THE IMPACT OF MARITIME SERVICE IN THE WHEAT SUPPLY CHAIN: EVIDENCE FROM THE AUSTRALIAN-INDONESIAN WHEAT SUPPLY CHAIN

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ABSTRACT

This paper explores commercial and operational impacts of maritime service interruptions from the case study of Australian-Indonesian wheat supply chain. Through the qualitative approach of telephone survey, uncertainties as risk factors for every event of maritime operations emerged in a supply chain network are identified.

KEYWORDS

Maritime service disruptions; wheat supply chain.

1. INTRODUCTION

The concept of the wheat supply chain has essentially evolved through the development of a generic food supply chain model connecting farm suppliers to farmers, marketers, processors, wholesalers, distributors, retailers and final consumers through transport operations including maritime service operations.

Traditionally, the wheat chain structure was a relatively small scale fragmented operation area which was primarily regional and localised (Saltmarsh & Wakeman, 2004). However, due to the trend of global sourcing, the wheat market consequently expanded operationally to a multifaceted chain structure affected by 'consolidation, and commoditisation' of wheat products (Roth et al., 2008, p.23). The complexity of the global wheat chain path furthermore depends on wheat characteristics in transport and handling operations including maritime operations, size of trading volume, and the market power of supply chain members in the wheat industry (Maloni & Brown, 2006). Within one particular flow of the international wheat supply chain, the dynamic performances of wheat flow is affected mainly by sharing of information (Young & Hobbs, 2002) and the effectiveness of vertical chain linkages particularly on maritime services between the points of the original source of wheat to consumers. This includes various disruptions that may occur along the wheat supply chain.

This paper, through the case study of Australian-Indonesia wheat supply chain finds 20 different interruptive events in the wheat supply chain and 31 disruptive events at ports and other maritime service operations including its consequences. The risks frequencies and its impact on the grain terminal are also recognised including the structure of third party logistics (3PL) and fourth party logistics (4P/L) in the chain. By exploring and identifying the impacts, entities in the wheat supply chain may plan an effective response and preparedness as mitigations due to these maritime service impacts. Further, the findings can be utilized as inputs to support decisions on preventing and managing responses when maritime disruptions occur in the wheat supply chain networks.

2. THE TREND OF WHEAT TRADE BETWEEN AUSTRALIA AND INDONESIA

The supply chain structure of wheat from Australia and Indonesia (as appeared in Figure 1) contains a complete process and thus a full logistics and supply chain flow both nationally (domestic) and

internationally in terms of the number and interaction of wheat handlers, processors, distribution centres, logistics agents/representatives, wholesalers, and customers (Gurning & Cahoon, 2009).

In addition, the modes of transport used in transporting wheat among Australia and Indonesia are relatively varied, utilising trucking and rail systems (for land modes) and maritime transport for both domestic and international shipment not only in Australia but also in Indonesia. Moreover, Indonesia dominantly uses maritime transport services more than Australia for distributing wheat products to its various domestic islands. Other factors that may increase the uncertainties within the wheat chain are the interaction of the two supply chain communities of the two countries that have significant disparities of supply chain practices, rules, technology level used, human resource skills, logistic facilities including maritime infrastructures, and mode of transports (Department of Foreign Affairs and Trade 2000). These may be aspects that indirectly adversely impact on the wheat chain which possibly creates uncertainties to disruptive outcomes to the Australia-Indonesia wheat supply chain flow (Instate, 1995). As highlighted by Syamsudin (2008) and Gurning (2008), climate effects come with its impact of drought and severe wave height are the significant interrupting factors in the existing wheat supply chain between the two countries. Droughts in Australia are the fundamental issue of the Australian supply side that affect the production capacity of Australian's wheat to Indonesia market. Similar to the climate issue, Indonesia is facing the major challenge of shipping service availability as the current maritime environment such as severe wave height disturbs the operation of ships and port operations due to the distribution processes to destinations on inter-islands.

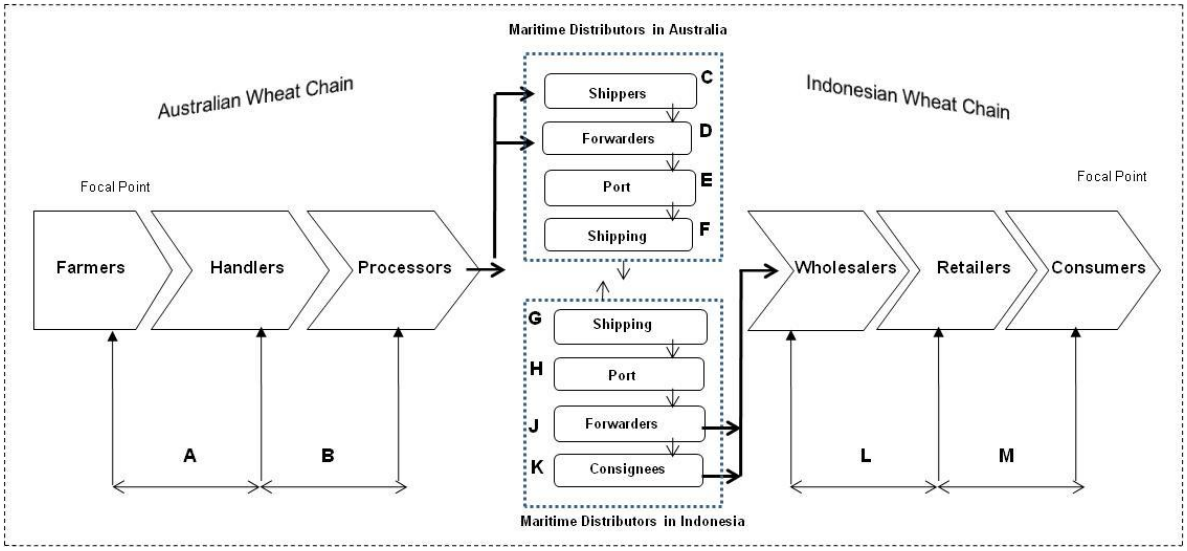

Figure 1. Australian-Indonesian wheat supply chain and the maritime services as a case (Gurning & Cahoon, 2009)

The sufficiency issue of wheat based food such as the noodle type of commodity has become an important basic food of every Indonesia house-hold both in urban and rural area as there is a trend away from the significant consumption basic food from rice to any new derivates of flour products (Ariani, 2003; Fabiosa, 2006). Indonesia has always been highly self sufficient in food but in relation to wheat based commodity, Indonesia relies on imports of wheat and meslin (raw-wheat) from Australia (Newman & Kopras, 1999). There are three main reasons revealed from the wheat industry in Indonesia regarding why Australia has become the top supplier of wheat to Indonesia. First is because of geographical advantage in terms of shorter distance between two countries when compared to other wheat resources such as India, Europe, North and South America (Byrnes & Nirang, 2000; ITS-Global 2006b).

