status. Because some public services have higher collected FS than private services and vice versa. The annual collected FS amount could be fluctuated by the service operation, customer rate and vehicle numbers and sizes. The optimum collected FS amount depended on the operating cost. The detailed break-downs of operating costs of the FS C&T per 1 m<sup>3</sup> for the public and private firms were analyzed to identify the main costs, as shown in Figure 4.2.



**Figure 4.3 Average operating cost for 1 m<sup>3</sup> FS C&T (US\$/m<sup>3</sup>) (Ta et al., 2018)**

Based on the financial state statements collected from the cases in Thailand and the primary data of cases in Vietnam (Nguyen et al., 2011), the Average Operating Costs for 1 m<sup>3</sup> FS C&T were calculated and compared showing in Figure 4.3. Particularly, Figure 4.3 demonstrates the operating-cost similarity in Vietnam public firms: 13.4 US\$/m<sup>3</sup>, private firms: 7.3 US\$/m<sup>3</sup>; Thailand municipalities: 13.5 US\$/m<sup>3</sup>, Private firms: 7.1 US\$/m<sup>3</sup>. Personnel cost occupied the biggest portion, fuel cost took the second portion, while maintenance, licencing and others were less. To deliver the services, the public firms and municipalities incurred more costs than private firms due to higher personnel costs.

This result confirmed the Ownership status of service organization affected the service cost. Due to fewer numbers of administrative staffs, lower personnel costs and fuel usage efficiency, the private firms could incur less cost than the public firms. These findings of operating cost structure are similar to the Annual Operation & Maintenance costs for FS emptying businesses in Southeast Asia (Rao et al., 2016).

## 4.2 Business Component, Conceptual Business Model and Business Model Innovation

### 4.2.1 Business components of FS C&T services

As stated in the method section, Nine business components were chosen to analyze the data collected from 53 services cases of 3 countries, presented in Table 4.3. Each business component of the FS C&T services was explained through the service providers' perspectives. Key resource, known as trucks and operators, was found as the main component to execute FS C&T. Key Activity as transport services can be optimized by Global Positioning System (GPS) installed into the trucks (Blackett et al., 2017) to track trucks' locations and navigate transport

routes. Key Partner or network partnership among small firms were deployed in the oligopoly market where there are several small services. In the scenario business competition, groups of firms should together form partnerships to utilize their Key Resource, to share Customer Segment and to gain the service association power. Customer Relationship and Distribution Channel can be improved by Customer Relationship Management (CRM) tools, which could reduce and exclude illegal unlicensed operators. Especially in Vietnam, there were co-operative organizations supporting the small services for truck licensing and maintenance.

**Table 4.3 Business Component Evolution by Scale of FS C&T Services**

<b>Business components of FS C&amp;T</b>	<b>Service scale, Numbers of trucks, Truck* investment cost (US\$)</b>		
	<b>Small 1 to 2 truck(s), Less than \$20,000</b>	<b>Medium 3 to 5 trucks, From \$20,000 to \$200,000</b>	<b>Large More than 5 trucks, More than \$200,000</b>
<b>1. Key Resource:</b> Inputs to operate services, including hardware and software resources.	Limited truck fleets and networks	Truck fleet increase with widening resources.	High-tech trucks with various FS emptying operation functions.  Skillful staffs with better working capacities.
<b>2. Key Partner:</b> External resources that support the service operation.	Limited partnerships and focus on internal resources	Partnerships among firms to form co-operative service provider networks.	Partnerships with truck providers and treatment plants to treat FS for byproducts.
<b>3. Key Activity:</b> Key role to produce the proposed value.	Only FS C&T services.	Diverse services related to FSM and after sale services.	Full range of FS, waste management and sanitation services for key customer segments.
<b>4. Value Proposition:</b> Value that the services propose and deliver to the customers.	The basic value is proposed for customers: C&T FS	Improved value with added pre-services and after sale services.	High proposed values with diverse services: scheduled FS services with sanitation and hygiene services.
<b>5. Customer Segment:</b> Types of customers served	The main market is private households.	Markets are private households and public buildings.	Various markets: domestic, public areas and industrial zones.
<b>6. Distribution Channel:</b> The way the service operators reach and	Limited communication tools without brand.	Telecommunication -based a with a well-known brand.	Information Communication Technology with

bring service to their customers through online and offline methods.			internet-based & call center.  Eco-friendly and well-known brands.
<b>7. Customer Relationship:</b> Interaction between service providers and their customers.	Loose relationship: Focus to serve customers who need one-time transaction service.	Moderate relationship: Find and keep customers.	Strong relationship: Apply Customer Relationship Management tool.
<b>8. Cost:</b> Investment costs and operation & maintenance costs	Cost-driven with optimized operational costs.	Cost-driven with shared marketing and operational cost.	Value-driven to take advantage of economies of scale.
<b>9. Revenue:</b> Amount of income earned from customers by providing the services	Revenue fluctuates depending on daily customers.	Increase revenues with frequent customers.	Stabilize revenue through key-account and regular customers.

*\*Trucks were brand new or assembled vehicles for FS C&T purpose*

It can be stated from Table 4.3 that Key Resource, Key Partner and Key Activity were the key business components to improve the service efficiency because these three components combine to produce and offer Value proposition. FS C&T business components have evolved tremendously by the technological innovation among large-scale services. Since Diener et al. (2014) suggested Value Proposition for FSM as “Resource recovery”, this study also proposed that Value Proposition was a prominent driver to increase FS C&T service quality. Regarding Thailand & Vietnam cases, Value Proposition was not well-recognized by most of the customers, who preferred low-cost services, so FS C&T services were more cost-driven than value-driven. Meanwhile, in Finland, there were compulsory requirements for de-sludge frequency, so with offered value-driven services, customers were more willing to pay and use leading to the increasing of Customer Segments.

Table 4.3 also shows that larger firms have more diverse Customer Segments and Distribution Channels. This study found that very small service cases with less than 3 trucks were less evolvable and sustainable, the same as the findings from Chowdhry & Koné (2012) and Hawkins & Muximpua (2015). The cost was decreased by service economic-of-scale and Revenue was increased by economies of scope. Taking the advantage of the scope and economies of scale, firm merger & acquisition activities were the development trends when small firms merged together to form larger firms or larger firms acquired the smaller ones, then becoming dominant service providers.

### **Extended business components of FS C&T services**

The field investigations in the three countries confirmed that, besides the nine business components, FS C&T services were affected by two other components including Legislation and Ownership which are varied according to the country development, as shown in Table 4.4. While Legislation for FS C&T services in both Thailand and Vietnam were still lacking and weak, Finland has formulated very strong regulatory systems. Clear legal and regulatory

systems enabled the FS C&T service performance with a fair competition environment under the market-driven economy. Monitoring activities were very important to ensure that business laws are obeyed by all service operators. Although most cases in Thailand were structured under municipal set-up, Vietnamese authorities fostered the private sector to handle these services and the Finnish system promoted the Public and Private limited companies. Table 4.4 demonstrates the Legislation development and Ownership types in high, middle & low-income countries. Ownership status of the FS C&T services varied among the three countries with key types: common, collective or private owners according to the country legislation rules. The business ownership types were defined based on the owners of stocks of business property such as Joint-stock or Limited company. Vietnam had a special model named “Co-operative organization” gathering small service providers while Thailand still runs FS services by the Local Administrative Organizations.

**Table 4.4 Extended Business Components of FS C&T Services**

Extended Business Components	Country		
	Finland	Thailand	Vietnam
<p><b>10. Legislation:</b> Legal frameworks and regulations for FS services.</p>	<p>Ministry of the Environment clearly defines septic tank sludge as municipal waste required to be collected and transported to the treatment plant.</p> <p>There are clear regulations concerning the punishment for the activities harming the environment.</p> <p>European commission guides the disposal and recycling routes for sewage sludge (Ministry of the Environment, Finland, 2012).</p> <p>Monitoring activities are strictly controlling forcing the service provider to comply with the Law &amp; regulations.</p>	<p>Ministry of Public Health supervises the FS practice by providing the regulations, criteria, provision, service fee and licensing.</p> <p>The Enhancement and Conservation of National Environmental Quality Act, 1992, Public Health Act 1992</p> <p>There are standards or guidelines on FSM practices monitoring or enforcing punishment as the human excreta management</p>	<p>Ministry of Construction is responsible for establishing and implementing policies on sanitation and wastewater infrastructure which does not mention the FS C&amp;T service.</p> <p>National technical regulation on the hazardous threshold for sludge from the water treatment process (MONRE, 2013)</p> <p>There are penalties for illegal FS dropping or not maintaining hygienic conditions during transport</p>

	Organization framework: Top-down operation with local monitoring	regulation is not clear (Suebsoh & Chareerntanyarak, 2009)  Organization framework: Top-down operation	routes. (Nguyen et al., 2011)  Organization framework: Top-down operation
<b>11. Ownership:</b> Capital and asset owners who keep the most significant roles in services management.	Public company: Limited & Joint Stock  Private sector: limited company	Local administrative organization (City, Town, Sub-district Municipals)  Private sector: Licensed and unlicensed limited company	Public company: Limited & Joint Stock  Licensed and unlicensed limited company  Co-operative organizations

Cross-country field observation results showed that FS collection and transport business model evolves tremendously in the technology and customer interface management between countries. In a developed country like Finland, infrastructure is the key business factor to improve the service efficiency while the customer segments tend to be willing to pay the service fee according to domestic de-sludge frequency regulated by the law. Operating costs and revenue flows are systematically optimized with increasing revenue by service economies of scope and decreasing cost by business economies of scale. In Thailand and Vietnam, business models are more cost-driven than value-driven because the service value propositions are not well recognized by the customer segments who prefer low-cost services.

## Legislation

Recognizing the legislation improvement, Vietnam government has issued the Decree 80/2014/ND-CP in 2014, then Vietnam Ministry of Construction MOC (2015) has issued Circular No. 04/2015/TT-BXD guiding a number of articles of the Government's Decree No. 80/2014/ND-CP of 6 August 2014, on water drainage and wastewater treatment. Thailand Ministry of Public Health had published the guidelines for FS collection and treatment (Taweesan et al., 2017) to regulate the management of sludge from the water drainage systems, septic tanks as well as the reuse of faecal sludge. The information from Table 4.3 and Table 4.4 suggested that no typical business models could be best fitted to every service, so the 11 business components of FS C&T services should be modified or adjusted to adapt to local situations. In the legislation process, law and regulations would be the framework for authorities to monitor the services and for service providers to comply. The crucial legal tool is the licensing and monitoring to make sure the compliances are rewarded and the violations are penalized.

## Licensing

The licensing can be categorized into two types of licensing. Firstly, private companies only pay the annual license fee for faecal sludge collection and transportation. Secondly, the private companies have to pay the annual license fee and the concession fee which can be paid monthly or annually depending on the contract. The contract duration can be 1-3 years depending on their agreement in both cases. The typical FS C&T licensing in Thailand with four steps:

- Step 1: The FS collection and transportation truck have to be allowed by the Department of Land Transport.
- Step 2: The collection tank must be sealed and could prevent odour.
- Step 3: The truck has to have a pump and a FS level to be checked and controlled.
- Step 4: There must be cleaning equipment such as a bucket, broom or detergent.

There have to be a clear sticker or texts which includes name, registration license in local written languages to show that this truck is only used for FS C&T. The private company's owners will sign the contract, and pay annual license fee after the request is approved. The license fee varies by municipality laws and regulations but it usually costs 5,000 Baht/year (166.67 US\$/year). However, from the field observation, it was found that the license fee of FSM is divided into FS C&T and FS treatment in some municipalities. Thus, the total annual fee will be 10,000 Baht/year (333.33 US\$/year) includes FS collection and transportation license fee 5,000 Baht/year and FS treatment and disposal license fee 5,000 Baht/year (166.67 US\$/year).

In Thailand and Vietnam, Municipality officer will issue the FS collection and transportation license to the private companies. The license is available approximately 1 year, so the owners of private companies have to renew a contract every year. In Thailand, private companies have to pay an annual licensing fee and the concession fee. To renew the license, the private companies also have to pay to renew contract fee 500 Baht/year (16.67 US\$/year). The steps of licensing are similar to the first case. The difference is the additional auction step to select the private provider. A selected private company has to pay not only a licensed fee but also a concession fee. The concession fee can be paid monthly or annually depending on the contract. From the field observation, it was found that a private company will have to pay about 30% of concessions for the first month. The remaining cost will be divided for another 11 months for the monthly payment system.

**Table 4.5 Private FS C&T Service Characteristics**

<b>Ownership</b>	Licensed Private Company, Business enterprise, Family business.
<b>Description</b>	The licensed private companies are formed by a group of people or individual person. The private companies were licensed to provide FS C&T services and operated the FS treatment plant with concession and license under the control and supervision of the municipalities
<b>Financial support</b>	Personal budget, Commercial banks and Loan from the government agency
<b>Licenses</b>	Yes
<b>Service areas</b>	Larger areas where the services are responsible
<b>Annual Remuneration</b>	Private services and companies have to pay the annual remuneration to municipality depending on the agreements.
<b>Business goal</b>	For-profit organizations
<b>Pros</b>	<p>Not only private company earned profit from service fee, but also municipality earned income from annual licensing fee.</p> <p>Legislation systems controlled the FS C&amp;T activities by supervision of Local Administrative Organizations.</p> <p>Services could be expanded to emerging markets since they could serve many areas and several market segments.</p>
<b>Cons</b>	<p>The licensed duration and concession have to be resubmitted from 1 to 5 years, thus companies bear the risk for their return of investment</p> <p>Lack of investment bank loan or funds.</p> <p>The family business had a shortage of investment capital to grow business.</p>

### **Ownership**

The financial performance analysis of FS C&T services showed that Ownership is one of the key factor affecting service performance. So ownership was suggested to be the extended business component for FS C&T services. To elaborate the research hypothesis regarding the privatization development trend when Private ownership to replace Public ownership, 52 service cases in Thailand and Vietnam were gathered and compared in terms of Financial support, Licenses, Service areas, Annual remuneration, Business goal Pros & Cons. The licensed private company performance was showing the possibilities to incrementally replace public services of FS C&T services.

