The Impacts of Management Practices on Firm-Level Performances in Thailand Trucking Services Industry*

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Abstract

What does cause the firm-level performance in the trucking services in developing economies? This paper answers question on the role of managerial inputs influential to profitability, operation efficiency, and quality in truck service. We ran the in-depth interviews and unique and detailed firm-level survey to trucking industry in Thailand. Firm-level dataset presents there are large variation in basic firm-level characteristics and performances in trucking services even within trucking services. This is verified by field research. We ask how operation efficiency and quality in service drives firm's profitability. The dataset implies increase in profitability is associated with increase in usage efficiency, increase in driving distance with cargo, and reduction in costs. Furthermore, to seek for the sources of variation in profitability, efficiency, and quality in service, this paper constructs score of management practices to know what managerial technologies firms have. This paper focuses on incentive payment scheme as main management practices in trucking industry. We then estimate the effects of incentive pay scheme on profitability, operation efficiency, and quality of services. Empirical results show the following findings: (1) an adoption of incentive scheme itself does not lead to higher profitability; (2) an adoption of incentive pay can increase profitability and efficiency as long as firms invest in firm-sponsored training for drivers; (3) a joint adoption of teamwork and training does not lead to improvement in efficiency and quality as well as profitability.

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1 Introduction

The aim of this paper is to examine the determinants of firm-level performances in service sectors to look at an adoption of incentives pay scheme in trucking industry in Thailand. It has been well know that there are large disparity in firm-level performances such as productivity, profitability, or sales growth even within narrowly defined industries (Syverson, 2012). The literature asks what drives the huge variation in performance across firms within each manufacturing industry. The previous research line also asks why it persists overtime in manufacturing and service sectors (Gibbons and Henderson 2013). Furthermore, personnel management through incentives, monitoring, skill development, or organization of work could contribute to explain persistent performance differences within narrowly defined industries or among seemingly similar enterprises (Lazear 2000, Lazear and Oyer 2013). Complementarities of human resource management practices can also contribute to explain firm-level performances (Ichniowski, Shaw, and Prennushi 1997, Ichniowski and Shaw 2013). These questions have been quite important for trucking industry in emerging economies where play an essential role of production linkages. Since firms in trucking industry in developing economies have newly adopted several management practices as production networks have grown, studying trucking industry provides an essential implication to the relationship between personnel management and economic development. This paper investigates how human resource management practices affect firm-performances (as well as accidents) by focusing on an adoption of incentives pay scheme among logistics firms located in Greater Bangkok Metropolitan area, Thailand which connects upstream suppliers with downstream manufacturers in a center of production networks in East Asia.

Literature on supply chain management in the manufacturing sector has been focused on supply chain collaborations among manufacturing firms to optimize procurement, production, and delivery of goods along a production chain. If careful attentions are paid to the part of inter-firm linkages, it is natural to emphasize the importance of logistics function that interconnects flows of goods between firms. Without logistics, different establishments cannot be linked physically. Logistics is one of the fundamental inter-firm collaborations to improve operative performances in the manufacturing sector. Expected impacts of such collaboration in logistics on manufacturers are not limited to logistics and inventory controls. They affect efficiencies in production, procurement and other practices indirectly related to logistics.

Logistics supports citizen's daily life too. Among several transportation modes, commercial trucking forms a backbone of domestic physical distribution systems. Trucking is indispensable even to sea and air cargo transportation when cargos are conveyed to seaport and airport. Logistics is also very relevant to urban development especially for fast growing developing countries where rapid motorization and increase of cargo transportation cause traffic jams and accidents, air pollutions, and other environmental deterioration. Efficient logistics contribute not only to competitiveness of industries but also to quality of life. Thus, it is important to foster a competitive trucking industry to develop competitive manufacturing sector and economy as a whole. In spite of its importance, most of the previous studies on supply chain management in developing countries have focused on the user of logistics services, or on the case of modern large logis-

tics service providers. In reality, it is not easy to assess what is really going on in the trucking industry especially in developing countries. The industry is very heterogeneous and dynamic. The industry is dominated by SMEs including a self-employed driver who owns a truck. Entry barriers to the industry are so low that the industry is very competitive, and many firms enter to and exit from the industry. On the other hand, there are large logistics companies who operate hundreds of trucks, provide multi-modal services, and introduce capital-intensive equipment and state-of-the art technologies. There are also third party logistics (3PL) service providers who are service-oriented without having trucks and other related equipment.

As we can see, adoption of modern management practices matters firm's performance. We ask how this is also true for the case of trucking services. In this paper, we ask following three important questions on Thailand trucking industry. First, how operation efficiency and service quality drive firm-level performances, in particular, increase in profitability. Second, how choice of management practices affects profitability, operation efficiency, and quality in service. Third, what is the extent of complementarity between management practices. For example, adoption of incentive payment scheme could be highly controversial in trucking industry. It is worth to study the consequences of adoption of incentive payment scheme on profitability, production efficiency, and quality in service. Answering these three questions quantitatively and qualitatively helps policy planners and policy arena to discuss the consequences of government intervention to road safety and saving energy as well as efficiency of distribution services. To answer these matter, the authors ran field interviews and questionnaire survey to trucking industry in Thailand. Findings from field research enables us to connect our conceptual framework and previous studies with survey questionnaire. Without this, we cannot get accurate answers from trucking industry. Firm-level dataset with careful questions enables us to examine the determinants of increase in profitability and the potential channels of improving profitability. Again, this study is motivated by findings from in-depth interviews of the firm-level case studies. As far as we know, measuring and testing the explanation of the relationship between choice of management practices and profitability is a first challenge in the context of Trucking industry. In Section 2 below, we briefly review previous research. Section 3 presents industry background and institutional setting of Thailand trucking industry. The conceptual framework, empirical strategy, and research design to generate data are shown in Section 4. The data used in this paper is shown in Section 5. Empirical evidence in this paper is presented in Sections 6. We discuss the findings from field research in Section 7. Finally, Section 8 concludes and show remaining issues.

2 A brief review of literature

We provide a brief bird view of related research. There are two lines of research on economic organization of trucking industry which we focus. First, this paper shows the previous important research on the relationship between contract forms and coordination focusing on the U.S. trucking industry. This line of research gives us a clear evidence how allocation of control or decision rights affects firm-level performances. Since this line of research has emphasized that choice of (inter) organizational arrangement rules out firm's performance through efficient matching be-

tween trucks and loads, this paper is going to derive an implication to economic performances of shippers and senders in developing economies. Second, this paper presents a recent research on the relationship between an adoption of modern management system and firm-level performances. The reason why this paper focuses on management practices in the context of trucking industry as well as contract or decision rights is adoption of modern management practices can reduce the transaction costs within and between firms. We will also drive an implication to Thailand trucking industry.

2.1 Contract, coordination, and technology adoption in the trucking industry

In trucking industry, it is generally known that transport costs are lower when truck loads are full as well as distance between origin and destinations is short. These technical constraints restrict firm's efficiency of production and distribution. As Bresnahan and Levin (2012) summarized, firm's efficiency comes from efficient matching between trucks and loads. Since trucks and loads have not always been necessary to co-locate each other, it is crucial to achieve spatial and temporal coordination between trucks and loads. A new technology, for example, on-board computers (OBC) enables shippers to achieve coordination across time and space. We will overview what was happening to the trucking industry after adoption of new technology especially by looking at the seminal empirical contributions on the U.S. trucking industry.

First, we start from the question how firms in trucking industry achieve coordination between trucks and loads. The first hypothesis is that trucking firms utilize trucking employee to manage the potential mismatch between trucks and loads. For example, since "less-than-truckload (LTL)" carriage has potential room for creating value from coordinated scheduling, firms in trucking industry has an incentive to invest in trucking employee or data tracking technologies to exploit the value from coordination. Empirically, Nickerson and Silverman (2002) shows that employee drivers are more likely to drive "less-than-truckload (LTL)" carriage than independent operators. Contract duration is also a device of reducing higher transaction or coordination costs arising from back-haul trucking when long-haul transaction happens. Hubbard (2001) tests this implication and finds that the spot market transactions for long-hauls is not prevalent when markets are thin. His finding suggests that market thickness determines contractual arrangements.