This reason consequently may create a more competitive price of wheat or flour based commodities to Indonesia markets. The second reason relates to Australia's reliability and consistency in contributing to the international market which Indonesia needs to guarantee the availability of wheat for Indonesia markets. (Bogasari, 2007; Purnama, 2006). Based on the report of the Canadian Wheat Board (2007), in 2005 Australia produced about 4 per cent of the global production of wheat which was about 609.5 million-tons (MT) in 2005. However up to 2007, the exportation of wheat from Australia was about 40 to 60 per cent annually (as in Wheat Exports Australia 2008). This productivity is relatively higher than Asian countries such India, China, and Europe which predominantly used production for domestic

consumption (as in Food and Agriculture Organization 2008b). The third reason why Australia is the top supplier of wheat is due to preference factor of the wheat quality produced from Australia which is favourable to Indonesia' customers in terms of its taste and colour (Bogasari, 2007; N.A, 2003; Wijaya et al., 2005). This is the important fact that Australia wheat-product has been a significant choice of most Indonesia's consumers which potential ensure the continuity of Australia and Indonesia wheat trade. As a basic food mainly in Asia, Africa and Europe, wheat products are imported from main wheat global exporters such as Canada, United States of America, China, Argentina, Australia, India, and Ukraine (Australian Bureau of Agricultural and Resource Economics 2007; Food and Agriculture Organization 2008a).

In the case of Australia and Indonesia, there are eight main grades of wheat which have commonly traded and considered the transportation requirements based on its particle size index and protein content. The eight main grades are standard white (ASW), premium white (APW), standard hard (APH1), extra hard (APH13), standard noodle (SWN), soft, extra soft and durum wheat (as stated in Australian Wheat Board 1998; Coombs, 1994; Williams, 1998). In addition, in terms of uses of wheat in these two countries, these eight common wheat commodities have been significant for the wheat industry clustered in five main uses such as starch and industrial wheat, durum wheat for pasta, novelty wheat (purple wheat) for beverage, wheat for ethanol production and fodder wheat for hay, chaff, and grazing (as in Anderson & Garlinge, 2000a).

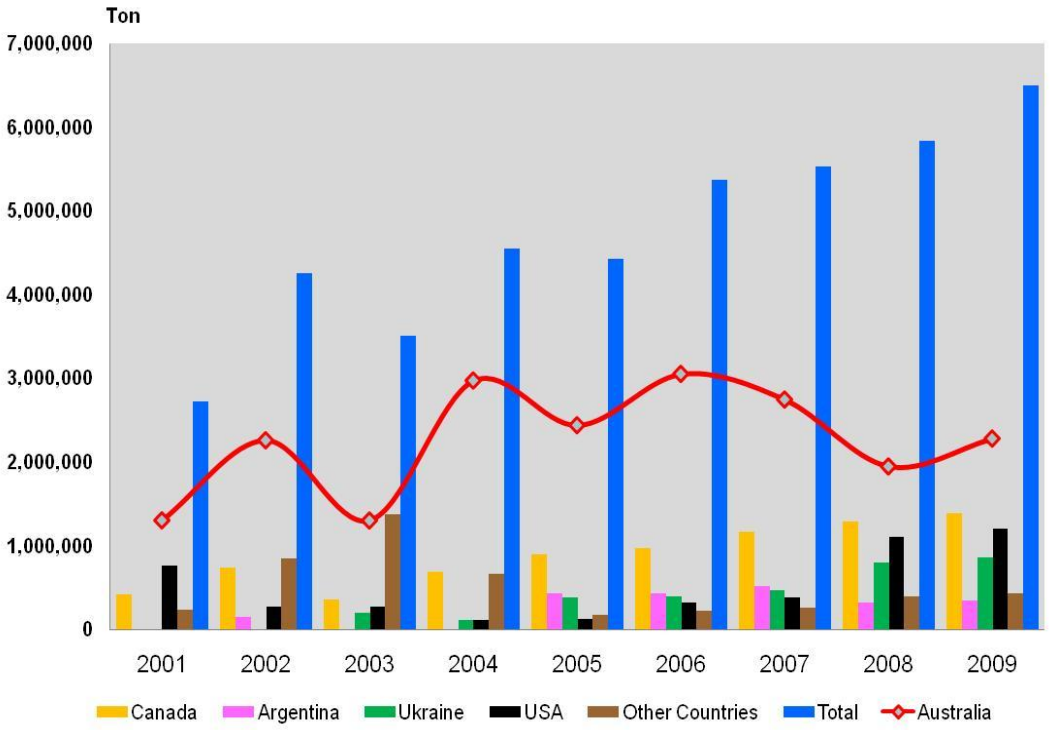

Figure 2. The trend of importing wheat source of Indonesia over 2001-2007 (BPS 2007-2010)

The other factor that has been considered for wheat trade between Australia and Indonesia is the reason of geographical variety of wheat source from Australia. In many cases of shipment process, quality uncertainty usually becomes a main problem confronting buyers and sellers especially in the stage of shipment process of wheat commodity (Asosiasi Produsen Tepung Terigu Indonesia 2003; Asosiasi Produsen Tepung Terigu Indonesia 2007b; Badan Urusan Logistik 2007; Wheat Exports Australia 2007). Further, William et al (2004b) found that the variability of functional performance happened in the process of wheat shipment due to varietal differences, agronomic practices, environmental conditions, handling, and marketing practices in the global wheat trading.

