MODELLING FREIGHT LOGISTICS: THE VIENTIANE-SINGAPORE CORRIDOR

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Abstract: The purpose of this paper is to present a cost model of multimodal transport, which was originally proposed by Beresford and Dubey (1990) and developed by Beresford (1999). The model is stand-alone and flexible enough to be applied to any operational circumstances and to a supply chain of any length. The validity of this model is tested against a real case in international freight logistics, namely the export of goods from Vientiane in Lao PDR to Singapore. Lao PDR, as the sole land-locked country in South East Asia, is dependent on infrastructure available in neighbouring countries for fast and efficient international distribution channels. The main elements of the model are as follows: cost, time, distance, transport mode and intermodal transfer. The model is tested using real data over a series of alternative routes between Vientiane and Singapore. The selection of the transport mode or combination of modes will have a direct impact on the performance of Lao PDR logistics channels. Depending on the mode or the combination of modes chosen, the efficiency of the logistics system will be affected. Interviews were used in order to obtain data from Laotian exporters, logistics service providers, and international shipping lines. The research findings clearly demonstrate that the "road-sea" combination via Bangkok Port in Thailand is the most competitive in term of costs while the "all-road" option offers the fastest transit time.

Keywords: Southeast Asia, logistics modelling, corridor routeing.

1. INTRODUCTION

Tougher international competition and the expansion of geographical markets have forced manufacturers and exporters to focus on integrated production and logistics strategies in order to reduce costs, and at the same time, to obtain a higher service standard. The need to control the transport costs has become as important as the need to keep down other production costs.

Lao PDR is the only land-locked country in Southeast Asia and the movement of Lao exports to Singapore is chosen in this paper as an illustrative case study. The country is surrounded by five states: the Peoples Republic of China, the Socialist Republic of Vietnam, The Kingdom of Cambodia, the Kingdom of Thailand and the Union of Myanmar.

2. METHODOLOGY

The choice of transport mode or combination of transport modes has a direct impact on the efficiency of logistics channels and system. Depending on the mode chosen (Liberatore & Miller, 1995), the overall performance of the supply chain will be affected. Simple cost-distance models of road versus rail are commonly found (Fowkes *et al*, 1989; Hayuth, 1992; Marlow & Boerne, 1992) for national movements or sea versus air (Hayuth, 1985; Jung, 1994) over longer, intercontinental routes. As the choice of logistics channels is of vital importance to the success of a country's international trade, various models have also been created (Beresford & Dubey, 1990; Min, 1991; Barnhart & Ratliff, 1993; Yan *et al*., 1995; Beresford, 1999) to aid logistics decision makers in choosing the most effective logistics channel that not only minimises cost and risk, but also satisfies various on-time service requirements.

The cost model, which is presented here, includes both transport (road, rail, inland waterway, sea) and intermodal transfer (ports, railfreight terminals, inland clearance depots) as cost components (See Figure 1). This model has been adapted from Beresford & Dubey (1990) and improved by Beresford in 1999.

The model assumptions are based on the premise that unit costs of transport vary between modes, with the steepness of the cost curves reflecting the fact that, for volume movements, sea transport should be the cheapest per tonne-km, road transport should normally be the most expensive (at least over a certain distance), and waterway and rail costs should be intermediate. At ports and inland terminals, a freight handling charge is levied without any material progress being made along the supply chain; a vertical "step" in the cost curve therefore represents the costs incurred there.

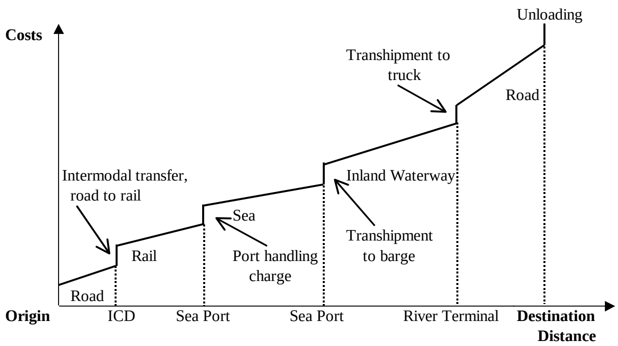

Figure 1: Cost-model for multimodal transport

The height of the step is proportionate to the level of the charge. Depending on the route chosen, the combination of modes and cost will be different. The purpose is to find the most competitive route cost wise. Although this approach in itself is not new (Levander, 1993; Christopher, 1998), the portrayal of the costs components as increments along the supply chain is quite novel.