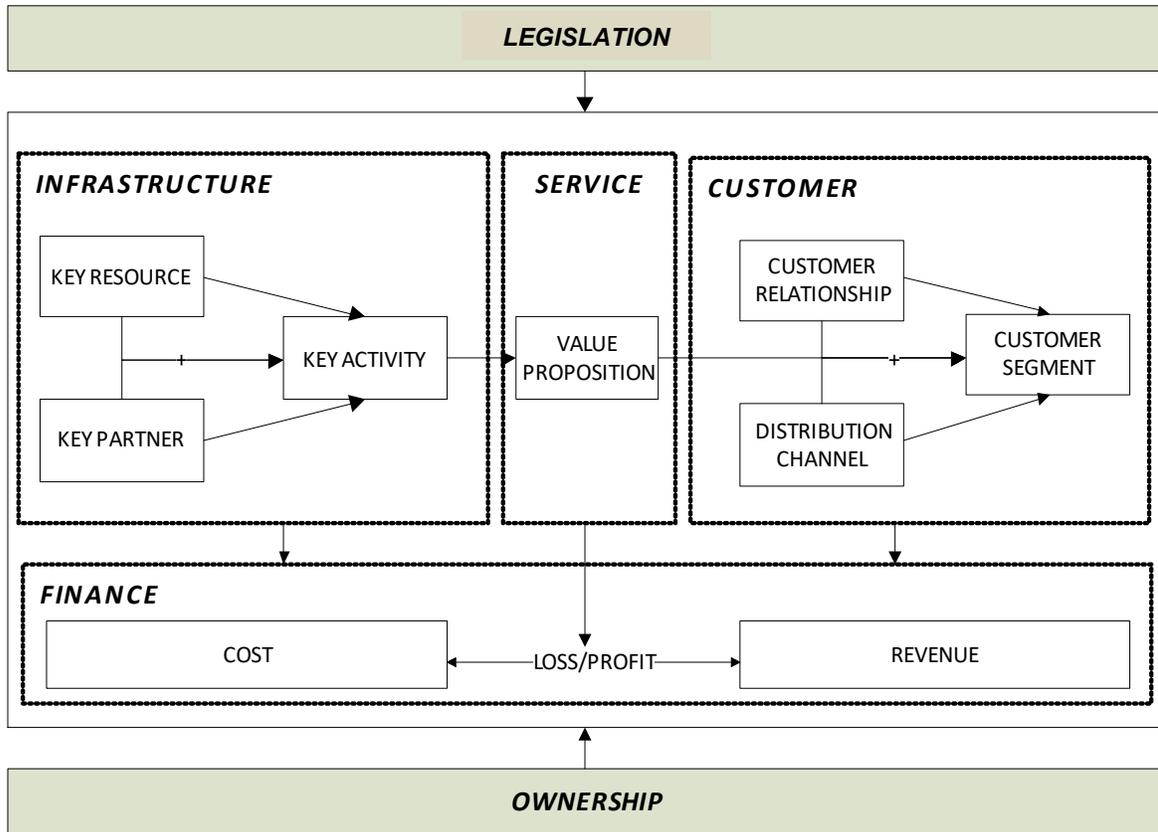
**Table 4.6 Public FS C&T Service Characteristics**

<b>Ownership</b>	Government-owned, State-owned organization		
	Local Administrative Organization (LAOs)		Services outsourcing under the monitoring of LAOs
	LAOs only	Cooperating with other organizations or LAOs	
<b>Description</b>	<p>LAOs referred to municipalities, Sub district-administration-organizations, and Provincial-administration-organizations.</p> <p>The LAOs provide all FSM activities including C&amp;T and FS treatment plant.</p>	<p>Several FSM activities including FS C&amp;T and FS treatment plant in the assigned areas. Moreover, each FSM activity could be delivered by LAOs and other organizations which depended on the agreements of the providers. The lacking FS treatment plant and disposal led to the co-operation between FS C&amp;T providers and FS treatment plant agencies.</p>	<p>The outsourcing services are third-party service providers contracting with LAOs to FS provide services under the control and supervision of the municipality.</p>
<b>Financial support</b>	<p>Local Budget</p> <p>Funds Government agency</p> <p>A loan from a government agency</p>	<p>Local Budget</p> <p>Funds Government agency</p> <p>A loan from a government agency</p>	<p>Local Budget</p> <p>Funds Government agency</p> <p>A loan from a government agency</p>
<b>Licenses</b>	No need as they are owned by a municipality	No need as they are owned by a municipality	Yes (with the contract)
<b>Service areas</b>	Only assigned areas that LAOs are in charge.	Broader areas	Broader areas
<b>Annual Remuneration</b>	The municipality received revenue directly.	The fee of FS treatment and disposal paid per trip, month or FS volume	Got lump-sum appropriation from LAOs to management in outsourcing
<b>Business goal</b>	Non-profit public service	Non-profit organization. Public Service	<p>LAOs did not focus on profit, aim to the public service.</p> <p>Outsourcing services</p>

			managed to make profit.
<b>Pros</b>	<p>Organizations are highly reliable since they are government organizations.</p> <p>FS C&amp;T services are regulated by municipal legislation systems.</p>	<p>Government organizations get trust from communities.</p> <p>Benefit for both service provider and municipalities.</p>	<p>Reducing the burden to the management of the administration.</p> <p>Funding from the government.</p> <p>Reducing the risk of business loss thanks to the low competition from other competitors.</p>
<b>Cons</b>	<p>Service areas are limited so fewer customers are reached.</p> <p>FS C&amp;T budget is limited because most of the Municipality focused on solid waste management (SWM) more than FSM</p>	<p>There were difficulties regarding agreements between municipalities due to the unclear responsibility and profitability sharing.</p> <p>Limited numbers of FS treatment plants and collected FS volumes were over the FS treatment plant capacity.</p>	<p>Not fully controlled by LAO.</p> <p>The outsourcing activities operating costs increased leading to high tariffs</p> <p>FS C&amp;T service operators need to be employed by the municipalities.</p>

#### 4.2.2 New conceptual business model for FS C&T services

The business model is a managerial tool for FS C&T service providers to organize operational activities based on clearly-defined ownership under the laws, regulations and monitoring guidelines. Figure 4.3 proposes the new conceptual business-model for FS C&T services which is based on the nine-component business model canvas (Table 4.3) and the two extended components (Table 4.4). The nine business components are arranged into four key business component groups: Infrastructure, Service, Customer and Finance with two external components: Legislation and Ownership.



**Figure 4.4 New conceptual business model for FS C&T services (Ta et al., 2018)**

The arrows show the relationship pathways that link the business components among groups. Within the Infrastructure group, Key Resource combines with Key Partner to produce the Key Activity. Key activity is transformed into the Service, which is then proposed to the Customer based on Customer segment. Service is delivered to the customers through the Distribution Channel and Customer Relationship. The Finance group consists of Cost and Revenue components. The mutual relationship between Cost and Revenue produces profit or loss for the service providers. The Infrastructure creates Cost while the Customer rewards the Revenue and Value Proposition is the key component to produce the Loss or Profit. Because Value proposition is the component to create added value of the services for the customers leading the customers to have the decision to buy the services.

Legislation and Ownership affect whole business operations as Legislation creates the law and regulation platforms for business owners to follow while Ownership defines the right of possessing the services. This conceptual business model was formalized dedicated to FS C&T services. Same as every service businesses, these FS service business models undergo three stages of evolution: self-optimization, development and innovation. Business model and FSM innovation (Blackett et al., 2017) are the key forces for every operator to leverage their services to thrive and compete in the competitive markets.

The business model is a managerial tool for service providers to organize operational activities based on clearly-defined ownership under the law, regulations and monitoring guidelines. Figure 4.3 shows the comprehensive business model and business components of FS C&T

services with the adapted nine-component business model canvas, the organizational ownership as well as the legal and regulatory system.

Within the Infrastructure group, key resources combine with key partners to produce key activities. Key activities transform into the value proposition, which is proposed to the customer based on customer expectations and requirements. The service is carried to the customers through the distribution channel by customer relationship. Finance group compounds the subsequent cost and revenue components. The mutual relationship between cost and revenue produces a profit or loss for the business model owner. Infrastructure creates cost while the customer rewards the revenue and the value proposition is the key component to create a positive profit.

**Key Resource** is described as inputs to the start and operate of services, including hardware and soft resources. Hardware includes equipment such as hammers, chisels, buckets, etc., used to open and close pit or septic tank systems. Transportation vehicles with motors are considered new, second-hand or assembled trucks. Soft resources include not only human resources, but also the labour skill, working knowledge and networking capacities. Although the network relationship is intangible, it is very valuable for service providers to create the value they are delivering to the customer. Human resources are categorized into two subgroups: official and operational staff. The office employees are typically from municipality service providers or large private companies. Private companies operated by individuals, usually employ only operators who are involved in all service processes including receiving customer requests. The operators include truck drivers and service assistants. Key resources are considered as assets to produce services for customers which can be optimized by improved technology.

**Key Partner** is described as the external resources that support the service operation. Key partners are classified into two key groups. The first group includes the supportive partners that supply the external resources to run the service such as suppliers of trucks, spare parts, and equipment, oil, gasoline as well as truck maintenance technicians. The second group includes partners in the value chain such as other FS C&T or treatment providers who collaborate together to serve the customers. Key partner contributes to service performance and outcomes.

**Key Activity** plays a crucial role in the business model to produce the value proposition. Key activities include FS collection or de-sludging the pit or septic tank and FS transportation to haul the collected FS to disposal sites. Logistic models define the transportation routes that incorporate the parking lots, the customer location and the disposal sites. The service distance depends on the customer density of each service areas as well as the distance to FS treatment plants. Extended activities include leasing public or mobile toilets, solid waste or hazardous waste collection, FS treatment, construction, maintenance sanitation systems as well as sewer dredging.

**Value Proposition** is the value that the services propose and deliver to the customers. The primary value proposition does not limit to FS C&T but includes the convenience, promptness and tidiness of service. Customers prefer fast and less noisy services as not to disturb their neighbours with the service noises and odour. The value proposition includes additional customer services and after-sales service to assure customer satisfaction. The higher the satisfaction that customers have, the larger that service values have been delivered.

**Customer Segment** refers to types of customers divided into three main groups: individual households, buildings and community toilets. The property owners are considered as the service buyers since they have the purchasing power to decide and choose operators to collect FS. Under high competition and resource constraints, appropriate customer segmentation brings the highest net margins and profits as revenues increase and operating costs decrease. Targeting specific customers or focusing on the key repeated customers is a strategic choice each service providers have to consider to position themselves in the market.

**Distribution Channel** is defined as the way the service operators reach customers and bring service to them through communication with online and offline methods. Popular communication methods used by FS C&T service providers are word-of-mouth, newspaper advertisements and websites. The phone-number sticker is the most popular form of advertisement, which is posted on eye-catching walls and convenient places. Services using an easy-to-remember phone number as the key communication channel. Customers urgently need to be served as soon as possible when their pits or septic tank overloaded or blocked. When these channels are firmly integrated, they will create economies of scope where service operators can offer various services.

**Customer Relationship** can be defined as the interaction between the service providers and their customers. Service brand name contributes to strengthen the relationship but few services focus on branding. The more robust the relationship between customers and service providers, the more loyal the customers are, to avoid the high switching costs when changing to new service providers. The best way to keep customers is to provide better service quality that increases customer satisfaction. In general, for FS C&T, repeated usage frequency is quite low that affects the long-term relationship. Some public service providers tend to deny remote customers or postpone the services due to their operational problems or limited resources so this relationship is not strong in some municipalities.

**Cost** includes investment costs and operation & maintenance costs, which are fixed cost and variable cost respectively. Fix costs include the costs that depend on the size, year of purchase, and the state of trucks as well as the equipment and other facilities. Variable costs include costs for energy, personnel cost, administrative expenses, and license. FS C&T is a cost-driven business in which costs must be optimally minimized as customers are more price than value-oriented. Economic of scale and scope should be utilized to decrease these operating costs of individual services.

**Revenue** is the amount of income earned from customers by providing services to them. FS C&T service providers primarily gain income in the form of fees with services incurred during the service deployment. In each country context, the service fee rates depend on municipal regulations, which are called the ceiling tariffs or fluctuate depends on market demand and competition. The higher the proposed service value or the larger the collected FS volume, the higher the revenue that a service provider can capture. The core aim of the business model revolves around revenue maximization and cost minimization through an optimal value-capture mechanism.

**Ownership** depends on the capital and asset owners who keep the most significant management role in operating the services. The case studies revealed two different types of ownership: private and public. The ownership set-up was found as the key component affecting the business model and service performance. In this study, all of the four municipal-based services claimed about annual financial losses, which required subsidized funds from their

governments. On the other hand, the remaining eleven company-based services confirmed the annual profits. To confirm the best types of ownership which can positively affect the business performance, long-term financial data need to be collected to conclude.

**Legislation** on FS management, particularly for FS C&T services, are still lacking and limited, especially in developing countries. Typically, laws and regulations are established primarily for solid waste and sewage sludge. Through field investigation and secondary data review, this research founded that once the law, regulation and monitoring guidelines are improved, the business model can be developed better. Having the dominant purchasing power, customers and communities could contribute their forces on the operators to obey the environment code-of-conduct. Service licensing is a good tool to monitor the service activities within the regulated service areas. In Thailand, the authorities regulated that the service providers only serve the customer properties within the licensing areas whereas, in Vietnam and Finland, the service providers have the freedom to approach customers in an open market.

#### **4.2.3 Business model performance indicators for FS C&T services**

Since cross-country study aimed to figure out the advantages from each case in different social contexts, the Finnish case performed an advanced business model with service productivity, personnel cost optimization and reduction of statutory duties. Business transparency is the unique characteristic of service case from Finland to support the business performance following the environmental code-of-conduct. The strong internal quality assurance and clear external communication with investors, shareholders and customers were implemented professionally in the Finnish case. Transparent annual business reports and environment-friendly branding were the successful key activities which created trust and customer satisfaction. While limited FS treatment plants and transfer stations are set up in Thailand and Vietnam, the volume of collected FS and the distance from property locations to the disposal sites should be set as two key measurable units to define the service fees. Sufficient FS treatment plants or transfer stations are planned according to the dynamic population increases.

