SUPPLY CHAIN EFFICIENCY ON THE MARITIME CONTAINER SHIPPING MARKETS – SELECTED ISSUES

Jędrzej Charłampowicz
Gdynia Maritime University, Poland
E-mail: j.charlampowicz@wpit.am.gdynia.pl

Received: May 13, 2018
Received revised: July 4, 2018
Accepted for publishing: July 4, 2018

Abstract

Higher market concentration in the Maritime Container Shipping Market means that supply chains need to adapt to rapidly changing market conditions, where dominant role is played by top container operators. Strongly integrated supply side of the market impacts on the efficiency of supply chains passing through it. Strategic alliances enhanced this phenomenon. In this state of affairs, the most suitable supply chain strategy is resilient, which main characteristics are operating free of errors in an unpredictable and full of disruptions situations and despite of these failures managing to fulfill its tasks and deliver its products or services. The aim of this paper, based on literature review, is an attempt to discuss selected issues of the supply chain efficiency on the MCSM and develop efficiency indicators for SC passing through MCSM with respect to time and cost.

Key words: maritime container shipping market, supply chain management, measurement of efficiency, supply chain efficiency, market concentration

1. INTRODUCTION

Introducing containers to the global trade was revolutionary and game-changing event. Maritime Container Shipping Markets (MCSM) are one of the fastest developing transportation branches. Since the beginning, boxes have influenced on whole transport systems. The need for adaptation of ports, vessels and inland infrastructure and suprastructure has become one of the main factors in achieving competitive advantage, also on the local as well as on the global level. The readjustment of cargo handling equipment in ports, as well as in vessels, has significantly reduced transportation costs (Lee & Song, 2017, p. 442). Those activities have led to continuation of development of the maritime container shipping. This evolution was made by joining new participants to the market, such as e.g. specialized container carriers or container terminals operators. The rearrangement of the legal regulations was likewise necessary. Those actions also prompted further processes that helped in the global trade liberalization. Containerization is considered to be one of the main impulses for globalization in the 20th century (Bernhoffen et al., 2016, p. 36).

Nowadays, the trend of the costs reduction is still one of the most important factors in the industry. For container shipping operators it is achieved through introducing mega container ships, slow-streaming strategy and further market consolidation. All these activities influence on the global supply chain, where, with respect to spatial and time matters, maritime shipping is the longest link. Supply chains passing through MCSM are liable for any disruptions and this is the reason why SCM, understood as the combination of the relations between production, distribution and suppliers, has become such an important matter (Caniato et al., 2013, p. 286). The management of the SC in order to delivering higher value for the final customer can be achieved by increasing the efficiency of each link and whole chain.

The issue of supply chain efficiency is an area of interest for many researchers (Brandenburg, 2016; Beamon, 1998; Gunasekaran et al., 2004; Mathivathanan et al., 2017; Banaszewska et al., 2012; Charłampowicz, 2017). In spite of this, however, there has not been much space in the literature devoted to the discussion of the maritime container shipping markets with reference to supply chain efficiency.

The aim of this paper, based on literature review, is to make an attempt to discuss selected issues of the supply chain efficiency on the MCSM, in spite of time and cost and develop the efficiency indicators for those supply chains.

This paper is divided as follows:

- Section 2 reviews the literature on the resilient supply chain management strategy, chain efficiency and its performance;
- Section 3 provides a brief overview of the supply side of the MCSM;
- Section 4 discusses the characteristics of the MCSM in context of the SC efficiency and presents SC efficiency indicators
- Section 5 describes research limitations and further research directions;
- Section 6 presents final conclusions.

