The Asian Journal of Shipping and Logistics xxx (2019) xxx–xxx

HOSTED BY

Contents lists available at ScienceDirect

The Asian Journal of Shipping and Logistics

journal homepage: www.elsevier.com/locate/ajsl

Original Article

Can rivalling truck companies collaborate? An Indonesian case study

Dania Sitadewi, Liane Okdinawati*, Desy Anisya Farmaciawaty

Institut Teknologi Bandung, School of Business Management, Indonesia

ARTICLE INFO

Article history:
Received 14 April 2019
Received in revised form
11 November 2019
Accepted 3 December 2019

Keywords:
Collaboration Transportation Management (CTM)
Horizontal collaboration
Behavioural approach
Agent-based modelling
Freight transportation

ABSTRACT

Trust is essential to maintaining secure collaboration in an uncertain competitive market environment in Indonesia. However, low levels of trust are proving to be a challenge for rival Indonesian truckload and less-than-truckload companies to establish long-term horizontal collaborations. This paper aims to analyze the role of key enablers in the behavioural aspect of trust development within horizontal collaborations characteristic of a significant section of freight trucking transportation. Authentic industrial data in the form of Indonesian case studies and simulations were utilized to establish whether a partnership can prove successful in a simulation context before the initiation of actual collaboration.

© 2019 The Authors. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

The contemporary unpredictable competitive commercial context, together with globalization, has induced numerous companies active in various industries to adapt to the situation. Truckload, less-than-truckload and other transportation companies responded and readjusted through efficient operation and shipment delay reduction to maintain their market share. Inefficiencies on the part of truckload and less-than-truckload companies can lead to both delayed delivery times and extended lead times. Shippers are compelled to utilize multiple freight trucking companies to avoid shipment delays, thereby potentially enabling them to achieve the flexibility to change carriers easily in the short-term. However, transport company shipping costs could increase since the contract rates charged by secondary carriers may not prove as reasonable as those of primary carriers (Feng, Yuan, & Lin, 2005).

Globalization had an impact on Indonesia through the dissolution of trade barriers and the growth of competition from outside the country's borders. Truck transport in Indonesia accounts for approximately 70% of freight distribution (Herliana & Parsons, 2010). Unfortunately, most domestic freight trucking companies rely on price-based competition due to a lack of differentiation relating to shipping services. Low entry barriers to the freight trucking industry exacerbate the existing intensely competitive situation. Indonesia's significant logistical issues include: a backhauling (empty truck) problem, traffic congestion and poorly-maintained roads (Sandee, 2016). These challenges resulted in truck operation-related inefficiencies, thereby increasing shipping costs. The lack of available trucks resulting in an inability to satisfy the shipping requirements of customers represent another hurdle confronting Indonesian freight trucking companies. One of the characteristics of a transportation company is its inability to increase its supply capacity at short notice and the challenges its faces in securing additional carrier capacity (Feng et al., 2005).

Companies may seek to address this predicament through either a collaborative or competitive strategy (Jagoda, 2013), each of which has its respective advantages and disadvantages. The characteristics of the competitive strategy include: lacking value, being short-lived and breeding distrust between rival companies. Meanwhile, the adopting of a collaborative approach can result in long-term, high value and high trust relationships (Jagoda, 2013). According to Silva, Novaes, Scholz-Reiter, Frazzon, and Coelho (2010), the development of greater levels of collaboration between companies over the past decade has been increasing. The goal of commercial enterprises is to share expertise and provide enhanced results for their logistical networks instead of seeking individual ones. In the specific case of freight trucking companies, one means of achieving efficiency is through the elimination of wastefulness through collaboration with trading partners and other companies involved in transportation management.

Collaborative Transportation Management (CTM) constitutes an integrated process unifying all collaborating parties in achieving

* Corresponding author.
E-mail address: aneu.okdinawati@sbm-itb.ac.id (L. Okdinawati).
Peer review under responsibility of the Korean Association of Shipping and Logistics, Inc.

https://doi.org/10.1016/j.ajsl.2019.12.002
2092-5212 © 2019 The Authors. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

the goals of inefficiency reduction and performance improvement in transportation planning and implementation (CTM White Paper, 2004). Collaboration enables each participant to complement its partners, thereby introducing flexibility and competitive edge to the entire business network (Prakash & Deshmukh, 2010). Coordination and planning between collaborating companies can reduce the number of empty truck trips and backhauling (transporting cargo back from point B to the originating point A), thereby reducing the release of emissions into the environment (Schulte, Lalla-Ruiz, González-Ramírez, & Voß, 2017).

The focus of previous research has been on the issue of cost savings through horizontal CTM (Audy, D'amours, & Ronnqvist, 2008; Chabot, Bouchard, Legault-Michaud, Renaud, & Coelho, 2018; Nadarajah, 2008; Taherian, 2013), profit sharing (Frisk, Gothe-Lundgren, Jornsten, & Roonqvist, 2010; Liu, Wu, & Xu, 2010) and increasing capacity utilization (Peeta & Hernandez, 2011). The objective of such investigations is to improve overall collaboration performance through the use of resource and information sharing in the collaboration mechanism.

Scant research has analyzed the relationship and interaction between partnership elements within a horizontal collaborative transportation management context. Pomponi, Fratocchi, and Tafuri (2015) developed a theory-based framework for horizontal collaboration relating to logistics based on the extent of cooperation and mutual trust between cooperating parties. However, previous research is limited in addressing the issue of how trust develops from the interactions between collaborative agents. The absence of trust between parties to the collaboration is one of the behavioural issues that can negatively affect operational success (Bendoly, Donohue, & Schultz, 2005).

Understanding the interaction between horizontal collaborative agents and analyzing the trust resulting from a deepening and recurring collaboration from the operational to strategic levels constitute the aims of this study. The focus on behavioural aspects in this research is based on the assumption that collaborating parties will behave adaptively in response to their interactions with each other. Agent-based modelling (ABM) simulation is also utilized to obtain empirical evidence of trust development in horizontal CTM mechanisms. This simulation represents a modest contribution to the deepening understanding of horizontal collaboration between companies in Indonesia, particularly those involved in the freight trucking industry. Moreover, this paper constitutes a preliminary investigation into horizontal CTM in a real-life context.

2. Literature review

2.1. Horizontal collaborative transportation management

Collaborative structures in transportation management are classified as one of three forms: horizontal collaboration (Carrier–Carrier), vertical collaboration (Shipper–Carrier–Receiver) and lateral collaboration (a combination of horizontal and vertical collaboration) (Simatupang and Sridharan, 2002). Asawasakulsorn (2009) defines horizontal collaboration as one between competing carriers within the same supply chain level, while Sutherland (2006) identifies CTM as cooperation between rival trucking companies. Therefore, horizontal collaborative transportation management is defined as integrated collaboration between competitors operating within the same level of the supply chain in order to improve performance and efficiency.

The horizontal collaboration model is based on the research of Taherian (2013) and McKinsey & Co. (2010), the latter of whom classified three types of horizontal collaboration model based on different forms of leadership approach: convened collaboration, primus inter-pares collaboration and inter-pares collaboration. Meanwhile, Taherian (2013) categorizes horizontal collaboration models based on their collaborative processes, i.e., manual DIY (Do-It-Yourself), semi-automated DIY and outsourced to 3PL (third-party logistics).