The novel conceptual twelve-component business model was used to assess the FS service performance of the representative cases by ownership types in 3 countries. Developed and adapted from the effective faecal sludge management measures (Taweesan et al., 2015) and City Service Delivery Assessment scorecards (Blackett et al., 2016), five performance indicators were: Environmental Code-of-conduct (Infrastructure), Service Efficiency (Service), Customer Satisfaction (Customer), Financial Success (Finance) and Corporate Social Responsibility (Legislation & Ownership). Legislating Corporate Social Responsibility (Hemphill, 1997) and following the rules of law should be the compulsory duties of business organizations. The ownership structure is associated to corporate social responsibility (CSR) in developed countries (Li & Zhang, 2010) and ownership concentration of firm has a positive association with Corporate Social Responsibility disclosure (Sufian & Zahan, 2013). The data utilized in assessing the FS service performance were based on the analysis results from field investigations, surveys, questionnaires and literature reviews. The levels of the indicator were qualitatively ranked as High, Mid and Low which generally indicated the service performance. The quantitative assessment Likert scales would be developed and conducted in the coming research.

The results shown in Table 4.7 were qualitatively testing of the proposed conceptual business model (Figure 4.4) which indicate its applicability for improving the FS C&T service performance. Due to the well-structured business model, all the five business performance

indicators of service case in Finland were evaluated to be High. In general, due to the Infrastructure set-up, Thailand municipals services and Vietnam public firms had mid-level Environmental code-of-conduct & service effectiveness, higher than private enterprise. The private firms could perform better than the public firms because they optimized the business components and follow the pathway list in the conceptual business model. The Customer satisfaction indicator was mid for Thailand and Vietnam cases, while the Corporate Social Responsibility was low.

**Table 4.7 Business Performance Indicators for FS C&T Services**

<b>Business model performance indicator (Key Business Group)</b>	<b>Finland</b>	<b>Thailand</b>		<b>Vietnam</b>	
	<b>Public Joint Stock Company</b>	<b>Municipality firms</b>	<b>Private Firms</b>	<b>Public Firms</b>	<b>Private Firms</b>
1. Environmental Code-of-conduct (Infrastructure)	High	Mid	Low	Mid	Low
2. Service Efficiency (Service)	High	Mid	High	Mid	High
3. Customer Satisfaction (Customer)	High	Mid	Mid	Mid	Mid
4. Financial Success (Finance)	High	Mid	High	Mid	High
5. Corporate Social Responsibility (Legislation & Ownership)	High	Low	Low	Low	Low

- *High: Fulfilling the rules & regulations of the country or municipality, customer expectation, efficiency and financially profitable*
- *Mid: Fulfilling few rules & regulations of the country or municipality, customer expectation, efficiency and cost & revenue balance*
- *Low: Not fulfilling the rules & regulations of the country or municipality, customer expectations, efficiency and financial loss.*

As the core aim of the business model revolves around revenue maximization and cost minimization through an optimal value-proposition mechanism, financial success is the service sum-up positive profit amount when balancing cost and revenue. Customer satisfaction ensures the revenue flows with the service efficiency and the service providers must perform Corporate Social Responsibility and commit to the environmental and business Legislation. The evolutionary trend for FS C&T services should follow the business model by minimizing the operating cost and increasing revenues with full ranges of services. While public sectors have better capital investment flow and the private sectors have dynamic innovations (Jeuland et al., 2004), the Public-private-partnership (Nguyen et al., 2011) is a potential model for both sectors to utilize each sector advantages.

#### **4.2.4 Business model innovation for FS C&T services**

A radical innovation in FSM would be to build a centralized sewage system directly connected to the treatment plant where FS would be treated and transformed into valuable by-products. In these contexts, the property owners must pay the connection fee in case their properties needed to be connected to the centralized system with a monthly fee or tax added in the water usage fee. Then the numbers of FS C&T services will be reduced as the fewer FS need to be collected directly from onsite systems. But the high construction investment costs and landscape infrastructure barriers obstruct this radical innovation. So the incremental innovation should be prioritized in the context of each municipality.

Applying technology more efficiently in business processes is the key trend for firms to improve services with lower operating costs and, therefore, higher profits. Reducing operating costs such as gasoline consumption and personnel expenses and earning more revenues can be accomplished with the increasing FS collection fees. The logistics planning tools should be applied in order to optimize the service and to reduce the operating costs. Additionally, human resource management should be implemented in order to decrease personnel expenses such as reducing FS truck assistants. Moreover, de-sludge usage frequency should be promoted to increase the volume of collected FS.

Key activities, customer relationships and distribution channels can be optimized by using information communication technology such as Global Positioning System for trucks and Customer relationship management tools. In the oligopolistic market, the co-operative model is suggested to share the costs between groups of small service providers to improve the operation.

Service ownership and the legislation varied among the three countries. A clear and up-to-date legal and regulatory system enables the business performance and business model development with a fair competition environment under a market-driven economy. Monitoring activities are very important to ensure that business laws are obeyed by all operators while environment policy and regulation for FS C&T services should be updated regularly to match with market development. Additionally, business models of both municipal and private service providers should be improved to identify the success factors for sustaining the business.

The nine business components of FS C&T services should be modified to adapt to each local law and regulation systems. When the authority establishes the rules of law and regulations, the service key stakeholders define the business ownership while business size forms key resource, key partner and key activity, customer relationship, distribution channel and customer segment. Sufficient FS treatment plants or transfer stations should be planned according to the dynamic population increases.

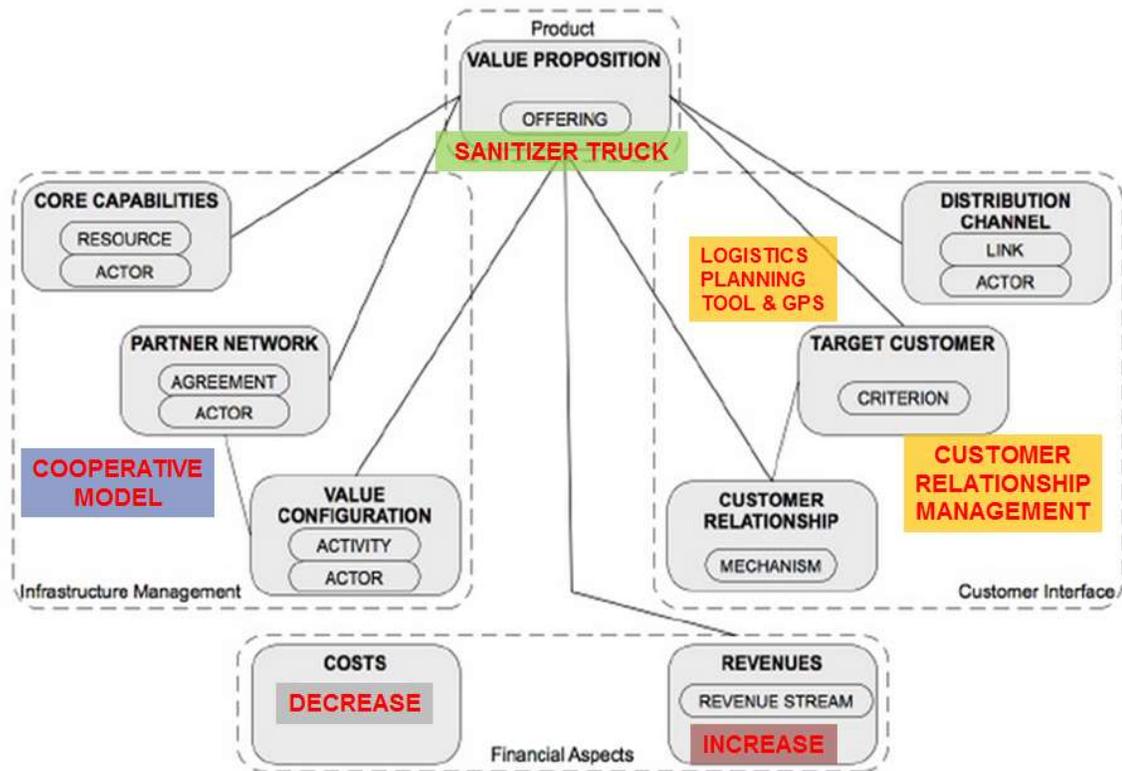
#### **The key possibilities for innovative solutions**

Outsourcing is a way to address the sustainability gap as competition is fierce and prices are falling with the reduction of industrial production. Procurement operations are being run very professionally – this means buying from fewer service providers and arranging competitive bidding for more comprehensive service packages. Increased service outsourcing in the public sector and public-private-participation due to the cost savings targets, municipalities may not be able to invest in support services, such as cleaning. New employees may not be hired to replace retiring personnel, which leaves a heavier workload for the remaining employees. Consequently, there is no time or resources for any service development.

**Table 4.8 Service Innovative Possibilities Description**

<b>Innovative possibilities</b>	<b>Number of sample</b>	<b>Minimum value</b>	<b>Maximum value</b>	<b>Mean</b>	<b>Standard Deviation</b>
1. Improved truck with FS treatment function	224	1	7	4.89	1.664
2. Technology application	224	1	7	5.08	1.564
3. Cooperative business model	224	1	7	5.01	1.421
4. Collection sludge volume pricing	224	1	7	5.38	1.374
5. Transport distance pricing	224	1	7	5.20	1.497
6. Environment-friendly branding	224	1	7	5.65	1.328
7. Transfer station	224	1	7	5.12	1.583
8. Customer relationship management	224	1	7	5.42	1.330

In the low- and medium-income countries, by outsourcing support services to a specialized service provider, municipalities gain access to the latest tools and technologies. With the right number of personnel always available, substitutes no longer need to be arranged. The soon to be revised procurement legislation will increase flexibility in public contracts and allows the social and ecological aspects of procurement to be factored in instead of simply making decisions based on price. The importance of responsible service production will continue to grow.



**Figure 4.5 Key possibility for innovative solutions adapted the business model group (Ta et al., 2017) adapted from the structure of the business model ontology (Braccini & Spagnoletti, 2012)**

While limited treatment sites are set up, the volume of collected FS and the distance from property locations to the disposal sites should be set as two key measurable indicators to define the service fee. Additional service fee such as sanitation system cleaning and maintenance will be included in the tariff to determine the total service fee which is paid by the customers. Based on these pricing systems, a business model can be evolved tremendously with operation efficiency, financial balance and customer satisfaction aligning with social responsibility to collect and transport all the FS to the well-planned sites. According to Chapman et al. (2003), new “resources”, such as technology, knowledge and relationship networks, were essential when services are operated effectively within the emerging business model. For FS C&T Service innovation, the Eight innovation solutions are elaborated and structured in Figure 4.5. The reasons for selecting the value proposition are described as follows:

### **1. Innovative truck: Sanitizer Truck with GPS tracking and Transfer station**

FS collection and transportation, the Sanitizer Truck was invented to eliminate the FSM problems such as lack functional FS treatment plant due to high investment, operating cost reduction and illegal dumping. Therefore, Sanitizer truck merchandise would be a new business solution as replacing existing FS truck with FS treatment and produce sanitary effluent. Sanitizer truck was designed to eliminate the FSM problems such as lack functional FS treatment plant, operating cost reduction and others. Sanitizer truck consists of three main sections; Pre-screening, FS dewatering unit and Engine heat recirculation function as

disinfection. The business model concept was applied to suggest for Sanitizer truck ask shown in Table 4.9

## **2. Truck Rental and finance lease under cooperative cooperation and Eco-friendly branding**

According to field observation, it is stated that service providers usually use personal savings or loan from family and friends as financial sources. Thus, the truck rental would give opportunities to people who lack the budget to get involved in the FSM business. Cooperative business model proved the utility and predominance in the Vietnam market where small service providers registering under the big umbrella of cooperation.

## **3. Comprehensive FSM center with Customer relationship management**

With knowledge support including training, FSM database and research and development of FSM is an important proposed strategy. Thus this idea was selected to overcome the problems of lack of knowledge and information support in the whole value chain including FS Collection, FS Treatment and FS reuse. Eco-friendly branding should be applied to impact on customer and user behaviour to choose licensing-approved services.

## **4. Logistic Planning Tools with Transport distance pricing, volume**

Proving the lack of logistic planning leads to an inappropriate number of FS trucks, insufficient FS treatment plant capacity, a long distance from the service area to the FS treatment plant, and high energy consumption and operating costs. Thus, logistic planning tool would help the service provider to plan and estimate their business requirement.

**Table 4.9 Business to Business (B2B) Business Model for FS C&T Operators Using Sanitizer Trucks To Serve The Customers**

<p><b>Key partners</b> Partnerships with truck providers and treatment plants to treat FS for byproducts.</p>	<p><b>Key activities</b> Full range of FS, waste management and sanitation services for key customers.</p>	<p><b>Value proposition</b> High proposed value with diverse services: scheduled FS services with sanitation and hygiene services.</p>	<p><b>Customer relationship</b> <b>1. KEEP:</b> Support service, Proactive Service, increase privileges from the service provider need to change the truck <b>2. FIND:</b> Advertising, Word of mouth, Design or Idea Competition, Branding, increase privileges to attract more customer <b>3. INCREASE:</b> Promotion, Proactive Service Strong relationship: Apply Customer Relationship Management tools.</p>	<p><b>Customer segment</b> Government company Private customer Various markets: domestic, public areas and industrial zones.</p>
	<p><b>Key Resources</b> -High-tech trucks with various collection operation functions. -Skillful staff with better professional capacities and occupational skills.</p>		<p><b>Customer channel</b> 1. Telephone 2. Office 3. Online system -Information Communication Technology with internet-based &amp; call center. -Eco-friendly and well-known brands.</p>	
<p><b>Cost</b> <b>1.Fixed Costs:</b> Truck and tank investment, License fee, Concession Fee. Value-driven to take advantage of economies of scale. <b>2.Varied Costs:</b> Personnel Cost, R&amp;D Cost, Advertisement Cost, Tax</p>		<p><b>Revenue</b> <b>Charge per service, transport distance, volume and requested service</b> Stabilize revenue through key-account and repeated customers.</p>		

### **4.3 Relationships of Business Components, Service Performance & Service Innovation Possibilities**

After the study has already defined the Business components, Service performance and Service innovation possibility, the last of aim is to analysis and confirm the relationship business components with service performance, the association between Service performance and Service innovation possibilities. An international survey with 224 services from 25 countries was conducted and analyzed to define the relationship among key business components, service performance and service innovation possibilities. The key business components included 12 factors with 38 observed variables as shown in Chapter 3. The Service performance includes 5 latent variables prep. And the service innovation possibility has 8 variables. To identify these relationships, the data set of these components were analyzed with the software SPSS 16 and AMOS through the following processes: Descriptive analysis, Correlation Analysis, Inter-correlation analysis, Confirmatory factor analysis, Structural Equation Model and Hypothesis testing which the analyzed results are presented respectively.