2. SUPPLY CHAIN MANAGEMENT (SCM) – OVERVIEW OF THE SELECTED LITERATURE

2.1. Resilient Supply Chain Management

The liberalization of the global markets has influenced on the decision-making processes. Time required to proper reactions has been shortened. The ability to possess the vulnerable information and know-how has become one of the main factors in gaining competitive advantage. Supply chain management was an answer for the rapidly changing market environment, increasing customers requirements and technology advances. Its primary tasks are to integrate and coordinate processes and relationships between members within chain. Those duties has to be fulfilled in context of maximizing added value, which translates into surplus values throughout the supply chain. The strategy of the SCM should be chosen with respect to the market characteristics and the specificity of the goods. The most popular strategies include include *lean* (Kisperska-Moroń & De Haan, 2011; Charłampowicz, 2016; Stratton & Warburton, 2013; Nieuwenhuis & Katsifou, 2015), *agile* (Purvis et al., 2014; Christopher, 2000; Stratton & Warburton, 2013; Kisperska-Moroń & De Haan, 2011;

Charłampowicz, 2016; Nieuwenhuis & Katsifou, 2015) and *resilience* (Kamalahmadi & Parast, 2016; Carvalho et al., 2012; Kristiano et al., 2017; Charłampowicz, 2017). For the purpose of the conducted research, only the resilient strategy has been briefly reviewed.

The resilience methodology emphasizes dynamic, unforeseen and even unknown types of threats, disruptions, complex interactions and uncertainty (Jain et al., 2018, p. 61) In the context of SC resilience refers to the ability of the SC to return to the original state, or new one, even more desirable, after experiencing disruptions (Ruiz-Benitez et al., 2017, p. 850). (Elleuch et al., 2016, p. 1449) proposes similar definition, where the concept of supply chain resilience, has to do with the ability (possibility) to operate free of errors in a situation full of disruptions and to return to the initial state after the disruptions disappear. According to (Brusset & Teller, 2017, p. 60) the truly resilient supply chain has the ability to fulfill its tasks, operate normally and deliver its goods/services despite of the unpredictable changes and other disruptions, of the internal nature as well as external. (Ribeiro & Barbosa-Povoa, 2018, p. 115) identified four main pillars connected with supply chain resilience: stage adaptive response, speed, performance level and focus event. Based on above framework and extensive literature review (Ribeiro & Barbosa-Povoa, 2018, p. 116) proposed definition of the resilient supply chain, in which RSC is a chain, that should be able to prepare, respond and recover from disruptions and afterwards maintain a positive steady state operation in an acceptable cost and time.

(Liu et al., 2017) propose four components of the RSC: risk management, agility, integration and SC (re-)engineering. (Soni et al., 2014, p. 13-15) identified 10 RSC enablers based on the literature review as well as conducted surveys. The recognized facilitators are: agility, collaboration among players, information-sharing, sustainability in the supply chain, risk and revenue sharing, trust among players, supply chain visibility, risk management culture, adaptive capability, and supply chain structure. (Kamalahmadi, M. & Parast, M., 2016, p. 121-122), meanwhile, distinguish factors such as: adaptability, flexibility and agility as the key elements of the resilient supply chain. (Luckert, F. & Seifert, R. W., 2017) defined resilience metrics that allows a firm to track supply chain resilience and assess trade-offs between risk mitigation levers in quantitative terms.

It can be stated that during implementing the resilient supply chain management strategy it is very important to develop specialized tools for forecasting future risk and to simulate the impact of the responses on the organization and on the whole supply chain (Carden et al., 2018, p. 29; Ribeiro & Barbosa-Povoa, 2018, p. 109). The main purpose of implementing any SCM strategy should be to improve the efficiency of the supply chain, which can be expressed in the form of cost reductions (cost efficiency) or time reductions (time efficiency). According to above characteristics the most suitable business environment to introduce RSC would be volatile, rapidly changing industries.

2.2. Supply Chain Efficiency

The concepts of efficiency and performance of the supply chain are generally conceptualized as the same (Ganga & Carpinetti, 2011; Shafiee et al., 2014; Estampe

et al., 2013). From the other hand, some authors noticed the difference between those two ideas. (Chopra & Meindl, 2016, p. 26) define efficiency as one of the components of performance, they understood efficiency as the inverse cost of manufacturing and delivering the good to the customer. Although above definition is in line with economic point of view, it does not match with the logistical approach, which can be defined as the timing of the operations. According to (Roh et al., 2014, p. 201) efficient supply chain must aim to achieve cost efficiency by eliminating waste and non-added value processes. Due to different targets of the SC, based on operating market environment and SC characteristics, (Charłampowicz, 2017, p. 474) believes that it is crucial to divide supply chain efficiency into time-related, cost-related and spatial, in order to better identify the most suitable strategy for the examined chain. Although spatial efficiency can be expressed in the form of optimization of the relationship between costs and time as in delivery time.