Convened collaboration is similar in character to the outsourced collaboration coordination proposed by Taherian (2013), where a neutral or third party logistics provider (3PL) orchestrates collaboration between several parties – according to Taherian (2013) of the three types of horizontal partnership, outsourced to 3PL encounters the fewest problems with minimal overheads since the neutral party manages the entire coordination process. Based on the findings of his study of the UK retail industry, Stephens (2006) suggests that the presence of a neutral party acting in the role of 'honest broker' will allow more initiative for horizontal collaboration. However, such collaboration will limit opportunities for small-scale shippers to influence this form of collaboration and reap the full benefits (Pomponi et al., 2015). Semi-automated DIY is similar to primus inter-pares collaboration in that, due to its size and critical mass, one partner takes the lead in facilitating the partnership. This constitutes a form of collaboration, potentially offering more substantial profits. Manual DIY is similar to the inter-pares collaboration proposed by McKinsey & Co. (2010) since both collaborating parties typically have a similar-sized operation. This type of collaboration enables them to consolidate existing activity or establish new joint ventures. Consequently, it requires full transparency and disclosure of confidential information such as routing, pricing and knowledge relating to consumers. Unfortunately, there is a higher risk of opportunism emerging when a greater degree of confidential information is disclosed (Pomponi et al., 2015).

2.2. Trust development in horizontal collaboration

Pomponi et al. (2015) have proposed a theoretical organizational framework for horizontal collaboration incorporating two levels of classification, namely; the extent of cooperation and trust. This trust corresponds with the scope of collaboration due to the belief that companies rarely choose to cooperate across all decision-making levels (Matopoulos, Vlanchopoulou, Manthou, & Manos, 2007). Meanwhile, Pomponi et al. (2015) further argue that continuous interaction and knowledge sharing cause this form of collaboration to evolve over time from mere cooperation at the operational level into a more strategic partnership. This research finding is in line with that of Lambert, Emmelhainz, and Gardner (1999). Moreover, at every level of cooperation (operational, tactical, and strategic), an ongoing trust development process exists (Lambert et al., 1999). Taherian (2013) suggests that trust relates to the commitment of the various parties involved in the collaborative relationship.

This paper focuses solely on the trust which justifies current collaboration through previous experience of cooperation and trust, which constitutes a prerequisite to a fruitful and sustainable partnership. As Bendoly et al. (2005) argue, the trust between supply chain partners can significantly influence operational success. Those arguments also supported by Fawcett, Jones, and Fawcett (2012) research. Fawcett et al. (2012) interview 238 leading supply chain companies, and the results showed that companies become mature and sustained through a virtuous cycle of trust in their collaborative alliances. Meanwhile, the existence of trust is essential for the development of enduring collaboration when all members in the supply chain have different interests and expectations is proposed by Ramaswami and Simatupang (2013). The extent to which supply chain collaboration is associated with trust also examines by Talavera (2014) using factor analysis of 57 Philippine companies. Similar results also showed by Al-Doori (2019)

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

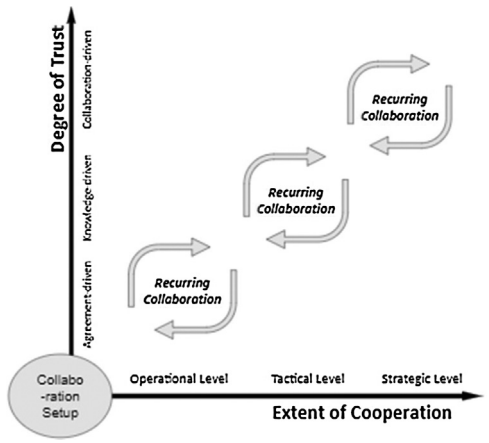

Fig. 1. Trust development framework.

where trust is one of the critical factors for effective collaboration initiatives.

Pomponi et al. (2015) classified the development of trust within horizontal logistic collaboration into three types. First, agreement-driven trust as a prerequisite to initiating collaboration. Second, knowledge-driven trust or trust born of a recurrent virtuous collaboration cycle where the requirements of each partner are met to a level exceeding their expectations. Third, collaboration-driven trust, or a high-trust relationship, which entails continuous open communication between collaborating partners and reduces uncertainty. These various forms of trust development are shown in Fig. 1.

Pomponi et al. (2015) proposed a framework within which companies ultimately collaborate at three levels: operational, tactical and strategic. According to Okdinawati, Simatupang, and Sunitiyoso (2015), the operational level focuses on the daily processes involved in processing customer orders, namely: scheduling, routing and order processing. The operational level refers to the initial phase of collaboration during which the level of trust is an agreement-driven trust (Pomponi et al., 2015). The tactical level focuses on improving efficiency through more effective and efficient transportation within the logistic process through the application of freight forecasting and order assignment which helps to map various carriers (Okdinawati et al., 2015). The tactical level corresponds with the knowledge-driven trust, which has been developed over time through the accumulation of reciprocal knowledge resulting from interaction (Pomponi et al., 2015). Finally, at the foundation of the supply chain collaboration process lies the strategic level which helps to identify the benefit, risk, commitment sharing and limitations of the strategic partnership model through front-end agreement and network planning to establish a collaborative relationship (Okdinawati et al., 2015). The strategic level corresponds to the highest level of trust, which is a collaboration-driven trust (Pomponi et al., 2015).

The research gap of this paper relates to the role of trust in horizontal collaborative transportation management in ensuring the continuation and extent of the horizontal collaboration process involved in truck freight transportation. Although previous research on this subject is limited in scope, Lambert et al. (1999) revealed ongoing trust development at every level of cooperation (operational, tactical, strategic). Meanwhile, a study by Pomponi et al. (2015) proposed that the evolution of collaboration was directly related to the prevailing level of trust from limited cooperation to a strategic partnership.

3. Methodology

3.1. Research method

The research design applied in this paper consists of seven stages adhering to the principles of soft system methodology (SSM), as shown in Fig. 2.

Soft systems methodology (SSM) focuses on the means of achieving a desired future scenario by comparing the current situation with an ideal one (Checkland & Scholes, 1990). Checkland stated that when a researcher is faced with a situation, both dynamic and unpredictable in character or when goals and objectives defy precise quantification, then an SSM should be utilized. According to Novani and Mayangsari (2017), when a problem could benefit from a different form of analysis, SSM can be applied. However, its effective application requires a situation within which sufficient time exists for participants to share knowledge and experiences, thereby learning from each other. This, in turn, requires the existence of sufficiently high levels of trust for the participants to feel comfortable in openly expressing their requirements and preferences (Novani & Mayangsari, 2017). SSM is applied through seven stages (Checkland, 1981) whose implementation does not need to adhere to a particular sequence, namely: (1) unstructured problem situation, (2) structured problem situation, (3) root definition formulation, (4) conceptual model development, (5) comparison of models with "reality", (6) defining desirable and culturally feasible changes and (7) implementation of ameliorative action.

