Co-creation of a digitalised aftermarket service model:

A case of trucks tyres

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1. Introduction

It is conceivable to solve various problems through cooperation and co-creation that transcend established business relationships' boundaries in a rapidly changing competitive environment. For example, a trucking company is trying to link its own core business while contributing to solving its customers' problems by utilizing its accumulated know-how to take on cumbersome tasks. Meanwhile, tyre suppliers try to visualize the value and contribution of tyres that do not necessarily account for a large percentage of truckers' operating costs by using truck operation data to demonstrate tyre's contributions. Some tyre suppliers are even expanding into new business areas by acquiring a fleet management system company, thereby expanding the value of its offerings to trucking fleets.

This paper aims to e clarify the content of the firms’ capabilities to

respond to rapid environmental changes in a practical manner. First, the current state of the Japanese trucking industry is explained based on materials published by the Japan Trucking Association, and the results of interviews with several trucking companies are presented to show their awareness of the respective issues and the direction of their response. Next, the strategies of tyre suppliers who aim to provide new value to truckers through digital technology will be explained. Finally, the challenges and possible solutions to implement these strategies will be discussed. Our findings will provide a foundation for future research on co-creation in a rapidly changing business environment.

2. Theoretical Lens

The resource-based view (RBV) aspires to explain the internal sources of a firm's sustained competitive advantage (Kraaijenbrink et al., 2010). Barney (1991) defines the four attributes of firm resources for sustained competitive advantage: (a) it must be valuable. (b) it must be rare. (c) it must be imperfectly imitable, and (d) there cannot be strategically equivalent substitutes for this resources that are valuable but neither rare nor imperfectly imitable.

However, one of the critiques over RBV is the limited way RBV deals with dynamic issues such as boundaries, timing, innovation, and entrepreneurship. With its focus on the possession of resources and capabilities, the RBV is inherently static, not well equipped to explain the timing of when value is created, rents are appropriated and how firms innovate and generate new sources of sustained competitive advantages (Kraaijenbrink et al., 2010).

Teece et al. (1997) define dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competencies to address a rapidly changing environment. The dynamic capability framework addresses the firms' ability to constantly adapt and innovate while using the basic tenets of the RBV (Kraaijenbrink et al., 2010).

For our purpose of explaining the firms' activities in the rapidly changing business environment, we focus on the ability to reconfigure

external competencies to lead to co-creation:

3. Background of trucking industry in Japan

3.1 Industry trends:

The Japan Trucking Association (2020) reported the Japanese trucking industry's challenges as follows.

3.1.1 Transition in transport volumes

The trucking share by the mode of transport in Japan accounts for approximately 90 per cent on a tonnage basis and 50 per cent on a tonne-kilometre basis, according to 2018 statistics.

Japanese truck transport can be divided into two types: private use, where companies transport their freight, and commercial use, where companies transport customers' freight on a contract basis. As shown in Table 1, private-use and commercial-use transport volumes were 3,153 and 2,922 million tonnes respectively in 1998, private-use and commercial-use transport volumes had shifted to 1,311 and 3,019 million tonnes respectively in 2018. While the overall transport volume is falling, the transition is that commercial transport is almost unchanged and private use is decreasing.

Table 1 Transition in trucking transport volumes

mil. tonnes	1998	2018
Private Use	3,153	1,311
Commercial Use	2,922	3,019
Total	6,075	4,330

bil. ton-kilometres	1998	2018
Private Use	69	28
Commercial Use	140	182
Total	209	210

In terms of tonne-kilometres transported, in 1994, there were 69

billion tonne-kilometres for private use and 140 billion tonne-kilometres for commercial use. In 2018, there were 28 billion tonne-kilometres and 182 billion tonne-kilometres, respectively.

3.1.2 Size of trucking operator

Regarding the size of trucking operators as of 2018, the structure is predominantly small and medium-sized, with operators with less than 100 vehicles accounting for more than 98 per cent of 62,461 operators.

3.1.3 Regulatory trends

Since 1990, the economic regulation of the trucking business (e.g., business entry, rate setting, the scope of operation, size of business) has been progressively deregulated, leading to increased market competition.

In 2018, the Government of Japan amended the Trucking Business Law, prioritising improving the working conditions of truck drivers to realise reforms in the way they work. The amendments to the Act include urgently implementing measures to improve truck drivers' working conditions and contribute to the soundness of the trucking business.