Second, an adoption of new technologies also changes the coordination within and across organizations. The impacts of new technologies such as information and communication technologies on organizational performance are usually ambiguous. The reason of this comes from the fact that each organization face agency problems, problems of resource reallocation, or complementarities. Hubbard (2000) studies the consequences of an adoption of improved monitoring technologies called "on-board-computers (OBCs)" in the U.S. trucking industry to distinguish empowerment of incentives and improvement of resource allocation. He finds the channel that an adoption of new technologies raise productivity through reduction of agency costs between firms (principals) and truck operators (agencies). The works by George Baker and Thomas Hubbard go beyond employment as a device of coordination to look at on-board-computers. Baker and Hubbard (2003) shows that an adoption of on-board-computers gives more chance for coordination to

truck drivers, while firms in trucking industry have more chance to outsource trucking services to other third parties as monitoring technologies also improve. To quantify these cases, Baker and Hubbard (2004) assumes that on-board-computers also improves contracting environment and asks whether a greater prevalence of adoption of on-board-computer make truck drives own the trucks. They find that truck drivers are not likely to own trucks they drive if they adopt improved monitoring technologies. This is particularly true in the case of longer-hauls. That is, Baker and Hubbard (2004) concludes that better contracting environment through an adoption of improved monitoring technologies leads to more integration.

Third, Hubbard (2003) focuses on the impacts of adoption of new technologies on productivity in the trucking industry. They ask how much on-board-computers increased the productivity through increasing efficiency of matching between loads and utilization of truck capacities. He finds that trucks adopting on-board computers have experienced 13% increase in productivity. This is economically sizable and significant. Since transport services have had a greater prevalence in the U.S. economy, the impacts of adoption of new technologies on aggregate economy are also non-trivial in the U.S. growth. Finally, it is crucial for the trucking industry to achieve efficient matching between trucks and loads. Since contract environment has played an important role to reduce the transaction costs arising from long-haul or backhaul through lengthen contract durations, hiring employee drivers, and improving monitoring technologies, previous research emphasized contract environment as a coordination device. If this is especially true for trucking industry in developing economies, then quality of contractual institution may affect productivity of industry and aggregate economy in developing economies.

2.2 Management and work practices

In addition to the importance of contractual environment, this paper also emphasizes the role of management practices ensuring efficient matching between trucks and loads within each firm. First, even within narrowly defined industries and technologies, there is huge variations in firm-level performance. In the case of homogeneous steel production lines within and across firms, an adoption of the set of innovative human resource management (HRM) practices explains productivity growth in the steel finishing lines (Ichniowski, Shaw, and Prennushi, 1997). They emphasize that production lines are more likely to improve uptime productivity if they jointly adopt innovative HRM practices compared to the case if they adopt only single innovative management practice. In the case of valve making industry, firms newly adopting information technologies (IT) has moved to produce more customized products while IT give an option to change business strategy and require skilled workers and supporting management practices (Bartel, Ichniowski, and Shaw, 2002). The strong complementarity between IT adoption, work organization, and firm-performance (product innovation) has also been shown using the firm-level IT utilization survey including survey to human resource managers by Bresnahan, Brynjolfsson, and Hitt (2002). They also find that IT-induced product innovations require more skilled workers. This research line commonly suggests the importance of complementarity between new technologies, work practices, and quality of workers to achieve higher efficiency within a firm.

Second, it is also true that an adoption of more broadly-defined workplace management system makes huge performance difference across firms in developed and developing economies. It has been well known that an adoption of modern management practices is strongly correlated with higher productivity and sales growth within and across countries (Bloom and Van Reenen, 2007 and See survey papers by Bloom and Van Reenen 2010, 2011 and Bloom, Sadun, and Van Reenen 2010). The lower productivity among firms in developing economies is driven by management practices (Bloom, Mahajan, McKenzie, and Roberts, 2012). Bloom, Sadun, and Van Reenen (2012) finds that trust between headquarters and affiliates makes productivity difference among multinational affiliates even within a group of multinational affiliates located in same destinations. Finally, Bloom, Eifert, Mahajan, McKenzie, and Roberts (2013) ran more rigorous field experiments of free modern management consulting to Indian large textile firms. They found that treatment plant experienced 17% productivity growth in the first year. They also find the main channels driving this gain: improved quality and efficiency and reduced inventory. This gain led to the opening of more production plants within three years. This empirical results from the experiment imply that non-adoption of modern management practices mainly comes from informational barriers to access the benefits and returns to management practices.

To close the section, we briefly review Bloom and Van Reenen (2007) showing an important implication to the trucking industry in developing economies. Bloom and Van Reenen (2007) surveyed eighteen different types of management practices through phone interviews to sample of 730 medium-sized enterprises in the U.S., France, Germany, and the U.K. The survey questions they interviewed can be grouped into four areas: (1) operations of modern manufacturing process; (2) monitoring of performance; (3) making targets; (4) incentives (human resource management). Based on collecting the accurate responses and normalizing management practices, they utilize firm-level measure of management practices to explain productivity. Findings from the survey report that the measure of managerial practices is strongly correlated with firm-level performance (productivity, profitability, Tobin's Q, and survival rates). Furthermore, their findings show that weak competition in product market and the family-owned firms habit are primary factor explaining poor management practices.

3 The trucking industry in Thailand

We overview of background and institutional setting of Thailand logistics in this section. The purpose of this study is to collect data and information about trucking companies in Thailand in order to investigate the influential factors affecting the service quality of Thai trucking industry. The survey respondents are targeted at the top management level, in cooperation with staff or managers who could provide appropriate answers to the surveyed questions. The results are summarized in three main parts: Thailand logistics overview, methodology, and key results from the survey. Thailand has recently seen itself changing from agricultural-based industry to manufacturing and service sectors. In 2011, Thailand's GDP is worth approximately US $ 351 billion (10.54 trillion baht). The second highest sector, which accounts for 38% of the national GDP in 2011, is the manufacturing sector which delivered up to US $ 113 billion (3.40 trillion baht).

Upon considering the total export of Thailand in 2011, the manufacturing export accounted for 81% of the total Thai exports and is valued at US $ 186.27 billion (5.59 trillion baht). The most exported products include computer products and parts, auto parts and accessories, and jewelry and related articles (Bank of Thailand, 2014).

The increasing importance of the manufacturing sector and manufacturing exports to the Thai economy is becoming very obvious. Bangkok and its vicinities are the center of the manufacturing distribution in Thailand, accounting for 47% of the country's distribution. Thailand's top three manufacturing sectors are: food and beverages, textile and garments, and furniture.

In 2015, Thailand and other ASEAN countries will officially inaugurate the ASEAN Economic Community (AEC). As one of the member countries having a central location among all other members, Thai logistics service providers could play quite a significant role in the regional logistics industry given the close proximity and connection to other member countries. Thailand is well-connected to other countries via roads, rails, water and air. Given its location advantage, Thailand could position herself as the logistics hub for the AEC and ASEAN plus 3 and plus 6 if her logistics' quality, cost and efficiency are managed properly. According to World Bank's logistics performance index in 2012, Thailand was ranked at number 38 out of 155 economies worldwide, scoring 3.07 out of 5. The analysis has pinpointed the needs for Thailand to improve in the areas of customs, logistics competency, infrastructure, and cargo tracking and tracing.

According to the Office of the National Economics and Social Development Board, the current structure of Thai logistic business could be classified into five main areas: freight transportation and forwarding; warehousing/inventory management and packing; non-asset based logistics services; information and communication technology/consulting; and courier and postal services (Office of the National Economics and Social Development Board, 2012).

Road transport was Thailand's main mode of freight transportation which account for 82.6 percent share of the total domestic freight transport in year 2011. The volume of international trade transport was 5.8 percent increase in year 2011 by almost all modes of transportation except rail transport. Sea transport contributed to 88.8 percent of the total international freight transport.