The transport costs in this paper are based on offers that were obtained by interviewing exporters, logistics service providers, and shipping lines, which operate between Vientiane, the capital of Lao PDR, and Singapore. Prices quoted concern the shipment of 1 TEU (Twenty Foot Equivalent Unit) on a Freight All Kind (FAK) basis.

These quotes are only accurate for export cargo out of Lao PDR. Depending on the quantity of goods transported, lower quotes may be possible. Below is a non-exhaustive selection of routes and combination of transport modes available on the Vientiane-Singapore corridor as provided by the respondents. The airfreight option was not examined in this selection of logistics channels, between Vientiane and Singapore, as they are usually considered more as "emergency networks or channels " in the supply chain (Banomyong *et al.*, 1999). However, the role of airfreight must never be discounted especially when high value or perishable goods are involved.

3. FINDINGS

3.1 Route no. 1: "Road-Sea" via Danang (Vietnam)

Route No. 1, via Danang (Vietnam) has been, traditionally, the only sea access for Lao PDR but for many of the respondents there are still many uncertainties when transiting via Vietnam. The total transport cost for Route No. 1 is USD 2,150/TEU. The distance between Vientiane and Danang is 1,060 km and with a cost of USD 0.71/km. The sea-leg between Danang and Singapore is 1,910 km long and costing USD 0.21/km. The movement of freight itself is not considered to be the biggest difficulty even with road transport having the highest ratio (34%) of the total transport cost while sea transport only represents 18%.

The main problem of this particular logistics channel is with the 'other' charges not directly related to transport, which are very hard to quantify precisely. Depending on the officials involved in the transit process the 'other' charges may increase or decrease. This is one of the reasons why 'other' handling charges are very high for transit via Vietnam at around USD 700. It is assumed that Customs charges are distributed evenly among Lao and Vietnamese customs officials.

Figure 2 represents the cost build-up along Route No. 1. The steepness of the road transport curve is greater than for sea transport. This route has many weaknesses, especially with charges not directly related to transport, which is at 46.5% of the total transport cost with customs charges comprising up to almost 22% of the inland transport cost between Vientiane and Danang. The transit time for Route No. 1 is around 9 to 10 days, almost equally separated between the inland and the sea-leg. This transit time is based on the assumption that there are no administrative delays while the goods are in transit.

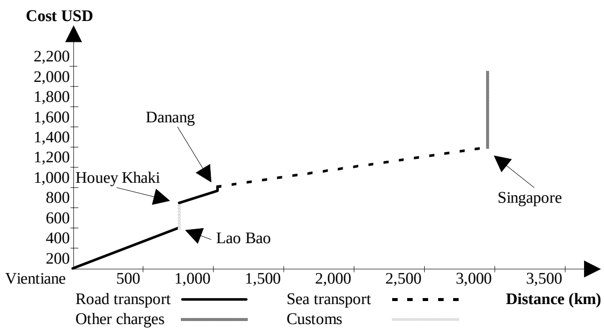

Figure 2: Vientiane-Danang Port-Singapore

3.2 Route no. 2:"All-Road" via Bangkok (Thailand)

This "all-road" option is in theory possible but it has never been used in practice even though the transit time is, theoretically, very competitive compared to Route No. 1 via Vietnam. It is possible for the cargo to move on the same truck for the whole journey but the only constraint is that truck must belong to the Express Transit Organisation (ETO), which is the Thai state-own trucking company. It is the only company that has all the transit rights from Vientiane to Singapore via Malaysia. If a different trucking company is involved, the goods will have to be transloaded in Nongkhai, Bangkok, and Padang Besar at an average cost of USD 12 per transload. This cost is included in the 'other' handling charges of USD 300.