Trucking is a typically labour-intensive business. According to a business analysis report published by the Japan Trucking Association, labour costs account for the highest transport costs. Furthermore, due to the recent driver shortage, labour costs have risen and amounted to 39.7 per cent of the national average in FY2018. Fuel and oil costs follow at 15.1 per cent.

According to statistics from the Ministry of Health, Labour and Welfare, wage levels in the road freight transport industry remain low compared to the average for all industries. At the same time, the annual working hours of truck drivers are longer than the average of all industries.

As for the fuel, most business trucking in Japan relies on diesel fuel.

Trucking operators face difficulties collecting appropriate freight rates and charges for transport operations and ancillary services. In past business practices, the scope of "freight" was ambiguous. The freight

sometimes included charges for incidental work, such as loading and unloading, and waiting time until cargoes are ready. However, in November 2017, the Ministry of Land, Infrastructure, Transport and Tourism revised the Standard Conditions of Freight Forwarding. It issued a notification that clearly distinguishes between freight as compensation for transportation and charges for incidental services. In this sense, a clear distinction should be made between charges as consideration for carriage and charges as consideration for ancillary services.

In the trucking business, it is necessary to improve the environment to reduce long working hours. However, it is difficult for trucking operators to improve the situation through their efforts alone, such as reducing waiting time, loading and unloading and incidental work at the convenience of shippers.

In May 2017, the Japanese Government compiled the Action Plan for Workplace Reform, which stipulates that the maximum overtime work limit shall be 720 hours per year. However, the temporally maximum of 960 hours per year for automobile driving work will apply five years after the general rule (April 2024). This so-called 'truck logistics 2024 problem' includes the regulation of (i) maximum overtime hours, (ii) equal pay for equal work for regular and non-regular employees and (iii) increased premium wages for overtime work over 60 hours per month.

3.2 Introduction of information technology

The rapid spread and development of information technology (IT), as typified by the internet, has brought about significant changes in logistics. Thanks to the new technologies, various solutions for the existing challenges are proposed.

One such system is the vehicle fleet management system, which uses Global Positioning System equipment in each truck to manage operational information such as vehicle location, fuel consumption, driver operation information, and driving habits. Information collected by digital tachographs enables the system, and the information is shared with onboard terminals at the fleet operator's office. They monitor the trucks in real-time on a personal

computer. The system can visualise safe and energy-efficient driving and improve transport efficiency through vehicle operation and dynamics management.

The vehicle allocation support and planning system efficiently allocates order information (cargoes) to vehicles (drivers), automatically calculates the picking and loading of cargoes, truck allocation and delivery routes on the day of delivery based on order information and provides instructions to drivers and warehouse operators. In addition, the system supports a series of operations, such as giving instructions to drivers and warehouse staff.

IT roll call is face-to-face between the operation manager and the driver via IT equipment such as smartphones, cameras, and alcohol detectors. The system enables roll calls to be carried out late at night or early in the morning, even when the office and garage are far apart. The system reduces the working hours of the driver and roll caller and makes roll calls more efficient by allowing the roll caller at a particular office. The system can also improve the efficiency of roll call operations, for example, by allowing the roll call to be delegated to the roll call operator at a specific sales office.

IT can help make trucking operations more efficient and provide tools to deal with current difficulties truck operators face. In addition, there are several subsidies presented to assist the installation by trucking operators.

4. Case Study

4.1 Trucking operator A

Table 2 highlights the profile of operator A. One hundred thirty-three employees and a fleet of 149 vehicles (both as of February 2022). They own eight sales offices nationwide. The company is a sub-subsidiary of a major automobile parts manufacturer.

The company appeals for its stability as a sub-subsidiary of a manufacturer and favourable treatment of drivers compared to other companies; a reasonable operation plan, staff work that does not involve overtime, a complete education support system and support for obtaining a

truck driving license for an operation management qualification.

Table 2 Outline of trucking operators interviewed

	Operator A	Operator B
established in	1988	1975
Employess	133 (02/22)	120
Trucks	149 (02/22)	42
Sales in JPY	19 bil.	-
Main customers	Automotive supplier	Printing companies
	Sub-subsidiary of an automotive tier1 supplier	Specialised in printed materials.

Fuel costs account for 20 per cent of their operating costs and are particularly affected by recent price increases. Tyre-related costs are around 2 per cent plus of the total costs. Tyre and maintenance services are contracted under a fixed monthly payment programme that includes all related services and replacing worn-out tyres with new tyres. They have not many tyre-related problems.