Upon examining the logistics cost of Thailand, the 2010 figure showed approximately the total value of 1.64 trillion baht (Office of the National Economics and Social Development Board, 2012). This cost was about 15.2 percent of the Thai GDP. The components of the logistic cost were made of: (1) Transportation cost (776.4 billion baht) accounted for 7.2% of the GDP, (2) Inventory holding cost (722.5 billion baht) accounted for 6.7% of the GDP, (3) Logistics administration cost (145.1 billion baht) accounted for 1.3% of the GDP. Likewise, it is worth pointing out that the transportation cost was still the largest cost component, accounting for 47.2% of the total logistics cost, while the inventory holding cost constituted approximately 44% of the total logistics cost. Moreover, the logistics administration cost yielded 8.8% of the total cost (Office of the National Economics and Social Development Board, 2012).

The logistics activities are handled by the logistics service providers (LSP) which could be divided into four categories: subcontractors, logistics providers, third party logistic providers, and fourth party logistics providers. In 2011, there were 18,399 logistics service providers (LSPs)

registered with the Department of Business Development. The number of LSPs has continued to grow since 2005 with an average growth of 3.7% per year. The majority of LSPs were engaged in transport-related activities (66% of the total LSPs) or approximately 12,000 businesses (Office of the National Economics and Social Development Board, 2012). According to the Foreign Business Act 1999, the end of the Business Act that is to say the classification for investment business of foreigner forbid foreigner to make transportation business by air land and sea within the country. Therefore, the transportation business is limited to local Thai people. There are 9,607 companies registering their trucks with the ministry of transportation.

4 The research design

The questionnaire survey was planned and conducted with such understanding of the trucking industry. The case study country is Thailand, where medium-tech manufacturing industries like automobile and chemical industries have been developed with the strong political supports for introducing FDIs. The country has also internationally competitive industries especially in the manufacturing of natural resource-based products. Both types of industries cannot be competitive without supporting industries like logistics.

The questionnaire survey focuses on factors that affect efficiency of trucking companies, putting mainly two elements potentially influential to operational performances of trucking companies. First is the inter-firm linkage that may facilitate information exchange and collaboration with consignors (the person sending a shipment (shipper), or origin of the transportation) and consignees (the person to whom the shipment is delivered, or destination of the transportation). Our interest in the firm linkage also goes to alliances with other trucking firms for sharing transportation capacity or cargos. IT and other equipment that enable information sharing and collaboration are also recognized as important topics for the survey.

The second is internal resources and organizations that include capacity of truck drivers and communications among drivers, office workers, and top management. Among several factors influential to efficiency of trucking firms such as storages, distribution center, IT and other solution services, efficient utilization of trucks is fundamental to improve operational efficiencies. As utilization of trucks depends not only on managerial practices like trucking scheduling but also on driver's capability of on-time delivery including driving safety and cargo handling, HRD of drivers is indispensable. Consignors and consignees can cooperate with their partner trucking firms, providing drivers with technical assistances and training, for example, on special handling for cargos in their sites. The capability of drivers to understand, handling, and sharing information is also a key intangible asset. Drivers have the most opportunities for trucking firms to have contact with consignors and consignees because drivers visit their sites periodically. Capable drives can understand and suggest their trucking company's business opportunities from their observations on the logistics problems their customers have and advantages against their competitors serving for the same consignors or consignees. In other words, effective information sharing with drivers are crucial for top management to make their companies more competitive.

An additional source of information and know-how that can improve operational efficiency

of trucking companies is cooperation among trucking companies. Because the trucking industry is dominated by small and medium-sized firms, many of them cannot carry large fixed costs of investment in training and sector-specific infrastructure like information systems, or do not have bargaining power against large suppliers. Small and medium-sized trucking firms are also subcontractors serving for large trucking companies directly contracted with consignors or consignees. Such situation makes a room of cooperating with rival trucking firms directly or indirectly through sectoral business associations. In practice, government provides supports through business organizations, so that substantially governments motivate private firms to work together at business organizations.

Thus, the conceptual framework, based on which the questionnaire was designed, can be figured out as follows. In the figure, cargos are flown from consignors to consignees. Trucking firms under a subcontract agreement may collaborate to transport cargos from a consignor or to a consignee. Information can be flown or shared not only between consignors, trucking firms, and consignees in their customer-supplier relationships vertically but also among trucking firms under their subcontract agreements or sector-wide cooperative schemes horizontally.

It has been not easy to obtain detailed information on inter-firm relationships in the logistics operations and the trucking industry. Availability of official statistics on the sector is limited. Most of the statistics are not necessarily designed, considering unique characteristics of the sector. Therefore, the investigation of the vertical and horizontal collaborative relationships in the logistics industry will be useful to open the black box of the sectoral characteristics of innovation systems. The sector specific survey enable to taken into account various natures of consignor, consignee, and trucking firms. For example, the duration of the consignor-trucking firm-consignee would be matter for tightness of their collaborations. The collaboration might be in the loose form if they handle once or twice shipment monthly, while the tight relationship can be established when the party have closed a yearly contract. This should also give us the better knowledge transfer and innovation. It might be very interesting to observe the effect of the size of both consignor and consignee and their system. It is often seen that once the size of consignor or consignee are big, the system would be in the stricter form and thus, the trucking firms must improve their service quality to fit into their customers' system. In the case of the Toyota with the Just in Time system, all of the trucking firms must pick up and arrive at the exact time so that the service quality must be very precise to be qualified. The questionnaire survey has a advantage of enabling to ask trucking firms about such detailed information, although it has a disadvantage of making the limited number of observations available from a huge population of trucking firms.

5 Data

5.1 Survey and sampling strategy

The surveys were distributed via mail, telephone, and in person. The trucking company list is from Siam List Database Marketing Company[1] which contains 13,418 logistics companies and

[1](http://www.companyinthailand.com/database/)

the additional 9,607 logistics companies are from the ministry of transportation. We randomly selected 200 companies from the list and send the mail survey. In total we received 112 responses where 14 responses via mail, 35 responses via phone, and 63 responses via in-person survey. We conducted a questionnaire survey study in during end of January to beginning of March 2014 to collect data and information about trucking companies in Thailand and identify the influential factors affecting the service quality of Thai trucking industry. The survey translated in Thai is twelve pages and it includes following thirteen different sections;

- Profile and trucking business of firm,
- Operational performance and improvement of firm in the 2011-2013,
- Development of partners in 2011-2013,
- Product/service improvement of firm in 2011-2013,
- Communication and information sharing and within firm,
- Top management's principles and priority,
- Quality of firm's drivers,
- Quality control, training, and incentives,
- Main consignor of firm,
- Main consignee of firm, and
- Cooperation with partners and other trucking firms.

5.2 A first look at the survey

In Tables 1, we show the summary statistics of firm-level survey in Thailand trucking industry. Result from all surveys show that 40.19% are individual proprietor where there are 69.6% are "only one place" with no branch. There are 17.9% specifying that they are the Headquarter. There are 71.4% are 100% Thai own and 4.5% are Joint Venture and only 0.9 or 1 firms which is the MNC. For the sale in year 2013, there are 36.6% having 11-50 million THB, 21.4% having 51–100 million THB and 20.5% having lower than 10 million THB. For the overall capital lower than 5 million THB, there are 36.6% and between 6–25 million THB account for 37.5%. There are 30.4% having 31–50 number of employees, 14.3% having 21–25 number of employees and 11.6% having 51–100 number of employees. The size of the respondents is small and medium size which is the majority size of the Thai trucking firms. Moreover, according to the nature of the trucking business which is more preserved for local Thai, all of the respondent firms are Thai firms. It is interesting the note that in this set of responses, there are 52.7% of top management has education level at Master or Ph.D. and 22.3% are bachelor degree. This number is quite contrast to our believe where the trucking business would have the education level below bachelor

degree. This could be due to the majority of the respondents are medium size which could hire well-qualified top management. There are 43.8% of the top management having academic background in management or economics. However, these top management, 59.5% did not study oversea and 58% of them cannot drive the truck. Moreover, all of these respondents have Thai top management. There are only 3.6% of these firms having the foreign consultants.

