

# Approaches, Challenges and Impacts of Asian Regional Multimodal Logistics for Supply Chain Integration and Interdependencies



Michael Smith, Adam Voak, and Don Gunasekera

**Abstract** Asia's successful economic growth over the past few decades is well known and is receiving increasing attention from current and potential trading partners. The region is home to some of the world's largest emerging and dynamic economies, and this includes the 10 countries of the Association of Southeast Asian Nations (ASEAN). Along with this growth, there is a recognition that trade costs, along domestic and international supply chains in these Asian economies, can be significantly reduced by improving the logistics performance in each mode of transport involved in various logistics and supply chain transactions. These improvements may be conveniently facilitated by the optimisation of the transitioning strategies from unimodal to multimodal (or combined) transport services. In this context, we examine here the status of current multimodal logistics in the provision of supply chain integration and interdependencies practiced in the key Asian economies. For this chapter we have particularly focused on the current approaches, challenges and potential impacts of transforming and enhancing the levels of logistics and supply chain multimodal integration and interdependencies on the emerging economies of this region.

**Keywords** Multimodal logistics · Supply chain management · Integration · Supply chain interdependencies · ASEAN region

---

M. Smith (✉) · A. Voak · D. Gunasekera  
Deakin University, Melbourne, Australia  
e-mail: [michael.smith1@deakin.edu.au](mailto:michael.smith1@deakin.edu.au)

A. Voak  
e-mail: [adam.voak@deakin.edu.au](mailto:adam.voak@deakin.edu.au)

D. Gunasekera  
e-mail: [don.gunasekera@deakin.edu.au](mailto:don.gunasekera@deakin.edu.au)

# 1 Introduction

Within the current growth of the Asian economic sphere, there has arisen an ever-increasing demand for end-to-end handling of multimodal cargo which has driven the growth of multimodal logistics and supply chain management services. A well-integrated and sustainable multimodal process and handling system is an imperative for these Asian economies, particularly those within the ASEAN block of nations. For ASEAN to take full advantage of the emerging regional economic development opportunities and for capturing further regional trade growth, it needs to become cognisant of the conceptual nature of supply chain integration and global competitiveness. Such a realisation will enable it to leverage its location at the cross roads of Northeast Asia, South Asia and Oceania and to further bolster its growing strategic significance in the region.

It is important to comment here that, from the point of view of logistics and supply chain management, accessibility and efficiency become key decision-making considerations when utilising multimodal logistics and supply chain services. In this respect, it is the reliability and security of the service provision, together with an acute understanding of transit times and cost, that play an essential factor in informing the level of multimodal efficiency, the extent of seamless integration achievable and the completeness of the unified interdependencies of the service offerings.

We assert that improving and maintaining the quality of relevant, reliable and efficient multimodal logistics services throughout the supply chain, is extremely important for multimodal integration and improved supply chain performance. This is especially so for economies transitioning from mainly unimodal and intermodal operations towards integrated, interdependent and more sophisticated multimodal transport contracts. The current absence of consolidated regulatory frameworks within the ASEAN region, along with the somewhat incongruent accreditation systems for Multimodal Transport Operators (MTOs), presents a clear problem. This barrier, together with a shortage of the required human resource skills and capabilities, could combine to hinder the successful transition to multimodal transport integration and greater supply chain connectivity.

Our overall research intention is to contribute to the more efficient and effective utilisation of Asian regional multimodal logistics and supply chain integration, and to inform key players and stakeholders. This could be done through better understanding of those interdependencies along and within supply chains that are often neglected in broader systems-thinking discussions. To this end, this chapter focuses on a review of current approaches, challenges and impacts associated with evaluating the role played by regional multimodal transport, logistics and supply chain integration and their resultant interdependencies within ASEAN. Analysis was based on the research findings and investigation of a series of in-country missions to each of the 10 ASEAN contributing nations to assess their progress and development in the implementation of multimodal transport and logistics. The outcome resulted in the development and full adoption by these countries of an agreed implementation framework for the realisation of the ASEAN Framework Agreement on Multimodal

Transport (AFAMT) 2020–2025. It is noted that this implementation framework details a comprehensive suite of strategies and deployment guidelines, including a description of the regional action plans, which chart out, in detail, the key activities, implementation mechanisms, recommended measures, timeline and actions required for strengthening the regional approach for the realisation and implementation of the AFAMT.