2.1.1. Time Efficiency of The Supply Chain

Integration of the supply chain is type of action which gives opportunity and ability to possess more vulnerable data. The gathered information can provide more extensive and specific response for the rapidly changing market conditions. Supply chain time efficiency is a feature of the supply chain that assumes the ability to meet customer expectations in the context of lead-time reduction (Charłampowicz, 2017, p. 474). Other factors affecting time efficiency are: rapidness of information exchange, duration of physical operations, production time, delivery time.

(Kolinski & Sliwczynski, 2016) highlighted the problem of transposing strategic objectives to the operational level, some of the proposed calculating formulas are connected with time efficiency of the supply chain.

Characteristics of the time efficiency in the supply chain is connected with agility, which is one of the most important components of the resilience concept.

2.1.2. Cost Efficiency of The Supply Chain

The cost of the supply chain is defined as all significant costs present in the chain (Pettersson & Segerstedt, 2013, p. 358). In order to achieve proper cost efficiency, it is necessary to define and determine costs at each stage of the supply chain. (Gunasekaran et al., 2004, p. 338) note that supply chain efficiency is achievable through the use of a total logistics cost. In addition, they highlight the impact of cost-reducing activities in one area in terms of their impact on the costs of other areas (Gunasekaran et al., 2004, p. 338). They also proposed 46 performance indicators connected with time (e.g. efficiency of purchase order cycle time) and cost efficiency (e.g. cost per operations hour). (Swink et al., 2014, p. 9) state that highest level of supply chain efficiency can be achieved through implementation of the lean strategy. (Acar & Atadeniz, 2015, p. 214) calculated total cost as the sum of the inventory costs, transshipment costs and production costs.

2.1.3. Spatial Efficiency of The Supply Chain

The important determinant of the competitiveness of the supply chain is the geographic distribution of the centers of individual links and their network partners (Arnold et at., 2004, p. 256).

The spatial layout of the network should be determined taking into account the optimization and rationalization of the total path that must be covered between the centers. This aim can be expressed in the total savings generated by the individual participants of the chain as well as the total savings generated by the whole network. According to above statements, factors such as reduction of transportation congestion should also be considered (Weisbrod et al., 2016, p. 460).

(Charłampowicz, 2016, p. 475) propose several factors influencing on the spatial efficiency of the SC that should be taken into account during setting up a supply chain, such as: physical location of the individual links and partner, state and characteristics of the infrastructure linking the individual centers, and local regulations. (Charłampowicz, 2016, p. 475) also points out that regulations liberalization and improvement of the condition and availability of the infrastructure will affect supply chain participants in terms of gaining competitive advantage. Obtaining high level of spatial efficiency is expressed in the form of optimization of the relationship between costs and time.

3. SUPPLY SIDE OF THE MARITIME CONTAINER SHIPPING MARKET – SELECTED ISSUES

3.1. Characteristic of the MCSM

Market, in economic theory, is an area encompasses supply and demand. (Notteboom, 2012, p. 230) stated that container shipping industry, which is part of the supply side of the maritime container shipping market, consists of shipping companies, that core activity is transportation of the containerized goods between regular ports of calls via regular liner services. As (Stopford, 2009, p. 512) said, a liner service is a fleet of ships, which provide a fixed, regular, service between named ports.