In term of funding, there are only 17.9% receiving fund from Board of Investment, 2.7% receiving fund from Ministry of Transportation and only 0.9% receiving fund from the other sources. This portrait the similarity of the source of funding in other industrial sectors where they do not receive any funding or aid from the government. The survey data show that, 19.6% of companies interviewed have the number of driver is 1-5 peoples, 17% of them having 31-50 drivers, and 12.5% having 11-15 drivers. Therefore, we could say that the number of driver fluctuate from 1-5 to less than 50. About Logistics Quality System Program (LQSP) organized by Thai National Shippers' Council (TNSC), almost half of companies know this program but they still did not send their employee to train LQSP and the majority of 57.1% of these companies do not have their employee passing LQSP training. In case of the maintenance, it is usually the major concern for the trucking business in order to keep their service quality. There are 79.3% truck firms to have specific maintainer for truck every day. A construction is the major type of goods that company handle consisting of 44.6%, and follow by food/drinks/smoke which is 32.1%. There are 77.33% which is not a subcontractor and 54.84% which use 100% of their own truck in business. The types of goods which trucks handle are show in Tables 2.

For the Thai or international standards, the organization standards that we observe are Quality management (e.g. ISO 9001), Environmental management (e.g. ISO 14001), Occupational health and safety management (e.g. ISO/OHSAS 18001), Information security management (e.g. ISO 27001), Security management systems for the supply chain (e.g. ISO 28000), Road traffic safety management (e.g. ISO 39001), and Q-Mark. The majority of the firms do not yet adopt these standards. There are 43.33% do not yet adopt ISO9001, 60.53% do not adopt ISO14001, 42.53% do not adopt ISO8001, 70.67% do not adopt ISO27001, 66.67% do not adopt ISO28000, 70.27% do not adopt ISO39001, and 53.76% do not adopt Q-Mark. For technology adaptation, GPS tracking system is the most common system adopt by 50%, CNG trucks are used by 47.32%, and the fuel save tire are used by 25.9%.

In this survey, we collect the operational performance and improvement of the firms in 2011–2013. We consider the following factors: sales, profit, profitability (Profit/sales), transport volume per truck, load efficiency(actual loading capacity per maximum load capacity), laden miles (driving distance carrying cargo/ total driving distance), usage efficiency (Total days trucks are actually utilized/ Total days trucks are available), delivery in Full on Time (DIFOT), number of damages or losses of cargos, number of accidents per truck, total operating cost, the proportion of fuel expenses to total cost, malfunction of trucks in service, repair and maintenance expense per truck, automobile insurance rate (insurance cost to total cost), driver retention (decrease in driver turnover). Tables 3, we report the first look at data on improvement in firm-level performance. The highest average achievement is usage efficiency which has the average score of 3.32 and the

second highest is the automobile insurance rate which has the average score of 3.28. The next are laden miles and number of accidents without injuries per truck where the average score is 3.26.

In summary, we obtained 112 responses from the survey. The sample is good representatives which represent the overall trucking companies in Thailand. The major problem in this study is the respond number through the mail survey is very low which the normal response in Thailand is. For the future study, the study should conduct with the cooperation of the logistics association in order to get higher response.

== Tables 1 to Table 3==

6 Empirical results

6.1 Impacts of efficiency and service quality on profitability

Table 4 reports the correlation results between firm-level profitability and firm-level efficiency of trucking services. The outcome is measured by increase in profitability during last three years, 2011–2013. This is scaled by five grades from “Significantly worsen (1)" to “Almost same (3)" to “Significantly improved (5)". We have seven different measures for efficiency of trucking services. These seven measures of operation efficiency or production efficiency are also measured by five grades. We run OLS regressions to estimate the effects of increasing the firm-level performance of efficiency and service quality on profitability. The first four columns report the impacts of following measures on profitability: (1) usage efficiency (i.e., total days trucks are actually utilized is divided by total days trucks are available); (2) transport volume per truck; (3) load efficiency (actual loading capacity per maximum load capacity); (4) Laden miles (i.e., driving distance carrying cargo is divided by total driving distance). We will show the impacts of measures of operation efficiency on profitability under controlling number of trucks the firm operates (log), subcontractors, and types of goods trucks handle. These types of goods are measured by dummy variables.

Column 1 of Table 4 presents improvement of usage efficiency has a significant impact on increase in profitability. This implies higher utilization of trucks leads to higher profitability for firms. Columns 2 and 3 of Table 4 report transport volume per truck and both of load efficiency do not directly affect profitability. These results suggest quantity of order does not lead to higher profitability. Column 4 of Table 4 presents increase in laden miles has a positive impact on improvement in profitability. This means longer driving distance with cargo leads to higher profitability. There are two stories behind this results. On one hand, laden miles seems to be a measure of truck utilization as a measure of usage efficiency. On the other hand, since higher priced and vertically differentiated goods within narrowly defined products are transported longer distance while lower priced and non-differentiated goods are transported nearby in general, then trucking industry can charge higher price for goods with transporting

longer distance. In sum, results from these columns imply the importance of understanding about capital (trucks) utilization, quantity of demand, and

The columns 5 and 6 of Table 4 demonstrate the importance of cost reduction to improve profitability. Both of reductions in total operating costs and the proportion of fuel expenses to total costs directly show higher profitability. Finally, column 7 of Table 4 reports improvement in delivery in full on time as known as DIFOT does not significantly correlate with achieving higher profitability. In addition to these, there are not sizable and significant correlation between number of trucks and improvement in profitability. There are also no correlation between being subcontractors and achieving higher profitability.

== Table 4 ==

Let us move on to firm-level service quality. Table 5 reports the correlation between decrease in damages of cargos, malfunctions, accidents and improvement in profitability. Column 1 of Table 5 shows decrease in number of damages or losses of cargos does not correlate with increase in profitability. Columns 2 and 3 of Table 5 present how reduction in maintenance costs raise profitability. Decrease in malfunction of trucks in services has a sizable and significantly correlation with improvement in profitability (Column 2) and decrease in repair and maintenance expenses per truck also has a significantly correlate with profitability (Column 3). In other words, these columns imply costs arising from malfunction or repair can reduce profitability in Thailand trucking industry. These are costly activities for firms in trucking industries. Columns 4 and 5 of Table 5 deal with numbers of accidents without/with fatal or injuries per trucks. The reduction in these accident measures do not affect profitability. Column 6 of Table 5 presents that decrease in automotive insurance rate to total costs does not correlate with achieving higher profitability. Finally, decrease in driver retention does not correlate with improvement in profitability as well (Column 7 of Table 5).

== Table 5 ==

6.2 What drives profitability, efficiency, and quality: complementarity between management practices

In this section, this paper studies how choice of management practices affect profitability through increase in efficiency and service quality in trucking sector. Our survey questionnaire has many questions about firm-level management practices. These practices can be grouped into following seven different categories: (1) adopting international standard (ISO); (2) investment in adoption of new equipments; (3) investment in teamwork; (4) investment in periodical training on truck driving; (5) adoption of incentive pay or penalty scheme; (6) adoption of communication system of sharing information with consignor, consignee, or subcontractors; (7) adoption of joint

production system with other trucking firms to achieve gains from integration. Since these management practices have different scales, we standardize each category by mean zero and standard deviation one. Then we have seven types of z-scores of management practices. Table 6 reports the correlation matrix of standardized scores of seven management practices. One distinguished feature of Table 6 is strong correlation across management practice categories. In particular, there is 0.5088 correlation coefficient between choice of investment in teamwork among truck drivers and investment in training drivers. Furthermore, there is 0.5288 correlation coefficient between training truck drivers and introducing incentive scheme. In addition to this, introducing incentive scheme has 0.3067 correlation coefficient between investment in teamwork among truck drivers they hire. This paper focuses on these three distinguished management practices among trucking firms–giving incentives, improvement in teamwork, and investment in driving training– to look at the impacts of complementarity between these management practices on profitability, efficiency, and service quality. Summary statistics of management practices in these three categories are show in Table 7.