## 2 Other Studies on Multimodal Integration and Connectivity

The concept of integration and connectivity between trading economies have often been studied through the lens of single modality (Arvis and Shepherd 2016), as well as between modes within a single economy (Shepherd et al. 2011). While a number of multimodal connectivity assessments have been undertaken in relation to passenger transport (Litman 2017; OECD 2016; Krul et al. 2010), similar freight-based studies are not common. The Asia–Pacific Economic Cooperation (APEC) completed a detailed study on the economic impact of multimodal connectivity in the APEC region in 2010 which revealed, for each of the 19 countries analysed, the changes from 2005 to 2010. In addition, the relative position with regard to maritime, air and land transport, logistic competence and an aggregated multimodal transport indicator was presented. In addition, the correlation between exports and multimodal transport performance has been estimated using the Gravity Model of Bilateral Trade (Shepherd et al. 2011).

It is appreciated that the importance of engagement with intermediaries has long been recognised in both empirical (Grubel and Lloyd 1975) and theoretical (Batra and Casas 1973; Woodland 1977) studies. More recently, whilst these interrelationships have increased in importance, they are, however, being represented and becoming manifested in new phrases, terms and descriptive terminology (Hummels et al. 2001; Kohler 2004; Antras et al. 2006; Grossman and Rossi-Hansberg 2008; Koopman et al. 2010; Johnson and Noguera 2012). Moreover, it is becoming glaringly obvious that the supply-chain trade concerns goods that will be inputs into production processes in other nations. In this respect, missing information in the chain regarding the ‘next step’ in each part or segment of the supply chain is becoming a central problem to production. Further, it is the lack of visibility within the ‘next step’ along supply chains that leads to uncertainty and ambiguity around global patterns of cross-border multimodal transport freight data (in terms of volume and value), as data collection becomes increasingly more complex.

Zhao et al. (2019), postulate that many firms in a traditional supply chain setting constitute self-organizing networks, and, as a result, these supply chains can be innately adaptive or resilient in the face of external perturbation. However, due to the complexity, uncertainty of supply and interdependence in more globalised supply chains, there is an increased risk of loss of continuity in these more finely balanced

networks due to an interceding disruption event (Bode et al. 2011; Bode and Wagner 2015; Kamalahmadi and Parast 2016; Scheibe and Blackhurst (2018) contend that emerging new supply chain trends built around stringent efficiency demands, such as Just-In-Time (JIT) operations, can significantly increase the need for coupling and interdependence between entities within the structures. De Sá et al. (2019), also conclude that, in this environment, there are distinct managerial and social implications, especially around the interdependence of a firm's robustness and overall supply chain resilience. Nye (2020), commenting on power relationships in supply chains, also believes a situation in which interdependence exists without asymmetry of control generates little power imbalance, but when a discrepancy of control exists, interdependence within the chain creates situations that can be used to one party's advantage in strategic competitive systems. In this respect, Michalski et al. (2019) observed that the level of trust and innovation developed in symmetric relationships differs markedly from that in asymmetric situations with respect to organizational performance. It is suggested that the growth of 'deep dependence' comes from a Principal-and-Agent type of relationship based upon asymmetric knowledge, whilst 'deep interdependence' suggests a wider-ranging relationship between equal partners, which is manifested in a symmetrical unity and greater mutual reliance (Deif and Mohib 2019).

However, what is generally poorly understood, is the extent of the lack of general understanding regarding the level of complexity and attendant interdependencies within supply chains. These arise from an array of multifaceted issues which are essential to integrated multimodal transport and logistics services across borders. These intricacies and characteristics of modern supply chains are particularly evident in the interdependence and organisation of supply-and-demand processes in a global market. This complexity is manifested through a multitude of factors including raw material forecasting, asset investment, risk management and response to change. Successful supply chain enterprises must place a greater focus on a systems-thinking approach in order to better understand the increasingly complex nature of global supply chains. For example, supply chain professionals need to understand and appreciate the interdependent and interconnected system of labour, energy sources, transport and logistics operations, finance, business processes, service expectations, information technology, sourcing and procurement, commercial power, legal and regulatory frameworks and strategic asset investment. Added to this impressive list of requirements, we note that with cross-border supply chains, there are subtle barriers related to cross-cultural issues and competing political stances. As we have intimated earlier, the term 'global supply chain' is not a simple extension of a national supply chain.