#### **4.3.1 Relationship between business components and service performance**

Based on the presented Business model performance indicators, five service performance indicators are the same including Environmental code of conduct, Customer satisfaction, Financial success, Corporate social responsibility and Service efficiency. Financial success is the sum-up positive profit amount of service when balancing cost and revenue. Customer satisfaction ensures the revenue flows with service efficiency. Service providers also must perform Corporate Social responsibility and commit to environmental and business law and regulation. FS C&T ceiling tariff rate has to be proposed from the national or local regulations to assure that all customer segments can afford to use these services. The lessons learnt from good performing service in Finnish service case suggested three main impacts: service productivity, a decrease in personnel cost and reduction of statutory duties.

#### **Descriptive analysis of Service characteristics**

Frequency analysis was applied to analyze the characteristics of surveyed services and the respondents. The service characteristics included Service capital, Truck number, Service existing year (how many years the services run) and Country. The respondent characteristics were surveyed based on Working position, Working year related FS. Among 224 survey services, most of the services were from Asia & Africa countries, with small & medium business size, with less than 3 trucks and existed more than 10 years in the market. The detailed background characteristics are shown and analyzed in the following Tables.

Table 4.10 shows the FS C&T service capital which are the financial assets including property, tangible or intangible assets. Most of the services had capital less than \$200,000. Eighty-seven services (39,7%) had capital less than \$20,000. One hundred services (44.6%) had capital from \$20,000 to less than \$200,000. Twenty-two services (9.8%) had capital from \$200,000 to \$1,000,000 and only thirteen services (5.8%) has capital more than \$1,000,000. These percentages show that most of the FS C&T services belonged to small and middle enterprise categories.

**Table 4.10 Service Capital (US\$)**

<b>Service Capital</b>	<b>Frequency</b>	<b>Percent</b>
Less than \$20,000	89	39.7
From \$20,000 to less than \$200,000	100	44.6
From \$200,000 to \$1,000,000	22	9.8
More than \$1,000,000	13	5.8
Total	224	100.0

Table 4.11 shows the FS C&T service truck number with three main groups: from 1 to 2 truck, from 3 to 5 trucks and from 6 trucks and more. The majority of services had one truck (34.4%), 2 trucks (21.9%), 3 trucks (13.8%) and from 6 and more trucks (17%). Some services had 4 trucks (7.1%) and 5 trucks (5.8%). This survey shows that most FS C&T services were small businesses with limited truck numbers.

**Table 4.11 Numbers of Trucks**

<b>Truck number</b>	<b>Frequency</b>	<b>Percent</b>
1	77	34.4
2	49	21.9
3	31	13.8
4	16	7.1
5	13	5.8
6 and more	38	17.0
Total	224	100.0

Table 4.12 shows the years of existing FS C&T service in this research. One hundred and twenty services (53.6%) have more than 10 years of history. The rest of the other services have less than 10 year's history including 7 services less than 1 year (3.1%), 28 services from 1 to less than 3 years (12.5%), 69 services from 3 to 10 years (30.8%). Basing on the existing years, half of the services had a long developing process while the other services were on growing phases with less than 3 existing years. Half of the services have a long developing process with more than 10 years.

**Table 4.12 Service Existing Year(s)**

<b>Service existing year</b>	<b>Frequency</b>	<b>Percent</b>
Less than 01 year	7	3.1
From 01 to less than 03 years	28	12.5
From 03 to less than 10 years	69	30.8
More than 10 years	120	53.6
Total	224	100.0

Table 4.13 shows the respondents working position which belonged to two groups: 169 Operators (75.4%) and 55 Experts (24.6%). Within the operator group, various working positions had responded to this survey including 16 Business owner (7.1%), 13 Truck driver (13%), 13 Truck owner (5.8%), 45 Manager (20.1%), 29 Director (12.9%) and 53 Staff

(23.7%). Experts are the FSM researcher, policy markers have in-depth knowledge and practical working experiences dealing with FS C&T services.

**Table 4.13 Respondent Working Position**

<b>Respondent Working Position</b>	<b>Frequency</b>	<b>Percent</b>
Business Owner	16	7.1
Truck Driver	13	5.8
Truck Owner	13	5.8
Manager	45	20.1
Director	29	12.9
Staff	53	23.7
Expert	55	24.6
Total	224	100.0

Table 4.14 shows the working years related to FS of the respondents. The working years showed the experiences and insights of the respondents related to FS C&T services. One hundred and sixty-eight (75%) respondents have more than 3 working years. The rest of the respondents have less than 3 year's history including 7 services less than 1 year (3.1%), 28 services from 1 to less than 3 years (12.5%), 69 services from 3 to 10 years (30.8%).

**Table 4.14 Respondent Working Year Related to FS**

<b>Respondent Working Year related to FS</b>	<b>Frequency</b>	<b>Percent</b>
Less than 1 year	9	4.0
From 1 to less than 3 years	47	21.0
From 3 to less than 10 years	84	37.5
More than 10 years	84	37.5
Total	224	100.0

Table 4.15 shows the countries in which the service operated. Asian countries occupied 204 services, Africa had 10 services, Europe had 6 services and America had 4 services. Most of the services were deployed in Asian countries using onsite sanitation systems. The majority of services were based in Thailand (37.9%) and Vietnam (36.2%).

**Table 4.15 Service Cases by Country**

<b>Country respondent</b>	<b>Frequency</b>	<b>Valid Percent</b>
Argentina	2	0.9
Austria	1	0.4
Bangladesh	6	2.7
Burkina Faso	1	0.4
Congo	1	0.4
Finland	1	0.4
France	1	0.4
Ghana	4	1.8
Haiti	2	0.9
India	11	4.9
Ireland	1	0.4
Kenya	4	1.8
Malawi	2	0.9
Mongolia	1	0.4
Nepal	2	0.9
Netherlands	1	0.4
Nigeria	3	1.3
Pakistan	3	1.3
South Africa	4	1.8
Thailand	85	37.9
Uganda	3	1.3
United Kingdom	2	0.9
Vietnam	81	36.2
Zambia	1	0.4
Zimbabwe	1	0.4
Total	224	100.0

**Business component and Service performance Correlation & Inter-correlation analysis**

The dependent variable of Service performance consisted of 5 factors including Finance success, Customer satisfaction, Corporate social responsibility, Environmental code of conduct & Service efficiency. The independent variables included 38 factors. Mean and Standard deviation of dependent variables and independent variables were calculated. The inter-correlation for independent variables were calculated. Then, the correlations between the dependent variables and independent variables were analyzed.

Table 4.16 shows the inter-correlation among dependent variables. The service performance variables mean value ranged from the lowest value 4.56 of Financial Success to the highest value 5.46 for Customer satisfaction which was about the median value. Service efficiency, Corporate Social responsibility and Environmental code-of-conduct had the mean value of 5.13, 5.31 and 5.36 respectively. The service performance dependent variables had significant and high correlations with each other. All the correlation coefficients had the value from 0.239 to 0.666 which were nearly equivalent to or higher than 0.300. These results ensured the data matrix has sufficient correlations that could justify the applicability of factor analysis according to Hair et al. (1998).

Table 4.17 shows the correlation between Business components and service performance. All the mean values are higher than the average value 4.00, except two constructs Key resource replication and Key activity uniqueness. At a significant level of 1% up to 5%, most of the sub-constructs of business components variables were correlated significantly with the service performance criteria. There are some constructs did not show the correlation with the construct of Service performance such as Key resource prediction, Key activity uniqueness, Customer relationship strength, Customer relationship matching segment, Customer segment churn rate and Customer segment appropriateness. Particularly, two constructs Revenue Margin and Customer relationship binding customer have none or negative correlations with several service performance constructs. It can be explained that the relationship between customers and services are loose because FS C&T services are not regularly used so customers tend not to keep in touch with service providers before and after services. Revenue margin has a negative correlation with customer satisfaction and did not have a significant correlation with Corporate Social Responsibility, Environment code of conduct and Service efficiency.

**Table 4.16 Inter-correlation between Dependent Variables of Service Performance**

Dependent variables	Mean	Standard Deviation	Inter-correlation Coefficients				
			Financial success	Customer satisfaction	Corporate social responsibility	Environmental code-of-conduct	Service efficiency
Financial success	4.65	1.62	1				
Customer satisfaction	5.46	1.25	0.379**	1			
Corporate social responsibility	5.31	1.34	0.294**	0.613**	1		
Environmental code-of-conduct	5.36	1.50	0.239**	0.541**	0.594**	1	
Service efficiency	5.13	1.63	0.273**	0.489**	0.523**	0.666**	1

\*\* Correlation is significant at the 0.01 level (2-tailed).

**Table 4.17 Correlation between Independent and Dependent Variables**

Independent variables	Mean	Standard Deviation	Correlation Coefficients					
			Financial success	Customer satisfaction	Corporate responsibility	Social	Environmental code-of-conduct	Service efficiency
Key resource replication	3.85	1.45	0.440**	0.171*	0.225**		0.159*	0.151*
Key resource prediction	4.66	1.24	0.244**	0.244**	0.266**		0.161*	0.108
Key resource deployment	4.76	1.27	0.378**	0.391**	0.387**		0.399**	0.315**
Key partner necessary	4.90	1.28	0.277**	0.180**	0.207**		0.262**	0.252**
Key partner relationship	4.96	1.22	0.158*	0.159*	0.224**		0.289**	0.259**
Key partner contribution	4.75	1.34	0.254**	0.147*	0.152*		0.209**	0.170*
Key activity efficiency	4.86	1.36	0.420**	0.376**	0.296**		0.345**	0.388**
Key activity uniqueness	3.82	1.47	0.286**	0.071	0.131*		0.170*	0.107
Key activity balance	4.49	1.33	0.204**	0.219**	0.202**		0.286**	0.221**
Value proposition customer alignment	5.28	1.20	0.182**	0.383**	0.377**		0.454**	0.369**
Value proposition for value chain	4.92	1.30	0.192**	0.148*	0.222**		0.221**	0.205**
Value proposition customer satisfaction	5.19	1.21	0.154*	0.411**	0.384**		0.474**	0.385**
Customer relationship strength	5.09	1.30	.075	0.373**	0.162*		0.390**	0.296**
Customer relationship matching segment	4.92	1.22	0.102	0.229**	0.249**		.376**	.423**
Customer relationship binding customer	4.42	1.47	0.171*	0.104	0.118		0.148*	0.121
Customer relationship - Branding	4.63	1.46	0.350**	0.303**	0.330**		0.355**	0.256**
Channel visibility	5.08	1.31	0.146*	0.242**	0.250**		0.354**	0.287**
Channel efficiency and effectiveness	4.94	1.30	0.186**	0.361**	0.286**		0.388**	0.319**

Channel matching segment	4.74	1.24	0.182**	0.331**	0.279**	0.386**	0.237**
Channel economies of scope	4.78	1.35	0.260**	0.269**	0.271**	0.300**	0.247**
Customer segment churn rate	4.70	1.39	0.027	0.177**	0.118	0.230**	0.184**
Customer segment appropriateness	4.65	1.22	0.112	0.168*	0.242**	0.320**	0.275**
Customer segment - New customer	4.98	1.20	0.276**	0.389**	0.317**	0.264**	0.257**
Cost prediction	4.92	1.11	0.162*	0.164*	0.194**	0.213**	0.206**
Cost structure matching service model	4.86	1.30	0.406**	0.278**	0.271**	0.333**	0.312**
Cost efficiency	4.61	1.38	0.462**	0.240**	0.208**	0.284**	0.296**
Cost economy of scale	4.59	1.35	0.421**	0.175**	0.208**	0.285**	0.272**
Revenue frequency	4.70	1.24	0.261**	0.171*	0.222**	0.327**	0.271**
Revenue diversity	4.30	1.41	0.316**	0.153*	0.187**	0.197**	0.211**
Revenue willingness to pay	4.30	1.60	0.207**	0.187**	0.284**	0.262**	0.216**
Revenue Pricing mechanism	4.42	1.52	0.267**	0.089	0.156*	0.237**	0.185**
Revenue Margin	4.04	1.52	0.384**	-0.007	0.084	0.104	0.101
Legislation availability	4.89	1.60	0.059	0.239**	0.282**	0.398**	0.345**
Legislation monitoring	4.63	1.65	0.146*	0.252**	0.279**	0.352**	0.393**
Legislation obey	5.46	1.32	0.163*	0.219**	0.293**	0.301**	0.288**
Ownership determination	5.39	1.24	0.207**	0.288**	0.311**	0.305**	0.235**
Ownership - Service improvement	5.25	1.29	0.165*	0.311**	0.317**	0.349**	0.307**
Ownership - Income adequateness	4.99	1.45	0.245**	0.219**	0.239**	0.232**	0.193**

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

### Confirmatory Factor analysis of the Key business components

The survey data set of FS C&T services was analyzed and assessed the validity by three steps. Firstly, the business component and service performance were conducted with reliability analysis. Secondly, variables of Business components and Service performance were reduced by the Factor analysis into meaningful sub-sets of factors. Thirdly, the validity of the measure of constructs was confirmed by Confirmatory factor analysis.

Reliability analysis was applied for 11 groups of business components and Service performance. Table 4.18 shows the Cronbach's alpha values of the factor groups of Business components and Service performance. According to Yoon 1995, an acceptable threshold value of Cronbach's alpha is 0.6 with principal component analysis. So the factor groups which has the Cronbach's alpha value less than 0.6 such as Key activity (0.487) and Customer relationship (0.580) would be eliminated.