Agent-based modelling (ABM) was employed in this research as a computational model developed to analyze and understand the dynamic interaction between the environment and the behaviour of agents (Gilbert, 2008). ABM constitutes a method of studying the systems thinking, which consists of the interaction between both agents and the emergent properties arising from such interaction and the system more generally (Axelrod, 1997). ABM is able to demonstrate the comprehensive effects of agent diversity with regard to attributes and behaviour, enabling a researcher to observe the model as it gives rise to the behaviour of the system as a whole (Macal & North, 2009). The three elements used in ABM consist of: (1) the attributes and behaviours of agents; (2) the relationships and means of interaction between agents; and (3) the environment within which agents interact with each other. ABM constitutes a bottom-up approach that relies on the agents' relationships and interaction within the system which are potentially subject to change over time and considered to represent a process or systematic behaviour (Novani & Mayangsari, 2017).

3.2. Case description

In order to understand the contemporary state of the transportation industry in Indonesia and to develop a horizontal CTM model of freight trucking companies, this research encompassed two case studies. The adoption of a case study approach allows for a detailed description of agent interactions in horizontal CTM and the development of trust within a CTM mechanism to be developed. The selection of cases was based on the recommendations of both academics and practitioners with regard to the prevalence of horizontal collaboration in current business practice. Both case studies represent real-life conditions and are employed to confirm or disprove the conclusions drawn from the ABM simulation.

The two case studies used for this research comprise Case X, three freight companies in Indonesia, and Case Y, the Indonesian Association of the Freight Trucking Industry. The justification for selecting these cases lies in both having experience of either practicing or facilitating horizontal CTM between freight trucking companies. The collaboration models of both cases studies are similar to the horizontal collaboration model proposed by McKinsey

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

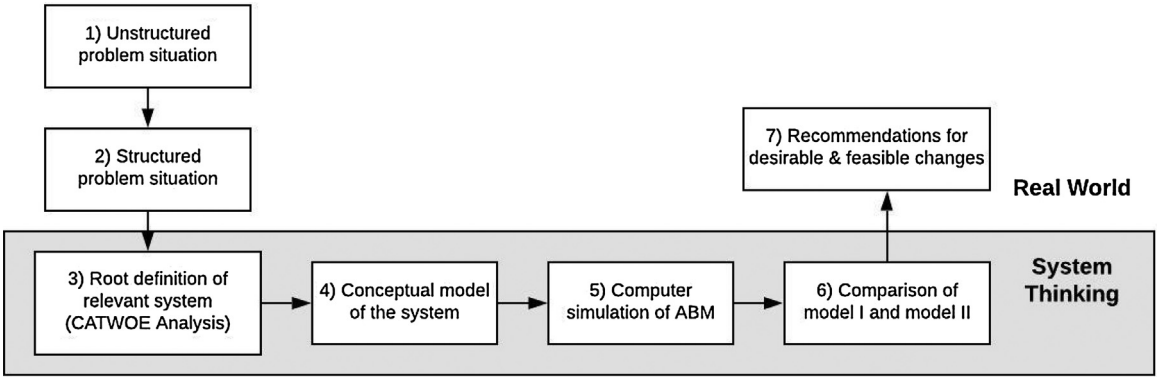

Fig. 2. Research methodology.

& Co. (2010). Case X is identical to the Inter-pares collaboration model, while Case Y is similar to a Convened collaboration model. The latter is one in which a neutral party helps to orchestrate the cooperation, while an Inter-pares model constitutes collaboration between companies with similar-sized operations (McKinsey & Co., 2010).

Case X involved the examples of three DKI Jakarta and Bandung-based transportation companies offering freight trucking transportation services, while Case Y featured the Indonesian Association of the Freight Trucking Industry. This body aims to create a business-conducive environment, especially relating to the field of freight trucking transportation, within which each member can develop its competence while, simultaneously, providing a strategic partnership network. Case Y was established in August 2014 by 48 trucking company owners. Based on the data elicited during the interviews conducted, the number of unregistered trucks in Indonesia trucking association within Indonesia remains persistently high. The Indonesian National Police (POLRI) confirmed the presence of 5.2 million registered trucks on the country's roads, while only approximately 0.8% of this number had joined the association (Case Y, 2018).

For the purposes of data collection, two informants constituting representatives of each case study were interviewed for 2–3 hours during four separate sessions. All informants were senior executives of their respective organizations with more than fifteen years' experience of the freight trucking transportation industry. The conduct of the interview aimed to define the nature of the current problems besetting this economic sector.

This investigation adopted a subjective approach of face validation to evaluate the model, its behaviour and underlying assumptions, together with the ABM simulation results. During face validation, the experts and the representatives of both case studies were asked to evaluate whether the model, the interactions and ABM simulation results represented the real system, is justifiable and within reason (Sargent, 1986).

3.3. Conceptual framework

The Case X study resembles the Inter-pares collaboration model since Case X usually provides shipping services for FMCG (fast-moving consumer goods) through its existing fleet of trucks. Customer shipment requests frequently relate to the delivery of a full truckload of FMCGs from Banten to East Java. Having provided an excellent delivery service, the empty trucks belonging to Case X must return to Banten, a requirement which, from an economic perspective, constitutes inefficiency since the return journey will incur operating expenses such as fuel, road tolls and the driver's salary. Therefore, Case X will contact competing trucking companies in an effort to collaborate in combining their respective cargos for the return trip to Banten. Such horizontal collaboration in the area of backhauling has significantly addressed the issue of empty truck capacity for Case X by consolidating cooperating partners' deliveries for a return trip.

In this case study, since both collaborating partners were carriers constituting either rival or unrelated freight trucking companies whose decision to collaborate was driven by necessity, they exhibited little or no mutual trust. This state of affairs was evidenced by the reluctance of each company to disclose confidential information such as their internal operation procedures, customer details or pricing to competitors – a fact confirmed by the interviews conducted. Interviewees expressed the fear that any information disclosed would be used by competitors to steal market share by offering lower pricing and providing more rapid shipping services to potential customers.

Due to a lack of mutual trust, the current collaboration between Case X and its partners is limited to the operational level, focusing largely on daily operations which involve customer order delivery. Consequently, less risk, particularly that resulting from sharing sensitive information with collaborating partners, is involved. No truck freight company possesses an inherent ability to orchestrate collaboration as the Case Y study serves to illustrate. Therefore, a neutral party acting as a mediator is required to help coordinate the cooperation process between freight trucking companies. Based on information elicited by the interviews conducted, the presence of Case Y as a neutral party has induced greater initiative for horizontal collaboration. Therefore, Case Y study bears a certain resemblance to the Convened collaboration model. Within this context, Case Y acts as the neutral party, while the freight trucking service companies are referred to as the carriers.

Recommendations by Case Y regarding membership and collaboration include: generating trust, lending credibility, and maintaining a good relationship between collaborating carriers. Any freight trucking company can request Case Y via the support of the association's communication channel in identifying fellow freight trucking companies interested in collaboration. Since the freight trucking company is a member of Case Y, other similar companies are likely to demonstrate greater trust in any partnership. In return for facilitating collaboration, the association levies a fee amounting to 2.5% of the value of the total freight trucking service provided, while the truck owner receives 2.5% and the company which handles customer orders payment equivalent to 5% of the value of the service. A potential framework for horizontal CTM based on the contexts of the foregoing case studies is contained in Fig. 3. This model should promote understanding of trust development at each level of horizontal CTM.