In general, seaborne trade between Australia and Indonesia in the period 2001-2009 as mentioned and explained in Figure 2 shows the dominance of bulk consignment compared to containers. This means that

shipping traffic for Australia-Indonesia over that period was dominated by tramp bulk shipping and is supported by bulk terminals. In addition this also the case of wheat trade between these two countries with shippers and consignees commonly deals with large parcels of commodities to be transported in longer period of shipping contract relatively at list for about one year contract (Gunawan, 2007). The orientation of Australian wheat trade to Indonesia is such that ships generally call at several main terminals on the island of Java (Tanjung Priok Port, Tanjung Emas Port, Tanjung Perak Port), Sulawesi Island (at Makassar Port), in Sumatera (at Belawan port), and in South Kalimantan (Banjarmasin Port). At unloading ports in Indonesia, the wheat shipments are received by unloading facilities and transported by trucks for inland distribution, which are the dominant mode for wheat distribution to the various millers and shipper premises in Jakarta, Semarang, Surabaya, Medan, Makassar, and Banjarmasin. Gurning and Grewal (2007) investigated the dry bulk flow trend between Australia and Indonesia. They found that about 25 per cent of Indonesia bulk cargoes called at the Port of Townsville (Queensland), 22 per cent at Newcastle, 32 per cent at Port Hedland (West Australia), and the remaining about 20 per cent at Gladstone, Broome, Darwin, and Wyndham. Furthermore, it was found that from Australia, the bulk commodities predominantly called at Tanjung Priok Port and Cigading Port (65 per cent), with around 30 per cent going to Tanjung Perak Port and other 5 per cent calling at various other ports in Indonesia (Gurning & Grewal, 2007). Further it was also predicted that the potential market of transportation service for dedicated bulk cargo type especially on dry-bulk cargo could be increased probably about 10-15 per cent due to the expansion of various agricultural and mining products both by Australian and Indonesian producers.

3. UNCERTAINTIES IN THE WHEAT SUPPLY CHAIN FROM LITERATURES

Over the period when wheat supply chain design decisions are in effect, changes of supply chain performance are identified beyond the assumption predicted in the planning stage. Those changes such variety of transportation costs, demands, the origin of supply sources including the factors of distances, and lead times may fluctuate widely (as discussed in Abbas & El Deen Aly, 2004; Bertrand, 1996) . However, supply chain optimization models have traditionally treated the wheat supply chain with certainty and frequently ignore some unpredicted events as disruptions and disaster due to resource limitation (for example Julie et al., 1998; Titus & Dooley, 1996; Young & Hobbs, 2002).

3.1. Interruptive factors

Similarly in the design of wheat transportation, the main aspect of wheat chain management with uncertainty events has been considered widely in the literature. However in general, those assumed that probability distributions of the uncertain parameters of transportation operation in wheat chain are given (for example Abbas & El Deen Aly, 2004; Anderson & Garlinge, 2000b; Canadian Wheat Board, 2003; Julie et al., 1998; Ryan, 1984; Sorenson, 1973; Titus & Dooley, 1996; Tucker & Brester, 1997; Uhm, 1986; William et al., 2004a; William et al., 2004b). In fact, when uncertainty events are occurred, the impact of those events on wheat supply chain may widely transform the whole chain into a stage where various services provided are interrupted.

In reality, however, operational parameter estimation may be inaccurate due to poor forecasts, measurement errors, changing demand patterns of wheat commodity, inadequate facility of sea transport, managerial problems or other factors. Moreover, even if all of the variables of the wheat supply chain are known with certainty, the system may realise any type of disruptions from time to time and in the case of wheat and its derivative products for example, these may be due to inclement weather, sea-terminal congestion, marketing systems and dry-bulk fleet shortage (for example as discussed in Jayne & Myers, 1994; Lian Qi, 2007; Ljungberg, 2006; Song et al., 2005; Sorenson, 1973; Titus & Dooley, 1996; Wilson & Dahl, 1999). Therefore, a significant attention paid to maritime disruptions in wheat supply chains is needed. As the wheat industry is more vertically integrated than in the past, and its supply chains are increasingly global (as stated in William et al., 2004a; Young & Hobbs, 2002).

Consequently, the globalisation of wheat may lead to more complexity level of the wheat supply chain and subsequently more difficult to handle if one uncertainty event occurred particularly on maritime operation. Brack (1998, p.36) argued that the disruption effect was never as 'local evident stage'. Further, the effects tend to cascade through the system, with upstream disruptions causing down-

stream 'stock-outs' and thus inconsistency in supply. Therefore, it may be presumed that the impact of maritime disruption on wheat supply chain may be taking place in and from each phase of the wheat supply chain. In general, similar to other uncertainty applications (for example Snyder, 2006; Yu & Qi, 2004), there are two types of uncertainties that occur in wheat chain; supply uncertainties (as per Acil, 2006; David, 2007; Gurning & Grewal, 2007; Pol, 2007; Quigley, 2007; Reuven, 2007; Wheat Exports Authority 2007; William et al., 2004b; Wilson, 2001) and demand uncertainties (for example Canadian Wheat Board 2007; Food Agricultural Organisation 2008b; Its-Global, 2006a; Robert, 2007; Robert & Sylvain, 2007; Wheat Exports Authority 2007). Moreover, actors from farmers to final consumers in the wheat supply chain used similar strategies such as holding extra inventory, using multiple suppliers (as in Anupindi, 1993), or improving their forecasts in order to protect against both supply and demand uncertainties (Kleindorfer & Saad, 2005; Larry et al., 2004; Qi & Shen, 2007).