== Table 6 ==

== Table 7 ==

Other management practices also have significant correlation with other types of practices. Adoption of ISO and an installing new equipments has 0.2786 correlation coefficient. Adoption of ISO has 0.2837 correlation coefficient with incentive scheme. Installing new equipments are broadly correlated with investment in teamwork, incentive, and communication with service partners such as consignor, consignee, or subcontractors. Finally, investment in communication systems correlate with choice of integration such as joint order acceptance, cooperative distribution to improve efficiency of trucking operation (e.g. back-hauling), joint purchasing (e.g. fuel), or joint training with other firms. These significant correlations between different management practices imply that there are returns to install new management practices together. We will show the other types of complementarities among work practices in the future.

6.3 Impacts of incentive on profitability, efficiency, and quality

In this section, this paper reports the evidence how incentive payment scheme affects profitability. Table 8 presents the impacts of adoption of incentive scheme on increase in profitability, increase in profits, and sales growth. We run OLS regression under controlling the number of trucks (log), subcontractors, and types of goods trucks handle. We will also look at how teamwork and training play a significant role of complementing incentive scheme on profitability. Column 1 of Table 8 shows there is no impact of increase in incentive (z-score) on increase in profitability. There is

no impact of investment in training on profitability. It is important to see the interaction term between increase in incentive and increase in investment in training positively and significantly affects increase in profitability. This result implies that incentive pay can work for higher profitability as long as firms invest in training drivers. Column 1 of Table 8 also reports the impacts of investment in teamwork and training. Investment in teamwork among truck drivers has negative impacts on increase in profitability. It is also controversial that profitability declines if investment in teamwork and training drivers jointly adopted. Column 2 of Table 8 examining increase in profits shows similar results as Column 1. That is, incentive payment scheme can increase in profits as long as firms also invest in training. Column 3 of Table 8 studies the impacts of incentive scheme on sales growth. This is also true that incentive scheme and training truck drivers are complement to explain sales growth. In summary, Table 8 presents the OLS regression results on whether standardized scores incentive, teamwork, and training affects improvement in profitability, increase in profits, and sales growth. There are no effects of incentive pay nor training itself. These performance measures are higher as long as firms adopted incentive payment scheme and training together. This means that investment in training is complement to incentive pay when firms aim to increase profitability.

== Table 8 ==

We turn to explore which channels–operation efficiency and service quality– are affected by adoption of incentive scheme. Table 9 studies the impacts of incentive, teamwork, and training on seven measures of operation efficiency. First three columns of Table 9 document adoption of incentive scheme can raise efficiency. Increase in adoption of incentive scheme has positive and significant impacts on usage efficiency, volume per truck, and load efficiency. Columns 1, 2, and 5 of Table 9 also show that the interaction term between incentive and training is positive and significant on usage efficiency, volume per truck, and delivery in full on time (column 5). However there are no significant impacts of training on these efficiency measures, incentive scheme plays a role of complementing the return to training. Joint adoption of teamwork and training is negatively associated with load efficiency and laden miles (columns 3 and 4 of Table 9). Finally, it is worth to say that interaction term between incentive, teamwork, and training is negatively associated with volume per truck and load efficiency. This means that adoption of incentive worsens volume and load efficiency if truck firms jointly chose teamwork and training. Table 9 reports reductions in operating costs and fuel expenses have no association with incentive, teamwork, and training.

== Table 9 ==

Let us move on to final empirical results of this section. This paper now studies how management practices associated with service quality measured by damages of cargos, malfunction

of trucks, or accidents. Column 1 of Table 10 presents being subcontractors is reducing damages of cargos. Scores of incentive, teamwork, and training have no impacts on reducing damages of cargos. Column 2 of Table 10 reports score of teamwork is negatively associated with malfunction of trucks. Interaction term between teamwork and training is also negatively associated with reducing malfunction of trucks. Incentive scheme does not affect the reduction of malfunction. Column 3 of Table 10 also reports incentive scheme is not associated with reduction of repair expenses, but adoption of teamwork has a negative impact on reducing repair expenses. Since the reduction in malfunction of trucks and repair expenses have been important channels to improve profitability, these findings should be examined and interpreted well.

Columns 4 and 5 of Table 10 show there are no impacts of incentive on reducing number of accidents without and with fatal or injuries. Investment in training does not have any complementary role on incentive to improve service quality measured by accidents. The number of trucks firms operate has a negative impacts on reducing accidents without fatal or injuries. This means larger trucking firms are less likely to reduce the number of accidents without fatal or injuries. Finally, columns 6 and 7 of Table 10 document there are no impacts of incentive, teamwork, and training on reducing automotive insurance rate or driver turnover rate.

== Table 10 ==

7 Findings from qualitative field research

7.1 Field interviews with logistics firms

The conceptual framework illustrated above is developed based mainly on experiences of Japanese trucking firms. There are differences between Thai and Japanese trucking industries in technical requirements from customers, regulations imposed by governments, or social responsibilities expected by citizens. These can make the conceptual framework and the questionnaire inappropriate and inapplicable to the case study of Thai trucking industry. To avoid such problems, interviews with four family-owned trucking firms in Thailand were conducted in December 2013 for pre-test of the survey and with members of the Eastern Transportation Association in Eastern Thailand in March 2014 for a follow-up study. There are several noteworthy features of the Thai logistics industry found from the interviews with firms conducted in December 2013. As a whole, trucking firms provide simple logistics services that transport cargos according to customers' requests. Most of the firms do not provide value added services that support transportation-related operations of their consignors and consignees. There may be few firms who can hire foreign consultants to make improvements. Thus, trucking firms pay attentions to simple performance indicators such as quantity of cargos they transport, on-time delivery, damages/losses of cargos, and diver's business manners.

Among the costs to provide logistic services, fuels account for about half of the total costs. Only large firms provide drivers with training of fuel saving driving technique, or try to improve

efficiency of truck utilization. Interviewed firms identify no training courses or public supports provided by business associations and public institutions to give trainings to save fuels. It is said that there are firms that provide drivers with limited amount of fuel expenses to decrease fuel costs. Wages paid to drivers are also a burden for trucking businesses. Drivers can gain 20,000 to 30,000 baht monthly (that is composed of monthly small fixed salary and daily incentives based on the number of trips), thus their salary is higher than civil servants. The high salary is not necessarily being inflated by high turn-over of drivers. The interviewed member firms of transportation association said turn-over is not so high because most of the trucking firms offer a similar level of salary. Even such high salary, most of the drivers completed secondary educations only and lack disciplines. Therefore, main concerns for top management is related not to improvement of driver's skills but to fostering driver's disciplines to improve appearance of drivers (by providing uniforms) and prevent drivers from drinking alcohols. In general, every truck driver must attend a training when newly employed and in every 6 months.

Introduction of IT equipment and systems would be limited to advanced firms. Even if firms have introduced GPS, they use it mainly to monitor location of trucks. Most of them do not utilize information from GPS for the purpose of scheduling of trucks and drivers. Among the firms interviewed, there is a firm that experienced serious difficulties in their business during the financial crisis happened in 1997 and avoid taking risks to make huge investments and expand their businesses. Also there is a firm substantially run by its founder's second generation who has bachelor's degree from a top engineering university in Thailand and is trying to introduce modernized management approach and systems. In the Eastern region, 80–90% of the owners of the trucking firms are founders who are mostly high school graduates, while larger firms hire top management team from outside who hold bachelor's and higher degrees. Thus, the propensity of introducing modern trucking management and systems could depend on owner's generation and strategy of top management team.

Collaborations with consignors and consignees may be also exceptionally developed between large logistics firms and their customers. There are logistics firms that locate their staff in their customers, or that receive staff from their customers at the site of logistics firms. Even such physically closer relationships have establishes, there are problems in communications and collaborations between office staff from different firms. How to make team work across firms more effective is a challenge for the trucking industry. However, consignors and consignees provide feedbacks and suggestions to the trucking companies, which may motivate trucking firms to make efforts for improvements to satisfy their customers.