The content of Fig. 3 represents the ideal situation regarding the structure of horizontal CTM that involves various collaborating agents. The three agents in the conceptual framework consist

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

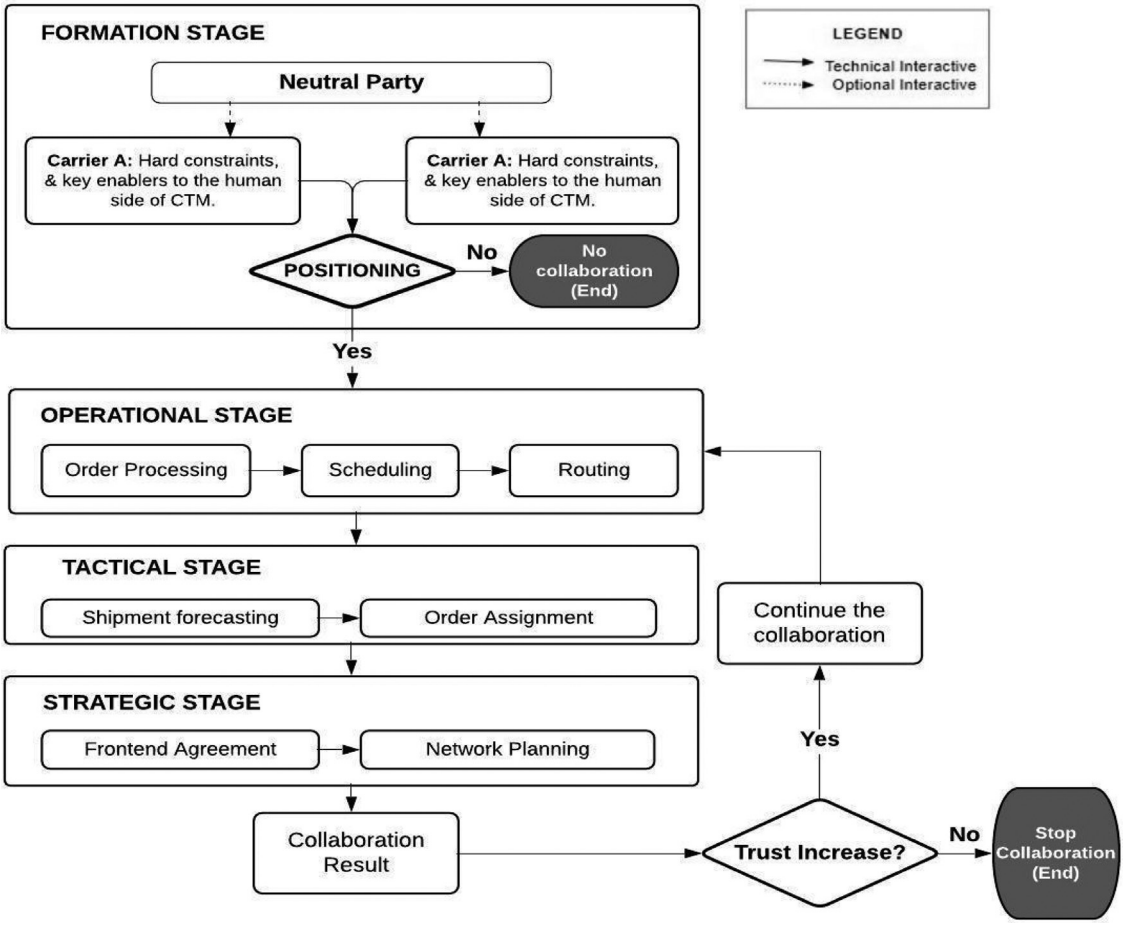

Fig. 3. The framework for horizontal CTM.

of Carrier A, Carrier B and a neutral party. To simplify simulation, one agent represents both the truck operator and the cargo owner. It is important to note that the roles of Carrier A and Carrier B are interchangeable. For example, Carrier A might be the truck owner who transports cargo to satisfy customer requirements. Carrier B might collaborate by using Carrier A's truck to avoid backhauling or reduce transportation costs. A carrier's goals are to satisfy customer requirements, expand market share and maximize their profits by either increasing freight trucking rates or reducing shipment costs (Okdinawati et al., 2015). Since both agents are carriers, each has similar clearly defined roles and activities. However, each agent offers a different capacity and resources to potential customers. Carriers may decide to collaborate in order to satisfy demand depending on the number of customers and the nature of their demands. The inclusion of both Carrier A and Carrier B represents a prerequisite for horizontal CTM, while that of a neutral party is optional and depends on the need for collaborative partners. The neutral party can facilitate collaboration even when the carriers are unable to cooperate due to the necessary skill set being outside their core capability or, alternatively, because of a lack of trust on their part.

The agents will seek a collaborative partner by enhancing their attractiveness to collaborate at the formation stage (Okdinawati, Simatupang, & Sunitiyoso, 2017). Both agents will indicate the hard constraints they face and the key enablers as behavioural aspects of CTM. Collaboration partner selection against a background of hard constraints is conducted to ease collaborative compatibilities across various factors, including: product, type of truck employed, geography and product handling (Taherian, 2013). If agents choose to collaborate, the subsequent step is to align the key enablers of CTM with each agent to ensure successful cooperation.

Key enablers of collaboration represent a concept focusing on the behavioural aspect of CTM, namely; how effectively individuals work together both internally and with cooperating partners (Sutherland, 2006). The key enablers of CTM consist of common interest, openness, prioritization, clear expectations, leadership, cooperation and trust (Sutherland, 2006). The term "Common interest" signifies, ensuring that all collaborating parties share an ongoing interest in and commitment to the outcome of the collaboration. "Transparency" or "Openness" means the behaviour of all collaborating parties in openly sharing their practice, resources and proprietary information. "Recognizing who and what is essential" or "prioritisation" means an agent should be mindful of what is essential and prioritize common goals. "Clear expectation" means all collaborating partners should have a firm understanding of the expected contribution and goals within the collaborative relationship. "Leadership" means nothing significant will be accomplished without a dominant party to drive the collaboration forward. "Cooperation and benefit-sharing" refers to distributing both profit and expenses among collaborating partners. On the basis of each of these key enablers, the CTM can decide whether the agent will have the capacity to conduct various functions at the operational, tactical and strategic levels.

The next stage is the degree of involvement in the collaboration at the three-levels of decision-making – the framework for the CTM planning stage adopted from the research of Okdinawati et al. (2015). In the opinion of these authors, the collaboration stage starts with the strategic stage, moving to the tactical stage

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

and culminating in the operational stage. The rationale underpinning these three stages is that horizontal collaboration is divided on the basis of their respective time horizons. Initially, strategic level collaboration serves as the foundation of the entire long-term collaborative planning process in identifying benefits, risks, commitments and limitations inherent to the strategic partnership model (Okdinawati et al., 2015). Collaboration moves from the strategic level to the tactical level whose aim is to improve transport utilization and increase efficiency on a weekly and monthly basis. Finally, collaboration moves from the strategic and tactical level to the operational level where the strategic and tactical plans translate into daily operational process flows which process the orders placed by customers (Okdinawati et al., 2015).