Those applications above highlight a need for new approach of responds that incorporate various forms of uncertainty including maritime disruptions into strategic decisions about wheat supply chain design. In addition, there is a trend towards a new demand for wheat consumers for bio-fuel application for human and animal food markets (Food and Agriculture Organization 2008a; Organisation for Economic Co-operation and Development 2007; Saha et al., 2004.). As maritime disruptions exist in all wheat supply chains, no wheat supply chain and logistics system, or its flow network is resistant to these risks. In specific, existing wheat supply chain between Australia-Indonesia is taken as the case of this study. The reason for utilising the Australia-Indonesia wheat supply chain is mainly due to the complexity of the wheat supply chain reflected in the different structures, interactions, and problems that the two country players face for wheat trade between the two countries. As a complexity and variety of factors exist, it may be assumed that uncertainties and disruptive events are the most probable consequences (as in Arns et al., 2002). Blackhurst et al. (2005; 2004) explored one particular supply chain characterised by their complexity and also by the inherent uncertainties in their operations. In relation to this, it can assumed that the wheat supply chain between Australia and Indonesia may perform a significant complexity of one particular supply chain on which, various uncertainties and disruptive events are probably existed.

3.2 Maritime entities of wheat handlers

Shipping, port operation, forwarding activities, and the relationship linking shippers and consignees are the major maritime units dealing with handling and distributing wheat commodities. Figure 2 shows the entities of wheat handlers in maritime services. Institutions such quarantine and custom office are two crucial parts in the process of wheat handling at ports both in the stage of loading and unloading process. Other transport providers for inland transport such as trucking and rail services additionally are the other principal transportation provider in relation to wheat chain in inland region.

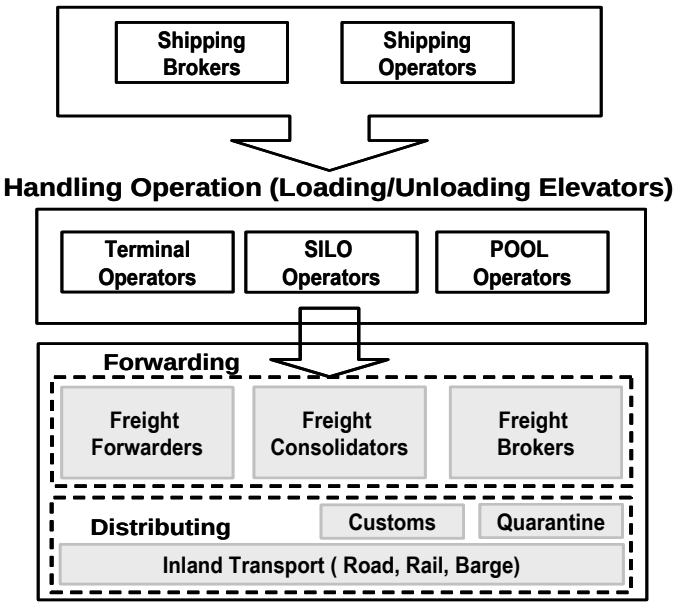

Figure 3. Structure of maritime entities as wheat handlers

The shipping sector is involved in the majority of maritime operation which shipping companies as fleet operators and shipping brokers playing a substantial role in transporting wheat globally. Bulk commodities carried in bulk ships represent the largest segment of international wheat shipping task compared to container services. Bulk transport in the shipping service carried for nearly 84 per cent of the total volume of global wheat trade and 15 per cent of its value (Bushell, 2007; Clarkson, 2007; Canadian Wheat Board 2007). They include services related to shipping freight regarding to wheat transport including fleet arrangement for specific regional routes. Another significant operation of the Australia-Indonesia wheat shipping market is the handling operation of wheat at ports. In general, operators providing services as loading or unloading elevators in this zone are terminal, Silo, and Pool operators (Department of Foreign Affairs and Trade 2007).

Terminal operators publicly provide its handling service for all users regardless the ownership of the wheat. Oppositely to terminal operators, Silo operators, they exclusively handle their own wheat cargoes due to the specific type of wheat commodities handled. Whereas Pool operators provide its handling services for several dedicated groups or the integration of several wheat traders or millers. The next stage which affects the logistical flow's effectiveness of wheat consignment relies on the process of forwarding services to which shippers and consignees are required to deliver and receive their cargoes. The situation of Indonesia and Australia seems to have similar condition where stronger forwarding positions are the observable facts compared to their shipping and port industries (Blankfeld & Fritz, 2001; Spiers, 2002). The forwarding services in practice are carried out by forwarders, consolidators, and freight brokers. There is also a need to fulfill any governmental or international regulations on wheat quality during the maritime operation in terms of fumigation, quarantine requirements and also customs procedures. Based on exploration study of the research by Gurning and Grewal (2007) found that that maritime plays a significant function in terms of costs used for one certain chain of wheat from Australia to Indonesia. They estimated that in average maritime related services contribute about 21 per cent of total contract value. The three major cost items related to maritime service are any costs correlated to cargo such freight, fumigation, AQIS, and Port fees which contribute about 9 per cent any correlated to sea freight including the insurance which also about 9 per cent and any related costs to port handling and clearance charges about 3 per cent of total contract value. Further, Gunawan in 2007 estimated that the portion of maritime per centage could increase due to continue rising of ship freight of dry bulk fleet especially for grain transport.

3.3 Structured maritime services for wheat chain

In general, the transportation terms are negotiable items for both consignees and shippers in Australia and Indonesia. For maritime related activities of wheat chain from Australia (farm gate) to Indonesia have a number of transportation arrangements levels such as silo delivered or delivered to processors, delivered port, pool delivered, free on board (FOB), and cost insurance freight (CIF) (Bushell & Macaulay, 2007; Wilkinson & Henderson, 2000). These arrangements as explained in Figure 4 which includes the pricing mechanism among farmers, traders (buyers or sellers), and marketing controllers. Wheat traders among two countries regularly use CIF (cost, insurance freight) and FOB (Freight on board) for trade terms depending on price level of wheat, volume of wheat imported, number of voyages, and type of consignment used (Anderson & Garlinge, 2000b; Aptindo, 2007a; Bogasari, 2007; ITS-Global 2006b).

The respondents were asked some confirmatory questions concerning their experience on maritime disruptive events along the wheat supply chain to ensure that the relationship of maritime disruptions and the Australian-Indonesian wheat supply chain being examined actually reflected the descriptions prescribed by this research. They were asked to provide an estimation of the frequency of maritime disruptive events, the level of previous consequences, impact level and future probability of occurrence.