The driver shortage is severe. Therefore, recruitment will become increasingly difficult in the future, even though the company's treatment is slightly better than other trucking companies as a sub-subsidiary of a manufacturer.

Cargo contracted from the parent company accounts for 85 per cent of the total. Requested shippers to raise prices under the recent fuel price hike, but this is not always as possible as they would like.

Transport from the parent company's factory to the various regions is often by mainline transport, chartered at a cost per 10-tonne truck. It is a long-distance, one-way transport. If there are cargoes to carry, it is loaded on the way back, but this is not the case very often. The shipper calculates the transport weight, including a loading plan, so there are no cases of overweight when loaded.

As for digital tachometer, they utilise a type where data is stored on an S.D. card rather than a real-time communication type. They use Yazaki-

made. The digital tachometer helps record various management and necessary regulatory data, such as driver driving manners and operation times. In addition, some truck manufacturers have a system to track vehicles with a global positioning system. In some cases, truck dealers learn about vehicle problems ahead of time with this system. The vehicle's location can also be tracked on a P.C. in the office.

The parent company's transport volumes have busy and off-peak periods, with significant differences in transport volumes. Efforts are made to take orders from external shippers during the off-peak period from May to September to avoid non-operating trucks.

Dispatch matching systems (e.g., WebKit from the Trucking Association, Hakobel, SBS Logistics) have emerged, but there is no sense that they have become widespread. The reasons may be that there are no suitable cargoes to look for, prices do not match, and there are limits to cargo that can be carried, as trucks vary widely. The trucking industry is an old industry, and there are horizontal solid business links between partner companies.

Tyre pressure monitoring system has been monitored and tried, but we have not heard of anyone being particularly happy to have it. The inspections are not just about tyre air pressure, so it is hard to see why people would pay for just that in the absence of other many tyre-related maintenance requirements.

The most pressing issues are the rising cost of fuel and the 2024 problem of work practices. The company believes that it is necessary to increase the efficiency of truck fleet utilisation. Currently, it is customary for one driver to be allocated one truck, but we are looking at how this can be changed to a 'truck sharing' system. They believe that there will be a need to increase sales per truck in the future and that all transport companies are considering converting to a 'truck sharing' system. However, the drivers' adverse reaction is expected.

Due to the 2024 problem, they are also troubled by the fact that drivers are expected to do the loading work and need to stay longer waiting until cargoes are ready. They do not know how strictly the administration will require compliance with the new regulation, but the challenge is great.

If the wage structure goes to working hours to meet the 2024 regulation, 20-30 per cent of the working hours considered as driver work will be lost. If drivers' earnings are also reduced, the challenges of a low-paid industry will not be solved. As a manager, the interviewee believes that it is just a question of how much unnecessary transport work can be reduced.

The supply of new trucks is slowing due to a shortage of semiconductors and other factors, resulting in longer delivery times for new trucks, and the new truck prices have increased. This situation also puts pressure on costs.

They believe that shippers will be more concerned about using suppliers who comply with the law and regulations in the future. Therefore, they feel that it would be good if they could share operation status data with shippers to discuss how to ensure smooth and regulation-compliance transport.

4.2 Trucking operator B

Trucking operator B focuses on neighbourhood transport, specialising in the transport of a wide variety of printed materials, from blank sheets of paper to delivery to printing plants, bookbinders, and bookshops. The company has 120 employees, a small to medium fleet of 42 trucks, three sales offices in the Tokyo and Kanto areas, and the head office.

The wave of digitisation is pushing the market for publications, and there is a great sense of crisis within them that simply carrying things from right to left will not be enough to survive. So for the past fifteen years, they have been developing a business that undertakes work that our customers find time-consuming. They have moved into contract packaging and acting vehicle dispatch arrangement services for cargo owners.

They have made a conscious effort to be involved in data entry work in particular, based on the belief that if they do not work on the data involved in transport, they will not be able to transport goods in the future.

The 'weight' of cargo is a perennial theme for transport companies such as themselves. The logistics pricing system is based on weight and

distance, but the weight of the cargo ordered by the customer is not always accurate, and sometimes the cargo cannot be transported as planned due to being overweight. It would be valuable if the weight of a load could be automatically weighed on the spot to comply with laws and regulations and improve the efficiency of vehicle operations. Although volume and cube units are conventionally prioritised in trucking and weight tends to be disregarded, logistics companies' weight is a significant issue.