General cargo accounts for around 60 per cent of the global value of shipped goods, most of it is transported by containerized liner services (Stopford, 2009, p. 505). Testament to it is the fact that over the last two decades (1990-2009) total port handling increased more than five-fold (Notteboom, 2012, p. 231). Despite the reduction in cargo flows on the main routes, the volume of transported containers amounted to 175 million TEU in 2015 (UNCTAD, 2016, p. 17). Similar increase has been noticed also in the TEU capacity per delivered container ship. Table 1 presents the change of quantity and capacity of container vessels in last decade. Despite of decrease in the number of vessels by around 4,3 per cent, there was significant increase in overall deployed capacity form 123,2 mil TEU to 183,8 mil TEU, which is almost 50 per cent growth (MDS Transmodal, 2016, p. 9)

Table 1. Number of vessels based on their capacity

	Ship size (TEU)	4Q 2007	4Q 2017
Number of vessels	<5000	4589	3523
	5000-7499	328	469
	7500-9999	172	527
	10000-12499	0	96
	12500-14999	8	172
	15000+	0	92
Total no of vessels		5097	4879

Source: MDS Transmodal, Container Business Model, November 2016, p. 9

Placing higher orders for container vessels sustain the situation of the oversupply of the market, where newly deployed vessels are larger than existing fleet. This state of affairs continues to exert pressure on ports and hinterland infrastructure to adapt and accommodate to mega container ships. Introducing of the mega container vessels was made due to achieving the economies of scale.

3.2. Strategic Alliances and Market Concentration

Weak demand growth and oversupplied market was in need of rationalization and consolidation to optimize capacity and reduce costs (UNCTAD, 2017, p. 13). Those goals were achieved by concentration on the supply side of the MCSM expressed by the mergers & acquisitions (M&A) and establishing strategic alliances on the main trade lanes. Main reasons for participating in such agreements are: risk sharing, knowledge sharing, economies of scale, technology exchange, vertical integration and strengthening market position (Rau & Spinler, 2017, p. 157). Researchers also confirms that the main drivers of change in the alliances are: competitive intensity, alliance complexity cost and freight rate volatility, while shorter lead times increase market concentration.

Settlements such as strategic alliances have significant impact on the competitiveness on the supply side of the MCSM. Generally top operators take part in these arrangements, which can help with risk sharing and cost reducing for alliance participants. This state of affairs also influence on the smaller entities, that cannot draw benefits from economies of scale, risk and knowledge sharing etc. (Lee & Song, 2017, p. 459-462) note that the slow-steaming strategy is applied by practically all shipping lines. This strategy influences on the decrease of the supply chain efficiency with respect to time and cost. Currently members of the main strategic alliances have around 80 per cent of the market share. Table 2 presents the members of the 3 main strategic alliances.

Table 2. Members of the current main operating strategic alliances

Name of alliance	Ocean Alliance	THE Alliance	2M
Members of the alliance	CMA CGM	K-Line	Maersk
	COSCO	NYK-Line	MSC
	Evergreen	Hapag-Lloyd	
	OOCL	MOL	
		Yang Ming	

Source: MDS Transmodal; UNCTAD Review of the Maritime Transport 2017

4. SUPPLY CHAIN PASSING THROUGH MCSM

Strong market concentration on the supply side of MCSM, expressed in M&A and establishing strategic alliances changed the market situation for smaller entities on the supply side and for other participants of the market on the supply as well as on the demand side (Choi & Yoshida, 2013, p. 39). In the event of oligopolistic type of market, prolonged transportation time, increasing customers' requirements, political disruption and technology development, finding savings in matter of cost and/or time has become the most crucial factor in gaining competitive advantage.

MCSM is the longest, in spatial point of view, link of the global supply chain – oversupplied, slow steaming strategy and weak demand growth has significant impact on the SC participants. The key to success is supply chain integration and implementation of the concept of the resilient supply chain management, which fits the bill as it assumes the ability to deal with unpredictable disruptions (Lam & Bai, 2016, p. 18). The market concentration of the supply side of the MCSM is influencing on the deterioration of the supply chain efficiency with respect to time as well as cost.

To verify the impact of the MCSM on the SC efficiency it is crucial to develop suitable indicators of supply chain efficiency with respect to time and cost. In the literature there are many examples of developing the performance and efficiency indicators for supply chain (Beamon, 1998, p. 287-288; Gunasekaran et al., 2004, p. 336-339; Carvalho et al., 2012, p. 337-338; Chopra & Meindl, 2016, p. 44-59), although none of them are dedicated to the SC passing through MCSM.