From the interviews conducted in December 2013, firms mentioned about vertical and horizontal collaborations as exceptional. However, according to Eastern Transportation Association, there are two types of training programs available in the Eastern region. First is a training program on safety training and driving manner, arranged twice a year by large consignors such as Siam Cement Group (SCG) and PTT group. The training courses of these two big Thai firms were mentioned by firms interviewed in December 2013. Second is a training program on, for example, safety training, modern organizational management, and worker's skill development

provided for the top management level and drivers by the Eastern Transportation Association for its member. The objectives of the training are reduce overall costs and improve management standard and quality.

7.2 Connection between fieldwork and data

The findings from the interviews allow to re-considering priorities of research topics to be examined with the dataset obtained from the questionnaire survey. As describe above, top managements are busy in improving simple operational performances, and for that purpose, in solving primitive managerial issues such as fostering disciplines among drivers, improving communications within their firms, and saving fuel consumptions to save costs. Thus what managerial practices are effective to improve operational performances is a fundamental question when the potential of improvements in trucking industry is discussed. Among operational indicators, fuel consumption would be one of the important ones for both trucking firms and Thai society that emphasize ecological sustainability.

Second is related to the impact of vertical information flow on operational performances. Firms consider vertical inter-firm collaboration as exceptional. However, there are firms that have staff at customer's sites or receive customer's staff at their own sites, even though problems in communications among them are identified. Also there are firms who receive feedbacks and suggestions from customers. How common such information flows are to Thai trucking firms and what impacts do they have on firm-level operational performance and product (service) improvements are important research questions.

Third is the role of business associations. There are mixed opinions about it. Firms interviewed in December 2013 do not consider business associations play roles in capacity building programs for drivers and top managements of the sector. In contrast, the Eastern Transportation Association provides these periodically. What should be noted is that the Eastern Transportation Association can be recognized as one of the most active associations in the sector. More in-depth examinations are needed to understand whether business associations contribute to improving operations and services of trucking companies.

Forth is an issue on the adoption of new technologies and managerial practices, which was emerged from the interviews. What factors promote trucking firms to adopt new technologies and managerial practices is not obvious. The interviews suggest generation and educational background of owners and top management, and size of the trucking firms would affect it. It seems that characteristics of consignors and consignees also influence to trucking firms decision on organizational reforms and necessary investments in equipment, facilities, and human resource development. Year of establishment, especially whether firms experiences Asian financial crisis in 1997, may also have influence on firm-level strategic behavior.

8 Conclusion

This paper starts from showing our data description for firm-level survey to Thailand trucking industry. The novel, unique, and detailed survey data enables us to ask what drives firm-level performances in trucking industry, and how. Then we present empirical results on the determinants of trucking firm performances, profitability, operation efficiency, and service quality including traffic accidents. Based on the survey data, empirical results suggest following three things. First, increase in profitability is positively associated with measures of operation efficiency (increase in usage efficiency, increase in laden miles, decrease in total operating costs, and decrease in fuel expenses) and decrease in malfunction of trucks and decrease in repair and maintenance expenses. Second, empirical results cannot find increase in profitability is associated with incentive payment. But incentive can raise profitability as long as firms jointly invest in training for truck drivers. Since complementarity between incentive and firm-sponsored training also positively affects increase in operation efficiency, we cannot reject that set of management practices plays an important role of improvement in firm-level profitability. These results are sizable and statistically significant. Third, adoption of teamwork across truck drivers and firm-sponsored training is substitutable each other. Firms are less likely to improve profitability and operation efficiency if they decide to adopt teamwork and training together. Counter to our initial guess, we cannot find joint adoption of these practices raise the profitability and operation efficiency.

Case studies also enable us to reformulate the theoretical framework and hypotheses to be tested. There are some key variables to be examined in the context of Thailand trucking industry: (1) managerial inputs for reducing fuel consumptions; (2) vertical flows of knowledge and information between principals and agents; (3) the extent of business associations and government interventions; (4) the extent of benefits and costs of joint adoption of set of management practices. In particular, it is also important to ask how foreign consignor and consignee influence the performance of the logistics firms. This question could be more important when we look at the situation of economic integration between countries. However these are emerged from interviews and case studies in Thailand, our dataset based on fieldwork and framework could be useful to understand the underlying situation of trucking industries in developing economies.

References

Baker, G, P., and T. Hubbard (2003) Make Versus Buy in Trucking: Asset Ownership, Job Design, and Information, *American Economic Review*, 93(3): 551–572.

Baker, G, P., and T. Hubbard (2004) Contractibility and Asset Ownership: On-Board Computers and Governance in U.S. Trucking, *Quarterly Journal of Economics*, 119(4):1443-1480.

Bloom, N., and J. Van Reenen (2007) Measuring and Explaining Management Practices across Firms and Countries. *Quarterly Journal of Economics* 122(4): 351–408.

Bloom, N., B. Eifert., A. Mahajan., D. McKenzie., and J. Roberts (2013) Does Management Matter? Evidence from India. *Quarterly Journal of Economics* 128(1): 1–51.

Bloom, N., R. Sadun, and J. Van Reenen (2012) The Organization of Firms across Countries. *Quarterly Journal of Economics* 127(4): 1663–1705.

Gibbons, R., and R. Henderson (2013) What Do Managers Do? Exploring Persistent Performance Differences among Seemingly Similar Enterprises, Gibbons and Roberts (ed), *The Handbook of Organizational Economics*, Chapter 17: 680–731.

Hubbard, T (2000) The Demand for Monitoring Technologies: The Case of Trucking, *Quarterly Journal of Economics*, 115(2): 533–560.

Hubbard, T (2001) Contractual Form and Market Thickness in Trucking, *RAND Journal of Economics*, 32(2): 369–386.

Hubbard, T (2003) Information, Decisions, and Productivity: On Board Computers and Capacity Utilization in Trucking, *American Economic Review*, 93(4): 1328–1353.

Ichniowski, C., K. Shaw, and G. Prennushi (1997) The Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines, *The American Economic Review*, 87(3): 291–313.

Ichniwoski, C., and K. Shaw (2013) Insider Econometrics, Gibbons and Roberts (ed), *The Handbook of Organizational Economics*, Chapter 7: 263–311.

Lazear, E (2003) Performance Pay and Productivity, *American Economic Review*, 90(5): 1346–1361.

Lazear, E., and P. Oyer (2013) Personnel Economics, Gibbons and Roberts (ed), *The Handbook of Organizational Economics*, Chapter 12: 479–519.

Nickerson, J., and B. Silverman (2003) Why Aren't All Truck Drivers Owner-Operators? Asset Ownership and the Employment Relation in Interstate For-Hire Trucking, *Journal of Economics, Management, and Strategy*, 12(1): 91–118.

Syverson, C (2011) What Determines Productivity?, *Journal of Economic Literature*, 49(2): 326–365.

Table 1: **Summary statistics**

Variable	N	Mean	Std. Dev.
Individual proprietor	109	0.431	0.498
Single unit firms	111	0.730	0.446
Local firms	90	0.922	0.269
Joint venture	90	0.067	0.251
Multinationals	90	0.011	0.105
Size of paid-up capital (THB)	99	24.293	20.741
Number of employee	110	49.655	98.417
Top management has bachelor degree	106	0.255	0.438
Top management has Master/Ph.D.	106	0.566	0.498
Top management studies management/economics	84	0.619	0.489
Top management studies in abroad	87	0.598	0.493
Hiring foreign managers	103	0.010	0.099
Hiring foreign advisors	104	0.058	0.234
Financially supported by BOI	76	0.263	0.443
Financially supported by Ministry of Transportation	77	0.039	0.195
Financially supported by other ministries of Thai government	76	0.013	0.115
Number of trucks	99	31.414	56.152
Knowing Logistics Quality System Program (LQSP)	92	0.467	0.502
Sending employees to Logistics Quality System Program (LQSP)	93	0.247	0.434
Certified Logistics Quality System Program (LQSP)	92	0.272	0.447
Having skilled mechanics for truck maintenance on a daily basis	96	0.792	0.408
Subcontractors	77	0.208	0.408
Quality management (e.g. ISO 9001)	94	0.351	0.480
Environmental management (e.g. ISO 14001)	80	0.125	0.333
Occupational health and safety management (e.g. ISO/OHSAS 18001)	92	0.174	0.381
Information security management (e.g. ISO 27001)	80	0.050	0.219
Security management systems for the supply chain (e.g. ISO 28000)	79	0.076	0.267
Road traffic safety management (e.g. ISO 39001)	79	0.025	0.158
Q-Mark	97	0.268	0.445
Driving recorder	97	0.237	0.428
Back eye camera	97	0.155	0.391
Global Positioning System (GPS)	97	0.598	0.493
CNG truck	97	0.567	0.498
Fuel-efficient tires	97	0.309	0.465
Alcohol checker	97	0.227	0.421
Storage/Warehouse	97	0.206	0.407
Transportation management system	97	0.330	0.473
Warehouse management system	97	0.134	0.342

Source: IDE Thailand Trucking Establishment Survey 2014.