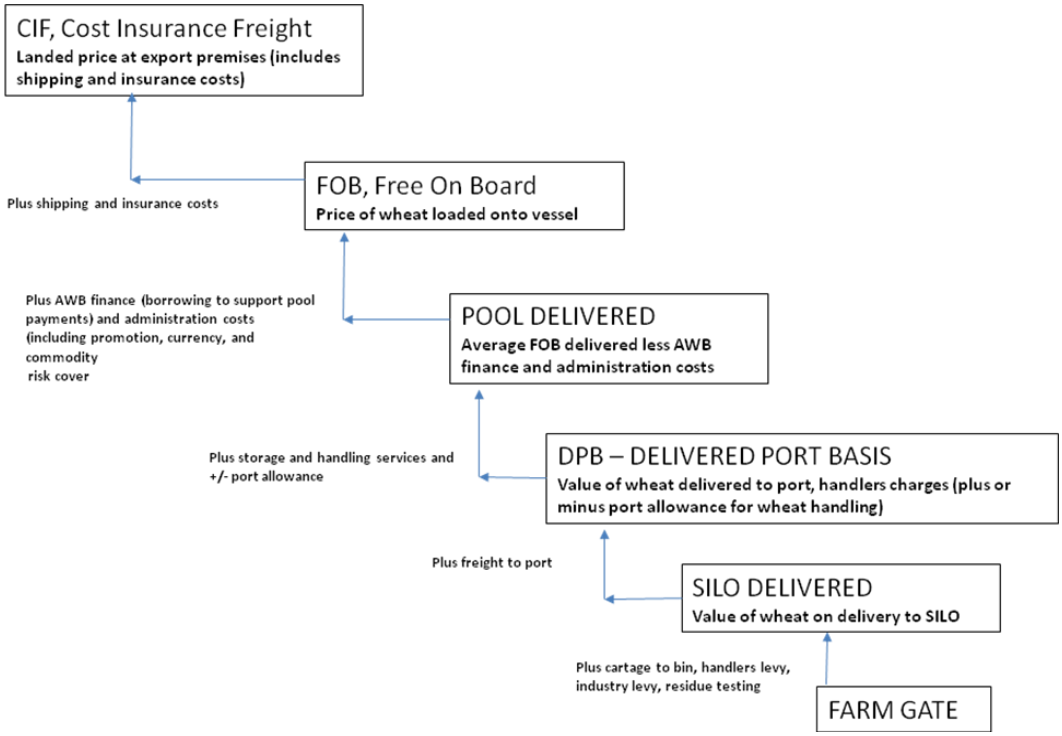

Figure 4.Wheat trading terms and its transport process
(Adapted from Wilkinson and Henderson, 2000)

4. MARITIME DISRUPTION STUDY BY TELEPHONE SURVEY

Maritime disruption study through telephone survey has been carried out to cover the research questions about impacts on maritime services transporting wheat commodities from Australia to Indonesia. Accordingly, a qualitative survey approach is selected to collect data of previous maritime disruptive events (in the period of 2007-2009) and its consequences on wheat supply chain. In addition, in order to get a systematic collection of data from a population sample of wheat supply chain entities, telephone interview is selected with a standardized questionnaire. As well as direct interaction with individual entities of wheat supply chain on one to one basis or in a group setting is possible to be achieved.

By doing this approach, a sampled of potential respondents both in upstream and downstream clusters of the Australian-Indonesian wheat supply chain from the general population may be derived. Of all the methods employed in qualitative surveys, telephone survey is the preferred choice to maximise response rates, as well as to maintain control over the quality of the data as it may produce a relatively high response rate compared to other qualitative approach especially for face-to-face interview (Cahoon, 2004; Fowler, 2008; Leon et al., 2005; Vaus, 2002). Further, as the study has a limitation of research funding, therefore telephone survey is one method which may incur efficient cost for gaining data (Saunders et al., 2009; Zikmund, 2007). Also, telephone surveys allow for data to be collected in a complete and accurate format with an acceptable level of total error at the time of the interview (Gray et al., 2007; Groves et al., 2004; Rubin & Rubin, 2004). Furthermore, the benefits of using this technique include richness of data and deeper insight into the phenomena of maritime disruptions on wheat supply chain under this study. However in order to avoid time consuming of data collection process of entire population of Australia-Indonesia wheat supply chain, smaller numbers of people were chosen with a sample frame. In total 50 firms were contacted from the stratified population frame of 151, and 34 interviews were conducted giving an effective conservative response rate of 68 per cent. Whilst other respondents about 32 per cent