### 3 Challenges Facing ASEAN Supply Chain Development

Given the dynamic environment in which ASEAN connectivity is now taking place, it is crucial to consider the forecasted emerging trends that are likely to influence the successful implementation of the 'Master Plan on ASEAN Connectivity 2025' ('MPAC 2025'). However, since the formal adoption of MPAC, it is clear that many challenges still face the 10 member nations, with much more needing to be done to realise the MPAC vision in achieving cross-border seamless logistics connectivity. Particular areas that will need to be addressed include the introduction of hard and soft infrastructure, the development of the various logistics service sectors, relevant education and skills programs, together with the challenges relating to the mobility of skilled labour, cross-border regulatory standards and multimodal transport and logistics connectivity. In this regard, there are particular ASEAN issues which we see as needing to be addressed before more systematic conjoint connectivity initiatives might be introduced. As a consequence, we note that there are words and concepts, which are essential to an understanding of the complexities of this area that are being continually introduced and, even more importantly, which are being modified as conditions and situations change. It is these notions, and their introduction, to which we now turn our research attention.

### 4 Methodology

The key purposes of this study were to (i) identify core ASEAN values, objectives and plans with regard to national and international transportation, logistics and connectivity strategies, (ii) assess the strengths, opportunities, weaknesses and related threats apparent within those logistical networks that potentially affect progress toward broader ASEAN goals, (iii) identify infrastructure deficiencies in the logistics environment of the ASEAN region, (iv) determine policy deficiencies which may impede economic growth and development, and (v) offer policy recommendations that may contribute toward achieving MPAC 2025's objectives by improving, expanding, or otherwise enhancing logistics infrastructure within the ASEAN region.

In order to meet these research aims, it was necessary to determine the current status of understanding and practice of multimodal logistics strategies related to the provision of supply chain integration and organisation of interdependencies common to the ASEAN economies. In order to achieve this, we needed to focus our research on establishing the perceived efficacy of current approaches, challenges and potential impacts of transforming and enhancing the levels of logistics and supply chain multimodal integration and interdependencies amongst key functionaries in the area. This level of understanding is clearly time and place dependent, thus we employed a qualitative data collection and analysis methodology. Primary data sources consisted of a collection of statements and perceptions provided by a purposively selected range of supply chain professionals and government officials. To facilitate this data

collection, a series of meetings in each ASEAN country was organised under the auspices of the ASEAN Regional Integration Support, using an opportunity which arose from the EU ARISE Plus program 'Supporting the Implementation of the ASEAN Framework Agreement on the Facilitation of Multimodal Transport'. These meetings, which were for invited delegates, included open and frank discussions with concerned government agencies including National Ministries of Transport and other relevant groups related to membership of the ASEAN National Transit Transport Coordinating Committee (NTTCC). The investigation was conducted with the support and guidance of the ASEAN Secretariat based in Jakarta (Indonesia), the ASEAN Transit Transport Coordinating Board (TTCB), the ASEAN Transport Facilitation Working Group (TFWG) and ARISE Plus. This primary data was collected directly by the researchers, with permission from the organising committee, and all comments were de-identified before analysis to protect the positions of the delegates.

To provide a sound background for the investigation, secondary qualitative and descriptive quantitative data were retrieved electronically from relevant governmental, intergovernmental, academic, trade and industry sources. In addition, a detailed literature review was carried out in order to compare ASEAN objectives and plans with existing conditions, to gain a sense of how successful existing plans have been. It is acknowledged here that our research findings have been advised by the 2019 technical assistance project related to the ASEAN Framework Agreement on Multimodal Transport (AFAMT).

## 5 Results

It was found that the most urgent matter that needed to be addressed by ASEAN member nations is the matter of intra-regional connectivity. It was noted that transportation and communications networks which serve as a conduit for the robust free trade that the union hopes to generate are currently below par. In this respect, Blyde and Molina (2015) have reported that the quality of logistics infrastructure impacts on the level of foreign direct investment, and it is also apparent that currently, infrastructure quality in eight of the 10 ASEAN states (excluding Singapore and Malaysia) lag behind the global average quality, which is seen to drag down regional economic productivity. Further, poorly constructed and managed transportation networks are found to act as trade barriers. Transportation safety and security are seen as major concerns that require immediate attention, and disparate customs policies across the region were found to increase time and cost in the import/export process. As part of the new open-border agenda, ASEAN members have been urged to harmonize their customs procedures, reduce documentation requirements, and allow for electronic processing of shipments. Our research has indicated that increased intergovernmental cooperation is desperately required to provide adequate security and safety compliance in shipping industries around the region. Infrastructure investment opportunities were found to be in abundance, but investment policies need to be amended to attract

further foreign investors. Another strong recommendation in this regard includes the establishment of a regional consumer credit rating bureau.