**Table 4.18 Reliability Analysis of Business Components and Service Performance**

No	Business components	Cronbach's Alpha	Number of sub-constructs
1	Service performance	0.801	5
2	Key Resource	0.628	3
3	Key partner	0.793	3
4	Key Activity	0.487	3
5	Value Proposition	0.711	3
6	Customer Relationship	0.580	4
7	Channel Distribution	0.913	4
8	Customer Segment	0.701	3
9	Cost	0.790	4
10	Revenue	0.786	5
11	Legislation	0.750	3
12	Ownership	0.818	3

In the conceptual model proposed from theory and literature review, there were 12 groups of business components with 38 variables to be assessed the key business components impacting the service performance. The higher the numbers of variables are, the more complex the interpretation is. Factor analysis will gather the variables into the same groups of factors and eliminate some variables with the minimum variable loss. The variables were grouped by the latent constructs of each variable groups. The factor analysis results identified 9 key factors of business components with 18 variables. Nine emerging key factors are Key resource, Key partner, Value proposition, Channel distribution, Customer segment, Cost, Revenue, Legislation and Ownership. The nine-factor loadings confirmed the appropriateness and the measurable constructs were distinguished with each other. The factors loadings value ranged from 0.503 to 0.951 which are greater than the set cut-off value 0.4.

**Table 4.19 Factor Analysis of the Key Business Components**

Business component Variables	Key Business Component Factor								
	Key resource	Key partner	Value proposition	Channel Distribution	Customer segment	Cost	Revenue	Legislation	Ownership
Key resource prediction	0.758								
Key resource deployment	0.506								
Key partner necessary		0.785							
Key partner relationship		0.771							
Key partner contribution		0.698							
Value proposition customer alignment			0.978						
Value proposition customer satisfaction			0.685						
Channel matching segment				0.905					
Channel efficiency and effectiveness				0.903					
Channel visibility				0.807					

Channel economies of scope				0.776					
Customer segment churn rate					0.812				
Customer segment appropriateness					0.715				
Cost efficiency						0.951			
Cost matching service model						0.914			
Cost economies of scale						0.674			
Revenue Pricing mechanism							0.926		
Revenue willingness to pay							0.743		
Revenue Margin							0.625		
Revenue diversity							0.569		
Legislation monitoring								0.951	
Legislation availability								0.694	

Ownership - Service improvement									0.891
Ownership determination									0.871
Ownership income affection									0.503
Extraction Method is Maximum Likelihood									
Rotation Method is Promax with Kaiser-Normalization									
Rotation converged in 7 iterations.									
Cronbach alpha	0.63	0.79	0.86	0.91	0.7	0.83	0.79	0.82	0.82

### 4.3.2 Structural equation model of key business components, service performance and service innovation possibilities

Structure equation model was applied for confirmatory validation of the variable constructs. This modelling tool supplied the testing method for theoretical or conceptual structures of the measurement instrument. By using this tool, the relationship among the constructs could be tested with a limited bias to produce the optimum relationship models. To test the conceptual relationship model and the research hypothesis, this study used AMOS software to process the confirmatory factor analysis function to confirm the relationship among the business component, service performance and service innovation possibilities of FS C&T services. This function output provides two results: the Overall model fit index is shown in Table 4.20 and the Structural Equation Model demonstrated in Figure 4.5. To explain SEM results, the study results distinguish three notions: Construct, Variable and Factor. A construct is an attribute that might not be measured directly but could be assessed by using some variables. A variable is the measurable expression of a construct. A Factor is an element that brings certain effects with a quantity indication (Jarvis et al., 2003).

**Table 4.20 Evaluation Results of Overall Model Fit Index of SEM**

Overall Fit Index	Recommended Value	Structural Model Value
CMIN/DF (minimum discrepancy)	Smaller than 3	2.76
CFI (Comparative fit index)	Closer to 1 is better	0.848
RMSEA (Root Mean Square Error of Approximation)	0.05 - 0.08 is reasonable	0.089
GFI (Goodness of fit index)	Closer to 1 is better	0.839
AGFI (Adjusted Goodness of fit index)	Closer to 1 is better	0.793
NFI (Normed fit Index)	Closer to 1 is better	0.783
SRMR (Standardized Root Mean Square Residual)	<0.09	0.086

The construct reliability estimates range from 0.26 to 0.47, which indicates a satisfactory estimation. The average extracted variances of all constructs range between 0.76 and 0.91 which exceed the suggested value of 0.5 (Hooper et al., 2008). The results indicate that the measurement model has good convergent validity. Therefore, the proposed measurement model is reliable and meaningful to test the structural relationships among the constructs. The structural model is estimated with a maximum likelihood estimation method.

The measurement of Overall model fit of SEM produced the observed and latent variable matrix. The structural equation model is estimated with a maximum likelihood estimation method. The overall model indicated that Chi-square value is 408.517 (df. = 148 significantly at p-value < 0.001). Other indicators fitting goodness value of Structural Equation model are: CMIN/DF (minimum discrepancy) = 2.76, CFI (Comparative fit index) = 0.848, AGFI (Adjusted Goodness of fit index) = 0.793, RMSEA (Root Mean Square Error of Approximation) = 0.089, GFI (Goodness of fit index)= 0.839, NFI (Normed fit Index) = 0.783 and SRMR (Standardized Root Mean Square Residual) = 0.086. Most of these values should vary from 0 (not fit) to 1 (fitting perfectly). Compared with the recommended value, the structural model shown in Figure 4.5 achieve the requirement. So the overall fit of observed variables and the validation of proposed constructs were confirmed good fit.

The conceptual relationship model presented the direct relationship of Business component and Service performance, Service performance and Service innovation possibility. After applying the SEM fitting, only three factors had a positive association impact on Service performance. The service performance had a positive association with the service innovation possibility.

All five constructs were related to service performance. Environmental code-of-conduct (0.77) had the strongest relation with service performance, followed by Corporate social responsibility (0.72), Customer satisfaction (0.69), Service efficiency (0.68) and Financial success (0.36). From this survey results, the service providers and experts confirmed that FS C&T services have complied with the environmental code of conduct even these services achieved less financial success.

In Figure 4.5, three factors represented three key business components Key resource, Value proposition and Legislation positively associated with service performance. Resource Prediction (0.75) and Resource efficiency (0.80) were significantly related to Key resources. The service providers should predict the resource needs to improve key resource efficiently. There were two constructs related to Value proposition including Value proposition appropriateness (0.85) and Value proposition customer satisfaction (0.88). This result implied that the FS C&T service proposed value should match with customer need to increase customer satisfaction. Law (legislation) contained two related constructs including Law monitoring (0.77) and Law availability (0.90). Creating and monitoring the law and regulation platform should support the factor Legislation to have a positive association with service performance. This SEM model has comprehensively presented 4 key variables and 19 measurable constructs which provided the insights for service providers to build up a fitted business model and business component to maximize the service performance and service innovation possibilities. The Standardized and Unstandardized estimates of Structural Model result of Relationship among Business Component, Service Performance and Service Innovation possibility will be presented in Figure 4.6 and Appendix 6, respectively.

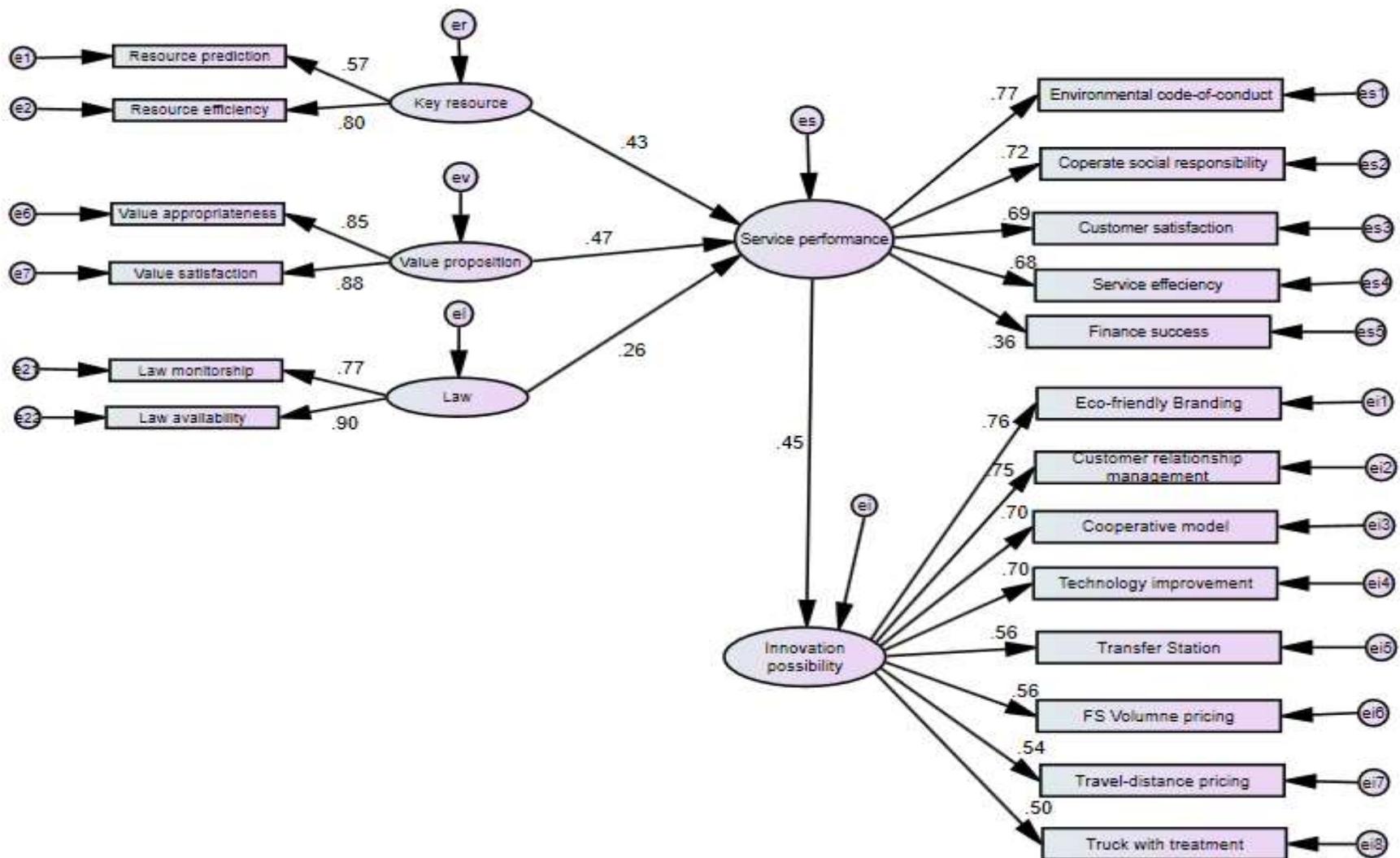


Figure 4.6 Structural model result of relationship among business component, service performance and service innovation possibility (Standardized estimate)

The service performance had an impact and was positively associated with service innovation possibilities with a path coefficient of 0.45. Eco-friendly branding (0.76) had the strongest relationship with Service innovation possibility, followed by the six constructs Customer relationship management (0.75), Cooperative model (0.70), Technology improvement (0.70), Transfer station (0.56), FS volume pricing (0.56), Travel-distance pricing (0.54) and Truck with treatment function – Sanitizer truck (0.50).

In Table 4.21, The service innovation possibility has Convergent validity results which were identified by constructs and item reliability, together with the extracted average variance. The Path coefficient of Key resource, Value Proposition and Legislation were 0.43, 0.47 and 0.46 respectively. This result reconfirmed that FS C&T service performance depended on Key source as these business components had the highest impact, followed by Value Proposition and Legislation.

**Table 4.21 Convergent Validity of Structural Equation Coefficients**

Structural path	Path coefficient	Result	Regression weight estimate
Key resource → Service performance	0.43***	Accepted	4.587
Value proposition → Service performance	0.47***	Accepted	6.235
Legislation → Service performance	0.26***	Accepted	3.064
Service performance → Service innovation possibility	0.45***	Accepted	5.446

\*\*\* p<0.05

### 4.3.3 Hypothesis testing and confirmation

According to the conceptual research model, the 11 research hypothesis was developed to identify the key Business component impacting on service performance. One hypothesis aimed to confirm the relationship between service innovation. Within the Structural model, the hypotheses testing results are presented in Table 4.22. Four hypotheses H1, H4, H11, and H12 were supported. Eight hypotheses H2, H3, H4, H6, H7, H8, H9 and H10 were rejected.

The empirical results provided the evidence to support the three business components including Key Resource, Value proposition and Legislation positively associated with the service performance. Service performance is positively associated with service innovation possibility. As Key resource is the main element to produce value for the FS C&T services, legislation is the foundation component to regulation the service performance. Service performance is the platform for service innovation.

**Table 4.22 Hypothesis Testing Results**

<b>Hypothesis</b>	<b>Description</b>	<b>Hypothesis testing result</b>
H1	Key resource is positively associated with service performance	Supported
H4	Value proposition is positively associated with service performance	Supported
H11	Legislation is positively associated with service performance	Supported
H12	Service performance is positively associated with service innovation possibility	Supported

In conclusion, Chapter 4 has presented the FS C&T service business model innovation characteristics and process. Business problems have been defined for service providers to diagnose their business. Financial structure with operating cost, profit structure has emphasized the role of service ownership. Conceptual business model included 9 business components and 2 extended components. Business model performance was assessed by 5 indicators which were used as the 5 constructs of service performance. Business model innovation was proposed with 8 service innovative possibilities. The Structural equation model has shown the relationships business component, service performance and service innovation. With an international survey on 224 services, Key activity, Value Proposition and Legislation have a statistically positive association with Service performance. Service performance positively associated with service innovation possibilities. The conceptual structural model has been confirmed with four hypotheses were supported.

## Chapter 5

### Conclusion and Recommendations

According to the research objectives, literature review, methodology and results, this chapter presents the conclusion by main findings, contribution, implications, limitations and future research direction.

#### 5.1 Main Findings

The main objective of this dissertation was to study the Business model innovation of FSM focusing on FS C&T services. Articulating the obtained results from the three objectives, the following conclusions:

1. The FS C&T service problems were classified into 4 issues such as Political, Economic, Social and Technological, in which the FS service providers could identify their own business problems and seek appropriate solutions.
2. From the analysis of service cases in 3 countries, the FS C&T services were found to consist of 9 business components and 2 extended business components.
3. From the financial analysis with profit & loss and operating structure, Ownership appeared to be the main factor impacting on the net profit of FS business services in which the private firms could incur more positive profits than the public firms.
4. New conceptual business-model of FS C&T services was developed which encompassed the 11 business components and comprising the pathway for operation. Qualitative testing of this concept with the cases from 3 countries showed its applicability in improving the FS performance.
5. Five business model performance indicators were: Environmental Code-of-conduct, Service-efficiency, Customer Satisfaction, Financial Success and Corporate Social Responsibility.
6. Business model innovation focuses on incremental innovation with 8 innovative possibilities: Eco-friendly branding, Customer relationship management, Cooperative model, Technology improvement, Transfer station, FS volume pricing, Travel-distance pricing and Truck with treatment function – Sanitizer truck.
7. Empirical results from an international survey with 224 services provide the structural equation model of the Business component, service innovation and service innovation possibilities. This model confirmed the positive association between Key Resource, Value proposition, Legislation with service performance. And the service performance is significantly related to service innovation possibilities. The conceptual structural model was tested with 4 supported hypotheses.