Based on the case studies conducted in the course of the research reported here, the majority of the collaboration in Indonesia starts at the operational rather than the strategic level. Both collaborating partners are carriers who are either rival or unrelated freight trucking companies (Asawasakulsorn, 2009; Sutherland, 2006). The rival carriers decide to collaborate out of necessity with little or no trust evident in the resulting relationship. Collaboration at the operational level mainly focuses on daily operations for customer order fulfilment and its initiating demands only a minimal amount of trust. Therefore, in real life, it is easier to initiate horizontal collaboration at the operational level. Reflecting on both case studies, the collaboration stages discussed start at this level, before moving to the tactical level and finally to the strategic level. The expectation of collaboration evolved as trust in the relationship developed.

This research adopted the framework contained in Fig. 1, relating to the extent of trust-based collaboration from the work of Pomponi et al. (2015). Within every level of collaboration (operational, tactical and strategic level), a process of trust development is ongoing (Lambert et al., 1999; Pomponi et al., 2015). The result of successful collaboration may increase the trust between participating partners. As the companies develop a more comprehensive mutual understanding, they gain more insight into and, subsequently, satisfy their respective performance expectations within the relationship. Meanwhile, unsuccessful collaboration may decrease the mutual trust between partners as companies fail to deliver satisfactory results at the operational, tactical or strategic level. Trust is vital to ensuring that the collaboration works and allows its participants to reap full benefit against the background of an uncertain competitive market environment and market demand. Carriers will decide whether to continue collaboration or dissolve the partnership based on the results of the development of trust. If carriers choose to maintain collaboration with existing partners, they will return to the formation stage and repeat the decision-making sequences. Even though the case study takes place within Indonesia as an emerging country, the results of the analysis of the conceptual model can be replicated within any context since they relate to the development of trust grounded in successful collaboration. Therefore, the application of the model is not restricted to the conditions prevailing within a specific country, in this case, Indonesia.

3.4. Agent-based modelling simulation

During the ABM simulation, every agent operates within conditions that consist of the hard constraints and key enablers as the behavioural aspect of horizontal CTM. Agent roles, rules and attributes, shown in Table 1, can affect their willingness to collaborate, ability to work and the trust between collaborating parties. The research involving this simulation assumes that customer demands are constant and at a level where carriers must collaborate in order to fulfil customer orders. Two scenarios run simultaneously in the NetLogo program. Indeed, in this simulation, both Scenario 1 and Scenario 2 ran concurrently using the same agents with the result shown in the plot monitor. The simulation was conducted 100 times, with each simulation run continued until both agents achieved the highest level of trust: Collaboration-driven trust. Moreover, a single iteration represented one cycle of the collaboration completed in the course of a month.

This research refers to the freight trucking companies as the Carriers, two of which, Carrier A and Carrier B, were employed. Two simulations were conducted to provide evidence of trust development in horizontal collaboration mechanisms. Two scenarios were included in the simulation. Scenario 1 was a reflection of the study of Case X, where the horizontal collaboration involved two carriers with similar-sized operations. Within this research, Scenario 1 is referred to as the model of the ideal situation since both agents demonstrated zero mutual trust prior to their collaboration.

Scenario 2 parallels the study of Case Y, in which a neutral party facilitated the horizontal collaboration between two carriers. In Scenario 2, Carrier A and Carrier B, both of whom are members of the trucking association, requested Case Y to provide a communication platform enabling them to meet and propose their intention to seek a collaborative partner. Case Y, as the trucking association, lent credibility to and enhanced the reputation of the freight trucking companies, thereby facilitating collaboration and adding a trust score of 5 (Tn + 5) to each agent.

Matopoulos et al. (2007) believe that it is rare for companies to collaborate in a straightforward manner at all decision-making levels. Meanwhile, Pomponi et al. (2015) state that a minimum degree of mutual trust constitutes a prerequisite to continuing the collaboration to the next level. Therefore, within this simulation, the collaboration stages also developed on the basis of a hierarchical decision-making structure commencing with the operational level, moving to the tactical level and ending with the strategic level. Different activities are conducted on each level from the operational level until the strategic level. When collaboration resulted in the completion of one of the activities at each level, the trust score increased (Tn + 1), while failure by agents to complete the activity caused them to lose one Trust (Tn – 1) score, then trust score will add up in each level. Assume that If the agreement-driven trust level were not reached, the collaboration would persist at the operational level.

Only when the level of trust achieves the trust milestones can the degree of participation within the collaboration extend from the operational level to the tactical level. The justification for the trust threshold adopted for the purposes of this simulation is that this research assumed that trust score (Tn) values range from 0 to 100. It is assumed that, at the operational stage, agreement-driven trust is achieved if the trust score is equal to or higher than twenty-five ($Tn \geq 25$). Should the trust score exceed seventy-five ($Tn \geq 75$), the "Knowledge-driven trust" level can be said to have been reached. Meanwhile, when the trust score surpasses ninety ($Tn \geq 100$), trust stands at the "Collaboration-driven trust" level.

Initially, the system will generate hard constraints, and key enablers score randomly using a binomial value scale of zero and one. A generated score of one (1) indicates "yes" and that the agent owns the factor. If the score is zero (0), this means that the agent does not own the factor. The total of the hard constraints for both agents constitutes consideration for collaborative partner selection. At this stage, potential collaboration requires the minimum value of four (4) hard constraints experienced by both agents. For this study, C represents the total of hard constraints experienced by agents, along the following lines:

If $C > 4$, the carriers will collaborate.
If $C < 4$, the carriers will not collaborate.

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

Table 1
Roles, rules and attributes relating to agents.

Collaboration stage	Carrier A	Carrier B	Neutral party	Information shared
Formation stage	Roles	Participate in the tender process	Facilitates collaboration between carriers	Hard constraints: - Type of cargo/products - Product handling procedure - Geography
	Rules	Disclose relevant information to enhance the incentive to collaborate	Lending credibility and reputation to the truck companies	Key enablers: - Transparency, - Clear expectation - Benefit-sharing - Leadership - Prioritizations - Common interest - Cooperation
		Positioning based on hard constraints and information provided by all agents.		
Operational stage	Roles	Focus on daily operational process flow to fulfil customer orders.	–	Progress towards completion of operational stage functions: order processing, routing and scheduling.
	Rules	Align order processing Draft delivery schedule Coordinate route planning	–	
Tactical stage	Roles	Achieve enhanced resource management to improve transportation utilization.	–	Progress towards completion of tactical stage functions: forecasting and order assignment.
	Rules	Forecast future shipment Arrange carrier/shipment assignment	–	
Strategic stage	Roles	Aim to achieve growth and long-term commitment sharing through a strategic partnership	–	Progress towards completion of strategic stage functions: front-end agreement and network planning.
	Rules	Mutual acceptance of front-end agreement Assemble network planning	–	

Table 2
Key enablers and activities at the various stages of collaboration.

Collaboration stages	Activities	Description
Operational level	Order processing	"Order processing" requires both agents to own either "clear expectations" or "transparency" as enablers of the human aspect of CTM.
	Routing	"Routing" requires both agents to own either "cooperation" or "transparency" as enablers of the human aspect of CTM.
	Scheduling	"Scheduling" requires both agents to own either "prioritization" or "transparency" as enablers of the human aspect of CTM.
Tactical level	Shipment forecasting	"Shipment forecasting" requires both agents to own either "benefit sharing" or "transparency" as enablers of the human aspect of CTM.
	Order assignment	"Order assignment" requires both agents to own either "cooperation" or "transparency" as enablers of the human aspect of CTM.
Strategic level	Front-end agreement	"Front-end agreement" requires both agents to own either "leadership" or "common interest" as enablers of the human aspect of CTM.
	Network planning	"Network planning" requires both agents to own either "clear expectation" or "transparency" as enablers of the human aspect of CTM.