Figure 3 illustrates freight movement on the "all-road" Vientiane-Bangkok-Singapore.

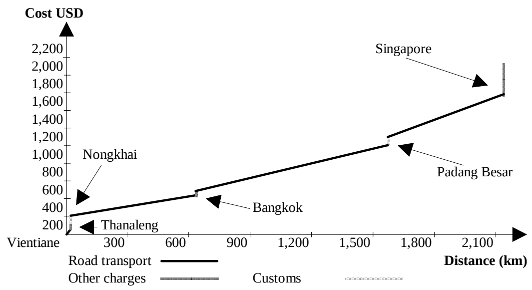

Figure 3: Vientiane-Bangkok Singapore

The total cost for Route No. 2 is USD 2,139/TEU for a distance of 2,190 km with a transit time of 4 to 5 days, but the many border crossings seem to be one of the main weaknesses of this route.

It is noteworthy that Malaysian customs have been given a fairly confident rating compared to the not very confident rating assigned to Thai and Lao customs. Customs fees take up to 7% of the total transport costs while document charges are at around 2.5%. 'Other' handling charges make up to 17% of the total transport cost as far as Singapore.

Road transport represents up to 73.5% of the total transport cost. Road transport cost is at USD 0.71/km per TEU from Vientiane to Singapore. A closer analysis of each segment will reveal that road transport cost break down as follows:

- Vientiane (Lao PDR) - Thanaleng (Lao PDR) leg is at USD 3.6/km per TEU;
- Thanaleng (Lao PDR) - Nongkhai (Thailand) leg is at USD 2/km per TEU;
- Nongkhai (Thailand) - Bangkok (Thailand) leg is at USD 0.49/km per TEU;
- Bangkok (Thailand) - Padang Besar (Malaysia) leg is at USD 0.67/km per TEU;
- Padang Besar (Malaysia)-Singapore leg is at USD 0.97/km per TEU.

3.3 Route no. 3: "Road-Sea" via Bangkok P0rt

Route No. 3 is currently the favoured and the most commonly selected route on the Vientiane-Singapore corridor. It is the cheapest route (USD 1,215/TEU) with a competitive transit time (6/7 days). Road transport represents 30% of the total transport cost while sea transport has a ratio of 19%. Customs charges are at 3%, tea money is at 2% and document charges are at 6% of the total cost between Vientiane and Singapore. 'Other' handling charges are representative of 40% of the whole transport cost.

Route No. 3 via Bangkok Port can become even more competitive if 'other' charges are reduced (i.e. THC, document charges, tea-money, etc.).

The deep-sea port of Laem Chabang in Eastern Thailand is another viable alternative though slightly more expensive by USD 26.2. It is then a question for the Lao exporter or logistics provider to select the best possible distribution channel. For Lao traders, transit time, reliability and cost are considered the three most important factors in their selection of modal choices (Banomyong, 2001). The combination of road and sea transport via Thailand to Singapore seems to fulfil Lao traders' criteria of reasonable transit time, higher reliability and competitive cost.

The transit time is slower than the "all-road" alternative by one to two days, which can be acceptable depending on the nature of the product transported. Another very important factor for the selection of the "road-sea" logistics channel via Thailand is the fact that the sea-leg represents 70% of the total distance. Sea transport is considered to be the safest mode of transport.

Figure 4 graphically illustrates how these other charges increase the total transport cost. The highest cost increase occurs during the intermodal transfer at Bangkok Port followed by the border crossing between Thanaleng, in Lao PDR and Nongkhai, in the North East of Thailand. The border crossing between Thanaleng and Nongkhai is the main entry and exit point into Lao PDR in terms of volume and value.