#### 5.2 Contributions

This study contributes to the existing literature in Business model innovation and FSM, FS C&T services field with three original contributions:

1. The original conceptual business model dedicated to FS C&T services was the first time proposed for improving the FS C&T services with 6 business component groups: Infrastructure, Service, Customer, Finance and Legislation & Ownership.
2. Validation criteria set for business model performance and service performance were comprehensively proposed with five indicators.

3. Eight incremental innovative solutions were suggested for Business innovation of FS C&T services.

### **5.3 Implications**

These research results could be a benefit for academia in research, practitioners in service deployment and authority in service monitoring.

1. The conceptual business model can be applied to several FSM services and other service sectors. PEST business problem matrix can be used to diagnose FS service problems to find out the solution. Individual FS C&T service performance can be assessed with the 5 indicators.
2. In a particular and well-prepared context service providers can optimize, develop and innovate their service business models with 8 innovative solutions. Key resource and value proposition should be improved to leverage the service performance.
3. Legislation platform should be updated with appropriate and robust law and regulation for FS C&T services by national and local Authorities. FSM service should foster privatization trend. Private sectors and Public-Private Partnership have proved their effectiveness in managing profitability.

### **5.4 Limitations**

1. Similar to some other empirical research, the FS C&T service context of this study limited the interpretation of the findings for other services.
2. Some adjustments should be tailored to apply these results to other service industries. The should be more.
3. One qualitative case assessment in Finland, as the model benchmarking for other cases, may not explain all the angles of FS C&T in other countries.
4. The use of some subjective measurements on constructs and variables may create possibilities of bias. To some extent, the research design with many factors with variable leading to many factor reductions.

### **5.5 Future Research Recommendation**

1. This study provides directions for future research in exploring the key success of innovative solutions for FSM services.
2. This research recommends for further studies on FS C&T services regarding the relationship between the optimum service scale (numbers of trucks), the most significant business components and service profitability. Moreover, quantitative testing on the conceptual business model should be studied in other countries.
3. For the SEM of Business model, more quantitative research should be conducted about the association between ownership status and service performance.
4. Customization of the current study for each country or regional contexts.

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**Appendix 1. Questionnaire in English**  
**QUESTIONNAIRE ABOUT BUSINESS MODEL**  
**OF COLLECT - TRANSPORT FAECAL SLUDGE SERVICE**

General instruction: Kindly give your own opinion about the Collect - Transport Faecal sludge service which you are doing or you have done or you have the most information about.

**PART 1: Rate your own opinion about the performance indicators of a Collect - Transport Faecal Sludge service which you have done, you are doing or you have information. Rating scale: From 1 “Absolutely not agree” to 7 “Absolutely agree”**

		Absolutely not agree						Absolutely agree
S1	Service has financial performance----- -----	1	2	3	4	5	6	7
S2	Service satisfies the customers----- -----	1	2	3	4	5	6	7
S3	Service meets the social standard and Corporate Social responsibility----- -----	1	2	3	4	5	6	7
S4	Service follows the environmental code of conduct-----	1	2	3	4	5	6	7
S5	Services efficiently collect all generated faecal sludge and transport to right location----- -----	1	2	3	4	5	6	7

**PART 2: Rate your opinion on the statements about the Components of the Business model of Collect -Transport Faecal Sludge service which you have done, you are doing or you have information. Rating scale: From 1 “Absolutely not agree” to 7 “Absolutely agree”**

		Absolutely not agree						Absolutely agree
KR1	Key resources are difficult for competitors to replicate-----	1	2	3	4	5	6	7
KR2	Key resources' needs are predictable----- -----	1	2	3	4	5	6	7
KR3	Key resources are deployed in the right amount at the right time----- -----	1	2	3	4	5	6	7
KP1	Service focuses working with partners when necessary-----	1	2	3	4	5	6	7
KP2	Service enjoys good working relationships with key partners	1	2	3	4	5	6	7
KP3	Key partners contribute to the service performance-----	1	2	3	4	5	6	7

KA1	Key activities are efficiently executed in high quality-----	1	2	3	4	5	6	7
KA2	Key activities are difficult to copy-----	1	2	3	4	5	6	7
KA3	Balance of in-house versus out-sourced key resource execution is ideal-----	1	2	3	4	5	6	7
VP1	Value propositions are well aligned with customer needs-----	1	2	3	4	5	6	7
VP2	Value propositions have a strong effect on Faecal Sludge Value chain-----	1	2	3	4	5	6	7
VP3	Customers are very satisfied with the proposed value-----	1	2	3	4	5	6	7
CR1	Service has strong customer relationships-----	1	2	3	4	5	6	7
CR2	Customer relationship quality correctly matches with each customer segments-----	1	2	3	4	5	6	7
CR3	Relationships bind customers with service through high switching costs-----	1	2	3	4	5	6	7
CR4	Service brand is strong-----	1	2	3	4	5	6	7
CH1	Customers can easily find the service channels-----	1	2	3	4	5	6	7
CH2	Channels are very effective and efficient-----	1	2	3	4	5	6	7
CH3	Channel reach is strong among customers and matched with each customer segment-----	1	2	3	4	5	6	7
CH4	Channels are strongly integrated and provide economies of scope-----	1	2	3	4	5	6	7
CS1	Customer churn rates are low-----	1	2	3	4	5	6	7
CS2	Customer base is well segmented-----	1	2	3	4	5	6	7

CS3	Service is continuously acquiring new customers-----	1	2	3	4	5	6	7
C1	Service cost is predictable-----	1	2	3	4	5	6	7
C2	Cost structure is correctly matched to service model-----	1	2	3	4	5	6	7
C3	Service operations are cost-efficient-----	1	2	3	4	5	6	7
C4	Service benefits from economies of scale-----	1	2	3	4	5	6	7
R1	Revenues are predictable, sustainable and frequently repeated-----	1	2	3	4	5	6	7
R2	Revenue streams are diversified-----	1	2	3	4	5	6	7
R3	Service only charges for what customers are really willing to pay for-----	1	2	3	4	5	6	7
R4	Pricing mechanisms capture full willingness to pay-----	1	2	3	4	5	6	7
R5	Service benefits from strong margins-----	1	2	3	4	5	6	7
L1	There are clear law and regulation for service-----	1	2	3	4	5	6	7
L2	There are monitoring activities for service from authority-----	1	2	3	4	5	6	7
L3	Service develops better when complying with the law and regulation-----	1	2	3	4	5	6	7
O1	Service has specific ownership-----	1	2	3	4	5	6	7
O2	Specific ownership makes the service provider offer better service-----	1	2	3	4	5	6	7
O3	Service providers have the income according to their contribution-----	1	2	3	4	5	6	7

**PART 3: Please rate your opinion about the innovative possibilities for Collect and Transport Faecal Sludge service. Rating scale: From 1 “Absolutely not applicable” to 7 “Absolutely applicable”**

		Absolutely not applicable ←————→ Absolutely applicable						
		1	2	3	4	5	6	7
I1	Using Improved truck with Faecal Sludge treatment function--							
I2	Apply technology: tracking the transport device by GPS, routing device to choose best transport way, liquid sensing to control dumping activities-----							
I3	Apply the Cooperative model to group the service providers to provide improved service-----							
I5	Pricing based on the sludge volume-----							
I4	Pricing based on the transport distance to right disposal place-----							
I6	Branding an environment-friendly brand with the commitment for environment protection-----							
I7	Using Faecal Sludge transfer station in case the treatment plant is far from residential area-----							
I8	Apply Customer relationship management tool---							

**Part 4. General Information about the Collect – Transport Faecal sludge Service that you have given your opinion in Part 1, 2 and 3 above**

**4.1 The country( which the service locate is:.....**

**4.2 Number of truck(s) of the service:**

- 01 truck
- 02 truck
- 03 truck
- 04 truck
- 05 truck
- More than 5 truck

**4.3 The service capital is:**

- 1.Less than 20.000US\$
- 2. From 20.000 to less than 200.000 US\$

- 3. From 200.000 to 1 million US\$
- 4. More than 1 million US\$

**4.4 The business type of service is:**

- 1. Government company
- 2. Limited Company or Joint Stock company
- 3. Private enterprise or Family business
- 4. Municipality service
- 5. Business without registration

**4.5 Types of service offers: (Can choose more than 1 choice):**

- 1. Collect & transport or doing business with Faecal Sludge
- 2. Collect and transport other Sludge
- 3. Install or maintain or repair DEWATS
- 4. Install, maintain or repair water supply or drainage systems
- 5. Faecal Sludge treatment
- 6. Other services

**4.6 Service existing year is:**

- 1. Less than 1 year
- 2. From 1 to less than 3 years
- 3. From 3 to less than 10 years
- 4. More than 10 years

**4.7 Your current working position is:**

- 1. Business Owner
- 2. Truck Driver
- 3. Truck Owner
- 4. Manager
- 5. Director
- 6. Staff
- 7. Expert

**4.8. Your working time dealing with Faecal Sludge is:**

- 1. Less than 1 year
- 2. From 1 to less than 3 years
- 3. From 3 to less than 10 years
- 4. More than 10 years

**Thank you for finishing the questionnaire.**

## Appendix 2. Questionnaire in Vietnamese

### BẢNG KHẢO SÁT VỀ DỊCH VỤ THU GOM - VẬN CHUYỂN Bùn HẦM CẦU (Bùn BỂ PHỐT)

**Hướng dẫn:** Nhờ Quý vị vui lòng trả lời về dịch vụ Thu gom - Vận chuyển Bùn hầm cầu (Bùn bể phốt) mà Quý vị đang làm hoặc đã làm cho cả bốn Phần 1, 2, 3 và 4 trong Bảng khảo sát. Cách trả lời là đánh dấu hoặc khoanh tròn lên mức độ mà bản thân Quý vị thấy phù hợp.  
Sau khi trả lời xong 4 trang của Bảng khảo sát, nhờ Quý vị giúp để Bảng khảo sát này vào bao thư trống đã dán sẵn tem thư và gửi bưu điện về cho chúng tôi; hoặc scan/chụp ảnh & email file Bảng khảo sát này đến [tahunganh@hcmut.edu.vn](mailto:tahunganh@hcmut.edu.vn); hoặc fax đến số: (08) 73083183. Trân trọng cảm ơn Quý vị.

**PHẦN 1:** Nhờ Quý vị cho biết ý kiến đối với 5 biểu thị sự thành công của một dịch vụ Thu gom - Vận chuyển Bùn hầm cầu (Bùn bể phốt) mà Quý vị đang làm hoặc đã làm.

		Rất đồng ý		←————→	Rất không đồng ý			
S1	Dịch vụ thành công về mặt tài chính----- -----	1	2	3	4	5	6	7
S2	Dịch vụ làm hài lòng khách hàng----- -----	1	2	3	4	5	6	7
S3	Dịch vụ phù hợp chuẩn mực và có trách nhiệm xã hội-----	1	2	3	4	5	6	7
S4	Dịch vụ tuân thủ qui chuẩn bảo vệ môi trường-- -----	1	2	3	4	5	6	7
S5	Dịch vụ thu gom - vận chuyển hầu hết lượng bùn phát sinh	1	2	3	4	5	6	7

**PHẦN 2:** Nhờ Quý vị cho biết ý kiến đối với các phát biểu sau về các thành phần trong mô hình kinh doanh của một dịch vụ Thu gom - Vận chuyển Bùn hầm cầu (Bùn bể phốt) mà Quý vị đang làm hoặc đã làm

		Rất đồng ý		←————→	Rất không đồng ý			
KR1	Nguồn lực chính khó bị đối thủ bắt chước----- -----	1	2	3	4	5	6	7
KR2	Nhu cầu nguồn lực chính có thể được dự đoán - -----	1	2	3	4	5	6	7
KR3	Nguồn lực chính được triển khai đúng lượng và đúng lúc--	1	2	3	4	5	6	7
KP1	Dịch vụ hợp tác với các đối tác chính khi cần thiết-----	1	2	3	4	5	6	7
KP2	Dịch vụ có mối quan hệ tốt với các đối tác chính-----	1	2	3	4	5	6	7
KP3	Đối tác chính góp phần cho dịch vụ thành công- -----	1	2	3	4	5	6	7

KA1	Các hoạt động chính được triển khai hiệu quả với chất lượng cao-----	1	2	3	4	5	6	7
KA2	Các hoạt động chính khó bị bất chước-----	1	2	3	4	5	6	7
KA3	Triển khai một cách hợp lý các hoạt động chính bằng nguồn lực nội bộ so với nguồn lực thuê ngoài -----	1	2	3	4	5	6	7
	<u>PHẦN 2 (TIẾP THEO)</u>							
VP1	Giá trị dịch vụ mang lại phù hợp với nhu cầu khách hàng---	1	2	3	4	5	6	7
VP2	Giá trị dịch vụ mang lại có tác động mạnh lên chuỗi giá trị của bùn thải-----	1	2	3	4	5	6	7
VP3	Khách hàng rất hài lòng với giá trị dịch vụ mang lại-----	1	2	3	4	5	6	7
CR1	Dịch vụ có mối quan hệ khách hàng chặt chẽ---	1	2	3	4	5	6	7
CR2	Chất lượng của các mối quan hệ phù hợp với từng phân khúc khách hàng-----	1	2	3	4	5	6	7
CR3	Mối quan hệ giúp hạn chế việc khách hàng chuyển đổi sang dịch vụ khác do hao phí chuyển đổi cao-----	1	2	3	4	5	6	7
CR4	Dịch vụ có thương hiệu có tiếng-----	1	2	3	4	5	6	7
CH1	Khách hàng dễ dàng nhìn thấy các kênh truyền thông, quảng cáo về dịch vụ-----	1	2	3	4	5	6	7
CH2	Truyền thông có hiệu quả và hiệu suất cao-----	1	2	3	4	5	6	7
CH3	Truyền thông tiếp cận tốt đến khách hàng và phù hợp với từng nhóm khách hàng-----	1	2	3	4	5	6	7
CH4	Các kênh truyền thông khác nhau kết hợp chặt chẽ và phát huy lợi thế do sự đa dạng-----	1	2	3	4	5	6	7