Table 3
Summary of simulation one and simulation two scenarios.

	Simulation Scenario 1	Simulation Scenario 2
Description	All agents independently used the key enablers of the human aspect of CTM to conduct horizontal collaboration and develop trust.	All agents, with the help of a neutral party, developed trust using key enablers of the human aspect of CTM to promote horizontal collaboration.
Agents	Carrier: Company Y Carrier: Company Z	Neutral party: APTRINDO Carrier: Company X Carrier: Company Y
Decision variables		
Formation stage	Hard constraints score $\geq$ 4 to join collaboration.	
Operational stage	Choose to conduct scheduling, routing and order processing based on the availability of key enablers of the human aspect of CTM. Agreement-driven trust reached when trust $\geq$ 25.	
Tactical stage	Choose to conduct forecasting and order assignments based on the availability of key enablers of the human aspect of CTM. Knowledge-driven trust reached when trust $\geq$ 75.	
Strategic stage	Choose to conduct front-end agreement and network planning based on the availability of key enablers of the human aspect of CTM. Collaboration-driven trust reached when trust $\geq$ 100.	

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

In this study, H represents the total of key enablers of behavioural aspects of CTM owned by the agents. For this simulation featuring two agents, the maximum value of key enablers is fourteen (14) since each agent owned a total of seven (7) (common interest, transparency, prioritization, clear expectations, leadership, cooperation and benefit-sharing). Each of these key enablers of CTM influences the ability of the agent to conduct various activities at the operational, tactical and strategic levels. The key enablers, as the behavioural aspects of CTM at each collaboration stage, are shown in Table 2. Meanwhile, Table 3 contains a summary of the simulation description and the parameters employed.

4. Results and discussion

In both Scenario 1 and Scenario 2, the agents can cooperate only at the operational level at the start of the collaboration. Scenario 1 starts the collaboration with zero trust. Scenario 2 starts with a trust score of ten due to the presence of a neutral party, which adds a trust score of five (Tn + 5) for each agent at the beginning of the collaboration. The simulation randomly generated the hard constraints and key enablers as behavioural aspects of CTM. During the initiation of collaboration, both Carrier A and Carrier B will align the hard constraint factors and decide to join the collaboration. The simulation indicated that both carriers encountered the following hard constraints: truck compatibility, product compatibility, product handling and geography. Table 4 contains a summary of the key enablers generated by the simulation for each carrier agent. Owning one of the key enablers will influence the ultimate outcome of the collaboration. For example, when no carrier owned the “leadership”, this resulted in none driving the partnership forward.

4.1. Simulation results with fourteen key enablers

In the ideal situation where all fourteen key enablers are present within both carriers, trust can develop much faster, allowing both agents to collaborate across all functions at every level of collaboration (operational–tactical–strategic). Trust can develop incrementally from the agreement-driven trust at the initiation of the collaboration to the highest level of trust, namely; collaboration-driven trust. Scenario 2 developed trust at a much faster rate compared to Scenario 1 due to the presence of a neutral party which instilled additional trust at the outset of the collaboration. Since both Carrier A and Carrier B were capable of collaborating in all functions of the operational stage (scheduling, routing and order processing), agreement-driven trust ($Tn \geq 25$) was achieved during the fifth iteration of Scenario 1 with a trust score of 32 (Tn = 32) and the third iteration of Scenario 2 with a trust score of 28 (Tn = 28). As the extent of the collaboration of both agents deepens at the tactical stage, shipment forecasting and conducting carrier assignment can be mutually undertaken. At the tactical level, both agents enhanced knowledge and understanding of their partner’s requirements and methods of working. Therefore, both carriers will deliver better collaboration results vis-a-vis their respective partner’s expectations, which, in turn, increases trust. Knowledge-driven trust ($Tn \geq 75$) in Scenario 1 was achieved after the ninth interaction with trust score s 78 (Tn = 78) and the eighth iteration of trust score 82 (Tn = 82). As the trust develops into knowledge-driven trust, both agents understand each other sufficiently well for them to extend the collaboration to the strategic level. In the eleventh iteration of Scenario 1 with a trust score (Tn = 106) and the ninth iteration of Scenario 2 with a trust score (Tn = 100), both agents achieved the highest form of trust development, a collaboration-driven trust ($Tn \geq 100$). At the highest level of trust, collaborating agents were comfortable with open communication which manifested itself as a greater commitment to information-sharing of knowledge and internal procedures which promoted transparency and reduced uncertainty (Kwon and Suh, 2005). Low levels of uncertainty, high levels of trust and transparency between collaborating agents allow for long-term collaboration.

4.2. Simulation results of six key enablers

In the simulation featuring a total of six key enablers owned by both carriers throughout every level of collaboration (operational–tactical–strategic), both Carrier A and Carrier B either successfully conducted or failed to conduct each equitable share of the partnership. At the operational level, both carriers jointly collaborated only during the routing phase, while only Carrier A conducted scheduling and Carrier B alone conducted order processing. Due to the presence of a neutral party which engendered additional trust at the initiation of the collaboration, Scenario 2 had the advantage of a head-start in developing trust compared to Scenario 1. Both agents achieved agreement-driven trust only after the trust score exceeded or equalled twenty-five ($Tn \geq 25$) in the thirteenth iteration of Scenario 1 with a trust score of 26 (Tn = 26) and in the eighth iteration in Scenario 2 with a trust score of 26 (Tn = 26). At the tactical level, both carriers jointly collaborated only on shipment forecasting and failed to cooperate on carrier assignment. Neither was willing to disclose internal information. Thus, both carriers were relatively slower at gaining more knowledge about their partners’ requirements and understanding how their partners worked. A paucity of “transparency” underpinned the reluctance of each carrier to share information about its internal organizational processes. However, both carriers owned “cooperation”, thus ensuring that each would attempt to solve problems jointly, rather than taking punitive action. Knowledge-driven trust ($Tn \geq 75$) was achieved in the thirty-eighth iteration in Scenario 1 with a trust score of 76 (Tn = 76) and in the thirty-third iteration in Scenario 2 with a trust score of 76 (Tn = 76). Only Carrier A owned “leadership” with the result that it represented the dominant party that led collaboration at the strategic level. Both Carrier A and Carrier B accumulated trust score s in every iteration of the strategic stage. When the trust reached a trust score of one hundred (Tn = 100), it developed into collaboration-driven trust, the highest level of trust in the horizontal collaboration trust model. Collaboration-driven trust ($Tn \geq 100$) was achieved in the fiftieth iteration in Scenario 1 with a trust score of 100 (Tn = 100) and at the forty-fifth iteration of Scenario 2 with a trust score of 100 (Tn = 100). Despite achieving the highest level of trust, collaborating agents remained uncomfortable with open communication. This translated into a reduced willingness for information sharing relating to knowledge and internal procedures for fear of opportunist behaviour by competitors. This situation hindered transparency and allowed uncertainty to persist, thereby inhibiting both carriers’ meaningful long-term collaboration at the strategic stage. This situation was similar to the findings of the case studies, which suggested that the development of trust between rival or unrelated freight trucking companies requires a greater length of time.