Table 2: **Summary statistics of types of goods trucks handle**

Variable	N	Mean	Std. Dev.
Agricultural, forestry, fishery	109	0.312	0.465
Petroleum, coal, ore	109	0.119	0.326
Food, beverage, tobacco	109	0.358	0.482
Textiles, apparels, leather	109	0.202	0.403
Woods, wood products	109	0.312	0.465
Pulp, paper, printed matters	109	0.138	0.346
Chemicals	109	0.211	0.410
Plastic, rubber products	109	0.303	0.462
Pharmaceuticals	109	0.046	0.210
Cements, construction materials	109	0.468	0.501
Metal, metal products	109	0.229	0.422
Electronic products, parts	109	0.202	0.403
Automobiles, parts	109	0.156	0.364
Other machineries, parts	109	0.174	0.381
Articles for daily use	109	0.275	0.449
Fertilizers, feedstuff	109	0.092	0.290
Wastes	109	0.018	0.135
Recyclable objects	109	0.009	0.096
Special handled products	109	0.064	0.246

Source: IDE Thailand Trucking Establishment Survey 2014.

Table 3: **Summary statistics of increase in firm-level performances**

Variable	N	Mean	Std. Dev.
Profit	96	3.042	0.679
Profitability (Profit/sales)	93	3.215	0.750
Transport volume per truck	93	3.215	0.640
Load efficiency (actual loading capacity per maximum load capacity)	89	3.191	0.672
Laden miles (driving distance carrying cargo/total driving distance)	93	3.247	0.732
Usage efficiency (Total days trucks are actually utilized/Total days trucks are available)	88	3.307	0.733
Delivery in Full on Time(DIFOT)	93	3.118	0.883
Number of damages or losses of cargos	93	3.097	0.922
Repair and maintenance expense per truck	93	3.247	0.940
Number of accidents per truck	88	3.114	1.055
Total operating cost	88	3.011	0.703
The proportion of fuel expenses to total cost	88	3.114	0.702
Malfunction of trucks in service	88	3.102	0.588
Repair and maintenance expense per truck	88	3.102	0.728
Automobile insurance rate (insurance cost to total cost)	93	3.280	0.757
Driver retention (decrease in driver turnover)	93	3.129	1.002

Source: IDE Thailand Trucking Establishment Survey 2014.

Table 4: **Impacts of increase in operation efficiency on profitability**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Usage efficiency	0.376**						
	(0.181)						
Transport volume per truck		0.252					
		(0.198)					
Load efficiency			0.284				
			(0.176)				
Laden miles				0.349**			
				(0.168)			
Total operating costs					0.301**		
					(0.143)		
The proportion of fuel expenses to total cost						0.537***	
						(0.110)	
Delivery in Full on Time (DIFOT)							0.0953
							(0.137)
Ln(Number of trucks)	0.00590	0.0473	-0.0764	0.0802	-0.0352	-0.0387	0.0705
	(0.103)	(0.126)	(0.125)	(0.114)	(0.120)	(0.116)	(0.131)
Subcontractors	0.0949	0.0840	0.123	0.0616	0.116	-0.0767	0.0608
	(0.238)	(0.258)	(0.296)	(0.272)	(0.264)	(0.266)	(0.269)
Type of goods trucks handle	√	√	√	√	√	√	√
Constant	1.408*	1.815***	1.922***	1.463**	1.869***	1.356***	2.274***
	(0.792)	(0.637)	(0.605)	(0.657)	(0.536)	(0.409)	(0.567)
N	61	65	61	65	61	61	65
R2	0.694	0.640	0.663	0.673	0.685	0.774	0.629

Note: Robust standard errors in brackets. *** p <0.01, ** p <0.05, * p <0.1. *Source*: IDE Thailand Trucking Establishment Survey 2014.

Table 5: **Impacts of increase in quality on profitability**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of damages or losses of cargos	0.0387						
	(0.0994)						
Malfunction of trucks in service		0.463***					
		(0.162)					
Repair and maintenance expense per truck			0.206*				
			(0.122)				
Number of accidents per truck				0.0981			
				(0.119)			
Number of fatal or injuries per truck					0.218		
					(0.146)		
Automobile insurance rate						0.227	
						(0.158)	
Driver retention							-0.0524
							(0.130)
Ln(Number of trucks)	0.0580	-0.00262	-0.0272	0.0888	0.0485	0.0505	0.0496
	(0.129)	(0.127)	(0.127)	(0.106)	(0.129)	(0.106)	(0.126)
Subcontractors	0.0347	-0.125	-0.00273	0.0108	0.111	-0.00283	0.0644
	(0.286)	(0.278)	(0.297)	(0.280)	(0.265)	(0.274)	(0.285)
Type of goods trucks handle	√	√	√	√	√	√	√
Constant	2.471***	1.410**	2.066***	2.224***	1.964***	1.907***	2.713***
	(0.398)	(0.529)	(0.437)	(0.480)	(0.525)	(0.506)	(0.430)
N	65	61	61	65	61	65	65
R2	0.624	0.713	0.656	0.630	0.672	0.646	0.626

Note: Robust standard errors in brackets. *** p <0.01, ** p <0.05, * p <0.1. *Source*: IDE Thailand Trucking Establishment Survey 2014.

Table 6: **Correlation between management practices**

	ISO	Equipment	Teamwork	Training	Incentive	Communication	Integration
ISO (z-score)	1						
Equipment (z-score)	0.2786*	1					
Teamwork (z-score)	0.2257	0.3750*	1				
Training (z-score)	0.2516	0.0953	0.5088*	1			
Incentive (z-score)	0.2837*	0.2855*	0.3067*	0.5278*	1		
Communication with partners (z-score)	-0.0842	0.3359*	0.1758	-0.2326*	-0.0746	1	
Integration (z-score)	0.2333	0.1014	0.079	0.1347	-0.0004	0.2719*	1

Source: IDE Thailand Trucking Establishment Survey 2014.