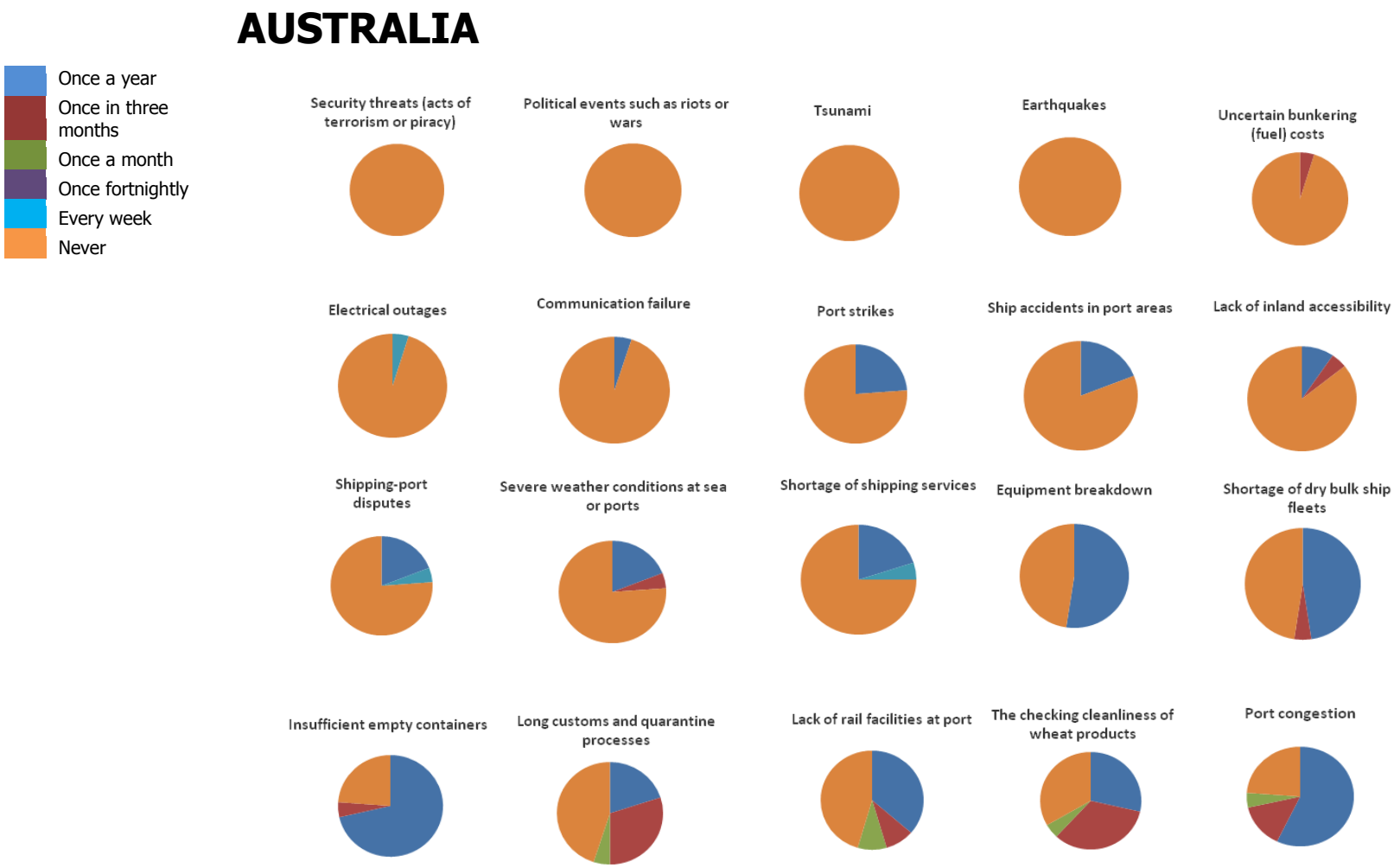

Figure 5. The frequency of 20 maritime disruptive events in Australia

INDONESIA

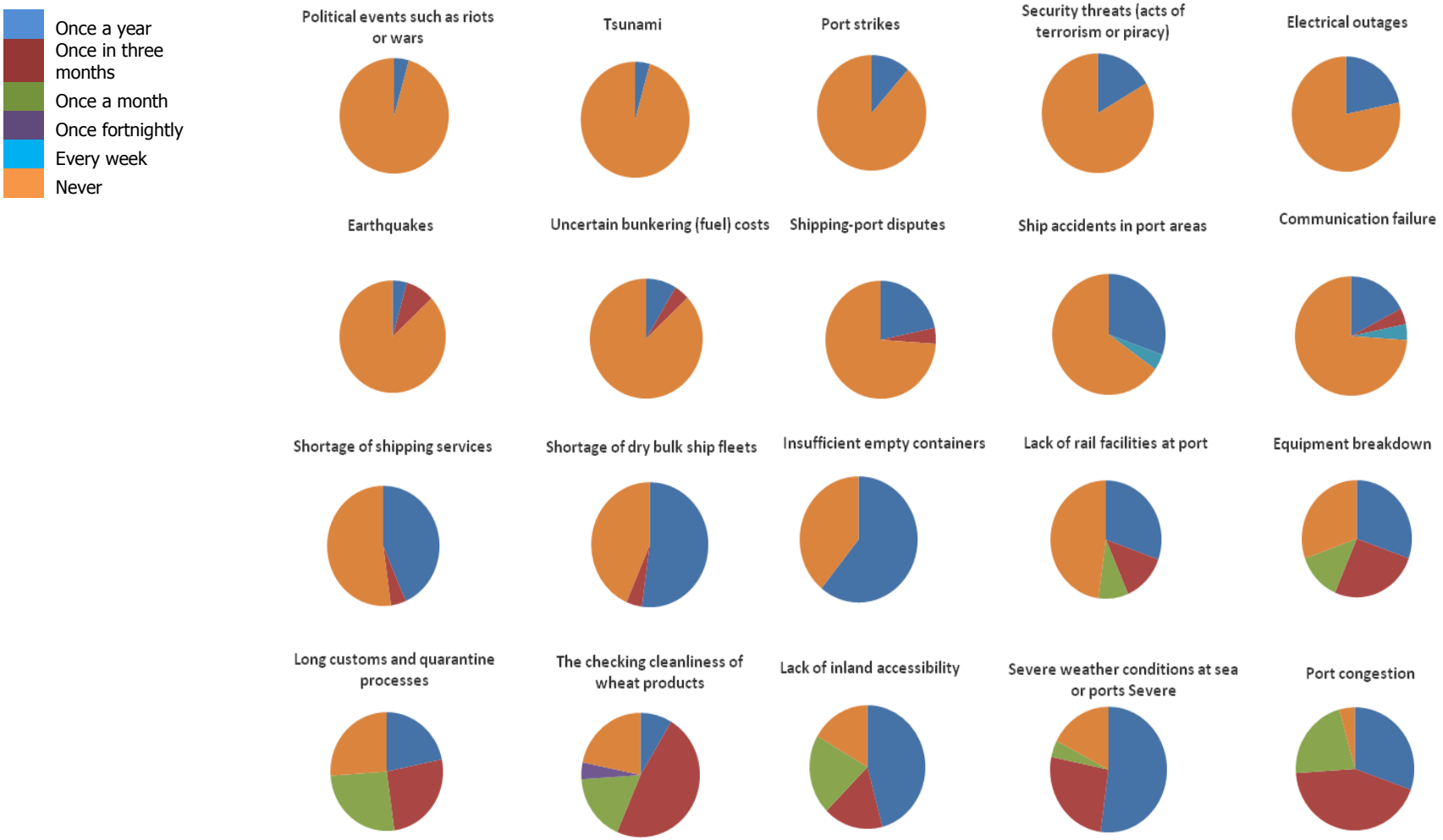

Figure 6. The frequency of 20 maritime disruptive events in Indonesia

were unwilling to participate due to sensitivity issues of their companies, 6 per cent because of the hectic period of harvesting time, and 4 per cent with no reasons at all. Of the remainder, about 10 per cent were unwilling to participate due to sensitivity issues of their companies, 8 per cent because they were busy due to the harvesting period, and 4 per cent provided no reasons.