- 1. Một xe
- 2. Hai xe
- 3. Ba xe
- 4. Bốn xe
- 5. Năm xe
- 6. Có hơn năm xe

4.2 Nguồn vốn của dịch vụ là:

- 1. Ít hơn 1 tỷ đồng
- 2. Từ 1 tỷ đến dưới 10 tỷ đồng
- 3. Từ 10 tỷ đến 50 tỷ đồng
- 4. Trên 50 tỷ đồng

4.3 Loại hình của dịch vụ là:

- 1. Công ty nhà nước
- 2. Công ty tư nhân
- 3. Doanh nghiệp tư nhân hoặc kinh doanh hộ gia đình
- 4. Dịch vụ công ích của nhà nước
- 5. Hợp tác xã
- 6. Chưa đăng kí loại hình

4.4 Ngoài dịch vụ Thu gom - Vận chuyển bùn hầm cầu (bùn bể phốt) thì dịch vụ khác được cung cấp cho khách hàng là: *(Có thể chọn hơn 1 lựa chọn)*

- 1. Mua bán Bùn hầm cầu (Bùn bể phốt)
- 2. Thu gom - Vận chuyển các loại chất thải khác
- 3. Lắp đặt, bảo trì, sửa chữa hệ thống hầm, nhà vệ sinh
- 4. Lắp đặt, bảo trì, sửa chữa hệ thống cấp thoát nước, cống rãnh
- 5. Xử lý bùn hầm cầu
- 6. Làm các dịch vụ khác

4.5 Thời gian hoạt động của dịch vụ là:

- 1. Ít hơn 1 năm
- 2. Từ 1 đến dưới 3 năm
- 3. Từ 3 đến 10 năm
- 4. Trên 10 năm

4.6 Vị trí làm việc chính hiện tại của Quý vị là:

- 1. Chủ dịch vụ
- 2. Tài xế
- 3. Chủ xe
- 4. Quản lý
- 5. Giám đốc
- 6. Nhân viên

4.7 Thời gian Quý vị làm việc liên quan đến dịch vụ về Bùn hầm cầu (Bùn bể phốt) là:

- 1. Ít hơn 1 năm
- 2. Từ 1 đến dưới 3 năm
- 3. Từ 3 đến 10 năm
- 4. Trên 10 năm

Sau khi trả lời xong 4 trang của Bảng khảo sát, nhờ Quý vị giúp để Bảng khảo sát này vào bao thư trống đã dán sẵn tem thư và gửi bưu điện về cho chúng tôi; hoặc scan/chụp ảnh & email file Bảng khảo sát này đến [tahunganh@hcmut.edu.vn](mailto:tahunganh@hcmut.edu.vn); hoặc fax đến số: (08) 73083183. Trân trọng cảm ơn Quý vị.

### Appendix 3. Questionnaire in Thai

#### แบบสอบถามความคิดเห็นของผู้ให้บริการเกี่ยวกับการเก็บขนส่งปฏิภูล

##### คำชี้แจง:

ขอความกรุณาท่านตอบแบบสอบถามเกี่ยวกับการให้บริการด้านการเก็บขนส่งปฏิภูลที่ทางหน่วยงานของท่าน ได้ให้บริการหรือมีข้อมูลเกี่ยวกับการเก็บขนส่งปฏิภูล กรุณาตอบแบบสอบถามโดยทำเครื่องหมาย O ในช่องระดับคะแนนที่เหมาะสมและตรงกับความคิดเห็นของท่าน

##### ส่วนที่ 1 กรุณาเลือกระดับคะแนนความเห็นของท่านต่อ 5 ตัวชี้วัดความสำเร็จ

ในการให้บริการเกี่ยวกับการเก็บขนส่งปฏิภูลที่หน่วยงานของท่านได้มีการให้บริการหรือมีข้อมูลในเรื่องดังกล่าว

		<div style="display: flex; justify-content: space-between; align-items: center;"> <span>ไม่เห็นด้วย</span> <span>↔</span> <span>เห็นด้วยมากที่สุด</span> </div>						
S1	การให้บริการของท่านประสบความสำเร็จทางการเงิน-----	1	2	3	4	5	6	7
S2	ผู้ใช้บริการมีความพึงพอใจต่อการให้บริการของท่าน-----	1	2	3	4	5	6	7
S3	การให้บริการของท่านได้มาตรฐานเกี่ยวกับด้านสังคมและการมีส่วนร่วมในการรับผิดชอบต่อสังคม -----	1	2	3	4	5	6	7
S4	การให้บริการของท่านมีหลักการให้บริการที่ยึดหลักตามมาตรการด้านการป้องกันด้านสิ่งแวดล้อม-----	1	2	3	4	5	6	7
S5	การให้บริการของท่านได้ให้การบริการที่คุ้มค่าสำหรับการจัดเก็บสิ่งปฏิภูลที่เกิดขึ้นทั้งหมด และเก็บขนไปยังบ่ออัดสิ่งปฏิภูลอย่างถูกต้อง-----	1	2	3	4	5	6	7

##### ส่วนที่ 2

กรุณาเลือกระดับคะแนนความเห็นของท่านเกี่ยวกับ องค์ประกอบของแบบจำลองการดำเนินการให้บริการ เกี่ยวกับการเก็บขนส่งปฏิภูลที่หน่วยงานของท่านได้มีการให้บริการหรือมีข้อมูลในเรื่องดังกล่าว

		<div style="display: flex; justify-content: space-between; align-items: center;"> <span>ไม่เห็นด้วย</span> <span>↔</span> <span>เห็นด้วยมากที่สุด</span> </div>						
KR1	ทรัพยากรหลักของหน่วยงานท่านมีความยากที่ผู้ประกอบ บริการอื่นๆ จะเลียนแบบ-----	1	2	3	4	5	6	7
KR2	ความต้องการทางด้านทรัพยากรหลักของหน่วยงาน สามารถที่จะคาดการณ์ล่วงหน้าได้-----	1	2	3	4	5	6	7

<b>KR3</b>	ทรัพยากรหลักของหน่วยงานท่านสามารถนำมาใช้ได้อย่างเหมาะสมกับปริมาณและเวลาในการให้บริการฯ----- -----	1	2	3	4	5	6	7
<b>KP1</b>	การให้บริการฯของหน่วยงานท่านสามารถที่จะทำงานร่วมกับหุ้นส่วนหรือประกอบการอื่นๆ เมื่อมีความจำเป็น----- -----	1	2	3	4	5	6	7
<b>KP2</b>	การให้บริการฯของหน่วยงานท่านมีความสัมพันธ์ที่ดีในการทำงานร่วมกับหุ้นส่วนหรือผู้ประกอบการอื่นๆ----- -----	1	2	3	4	5	6	7
<b>KP3</b>	หุ้นส่วนหรือผู้ประกอบการรายอื่นๆมีส่วนช่วยสนับสนุนให้การบริการฯของหน่วยงานของท่านประสบความสำเร็จ----- -----	1	2	3	4	5	6	7
<b>KA1</b>	หน่วยงานของท่านมีการดำเนินการการให้บริการฯที่คุ้มทุนกับกิจการที่ให้บริการในระดับคุณภาพที่สูง----- -----	1	2	3	4	5	6	7
<b>KA2</b>	กิจกรรมหลักของหน่วยงานท่านมีความยากที่จะเลียนแบบ----- -----	1	2	3	4	5	6	7
<b>KA3</b>	หน่วยงานของท่านมีการจัดสมดุลในระดับดีเลิศสำหรับการดำเนินงานฯภายในองค์กรและหน่วยงานภายนอก----- -----	1	2	3	4	5	6	7
<b>ส่วนที่ 2 (ต่อ)</b>								

		ไม่เห็นด้วย เห็นด้วยมากที่สุด  มากที่สุด
<b>VP1</b>	การให้บริการของหน่วยงานท่านมีการจัดการที่ดีเพื่อให้บริการครอบคลุมถึงความต้องการของผู้ใช้บริการ-----	1 2 3 4 5 6 7
<b>VP2</b>	การนำเสนอการให้บริการของหน่วยงานท่านส่งผลต่อระบบการดำเนินการเกี่ยวกับสิ่งปฏิกูล-----	1 2 3 4 5 6 7
<b>VP3</b>	ผู้ให้บริการมีความพึงพอใจกับการนำเสนอการให้บริการจากหน่วยงานของท่าน----- -----	1 2 3 4 5 6 7
<b>CR1</b>	การให้บริการของหน่วยงานท่านมีความสัมพันธ์ที่ดีอย่างมากต่อผู้ใช้บริการ----- --	1 2 3 4 5 6 7
<b>CR2</b>	ความสัมพันธ์กับผู้ใช้บริการของหน่วยงานท่านมีประสิทธิภาพตรงตามกลุ่มผู้ใช้บริการ----- -----	1 2 3 4 5 6 7
<b>CR3</b>	ความสัมพันธ์ระหว่างผู้ใช้บริการถูกเชื่อมผ่านทางต้นทุนที่สูงขึ้นสำหรับค่าใช้จ่ายจากการเปลี่ยนไปใช้บริการกับผู้ประกอบการอื่น-----	1 2 3 4 5 6 7
<b>CR4</b>	เครื่องหมายการค้า (แบรนด์) ในการการให้บริการของหน่วยงานของท่านมีความโดดเด่น----- -----	1 2 3 4 5 6 7
<b>CH1</b>	ผู้ใช้บริการสามารถเข้าถึงช่องทางการติดต่อเพื่อขอรับบริการได้ง่าย-----	1 2 3 4 5 6 7
<b>CH2</b>	ช่องทางในการติดต่อเพื่อขอรับบริการจากหน่วยงานของท่าน มีประสิทธิภาพและคุ้มค่า----- ----	1 2 3 4 5 6 7
<b>CH3</b>	การเข้าถึงช่องทางเพื่อขอรับบริการจากหน่วยงานของท่านมีความโดดเด่นต่อผู้ใช้บริการซึ่งตรงกับกลุ่มเป้าหมาย----- ---	1 2 3 4 5 6 7
<b>CH4</b>	ช่องทางการติดต่อขอรับบริการของหน่วยงานท่านมีลักษณะเป็นศูนย์รวมช่องทางการติดต่อ มีความคุ้มค่าและครอบคลุมขอบเขต	1 2 3 4 5 6 7

**(Economies of scope) ของการให้บริการฯ----**  
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<b>CS1</b>	อัตราการผลิตการขอรับบริการฯจากผู้ให้บริการมีระดับต่ำ-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
<b>CS2</b>	ฐานของผู้ใช้บริการเป็นกลุ่มลูกค้าที่อยู่ในระดับดี-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
<b>CS3</b>	การให้บริการฯของหน่วยงานของท่านมักได้รับการตอบรับจากผู้ใช้บริการรายใหม่อย่างต่อเนื่อง-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>

<b>C1</b>	ค่าใช้จ่ายเกี่ยวเนื่องจากการให้บริการฯเป็นสิ่งที่สามารถคาดการณ์ล่วงหน้าได้-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
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<b>C2</b>	โครงสร้างของค่าใช้จ่ายถูกนำมาสัมพันธ์เกี่ยวเนื่องกับแบบจำลองด้านการให้บริการฯ-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
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<b>C3</b>	การดำเนินการให้บริการฯของหน่วยงานของท่านมีความคุ้มทุนต่อค่าใช้จ่าย-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
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<b>C4</b>	การให้บริการฯของหน่วยงานท่านได้รับผลประโยชน์จากการประหยัดเชิงขนาด <b>(Economic of scale)</b> ของการให้บริการฯ-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
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<b>R1</b>	รายได้จากการให้บริการฯเป็นสิ่งที่สามารถคาดการณ์ล่วงหน้าได้ มีความยั่งยืนและเป็นไปในรูปแบบเดิมอยู่เสมอ-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
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<b>R2</b>	กระแสรายได้จากการให้บริการฯมาจากหลากหลายช่องทาง-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
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<b>R3</b>	การเก็บค่าบริการฯ ของหน่วยงานของท่านขึ้นอยู่กับผู้ให้บริการที่มีความพึงพอใจจะสามารถจ่ายได้-----	<b>1</b>	<b>2 3</b>	<b>4 5 6 7</b>
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**ส่วนที่ 2 (ต่อ)**

		<div style="text-align: center;">           ไม่เห็นด้วย เห็นด้วยมากที่สุด                         มากที่สุด         </div>						
<b>R4</b>	กลไกราคาของการให้บริการของหน่วยงานท่าน เน้นความพึงใจสูงสุดที่ผู้ใช้บริการสามารถจ่ายได้----- -----	1	2	3	4	5	6	7
<b>R5</b>	การให้บริการของหน่วยงานของท่านได้รับผลประโยชน์ หนักจากกำไรขั้นต้นเป็นส่วนมาก----- -----	1	2	3	4	5	6	7
<b>L1</b>	หน่วยงานของท่านมีการใช้กฎหมายและข้อบังคับที่ชัดเจน สำหรับการให้บริการ----- -----	1	2	3	4	5	6	7
<b>L2</b>	หน่วยงานของท่านมีกิจกรรมเกี่ยวกับการติดตามตรวจ สอบในการให้บริการฯ จากผู้มีอำนาจที่เกี่ยวข้อง----- -----	1	2	3	4	5	6	7
<b>L3</b>	การพัฒนาการให้บริการฯของหน่วยงานของท่านจะดี ขึ้นเมื่อมีการปฏิบัติตามกฎหมายและข้อบังคับ----- -----	1	2	3	4	5	6	7
<b>O1</b>	การให้บริการฯ ของหน่วยงานของท่านมีการระบุ กรรมสิทธิ์ (Ownership) อย่างชัดเจน ----- -----	1	2	3	4	5	6	7
<b>O2</b>	กรรมสิทธิ์ในการให้บริการฯที่ชัดเจนทำให้ผู้ให้บริการ ฯนำเสนอบริการได้มีประสิทธิภาพมากกว่า----- -----	1	2	3	4	5	6	7
<b>O3</b>	ผู้ให้บริการฯได้รับรายได้สุทธิ ขึ้นอยู่กับการได้รับการเงินช่วยเหลือและสนับสนุนหน วยงานฯ----- -----	1	2	3	4	5	6	7