4.3. Simulation result with four key enablers

The simulation featuring a total of only four key enablers restricted the ability of both Carrier A and Carrier B to collaborate seamlessly, mainly due to the lack of established common interest and a clear expectation of the collaboration outcome. It should be noted that in a horizontal collaboration involving rival companies,

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

Table 4
Key enablers to the CTM generated in the simulation.

	Total of four key enablers	Total of six key enablers	Total of fourteen key enablers
Carrier A	"Prioritization"	"Common interest" "Prioritization" "Leadership" "Cooperation"	"Prioritization" "Transparency" "Common interest" "Cooperation" "Leadership" "Clear expectation" "Benefit sharing"
Carrier B	"Transparency" "Prioritization" "Benefit sharing"	"Clear expectation" "Cooperation"	"Prioritization" "Transparency" "Common interest" "Cooperation" "Leadership" "Clear expectation" "Benefit sharing"

Table 5
Summary of trust values generated from the simulations.

Iterations	Trust development value					
	Key enablers 4		Key enablers 6		Key enablers 14	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2
1	2	12	2	12	6	16
3	6	16	6	16	18	28
4	8	18	8	18	24	38
5	10	20	10	20	32	48
8	16	26	16	26	64	86
9	18	28	18	28	78	100
11	22	34	22	32	106	128
13	26	38	26	36	134	156
24	50	60	48	58	288	310
30	62	64	60	70	372	394
33	64	64	66	76	414	436
38	64	64	76	86	484	506
45	64	64	90	100	582	604
50	64	64	100	110	652	674

Legend: Agreement-driven trust Knowledge-driven trust Collaboration-driven trust

both should harbour the common goal of developing a shared collaborative perspective (Pomponi et al., 2015). This condition limits the development of trust, as seen in Table 5, where collaboration stagnated at the tactical stage. In this simulation, agreement-driven trust was achieved when the trust score exceeded or was equal to twenty-five (Tn ≥ 25). Only after the trust score had reached 26 (Tn = 26) in the thirteenth iteration of Scenario 1 and the eighth iteration of Scenario 2, did the trust resulting from the collaboration develop into agreement-driven trust, thereby enabling the partnership to move to the tactical stage. As both agents in these scenarios entered the tactical stage, the key enablers owned by each influenced their respective ability to conduct activities at the tactical level. In the simulation, Carrier B performed the majority of the collaboration stage activities unilaterally, while willingly sharing this knowledge with Carrier A during the tactical stage. However, Carrier A did not reciprocate this gesture since it did not own the necessary key enablers. The longer the collaboration persisted, the more evident it became that the behaviour of Carrier A did not inspire trust, as it contributed little to the partnership. Rather, a higher risk of opportunism existed since Carrier B consistently disclosed its internal process, customer information and other confidential data to Carrier A. This situation hindered transparency and allowed uncertainty to persist between collaborating agents which restricted the development of trust. The collaboration no longer developed trust during the thirty-third iteration of Scenario 1, when the trust score was 64 (Tn = 64). Meanwhile, Scenario 2 required thirty iterations before trust ceased developing when the trust score was 64 (Tn = 64). Trust was unable to develop to the next level, the knowledge-driven trust level, and the extent of collaboration was restricted to the operational stage and tactical stages. The simulation result was almost identical to the situation in the case study in which rival carriers tended to restrict collaboration to the operational level since it focused primarily on daily operations relating to customer order fulfilment and minimizing the risk of opportunistic behaviour.

According to the simulation results, in order to achieve more rapid trust development in a shorter time period into the highest level of trust, all collaborating agents must own all key enablers as behavioural aspects of CTM. In contrast, trust stops developing when neither agent holds the majority of the essential key enablers. Therefore, key enablers of behavioural aspects of CTM are crucial to determining the success of collaboration both in terms of how well individuals cooperate both internally and externally with a collaboration partner. The result of the simulation proves the validity of the theory propounded by Gino and Pisano (2008). The company's behaviours are critical in influencing both the manner in which the vast majority of the operating systems function and the quality of their performance.

5. Conclusion

This paper presents an understanding of how the behaviour and actions of a company are critical in influencing horizontal collaboration and subsequent development of trust. Among the key

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

enablers within the behavioural aspects of CTM, "transparency" is the most crucial since it relates to information sharing regarding internal operation processes with collaboration partners. The simulation results showed that "transparency" is beneficial since it reduces the vulnerability of collaborating companies to opportunistic behaviour. Moreover, "common interest", "clear expectation", "cooperation" and "benefit sharing" are also essential to horizontal CTM. The simulation results indicated that where collaborating agents co-own "clear expectations", "cooperation", and "benefit sharing", this enables both companies to lay the groundwork for a long-term strategic horizontal collaboration agreement. This condition facilitates the development of trust on the part of both companies in achieving the full potential and benefits of the collaboration.

The simulation results of this research also made the following discovery. First, the presence of a neutral party facilitating collaboration is not crucial to accelerating the development of trust during the horizontal collaboration between truck freight companies. There exists the possibility that employing the services of a neutral party can be avoided provided that both collaborating agents control all necessary key enablers as behavioural aspects of CTM. However, the presence of a neutral party is crucial to inspiring trust and a good reputation, especially between carriers with no previous knowledge of each other. The Case X study is only applicable to collaborating carriers with a higher level of expertise and resources to manage the collaboration. Unfortunately, not all truckload companies in Indonesia have either the knowledge or capacity to manage horizontal collaboration.

Matopoulos et al. (2007) reported that some authors regard power as one of the elements that can significantly hinder the development of trust during collaboration. Since the research reported here does not analyze power play, bargaining strategies or the risks inherent to horizontal collaboration, these factors will be the focus of a future investigation. The focus of this study was limited to the difference in trust score based on a company's "willingness to collaborate". However, the research did not include the difference in trust score based on management performance in such areas as sales and revenue, which also represent an area for research.

This paper contributes to learning points contained both in the relevant literature and practical contributions of the final stage within SSM, namely; "implementation of ameliorative action". Since it is difficult to conduct field experimentation, thus, this research uses computational simulation using ABM to demonstrate the initiation and continuation of horizontal collaboration based on trust development. The simulation result based on both the current and ideal situation showed the collaboration can be developed and sustained through three stages of trust development (agreement-driven trust, knowledge-driven trust, and collaboration-driven trust) that are influenced by the presence of key enablers in the behavioural aspect (transparency, common interest, cooperation, leadership, clear expectation, prioritization, and benefit-sharing) in each collaboration party. Thereby, the practical contribution of this paper is to demonstrate that in the real system truck freight transportation companies can collaborate and continuously maintained its collaboration with the identified behavioural enablers. Incomplete key enablers in the behavioural aspect may hinder the continuation and extension of horizontal collaboration among truck freight transportations.