Table 7: **Summary statistics of teamwork, training, and incentive pay**

Variable	N	Mean	Std. Dev.
1. Sum of team work practices	79	8.848	2.896
Do you hold meetings with drivers periodically?	91	0.945	0.229
Do your office workers hold meetings with drivers periodically?	91	0.813	0.392
Do you thoroughly investigate the cause of your accident and take preventive steps?	88	0.852	0.357
Do you share of your drivers' accident examples in your driver' s meeting?	88	0.852	0.357
Do you share examples of your drivers' near-miss incidents in your driver' s meeting?	88	0.830	0.378
Do you share accident examples of your firm in a periodical training?	88	0.739	0.442
Do you share near-miss incident examples of your firm in a periodical training?	88	0.648	0.480
Do you share accident examples of other logistics firm in a periodical training?	88	0.636	0.484
Do you provide your drivers with uniforms?	89	0.820	0.386
Have you adopted so called "5S"?	90	0.667	0.474
Have you adopted QC circle?	91	0.571	0.498
Do you have a team or small group composed of driver and administrative staff?	95	0.526	0.502
2. Sum of training practices	87	5.126	3.691
Training on safe-driving skill	87	0.598	0.493
Training on fuel-efficient driving skill	88	0.489	0.503
Training on driving accompanied by a skilled driver	88	0.455	0.501
Training on handling cargos	88	0.534	0.502
Training on truck daily checkup before driving	88	0.591	0.494
Training on truck maintenance	88	0.636	0.484
Training on business manners	88	0.580	0.496
Training on laws or regulations	88	0.580	0.496
Do you provide drivers with health checkup?	88	0.614	0.490
3. Sum of incentive pay practices	81	2.914	1.790
Incentives for the number of trips?	88	0.739	0.442
Incentives for the number of accidents?	88	0.523	0.502
Incentives for fuel saving?	88	0.568	0.498
Incentives for better team work?	81	0.469	0.502
Do you impose penalties on employees violated your firm' s rule?	88	0.739	0.442

Source: IDE Thailand Trucking Establishment Survey 2014.

Table 8: **Incentive pay can increase in profitability as long as firms invest in training**

	(1) Increase in Profitability	(2) Increase in Profits	(3) Increase in Sales
Incentive (z-score)	0.180	0.265	0.183
	(0.218)	(0.291)	(0.219)
Teamwork (z-score)	-0.440**	-0.345	-0.333
	(0.206)	(0.239)	(0.260)
Training (z-score)	0.254	-0.117	-0.00896
	(0.185)	(0.270)	(0.275)
Incentive*Teamwork	-0.204	-0.0384	-0.0359
	(0.189)	(0.279)	(0.300)
Incentive*Training	0.676***	0.466**	0.335*
	(0.134)	(0.199)	(0.190)
Teamwork*Training	-0.349**	-0.443**	-0.330
	(0.148)	(0.204)	(0.221)
Incentive*Teamwork*Training	-0.213	-0.244	-0.161
	(0.155)	(0.230)	(0.203)
Ln(Number of trucks)	0.0203	-0.131	-0.168
	(0.116)	(0.124)	(0.121)
Subcontractors	0.345	0.574	0.0306
	(0.269)	(0.451)	(0.643)
Type of goods trucks handle	√	√	√
Constant	2.410***	2.550***	2.886***
	(0.373)	(0.536)	(0.704)
N	51	51	51
R2	0.821	0.749	0.716

Note: Robust standard errors in brackets. *** p <0.01, ** p <0.05, * p <0.1. *Source*: IDE Thailand Trucking Establishment Survey 2014.

Table 9: **Incentive pay with training increases efficiency**

	(1) Usage efficiency	(2) Volume per truck	(3) Load efficiency	(4) Laden miles	(5) Operating costs	(6) Fuel expenses	(7) On time delivery
Incentive (z-score)	0.713*	0.792***	0.915**	0.147	-0.168	0.157	0.117
	(0.374)	(0.274)	(0.354)	(0.325)	(0.564)	(0.421)	(0.510)
Teamwork (z-score)	-0.0497	-0.415*	-0.748**	-0.251	-0.508	-0.415	-0.0912
	(0.243)	(0.227)	(0.316)	(0.298)	(0.340)	(0.311)	(0.293)
Training (z-score)	0.0987	0.0629	0.187	-0.245	0.306	0.178	-0.0968
	(0.158)	(0.182)	(0.212)	(0.221)	(0.256)	(0.257)	(0.199)
Incentive*Teamwork	-0.413	-0.537*	-0.365	0.296	0.432	0.0526	0.0654
	(0.360)	(0.284)	(0.336)	(0.322)	(0.432)	(0.306)	(0.420)
Incentive*Training	0.744***	0.395*	0.247	0.130	0.0462	0.270	0.500**
	(0.193)	(0.200)	(0.294)	(0.204)	(0.449)	(0.398)	(0.236)
Teamwork*Training	-0.243	-0.485*	-0.721*	-0.615**	-0.365	-0.347	-0.251
	(0.253)	(0.261)	(0.369)	(0.244)	(0.349)	(0.322)	(0.298)
Incentive*Teamwork*Training	-0.383	-0.519**	-0.408*	0.122	0.293	-0.105	0.103
	(0.299)	(0.218)	(0.230)	(0.251)	(0.354)	(0.273)	(0.359)
Ln(Number of trucks)	0.0125	0.206	0.116	-0.180	-0.220	0.0427	0.0538
	(0.132)	(0.129)	(0.140)	(0.161)	(0.208)	(0.188)	(0.154)
Subcontractors	0.0369	-0.346	-0.575	0.422	-0.415	0.268	-0.0233
	(0.558)	(0.475)	(0.495)	(0.546)	(0.577)	(0.402)	(0.328)
Type of goods trucks handle	√	√	√	√	√	√	√
Constant	3.167***	3.514***	4.264***	3.319***	3.873***	2.817***	2.418***
	(0.636)	(0.551)	(0.594)	(0.766)	(0.920)	(0.634)	(0.780)
N	51	51	51	51	51	51	51
R2	0.770	0.765	0.732	0.651	0.616	0.687	0.662

Note: Robust standard errors in brackets. *** p <0.01, ** p <0.05, * p <0.1. *Source*: IDE Thailand Trucking Establishment Survey 2014.

Table 10: **There are no significant impacts of incentive pay on decrease in traffic accidents**

	(1) Damages or of cargos	(2) Malfunction of trucks	(3) Repair expense	(4) Accidents per truck	(5) Fatal or injuries	(6) Insurance rate	(7) Driver retention
Incentive (z-score)	-0.321	0.394	0.340	0.379	-0.117	0.584	0.438
	(0.348)	(0.408)	(0.351)	(0.519)	(0.342)	(0.398)	(0.663)
Teamwork (z-score)	-0.0632	-0.688**	-0.652*	0.301	0.329	-0.201	-0.553
	(0.259)	(0.312)	(0.336)	(0.296)	(0.391)	(0.294)	(0.470)
Training (z-score)	-0.0503	0.128	0.279	-0.473*	-0.285	0.158	0.106
	(0.314)	(0.181)	(0.235)	(0.259)	(0.270)	(0.171)	(0.347)
Incentive*Teamwork	-0.000188	-0.000262	0.332	0.356	0.519	0.239	0.525
	(0.320)	(0.307)	(0.371)	(0.458)	(0.424)	(0.332)	(0.548)
Incentive*Training	0.0323	0.184	0.0453	-0.0558	0.172	0.198	-0.238
	(0.310)	(0.373)	(0.455)	(0.315)	(0.247)	(0.301)	(0.573)
Teamwork*Training	-0.246	-0.777**	-0.590	0.0863	0.0549	-0.420	-0.572
	(0.230)	(0.372)	(0.390)	(0.323)	(0.393)	(0.324)	(0.486)
Incentive*Teamwork*Training	0.0891	-0.230	0.0465	0.0835	0.175	-0.163	-0.0793
	(0.251)	(0.271)	(0.253)	(0.388)	(0.300)	(0.263)	(0.488)
Ln(Number of trucks)	-0.215	-0.0495	-0.0357	-0.369**	-0.122	-0.0759	0.0768
	(0.140)	(0.133)	(0.193)	(0.172)	(0.145)	(0.158)	(0.276)
Subcontractors	0.852*	0.539	-0.0761	0.0533	0.426	0.275	-0.0483
	(0.455)	(0.367)	(0.426)	(0.546)	(0.505)	(0.491)	(0.680)
Type of goods trucks handle	√	√	√	√	√	√	√
Constant	2.622***	3.548***	4.275***	3.921***	2.024***	3.476***	3.374***
	(0.544)	(0.423)	(0.482)	(0.720)	(0.661)	(0.630)	(1.059)
N	51	51	51	51	51	51	51
R2	0.722	0.675	0.801	0.775	0.784	0.828	0.627

Note: Robust standard errors in brackets. *** p <0.01, ** p <0.05, * p <0.1. *Source*: IDE Thailand Trucking Establishment Survey 2014.