Digital tachographs are not used. The current digital tachograph is mainly effective for regulatory reporting functions. However, from their point of view, it is not worth the investment unless it has multiple functions, such as combining it with a navigation system. In addition, the vehicle dispatch function that can be used with digital tachographs is also unnecessary for a company of its size.

If a system can follow real-time information on all roads, people (i.e. drivers) and loads and the costs are correct; they will actively invest in it and are prepared to provide suppliers with as much operation-related data as possible if needed.

One of the high operating costs is fuel costs. So, reductions in fuel costs are becoming more critical, especially in recent price increases. Tyres cost a few per cent, but if data can show, for example, the fuel-saving effects of tyres, they feel this will appeal to value and are prepared to spend the appropriate costs.

A replacement tyre brand is selected based on the low initial purchase price. Tyre inspections are carried out twice a month and briefly by drivers at the start of the working day. They have not experienced any tyre-related problems in the past few years, but they are aware that a problem could bring operations to a halt and would like to try a tyre pressure monitoring system to check its effect.

They are acutely aware of the difficulty of finding drivers. For the past few years, they have been hiring drivers in their 50s and 60s rather than in their 20s and 30s. The operation does not involve too much hard work carrying heavy loads. In addition, as they are veterans with a good understanding of the horrors of driving, there are fewer accidents.

They want to change old and unreasonable industry practices on a proposal basis. They are prepared to invest in providing security to our customers. For example, they installed cameras in our vehicles to ensure the safety of our customers' cargo-carrying personal and financial data. They received an increase in the unit freight cost for this.

They also undertake vehicle dispatch services for customers using several logistics companies. They use their know-how for the benefit of their customers and are thanked for contributing to their customers' labour savings. The company has a high awareness of conformity and considers convenience and speed as customer values.

4.3 Tyre suppliers' digital strategy

Several tyre manufacturers have announced attempts to utilise truck operation data to propose optimised tyre use. Bridgestone and Michelin have acquired Fleet Management System companies to utilise vehicle operation data. They are in the business of managing overall vehicle operations for operation efficiency for truck companies. They are moving into a new business field.

4.3.1 Bridgestone's case

Bridgestone acquired TomTom's digital fleet solutions business in 2019. In the news release, they said that in addition to reinforcing Bridgestone's broad and leading portfolio, this strategic investment would also strengthen its position as an innovative leader in tire design and tire predictive maintenance service. Bridgestone will gain unprecedented insights into vehicle and tire operating conditions and be able to leverage a growing installed user base of 860,000 vehicles communicating 200 million data points per

4.3.2 Michelin's case

Michelin completed the acquisition of Sascar in 2014. The news release said that Michelin will benefit from the client base and technical and marketing

skills built up by Sascar in the rapidly expanding telematics market for professional truck fleets and thereby accelerate the development of services for its customers worldwide.

In 2019, Michelin acquired Masternaut in the U.K. They said that Masternaut operates primarily in France and the United Kingdom. It provides a technical platform equipped with the latest technology and offers onboard fleet telematics solutions to optimise vehicle fleet management and monitoring. Masternaut manages over 220,000 mostly light utility vehicles under contract.

For Michelin, the acquisition will increase the volume of data captured, allowing it to offer its customers the best solutions, improve product performance and develop its data science deployments, such as predictive maintenance.

Michelin has an inner-company startup company called Michelin Driving Data to Intelligence (DDI), specialising in analysing usage, driving data and tyre data. With the DDI, they understand driving behaviours better, identify risky stretches of road, and analyse uses to develop predictive maintenance intelligence.

5. Discussions and conclusions

5.1 Trucking operators

The current pressing issue for trucking operators is the rising cost of fuel. However, the looming 2024 problem is a common issue for trucking operators, as it will put further pressure on their performance under a growing shortage of truck drivers.

The approaches to problem-solving taken by the trucking operators interviewed in this study differ depending on their respective circumstances. Trucking operator A has the backing of an automotive parts manufacturer and is relatively stable. They appeal to the backing of a major manufacturer and its better benefits package when recruiting drivers; the 2024 problem is a significant concern, and the company is considering measures within the framework of its trucking business. They include considering a change from

'one truck for one driver' to 'truck sharing' and negotiating with shippers on freight rates and paid-for ancillary services.