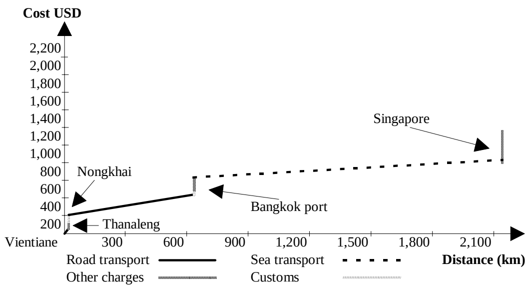

Figure 4: Vientiane-Bangkok Port-Singapore

3.4 Route no.4: "Road-Rail-Road" via Lad Krabang (Thailand)

There is the possibility of using rail transport for the Vientiane-Singapore corridor at a cost of USD 1,550/TEU with a theoretical transit time of 8/9 days but in practice rail is never used. The main reason is because there is no regular schedule from Nongkhai to Lad Krabang ICD. The price for rail transport between Nongkhai and Lad Krabang Inland Clearance Depot (ICD), in the outskirt of Bangkok is quite competitive at USD 350/TEU.

The transit time of 30 hours is longer than for road transport. The State Railway of Thailand (SRT) used to offer a regular schedule service but due to the low volumes of goods coming in and out of Lao PDR, the SRT decided to offer the rail service on a chartering basis and only for block trains.

The rail transport via Malaysia is somewhat less problematic with daily departures but most of the trains terminate at Port Klang or Sungai Wei ICD near Kuala Lumpur. Transloading will occur before the goods can be directed towards Woodland rail station in Singapore. Road transport for this route is done between Vientiane and Nongkhai, and between Woodland rail station and the warehouse in Singapore. Compared to the distance road transport is the most expensive mode of transport at USD 55/TEU for both segments. Figure 5 explains the cost structure of the "road-rail-road" combination between Vientiane and Singapore.

Road transport costs only take up 7% while rail transport, as the main mode of transport, represents 52% of the total transport costs. The distance covered by rail transport on this route is 98% of the whole journey. The transit time is marginally longer than for the "road-sea" combination via Bangkok Port but could be improved if a direct service is introduced from Lad Krabang ICD to Singapore. Due to the low volumes of freight involved in the Lao trade, a direct service between Nongkhai and Singapore does not seem to be feasible at the present moment. Vientiane cannot be connected because Lao PDR does not have a rail network.

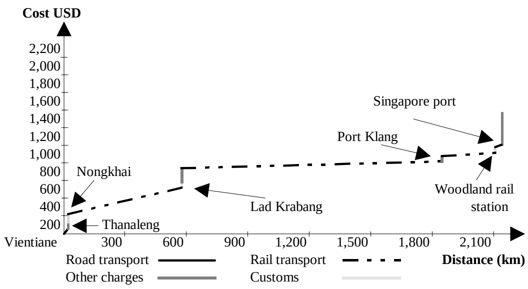

Figure 5: Vientiane-Lad Krabang-Singapore

4. CONCLUSIONS

In Southeast Asia, supply chain control processes including production scheduling, shipment of product and inventory maintenance are frequently de-centralised and remote from each other. Another issue in the region is the relatively high cost of logistics which is a by-product of inadequate physical facilities, cumbersome administrative barriers coupled with a legal framework not adapted to modern international business practices (Castro, 1999).

Logistics service providers could perform critical value enhancing functions that fully benefit all the players along the chain and increase the supply chain competitiveness (Kopicki, 1999). Designing and developing effective supply chains with the integration of logistics channels will probably enhance competitiveness. The outsourcing of logistics functions, and Just-in-Time (JIT) management techniques, have also forced service providers to design more dynamic and efficient supply chains within various operational constraints. However, it is the physical aspect of the supply chain that will ultimately shape supply chain dynamics.

The Vientiane-Singapore corridor has been taken as an illustrative case study of a range of transport and logistics issues that need to be addressed. This corridor offers a selection of alternatives relating to modal choice and combination of transport modes. The "all-road" option provides the fastest transit time and the "road-sea" alternative via Bangkok Port offers the cheapest transport cost. Table 1 summarises the different transport cost and transit time among the selected logistics channels.