First presented metric is connected with the supply chain time efficiency. This is the time required for all needed operations with container in ports and other transshipment points. The analysis of this information can be helpful in finding bottlenecks in the supply chain, and then cooperating with other participants of the supply chain in order to finding solutions for decreasing required time. Another indicator of time efficiency in supply chain would be the query time, which refers to the time it takes for firms to respond with required information to the interested parties. This metric is connected with information flow and communication within the chain, although above characteristics has high impact on the time and cost. The longer the time, for answering to the queries, the higher the cost of risk management will be.

Total cost of the supply chain is the combination of the production, warehouse, delivery, management, customer and supply chain members relations costs. There is a possibility to develop cost efficiency indicators referring to the every stage of mentioned above. The important factor in the cost efficiency of the supply chain is cost of integration within the supply chain. High level of integration is connected with lower costs of activities required to occur due to lack of proper information flow and knowledge sharing.

It has to be remembered that before implementing indicators of cost or time efficiency in the supply chain, it is crucial to determine the depth and width of the examined supply chain and the characteristic of the operated markets.

5. RESEARCH LIMITATIONS AND FURTHER RESEARCH DIRECTIONS

5.1. Research Limitations

The ability to utilize and have full access to *Science Direct* journals made it possible to review the literature in interesting areas. None the less, the fact of relying on only one database greatly limited the possibility of conducting a more extensive literature research.

First significant research limitation is the lack of possibility to acquire practical data regarding time and cost of the SC passing through MCSM.

Another research limitation is the possibility of conducting research based on publicly available reports like UNCTAD Review of Maritime Transport and briefs reports such as MDS Transmodal Container Shipping Bulletin.

Additional research limitation is the lack of research on the impact of the MCSM characteristics and readjustments on supply chain performance with respect to time and cost and lack of possibility to verify usefulness of the presented efficiency indicators.

One significant research limitation is the lack of possibility to verify the relationship between RSC and MCSM and opportunity to empirically find out the impact of MCSM and strategic alliances on the SC. Since those information are treated by companies as a source of their competitive advantage, thus the availability of those data are very limited.

5.2 Further Research Directions

(Charłampowicz, 2017, p. 480) points out that determining the impact of strategic alliances on supply chain efficiency will enable developing more efficient performance measures, which translates into having more complete information about the supply chain and thus gain competitive advantage. It is crucial to develop more suitable indicators for measuring supply chain efficiency and compare those with empirical data from the MCSM.

6. CONCLUSION

The characteristics of the MCSM like strong concentration, being the longest link in the supply chain, and volatile, rapidly changing market conditions made it necessary for supply chain operators to continuous adaptation of the SC. This readjustment must be in line with market characteristics and commodity type. Above conditions requires for the SC operator to constantly seeks savings in time and/or costs, which can be understood as regularly improving the supply chain efficiency. The M&A and establishing strategic alliances only enhanced the necessity of the implement proper SCM strategy. Due to market features the most suitable strategy include resilient, in which supply chain is able to operate normally and fulfill its task despite of unpredictable, rapidly changing conditions.

The aim of this paper, based on literature review, was an attempt to discuss the selected issues of the SC efficiency on the MCSM and develop efficiency indicators for SC passing through MCSM with respect to time and cost. The SC efficiency, in spite of time, cost and space, as well as the characteristic of the MCSM in the context of the SC efficiency were discussed. The literature on establishing strategic alliances on the MCSM were also reviewed. Moreover, the efficiency and performance indicators were proposed.

The main conclusions of this paper are: (i) the need of further research, based on empirical data, to determine the impact of the strategic alliances in the MCSM on the SC efficiency; (ii) the RSC proves an efficient SCM strategy for the SC passing through the MCSM; (iii) the need of empirically verify proposed performance and efficiency indicators.

7. ACKNOWNLEDGEMENTS

The author would like to thank the anonymous referees for their useful comments and suggestions, which have improved the paper.

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