On the other hand, Trucking operator B has a greater sense of crisis, as the cargo it handles is printed matter, which has long been said to be tapering off due to digitalisation. They expand their business to upstream contracting in the value chain, such as packing printed matter and contracting for shippers' vehicle dispatch operations. The company believes that the key to expanding operations in securing transport data and promoting the visualisation of operations using data, including data sharing with customers. However, the company believes that it will not invest unless it can see the benefits. The company takes a unique approach to the driver shortage problem, such as daring to employ older drivers.

Truck operators' significant approaches from the cases are summarised and discussed below.

5.1.1 Close co-operation with cargo owners

The companies explore and implement ways to solve problems through close communication with its customers, such as sharing issues with cargo owners and expanding its operations by taking in upstream and downstream areas in which it has an advantage and know-how.

Truck operator B takes in the operation areas of cargo owners. This approach is possible by understanding the cargo owner's business to identify the non-essential, time-consuming, but necessary process. A capability and know-how to efficiently operate these areas are needed. Also, close communication to obtain the trust of cargo owners is essential.

In the case of truck operator A, since a mother company backs them, these capabilities are less needed. Instead, they can concentrate on their business domain.

5.1.2 Return on investment

Investment effects need to be visible through data.

5.2 Tyre suppliers

Tyres are the only parts of the vehicle that contact with the road surface. They are critical components that support the vehicle's running, turning and stopping movements by transmitting the power from the powertrain, steering and brake actuation to the road surface, but as the case shows, their cost is only a few per cent of the overall fleet operating costs. However, opportunity losses by a tyre failure can be significant, as tyre failure can stop the operation of a vehicle and give rise to non-operating time.

In addition, visible fuel savings can be achieved through the correct use of low rolling tyres and proper maintenance of air pressure and tyre rotation, which can also be expected to reduce overall operating costs.

As the commercial vehicle fleet management system collects detailed operational data on individual and fleet-wide trucks and the driving behaviour of individual drivers, sharing this data with other companies could result in the passing on of information relating to the business of the fleet drivers concerned. From this perspective, it is conceivable that some trucking operators may resist 14tilizing operational data for tyres.

Tyre manufacturers also need to consider measures to ensure that data sources are not limited to individual fleet management systems users. Trucking operators usually use multiple tyre brands, and in fact, operations such as tyre stocking and removal services are often carried out through independent tyre dealers who handle multiple brands. There is a challenge regarding how the data-sharing infrastructure for a particular tyre brand can be established, at what cost, and who bears the cost. There are likely challenges in sharing data across truckers to tyre service providers and the costs involved in setting up the system.

Tyre suppliers going into the fleet management business need new capabilities to manage their new domain of fleet management and data analytics that connect vehicle operation data and tyre data. To remain competitive, they need to invest in updating the capabilities of the new business domain. They need to consider how they can realise the necessary capability update. They may need to retain the core analytics capability

within themselves and other capabilities through outsourcing, alliance or co-creation. The firm boundary may need to be re-considered for SCA.

Tyre competitors may need to collaborate in the cooperative areas to realise mobility data utilisation and build a common data-sharing platform. They also need to communicate with their customers, i.e., vehicle operators and OEMs, value chain collaborators, and regulatory authorities. They need to have capabilities to properly negotiate with these stakeholders to their advantage.

Although how they made the management decision to acquire fleet management companies is not disclosed, they must continue the capability to research relevant areas to retain SCA. Retaining and managing new capabilities will become significant challenges.

5.3 Importance of data

Data sharing should be able to provide solutions for various challenges in the hypercompetitive business environment.

Truck operators A and B recognised the importance of obtaining and analysing operation data. In contrast, truck operator A concentrates on internal operation improvement, and truck operator B target value creation for their customers. These different approaches will lead to different necessary capabilities and co-creation approaches. Capabilities to use data should be retained per the way they use, and this is not always easy for small and medium-sized companies such as truck operators A and B.

5.4 Future Direction

There is a limitation of information gathering since this study focus on the Japanese market. We plan to increase the number of examples in the Japanese market and overseas from the perspective of company capabilities to deal with the drastically changing competitive environment.

Even in the limited cases in this paper, the necessity of obtaining and retaining new capabilities to cope with digitalization is foreseen. Some may

stay internal, and some may come from external through alliance and co-creation. Our objective is to research the firm's capabilities more profoundly to understand the logic of co-creation better.

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