4.1 Frequency of maritime disruptive events in Australia

For the research survey, each respondent was asked to inform the frequency of 20 given potential maritime disruptive events in the period of 2007-2009 (as shown in figure below). Six alternatives were provided such as once a year, once in three months, once a month, once fortnightly, every week and never for both supply chain area of Australia and Indonesia. For Australian supply chain area (as seen in Figure 5 below), security threats, political events, tsunami, and earthquake are maritime risks that were not occurred in the period of research. Whilst uncertain bunkering cost, electrical outages, communication failure can be categorised as low frequency level as it was occurred below 10%. For the frequency level of 10% to 50%, the middle risk frequency are port strikes, ship accidents in port area, lack of inland accessibility, shipping port disputes, severe weather, and shortage of shipping service. Lastly, the high frequency level (for the level more than 50%) are shortage of dry bulk of ship fleets, insufficient of empty containers, long quarantine process (for the checking cleanliness of wheat products), lack of rail facilities, and port congestion. From the survey, two maritime disruptive events namely port congestion and insufficient empty containers have the highest frequency response of 74% or it occurred once a year during 2007-2009.

4.2 Frequency of maritime disruptive events in Indonesia

Different from Australia, the frequency of various maritime disruptive events have occurred along the Australia-Indonesia wheat supply chain. For Indonesian supply chain area (as appeared in Figure 6 above), political events and tsunami are the low frequency level of maritime disruptive events along the chain. The frequency level of 10% to 50% such as port strikes, security threats, electrical outages, earthquake, uncertain bunkering cost, shipping port disputes, communication failure and shortage of shipping services were the middle frequency level of maritime disruptive events. Whilst the high frequency level of more than 50% were shortage of shipping service, shortage of dry bulk of ship fleets, insufficient empty containers, lack of rail facilities, equipment break-down, long custom and quarantine process (for the checking cleanliness of wheat products), lack of inland accessibility, severe weather and port congestion. Overall, in the period of 2007-2009, three maritime disruptive events namely port congestion, lack of inland accessibility and severe weather conditions were the highest frequency level of maritime disruptive events along the wheat supply chain in Indonesia.

4.3 Operational impacts of maritime disruptive events at port

In relation to operational impacts, all respondents were asked one question concerning three possible consequences of 31 disruptive events at ports to ensure that the impacts being examined actually reflected the existence of maritime disruptive events recognized by this research.

Three possible consequences examined are port stoppages, reduced port operations, and no impacts at all or (not applicable). The table 1 above shows that the majority of the maritime risk consequences reduced port operations (in terms of delay and deviation of planned operations), whilst the events of queuing, severe weather, port strikes and insufficient handling equipment may generate port stoppages condition (total unavailability of port services). This finding is consistent with previous research where individual maritime disturbances were correlated with a short-term consequences (such delays and deviation) and extensive unavailability of port services with a long-term orientation (Vanags 2002; BearingPoint 2005; Pinto and Wayne 2006; Pettit 2007; Garcia 2008; Guerrero et al. 2008; Gurning and Cahoon 2009).

Table 1. The profile of disruptive events and its impacts

Possible disruptive events	Port Stoppages	Reduced Port Operations	Not Applicable
Problems in a nearby ship anchoring area of a port	6 (19.4%)	21 (67.7%)	4 (12.9%)
Coastguard delaying boarding and clearance	5 (16.1%)	20 (64.5%)	6 (19.4%)
Ship collisions	5 (16.1%)	22 (71%)	4 (12.9%)
Ship shortage	6 (19.4%)	20 (64.5%)	5 (16.1%)
Hazardous spill	3 (9.7%)	21 (67.7%)	7 (22.6%)
Low tide period	4 (12.9%)	17 (54.8%)	10 (32.3%)
Severe waves	10 (32.3%)	13 (41.9%)	8 (25.8%)
Queuing or congestion	16 (51.6%)	11 (35.5%)	4 (12.9%)
Strong winds	2 (6.5%)	19 (61.3%)	9 (29%)
Lack of pilotage and tug-boat services	5 (16.1%)	22 (71%)	4 (12.9%)
Port strikes	8 (25.8%)	17 (54.8%)	6 (19.4%)
Cranes and/or grain elevators disabled	3 (9.7%)	22 (71%)	6 (19.4%)
Breakdown of straddle carriers in shop	4 (12.9%)	20 (64.5%)	7 (22.6%)
Shortage of chassis and/or choppers	5 (16.1%)	19 (61.3%)	7 (22.6%)
Fire accident on a ship while at port	6 (19.4%)	16 (51.6%)	9 (29%)
Insufficient handling equipment	7 (22.6%)	19 (61.3%)	5 (16.1%)
Earthquake	2 (6.5%)	10 (32.3%)	19 (61.3%)
Tsunami	2 (6.5%)	2 (6.5%)	27 (87.1%)
Port facility failure such as water distribution systems	0 (6.5%)	15 (48.4%)	16 (51.6%)
Heavy rain	2 (6.5%)	18 (54.5%)	11 (35.5%)
Unavailability of empty containers	0 (0.0%)	29 (93.5%)	2 (6.5%)
Terminal information system failure	1 (3.2%)	23 (74.2%)	7 (22.6%)
Shortage of storage or silo area	5 (16.1%)	18 (58.1%)	8 (25.8%)
Insufficient container storage area	3 (12.9%)	22 (71%)	6 (19.4%)
Clearance of medical and quarantine checks	0 (0%)	25 (83.9%)	6 (19.4%)
The checking cleanliness of wheat products	0 (0%)	28 (90.3%)	3 (12.9%)
Customs clearance delays	0 (0%)	24 (77.4%)	7 (22.6%)
Delay of immigration processes	0 (0%)	23 (74.2%)	8 (25.8%)
Insufficient road transport infrastructure	1 (3.2%)	24 (77.4%)	6 (19.4%)
Downstream intermodal problems such as inland	3 (9.7%)	23 (74.2%)	5 (16.1%)
Transport contractual disputes	3 (9.7%)	20 (64.5%)	8 (25.8%)
Answered question			**31**
Skipped question			**3**