<b>ส่วนที่ 3</b>								
กรุณาเลือกระดับคะแนนความเห็นของท่านเกี่ยวกับ <u>ความเป็นไปได้ของนวัตกรรม</u> สำหรับการดำเนินการ การให้บริการเกี่ยวกับการเก็บขนส่งปฏิภูลที่หน่วยงานของท่านได้มีการให้บริการ หรือมีข้อมูลในเรื่องดังกล่าว								
		เป็นไปได้  เป็นไปได้ น้อยที่สุด มากที่สุด						
<b>I1</b>	การใช้รถเก็บขนส่งปฏิภูลที่ปรับปรุงแล้วควรที่จะมีการบำบัดสิ งปฏิภูลได้ภายในตัวรถ----- -----	1	2	3	4	5	6	7

	การประยุกต์ใช้เทคโนโลยี: ระบบ <b>GPS</b> เพื่อระบุตำแหน่งของรถเก็บขนสิ่งปฏิกูล								
<b>I2</b>	เพื่อค้นหาเส้นทางที่ดีที่สุดและสามารถที่จะควบคุมการปล่อยเ หของเสียโดยระบบเซ็นเซอร์ (Sensor) ----- -----		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>I3</b>	การประยุกต์ใช้แบบจำลองสำหรับการมีส่วนร่วมเพื่อเชื่อมต่อ กับผู้ให้บริการรายอื่นร่วมกับการให้บริการฯอย่างมืออาชีพ--- -----		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>I5</b>	การคิดราคาค่าบริการขึ้นอยู่กับปริมาณของสิ่งปฏิกูลนั้นๆ --- -----		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>I4</b>	การคิดราคาขึ้นอยู่กับระยะทางในการเก็บขนสิ่งปฏิกูลไปยังส ถานที่เหมาะสมในการกำจัด----- -----		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>I6</b>	การให้เครื่องหมายการค้า (แบรนด์) ในการให้บริการฯ ควรมุ่งเน้นเกี่ยวกับการเป็นมิตรกับสิ่งแวดล้อม และมีความรับผิดชอบต่อการป้องกันด้านสิ่งแวดล้อม-- ----- -----		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>I7</b>	ควรมีการใช้สถานีขนถ่ายสิ่งปฏิกูล ( <b>Transfer station</b> ) ในกรณีที่ระบบบำบัดสิ่งปฏิกูลอยู่ไกลจากบ้านเรือนที่ใ ให้บริการฯ-----		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>I8</b>	ควรมีการประยุกต์ใช้เครื่องมือด้านการจัดการความสม พันธ์ระหว่างผู้ให้บริการกับผู้ให้บริการ ----- -----		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>

**ส่วนที่ 4** ข้อมูลทั่วไปเกี่ยวกับการให้บริการเก็บขนสิ่งปฏิกูลของหน่วยงานท่าน

**4.1** จำนวนรถที่ใช้ให้บริการเก็บขนสิ่งปฏิกูล

- 1. 1 คัน
- 2. 2 คัน
- 3. 3 คัน
- 4. 4 คัน
- 5. 5 คัน
- 5. มากกว่า 5 คัน

**4.2** เงินลงทุน (ลงทะเบียน) สำหรับการประกอบการให้บริการเกี่ยวกับการเก็บขนสิ่งปฏิกูล

- 1. น้อยกว่า 600,000 บาท
- 2. 600,000 – 6,000,000 บาท
- 3. 6,000,000 – 30,000,000 บาท
- 4. มากกว่า 30,000,000 บาท

**4.3** รูปแบบของการให้บริการของหน่วยงานท่าน

- 1. บริษัทภายใต้การควบคุมของรัฐบาล
- 2. บริษัทจำกัด (มหาชน) หรือ
- 3. รัฐวิสาหกิจหรือธุรกิจครอบครัว
- 4. เทศบาล (นคร, เมือง, ตำบล)
- 5. ไม่ได้ลงทะเบียน

**4.4** การให้บริการด้านการเก็บขนสิ่งปฏิกูลสำหรับผู้ให้บริการ (ตอบได้มากกว่า 1 ข้อ)

- 1. การจัดเก็บและการเก็บขนส่งสิ่งปฏิกูล
- 2. การจัดเก็บและการเก็บขนกากตะกอนอื่นๆ
- 3. ซ่อม ติดตั้ง และบำรุงรักษาระบบบำบัดน้ำเสียจากส้วมแบบติดกับที่
- 4. ซ่อม ติดตั้ง และบำรุงรักษาเกี่ยวกับระบบน้ำประปา และระบบการจ่ายน้ำ
- 5. บำบัดสิ่งปฏิกูล
- 6. การให้บริการอื่นๆ

**4.5 ระยะเวลาการดำเนินการของหน่วยงานของท่าน**

- 1. มากกว่า 1 ปี
- 2. 1-3 ปี
- 3. 3-10 ปี
- 4. มากกว่า 10 ปี

**4.6 ผู้ตอบแบบสอบถามอยู่ในตำแหน่ง**

- 1. เจ้าของกิจการ
- 2. คนรับรถเก็บขนส่งสิ่งปฏิกูล
- 3. เจ้าของรถเก็บขนส่งสิ่งปฏิกูล
- 4. ผู้จัดการ
- 5. ผู้อำนวยการ
- 6. พนักงานทั่วไป

**4.7 ระยะเวลาการทำงานของท่านสำหรับการให้บริการเก็บขนส่งสิ่งปฏิกูล**

- 1. น้อยกว่า 1 ปี
- 2. 1-3 ปี
- 3. 3-10 ปี
- 4. มากกว่า 10 ปี

**Appendix 4. Financial Analysis Factor & Calculation**

<b>Measurables</b>	<b>Description</b>	<b>Unit</b>	<b>Calculation</b>
<b>Service Factor</b>	Area	km <sup>2</sup>	
	Population (Registered)	persons	
	Number of households	HH	
	Household Density	HH/km <sup>2</sup>	Number of households/area square
	No of Truck ( <i>TOTAL</i> )	Truck	
	No of Truck ( <i>FUNCTIONAL</i> )	Truck	
	Truck Capacity ( <i>TOTAL</i> )	m <sup>3</sup> /all truck/trip	
	Truck Capacity ( <i>FUNCTIONAL</i> )	m <sup>3</sup> /all truck/trip	
	Number of Trip	Trip/year	Actual Collected FS / Truck Capacity (Functional)
	Traveling Distance	km/day	
	Age of trucks (Average)	Years	
	Working day	Day/year	
	Actual FS Collection	m <sup>3</sup> /year	
	No. of served household (per year)	HH/year	Actual Collected FS / 1.08 m <sup>3</sup> /HH
	FS collection fee rate	US\$/m <sup>3</sup>	
<b>Investment</b>	Truck investment cost at buying year	Baht/US\$	
	Year of truck invest	Year	
	Truck investment at year 2013	Baht/US\$	(Invest 20xx /CPI year 20xx)* CPI 2013
	Truck Estimate useful life	Year	
	Truck Depreciation per year	US\$/year	Invest 2013/Useful life
	Truck investment at year 2013	US\$	
	Truck Depreciation per year	US\$/Year	

<b>Expenses</b>	<b>Personal</b>		
	Actual Personal Cost	US\$/year	
	Number of the office staff	Persons	Actual Number
	Number of truck driver	Persons/truck	1 Assistant per truck
	Number of assistants	Persons/truck	1 Assistant per truck
	<b>Estimated Personal Expenses</b>	US\$/year	No of all staffs * Salary rate
	<b>Fuel</b>		
	Actual Fuel Cost	US\$/year	
	Amount of fuel	Liter/year	
	Fuel cost	US\$/Liter	
	Estimated Fuel Cost	US\$/year	Amount of fuel * Fuel cost
	<b>Fuel Expenses</b>	US\$/year	If there is no actual fuel cost, this will show the estimated fuel cost
	<b>Maintenance</b>		
	Actual Maintenance Expenses		
	% of Fuel and Lubricant (TDRI)	Percentage	
	% of Maintenance.Tire.Tax.Insu (TDRI)	Percentage	
	Estimated Maintenance Expense	US\$/year	=Total Cost*% of Maintenance, tire, tax, insurance = (Fuel cost/% of fuel and lubricant)*% of Maintenance, tire, tax, insurance
	<b>Maintenance Expenses</b>	US\$/year	If there is no actual maintenance cost, this will show the estimated maintenance cost
	<b>Licenses</b>	US\$/year	
	<b>Others</b>	US\$/year	
<b>FS collection Expenses (US\$/year)</b>			
<b>Estimated Personal Expenses</b>	US\$/year		
Fuel Expenses	US\$/year		
Maintenance Expenses	US\$/year		

Licenses	US\$/year	
Others	US\$/year	Other Expenses in US\$/30
Total Expenses	US\$/year	Salary+Fuel+Maintenance+License+Other
<b>Unit Cost</b>		
Actual Personal Expenses	US\$/m <sup>3</sup>	
Actual Fuel Expenses	US\$/m <sup>3</sup>	
Actual Maintenance Expenses	US\$/m <sup>3</sup>	
<b>Estimated</b> Personal Expenses	US\$/m <sup>3</sup>	Personal Expenses in US\$/ Collected FS
Fuel Expenses	US\$/m <sup>3</sup>	Fuel Expenses in US\$/ Collected FS
Maintenance Expenses	US\$/m <sup>3</sup>	Maintenance Expenses in US\$/ Collected FS
Licenses	US\$/year	License Expenses in US\$/ Collected FS
Others	US\$/m <sup>3</sup>	Other Expenses in US\$/ Collected FS
Total Expenses	US\$/m <sup>3</sup>	Salary+Fuel+Maintenance+License+Other/Collected FS

<b>Revenues</b>	<b>FS collection fee</b>		
	Actual FS collection Revenue	US\$/year	
	Actual FS collection	US\$/year	
	FS collection fee rate	US\$/m <sup>3</sup>	
	Estimated FS collection fee	US\$/year	Actual FS collection * FS collection fee rate
	<b>FS collection revenue (Estimated)</b>	US\$/year	Use the value of <b>Estimated Revenue</b>
	<b>Other Revenue</b>	Baht/US\$/year	
	<b>Revenues (US\$/Year)</b>		
	Actual FS collection Revenue	US\$/year	Actual FS collection Revenue in Baht/30 1 US\$ = 30 baht
	<b>Estimated</b> FS collection revenue	US\$/year	FS collection revenue (Estimated) in Baht/30
	Other Revenue	US\$/year	Other Revenue in Baht/30
	Total Revenues	US\$/Year	<b>Estimated FS</b> Collection Revenue Revenue + Other Revenues in Baht/30
	<b>Revenue Per Unit</b>		
	Actual FS collection revenue	US\$/m <sup>3</sup>	Actual FS collection Revenue in US\$/Collected FS
	<b>Estimated</b> FS collection revenue	US\$/m <sup>3</sup>	Estimated FS collection revenue in US\$/Collected FS
	FS as fertilizer Revenue	US\$/m <sup>3</sup>	FS as fertilizer Revenue in US\$/Collected FS
	Other Revenue	US\$/m <sup>3</sup>	Other Revenue in US\$/Collected FS
	Total Revenues	US\$/m <sup>3</sup>	<b>Estimated FS</b> Collection Revenue+ FS as fertilizer Revenue + Other Revenues in US\$/Collected FS

### Appendix 5. Characteristic of 15 Representative Services Cases Profiles for In-depth Interview in Finland, Thailand and Vietnam

Case	Service name	Municipality	Country	Service type	Truck fleet (m <sup>3</sup> )	Staff number	Truck number	Distance from truck parking to Discharge area (km)	Average FS service fee rate (US\$/m <sup>3</sup> )	Annual Profit/Loss (2013)
1	Pakkret City Municipality	Pakkret City	Thailand	Municipality	3 to 6	10	3	20	6.6	Loss
2	Bangbuathong Town Municipality	Bangbuathong Town	Thailand	Municipality	6	4	1	10	6.6	Loss
3	Nonthaburi City Municipality	Nonthaburi City	Thailand	Municipality	3 to 6	5	4	5	8.3	Loss
4	Songkla City Municipality	Songkla City	Thailand	Municipality	6	8	4	12	8.3	Loss
5	Thongtawil Service Company	Rayong province	Thailand	Licensed private Co.	6	More than 10	14	60	8.3	Profitable
6	Suwan Company	Khonkaen city	Thailand	Licensed private Co.	3	6	3	18	10	Profitable
7	Lung Nuad Company	Chiang Mai city	Thailand	Licensed private Co.	6	7	6	35	10	Profitable
8	Charan Service	Banpru sub-district	Thailand	Unlicensed private Co.	4	3	1	10	13	Profitable
9	Mr. Chang – 350/29 Tung Thien Vuong, District 8	Ho Chi Minh city	Vietnam	Licensed private Co.	3	2	1	30	10	Profitable
10	Mr. Ly - 5/18B Chanh Hung, District 8	Ho Chi Minh city	Vietnam	Licensed private Co.	3	1	1	30	13.3	Profitable
11	Mr. Nhan – 17 Cao Lo, District 8	Ho Chi Minh city	Vietnam	Licensed private Co.	3	1	1	30	11.6	Profitable
12	Mr. Anh – 5 Lo Sieu, District 11	Ho Chi Minh city	Vietnam	Licensed private Co.	3	2	1	45	10	Profitable
13	Mr. Cuong -233/235 Hoa Binh, District Tan Phu	Ho Chi Minh city	Vietnam	Licensed private Co.	3 to 6	4	2	30	11.6	Profitable
14	CITENCO – 42 – 44 Vo Thi Sau, District 1	Ho Chi Minh city	Vietnam	State One member Ltd Co.	3 to 6	More than 10	7	40	12	Profitable
15	L&T Naantali brand	Naantali	Finland	Public Ltd. liability Co.	3 to 10	More than 10	3	14	30	Profitable

Appendix 6. Structural Model Result (Unstandardized estimates)