References

Al-Doori, J. A. (2019). The impact of supply chain collaboration on performance in automotive industry: Empirical evidence. *Journal of Industrial Engineering and Management*, *12*(2), 241–253.
Aptrindo. (2018). *Tentang APTRINDO*. http://aptrindo.or.id/tentang-aptrindo/
Asawasakulsorn, A. (2009). Transportation collaboration: Partner selection criteria and inter-organizational system (IOS) design issues for supporting trust. *International Journal of Business and Information*, *4*(2), 199–220.
Audy, J. F., D'amours, S., & Ronnqvist, M. (2008). Cost allocation in the establishment of a collaborative transportation agreement: An application in the furniture industry. *The Journal of the Operational Research Society*, *62*(6), 960–970.
Axelrod, R. (1997). *The complexity of cooperation: Agent-based models of competition and collaboration*. Princeton, New Jersey: Princeton University Press.
Bendoly, E., Donohue, K., & Schultz, K. L. (2005). Behaviour in operations management: Assessing recent findings and revisiting old assumptions. *Journal of Operations Management*, *24*(6), 737–752.
Chabot, T., Bouchard, F., Legault-Michaud, A., Renaud, J., & Coelho, L. C. (2018). Service level, cost and environmental optimization of collaborative transportation. *Transportation Research Part E*, *110*, 1–14.
Checkland, P., & Scholes, J. (1990). *Soft systems methodology in action, include a 30-year retrospective*. Chichester: Wiley.
Checkland, P. (1981). *System thinking, system practice*. Chichester: John Wiley & Sons.
Fawcett, S. E., Jones, S. L., & Fawcett, A. M. (2012). Supply chain trust: The catalyst for collaborative innovation. *Business Horizons*, *55*, 163–178.
Feng, C., Yuan, C., & Lin, Y. (2005). The system framework for evaluating the effect of collaborative transportation management on supply chain. *Journal of Eastern Asia Society for Transportation Studies*, *6*, 2837–2851.
Frisk, M., Gothe-Lundgren, M., Jornsten, K., & Roonqvist, M. (2010). Cost allocation in collaborative forest transportation. *European Journal of Operational Research*, *205*(2), 448–458.
Gilbert, N. (2008). *Agent Based Models*. Los Angeles: SAGE Publications.
Gino, F., & Pisano, G. (2008). Toward a theory of behavioral operations. *Manufacturing and Service Operations Management*, *10*(4), 676–691.
Herliana, L., & Parsons, D. (2010). *Chapter 22 Logistics in Indonesia*.. https://www.apec.org/-/media/APEC/Publications/2011/1/The-Impacts-and-Benefits-of-Structural-Reforms-in-Transport-Energy-and-Telecommunications-Sectors/TOC/Logistics-in-Indonesia.pdf
Jagoda, P. A. (2013). *Competitive and collaborative conflict strategies*.. http://www.conflicttango.com/competitive-an-collaborative-conflict-strategies/
Kwon, I. W. G., & Suh, T. (2005). Trust, commitment and relationships in supply chain management: a path analysis. *Supply Chain Management: An International Journal*, *10*(1), 26–33.
Lambert, D. M., Emmelhainz, M. A., & Gardner, J. T. (1999). Building successful logistics partnerships. *Journal of Business Logistics*, *20*(1), 165–182.
Liu, P., Wu, Y., & Xu, N. (2010). Allocating collaborative profit in less-than-truckload carrier alliance. *Journal of Service Science & Management*, *3*(1), 143–149.
Macal, C. M., & North, M. J. (2009). Agent-based modelling and simulation. In *Proceedings of the 2009 winter simulation conference*.
Matopoulos, A., Vlanchopoulou, M., Manthou, V., & Manos, B. (2007). A conceptual framework for supply chain collaboration: Empirical evidence from the agri-food industry. *Supply Chain Management: An International Journal*, *12*(3), 177–186.
Mckinsey. (2010). Identifying and assessing horizontal collaboration partnerships. In *Eye for transport conference*.
Nadarajah, S. (2008). *Collaborative logistics in vehicle routing*. The University of Waterloo.
Novani, S., & Mayangsari, L. (2017). *Soft systems agent-based methodology: Multi-methods approach between soft systems methodology and agent-based modelling*. Springer Nature Singapore Pte Ltd.
Okdinawati, L., Simatupang, T. M., & Sunitiyoso, Y. (2015). Modeling collaborative transportation management: Current state and opportunities for future research. *Journal of Operations and Supply Chain Management*, *8*(2), 96–119.
Okdinawati, L., Simatupang, T. M., & Sunitiyoso, Y. (2017). Co-creating value through agents interaction within service network. *Journal of Industrial Engineering and Management*, *10*(1), 49–73.
Peeta, S., & Hernandez, S. H. (2011). Modeling of collaborative less-than-truckload courier freight networks. In *USDOT Region V Regional University Transportation Center Final Report*.
Pomponi, F., Fratocchi, L., & Tafuri, S. R. (2015). Trust development and horizontal collaboration in logistics: A theory based evolutionary framework. *Supply Chain Management: An International Journal*, *20*(1), 83–97.
Prakash, A., & Deshmukh, S. G. (2010). Horizontal collaboration in flexible supply chains: A simulation study. *Journal of Studies on Manufacturing*, *1*(1), 54–58.
Ramaswami, S., & Simatupang, T. M. (2013). Power and trust in supply chain collaboration. *International Journal of Value Chain Management*, *7*(1), 76–96.
Sandee, H. (2016). *Logistic challenges in Indonesia*. Media round-table talk. World Bank Indonesia Office. World Bank Group.
Sargent, R. G. (1986). The use of graphical models in model validation. In *Proceeding 1986 winter simulation conference* (pp. 237–241). Piscataway, New Jersey: Institute of Electrical and Electronic Engineers Inc.
Schulte, F., Lalla-Ruiz, E., González-Ramírez, R. G., & Voß, R. G. (2017). *Reducing port-related empty truck emissions: A mathematical approach for truck appointments with collaboration*.
Simatupang, T. M., & Sridharan, R. (2002). The collaborative supply chain: A scheme for information sharing and incentive alignment. *The International Journal of Logistic Management*.
Silva, V. M. D., Novaes, A. G. N., Scholz-Reiter, B., Frazzon, E. M., & Coelho, A. S. (2010). Proposal of a system of collaborative transportation between manufactured export industries and maritime carriers using the concept of Autonomous

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002

Agents. In *XVI international conference on industrial engineering and operations management (ICIEOM)*.
Stephens, C. (2006). *Enablers and inhibitors to horizontal collaboration between competitors: An investigation in UK retail supply chain*. Bedfordshire: Cranfield University.
Sutherland, J. L. (2006). Collaborative transportation management: A solution to the current transportation crisis. In *CVCR white paper 602*. Pennsylvania, U.S.A.: Lehigh University.
Taherian, H. (2013). *Outbound transportation collaboration do-it-yourself (DIY)*. Thesis Engineering System Division, MIT.
Talavera, M. G. V. (2014). Supply chain collaboration and trust in the Philippines. *Operations and Supply Chain Management*, *7*(1), 1–12.
VICS (CTM sub-committee of the voluntary inter-industry commerce standard logistic committee). (2004). *Collaborative transportation management white paper. Version 1.0.*. http://www.vics.org

Please cite this article in press as: Sitadewi, D., et al. Can rivalling truck companies collaborate? An Indonesian case study. *The Asian Journal of Shipping and Logistics* (2019), https://doi.org/10.1016/j.ajsl.2019.12.002