4.4 Third and fourth party logistics controlling maritime process in the chain

Trechter & Murray-Prior (2003) suggested that the bargaining power in supply wheat chains is relatively controlled by dominant agribusinesses corporation in the chain rather than individual farmers. Further, in relation to this, Rubzen et al. (2005) explained that oligopolistic firms controlling various stages in the wheat supply chain both in upstream (input suppliers) and downstream (food processors/manufacturers and retailers) are entities that farmers or growers have to deal their commodity especially for international trade. In relation to this, the study on maritime disruption through telephone survey has found that the structure of bargaining power in the wheat supply as recommended by Trechter and Murray-Prior (2003) and Ruben et.al (2005a).

Further, through the interviews it was found that there are third and fourth party logistics (3PL/4PL) in the Australia-Indonesia wheat supply chain connecting and also controlling the bargaining power including maritime operations. For example, a respondent commented:

> *We really rely on the role of some export agencies. These agencies are the party that control and arrange the flow of our cargo from Australia to Indonesia. Including the transport or shipping process to load wheat from ports in Australia*.
>
> - *CEO, wheat buyers*

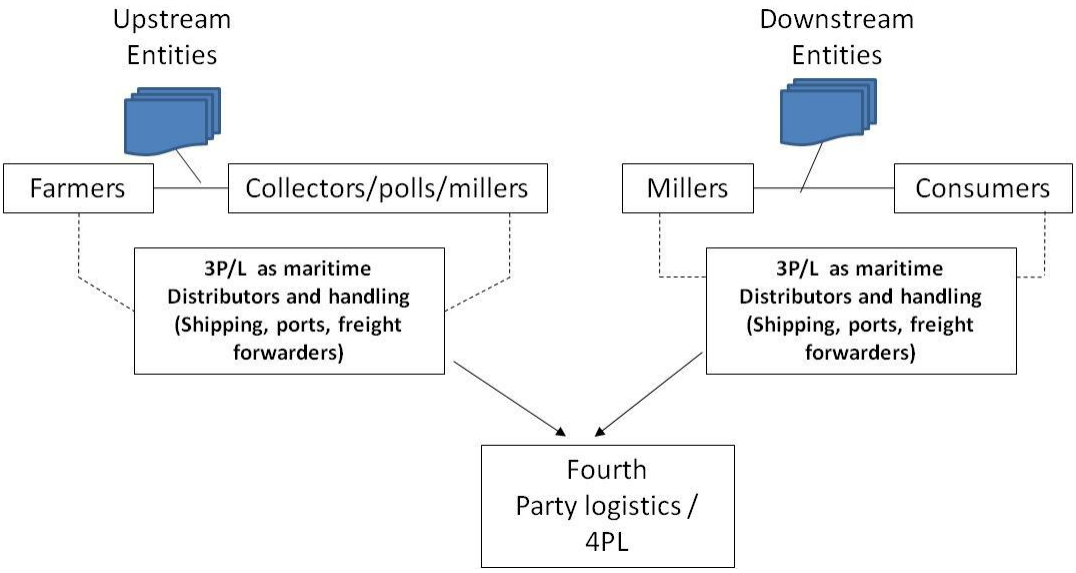

Figure 7. Existing supply chain entities controlling transport services

Figure 7 above shows the general roles and controlling power of third and fourth logistics parties dealing with transportation process of wheat from Australia to Indonesia as results of the telephone interview. Following the concern discussed about, those parties as informed by respondents may take their roles as wheat collector, millers or the owner of pooling centres, export agencies, export authority, and wholesalers are existed both in Australia chain and also in Indonesia chain. In terms of their function on maritime operations, third party logistics have their own shipping fleet and control major grain terminals in each side of the market. For example, respondents reported:

> *In our case, the agencies decide the port of call and volume to load in one period. Sometimes, it is quite hard to get our schedule on time as we found that they frequently change the route of our ships. Their functions seem similar like AWB (Australian Wheat Board) before.*
>
> - *CEO, wheat buyers*

> *We offer services for containerised shipment from Australia to Indonesia for raw wheat and vice versa with manufactured products of wheat to Australia. But, during these two years, we never have contracts with millers here (Indonesia) as they owned their fleets but mainly dry bulk. We always had shipment contracts with third party logistics mainly from those in Australia. So the freight, additional shipping costs including risks of cargo and demurrage were arranged in our shipment contracts. That's for sure.*
>
> - *Bulk shipping manager*

In support to this, inland transport facilities and between the third parties of the market is connected with the fourth logistics party as marketing agent or wheat marketing bodies. For example, one respondent commented:

> *However, in terms of market channel, buyers in Indonesia are free to establish our business relationship not only through one single body like AWB but sources may come through pooling centres, millers, collectors, or grower associations. On top of that, we still have to deal with several*

bigger players there which also control the supply chain process of the wheat from Australia. These companies are agencies who connect Australia distributors to us here. Or even, they also are the distributors and the buyers. So, once the cargo was unloaded in Indonesia, and then we may control and monitor our chain here.

- *CEO, wheat buyers*

5. CONCLUSION

The paper has confirmed that supply chain disruptions in maritime service exists and contributes to the wheat supply chain between Australia and Indonesia, trough the changes of supply chain performance in terms of time and costs. In general, respondents of the maritime disruption survey determine that the lacking infrastructures of maritime and inland operations have been found as evident of generating disruption mainly due to inadequate of handling equipment, availability of terminal, congestion due to equipment breakdown, insufficient rail facilities, and severe weather conditions.

Through the study of maritime disruptions, it is found that there is a competition problem of loading accessibility in the chain that contribute significantly to the recurrent delays of wheat transport. Consequently as a result, mitigations and responses of entities along the chain are relied upon external factors of their organisation such as third or fourth party logistics (3PL/4PL).

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