## 6 Discussion

There is little disagreement that infrastructure clearly continues to play a big role in assuring basic connectivity and access to gateways for most developing countries. In all income groups, survey respondents reported that infrastructure was improving, but it was indicated that in all ASEAN countries except Singapore and Malaysia, the scores for infrastructure were lower than the overall scores. The introduction of better logistics connectivity, not only within each ASEAN member nations but between countries in ASEAN, will boost the region's value chain and economy. However, there are, in fact, a number of deep-seated problems that we see on the horizon for the logistics and supply chain industry that could hinder the future growth of the ASEAN Economic Community (AEC).

The largest economy in the AEC (Indonesia) spends 26% of its GDP on logistics, one of the highest rates of spending on logistics per capita in the world. In the meantime, there are major commodity price gaps between provinces in Indonesia as well as major logistics inefficiencies that hamper economic development and connectivity. In a similar way, Thailand, despite offering easy access to Cambodia, Vietnam and the Lao PDR, still spends almost 20% of its GDP on logistics.

Limited facilities at ASEAN ports make congestion problems worse, but the greatest challenge is the reducing the cost of getting products from manufacturers to consumers, and addressing the problem of why land transport through ASEAN areas actually takes up more time than processing in the ports. Inadequate roads because long transport times since rural roads are often closed for maintenance, and poorly maintained open roads can only be used by small vehicles, a restriction which implies high operating costs and which urgently needs to be redressed. Rail and air cargo networks are also inadequate in many ASEAN nations, with more on-dock rail facilities needed throughout Vietnam and the Philippines. If these problems are not addressed, it is likely that China will step in to fill the infrastructure void, thus influencing and accelerating its own transport development across Asia to the detriment of ASEAN.

In the logistics and supply chain sector, transport is the central issue determining performance, but there are still many companies that do not think seriously about integrated multimodal logistics and supply chain management. For example, many small manufacturers still use containers only for loading and unloading in ports, rather than at the origin and destination of their cargo. Highly fragmented supply and demand scenarios for road transport services means that truckers frequently return home empty, which incurs costs and erodes margins. In Indonesia, for example, trucking accounts for 72% of transport costs, and yet trucks are only half full most of the time. At a time of great change in the logistics sector, ASEAN governments have indeed started to focus on policy development and have ramped up investment

in an effort to revamp long-neglected infrastructure. However, by itself, this action will not help the ASEAN countries to improve their performance and boost trade growth and competitiveness. In Indonesia, Thailand and several other AMS, there is an urgent need to reform the management of human resources and the adoption of new technologies to support more efficient and effective multimodal logistics and supply chain systems.

## 7 Conclusion

Emerging from this work is support for the notion that successful modern multimodal logistics development and supply chain integration can be summarised as ‘one network, one contract, and one set of standards. ‘One network’ stresses the importance of an integrated transport infrastructure network conducive to convenient, reliable, low-cost logistics services. ‘One contract’ is the result of an open, collaborative and orderly freight market. ‘One set of standards’ provides unambiguous operating rules and performance appraisal across all national jurisdictions.

However, at present, it is perceived that the ASEAN multimodal market is largely fragmented and disorganised, with different government agencies remaining divided in their approaches. Currently, the lack of modern unified and, mutually agreed specifications and standards has led to high logistics costs, holding back ASEAN’s multimodal logistics development and integration. These are key issues in the development of ASEAN’s regional logistics and supply chain connectivity agenda and this hiatus should be the main focus of future policy reforms.

It is widely recognised that efficient multimodal transport is an essential part of the ASEAN connectivity agenda. In this respect, the AFAMT framework provides a suitable policy tool for a systems approach to integrate the different transport modes into one coherent transport system which caters for the needs of ASEAN Member State governments and industry. However, this research has identified that whilst the desire to reach uniformity of the laws governing multimodal transport is recognised to be viable, much work remains to make their introduction a reality. In this light, the challenge now, for ASEAN and Member States, is to adopt the action plan presented by the AFAMT framework to meet the milestone aspirations of the Kuala Lumpur Transport Strategic Plan 2016–2025 and to realise the AFAMT aims in the spirit of the agreement signed in 2005. This will require the willingness and co-operation of Member State governments, industry peak bodies and transport service providers and operators.

Finally, given the obvious growth of the logistics industry and the significant changes it is undergoing, there is a need to review the methodology for assessing the economic value of multimodal logistics and supply chain integration to the ASEAN regional economy, and we believe any detected shortcomings would be largely addressed by the development of a customised version of an economy-wide



Computable General Equilibrium (CGE) model, emphasising supply chain and logistics activities in ASEAN. Our aim is to stimulate further research into the way multimodal logistics for supply chain integration and interdependencies has transformed the nature and impacts of ASEAN regional supply chains. The importance of this topic has, to date, been overlooked.