Table 1: Summary of cost and time

Channel	**USD/ TEU**	**Duration**
1	2,150	9/10 days
2	2,139	4/5 days
3	1,215	6/7 days
4	1,550	7/8 days

Source: The Author

Currently, more than 80% of freight carried from Vientiane to Singapore is done by the "road-sea" combination through Bangkok Port. Singapore, in itself, is usually not the main destination for Lao cargo but it is a very important transhipment point for main-line mother-vessel connections to the rest of the world.

The combination of total transport cost, total transit time does explain to a certain extent why the "road-sea" option via Bangkok Port is the most favoured logistics channel. Nonetheless, the "road-rail-road" option via Lad Krabang ICD needs to be further explored. Especially if cargo volume increases in the near future, it might be possible that rail freight rates will become more competitive.

5. REFERENCES

Banomyong, R., 2001, International freight transport choices for Lao PDR, Paper prepared for the 9th WCTR Conference, Seoul, 22-27 July 2001.

Banomyong, R., Nair, R. VNP, & Beresford, A.K.C., 1999 *Managing 'Demand Amplification' in the supply chain: the Thai forwarders' experience*, Occasional Paper No. 59, Department of Maritime Studies and International Transport, Cardiff University.

Barnhart, C., & Ratliff, D.H., 1993, Modeling Intermodal Routing. *Journal of Business Logistics*, Vo.14, No.1, pp.205-223.

Beresford, A.K.C., 1999, Modelling Freight Transport Costs: A Case Study of the UK-Greece Corridors. *International Journal of Logistics: Research and Applications*, Vol. 2, No. 3, pp. 229-246.

Beresford, A.K.C. & Dubey, R.C., 1990, *Handbook on the management and operations of dry ports*, UNCTAD, RDP/LDC/7, Geneva, Switzerland.

Castro, C., 1999, Containerization, logistics cost and facilitation, Paper presented at the World Bank/ESCAP Regional Technical Workshop on Transport and Transit Facilitation, Bangkok, 19-21 April 1999.

Christopher, M., 1998, *Logistics and Supply Chain Management*, Prentice Hall, Harlow.

Fowkes, A.S., Nash, C.A. & Tweddle, G., 1989, *Valuing the attributes of freight transport quality: Results of the Stated Preference survey*, Institute For Transport Studies, University of Leeds Working Paper 276.

Hayuth, Y., 1992, Multimodal Freight Transport. *Modern Transport Geography*, Hoyle B & Knowles R (Eds.), Belhaven, London, pp. 199-215.

Hayuth, Y., 1985, Freight Modal-Split Analysis of Air and Sea Transportation. *Logistics and Transportation Review*, Vol. 21, No. 4, pp. 389-402.
Jung, T.Y. & Beresford A.K.C., 1994, *Intermodal Development on China's Railways*, Occasional Papers No. 24, Department of Maritime Studies and International Transport, Cardiff University.
Kopicki, R., 1999, Government support of efficient supply chains. Paper presented at the World Bank/ESCAP Regional Technical Workshop on Transport and Transit Facilitation, Bangkok, 19-21 April 1999.
Levander, K., 1993, The potential for fast ships in European freight transport. *European short sea shipping*; Wijnost N, Peeters C & Liebman P (Eds.), Lloyd's of London Press, London, pp. 22-39.
Liberatore, M.J. & Miller, T., 1995, A decision support approach for transport carrier and mode selection. *Journal of Business Logistics,* Vol. 16, No. 2, pp. 85-115.
Marlow, P.B. & Boerne G.L., 1992, *The Case for Inter-modalism in Freight Transport*, Occasional Papers No. 4, Department of Maritime Studies and International Transport, Cardiff University.
Min, H., 1991, International intermodal choice via chance-constrained goal programming. *Transportation Research A*, Vol. 25A, No. 6, pp. 351-362.
Yan, S., Bernstein, D. & Sheffi, Y., 1995, Intermodal pricing using network flow techniques. *Transportation Research B*, Vol. 29B, pp. 171-180.