**Acknowledgments** This study was funded by the ASEAN Regional Integration Support from the European Union ARISE Plus program, which provides technical support for ASEAN economic integration. We wish to thank ARISE Plus for giving permission to use the work funded by them to be used in this paper. We also thank the ASEAN participants who were involved in the conduct of the research, and ensure them of their anonymity.

## References

- Antras PL, Garicano E, Rossi-Hansberg E (2006) Offshoring in a knowledge economy. *Quart J Econ* 121(1):31–77
- Arvis J, Shepherd B (2016) Measuring connectivity in a globally networked industry: the case of air transport. *the World Economy* 39(11):369–385
- Batra R, Casas F (1973) Intermediate products and the pure theory of international trade: a Neo-Heckscher-Ohlin framework. *Am Econ Rev* 63(3):279–311
- Blyde J, Molina D (2015) Logistic infrastructure and the international location of fragmented production. *J Int Econ* 95(2):319–332
- Bode C, Wagner S (2015) Structural drivers of upstream supply chain complexity and the frequency of supply chain disruptions. *J Oper Manag* 36:215–228
- Bode C, Wagner S, Petersen K, Ellram J (2011) Understanding responses to supply chain disruptions: insights from information processing and resource dependence perspectives. *Acad Manag J* 54(4):833–856
- De Sá MM, Miguel P, Brito R, Pereira S (2019) Supply chain resilience: the whole is not the sum of the parts. *Int J Oper Prod Manag* 40(1):92–115
- Deif A, Mohib A (2019) A Typology to understand some dynamics of supply chain innovation location. *J Supply Chain Oper Manag* 17(1):47–55
- Grossman G, Rossie-Hansberg E (2008) Trading tasks: a simple theory of offshoring. *Am Econ Rev* 98(5):1978–1997
- Grubel H, Loyd P (1975) Intra-industry trade: the theory and measurement of international trade in differentiated products. *Econ J* 85(339):646–648
- Hummels D, Ishii J, Yi K (2001) The nature and growth of vertical specialization in world trade. *J Int Econ* 54(1):75–96
- Johnson R, Noguera G (2012) Proximity and production fragmentation. *Am Econ Rev* 102(3):407–411
- Kamalahmadi M, Parast M (2016) A review of the literature on the principles of enterprise and supply chain resilience: major findings and directions for future research. *Int J Prod Res* 171:116–133
- Kohler W (2004) Aspects of international fragmentation. *Rev Int Econ* 12(5):793–816
- Koopman R, Powers W, Wang Z, Wei S-J (2010) Give credit where credit is due: tracing value added in global production chains. National Bureau of Economic Research. In working paper 16426, Cambridge, MA
- Krul B, Kaikai S, Sheran R (2010) Hill uptown Oakland multimodal connectivity assessment. In: Report submitted to Oakland Planning and Development Corporation (OPDC), Pittsburgh, PA
- Litman T (2017) Introduction to multi-modal transportation planning: principles and practices. Victoria Transport Policy Institute, Victoria, BC, V8V 3R7, Canada

- Michalski M, Montes J, Naramsimhan R (2019) Relational asymmetry, trust, and innovation in supply chain management: a non-linear approach. *Int J Logist Manag* 30(1):303–328
- Nye J (2020) Power and interdependence with China. *Washington Quart* 43(1):7–21
- OECD (2016) Intermodal connectivity for destinations. A policy paper prepared by the OECD Centre for Entrepreneurship, SMEs and Local Development, as part of the Tourism Committee's Programme of Work for 2015–2016, Paris
- Scheibe K, Blackhurst J (2018) Supply chain disruption propagation: a systemic risk and normal accident theory perspective. *Int J Prod Res* 56(1–2):43–59
- Shepherd B, Serafica R, Bayhaqi A, Jing H (2011) The trade impact of enhanced multimodal connectivity in the Asia-Pacific region. *J Econ Integr* 26(4):624–650
- Woodland A (1977) Joint Outputs, intermediate inputs and international trade theory. *Int Econ Rev* 18(3):517–533
- Zhao K, Zuo Z, Blackhurst J (2019) Modelling supply chain adaptation for disruptions: an empirically grounded complex adaptive systems approach. *J Oper Manag* 65(2):190–212