# Chapter 4
# National Logistics Costs

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In today's world, economic climate changes more quickly, and countries realize that globalization has made the world smaller and more competitive. Also, customers seek products and services that can respond to their specific needs and firms make effort to create competitive advantages to keep their profit and market share. All of the above trends lead firms and countries to focus on supply chain and integrated logistics (Fig. 4.1).

Making supply chain activities more effective and efficient is a sustainable competitive advantage for countries. One of the important parts of these activities is logistics activities, which can make a significant reduction in costs. Efficient management of logistics activities is a perfect source for creating competitive advantages. Besides, it allows firms to respond to their customers' specific needs, which in turn, results in customer satisfaction.

## 4.1 Importance of Logistics Costs

Lack of information about logistics costs is a significant barrier to understanding integrated logistics. Optimizing the flow and integrating resources are important objectives in integrated logistics, so managers need transparent information about logistics costs in all stages of product flow. Without this information, it is impossible to measure the impact of decisions on costs through supply chain (Themido et al. 2000). This issue has been cited in the literature by researchers as follows.

"The distribution of products and services from the point of origin to point of consumption is a very important part of any country's gross national product, and indicates how much "money" the country has produced or made. Logistics activities thus mean money to a country." (Voortman 2004 cited in The First State of Logistics Survey for South Africa 2004).

"As the logistics functions become more integrated, they are able to achieve much efficiency. But, a barrier to fully implementing an integrated logistics function is the

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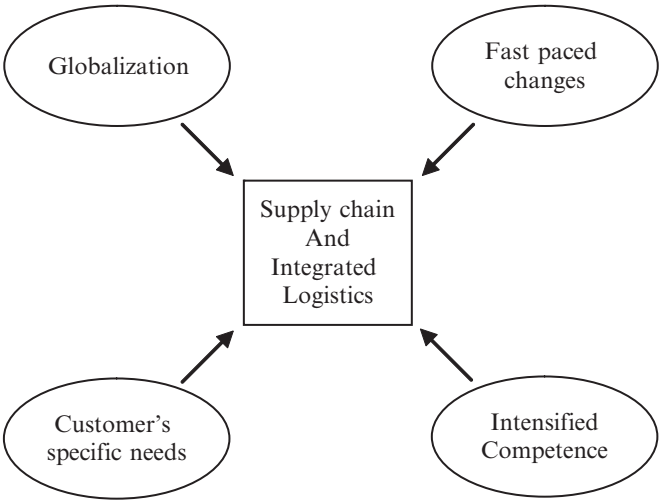


**Fig. 4.1** Trends lead to supply chain and integrated logistics

lack of accurate information about costs." (Fredendall and Hill 2001 cited in The First State of Logistics Survey for South Africa 2004).

Logistics costs measurement is a proper indicator for past and future. As a lead indicator, Logistics costs measurement would support national policy making and the targeted deployment of operational and capital resources (transport infrastructure investment). As a lag indicator, it would enable measurement of performance and pave the way for corrective actions.

As a result, measuring logistics cost is not a goal but it is a proper indicator for monitoring and evaluating national logistics. Importance of logistics costs increases when you know that efficiency of logistics activities is an important infrastructure for economic growth.

Researches show that first world countries have achieved a significant reduction in their transportation and inventory costs as most important parts of logistics costs in last five decades (The First State of Logistics Survey for South Africa 2004).

For example logistics costs in 1981 in USA were 16.2% of GDP[1] whereas in 2003 they are only 8.5% of the GDP. We know that USA gross domestic production in 2003 was approximately 12,400 billion $, so this reduction in logistics costs results in 954.8 billion $ saving (17th Annual State of Logistics Report of USA 2006).

Another important issue is logistics costs proportion of product price. We know that low price for the same product is a competitive advantage that could result in more market share. So because logistics costs are a substantial proportion of product prices (Fig. 4.2), calculating logistics costs and trying to reduce them is very important. Also, because logistics costs proportion of product prices is not

[1] Gross Domestic Product.

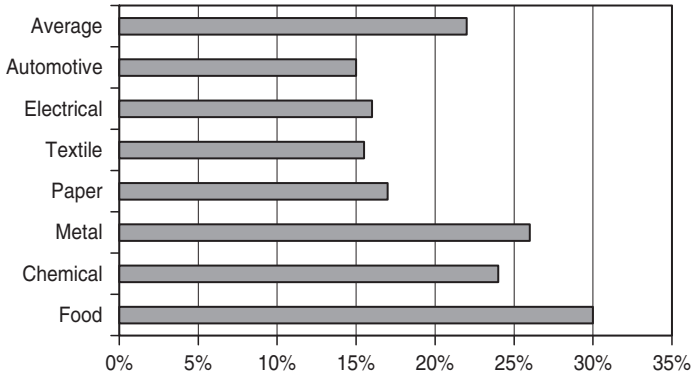


**Fig. 4.2** Logistics costs as a proportion of product prices (European Logistics Association cited by Amos 2007)

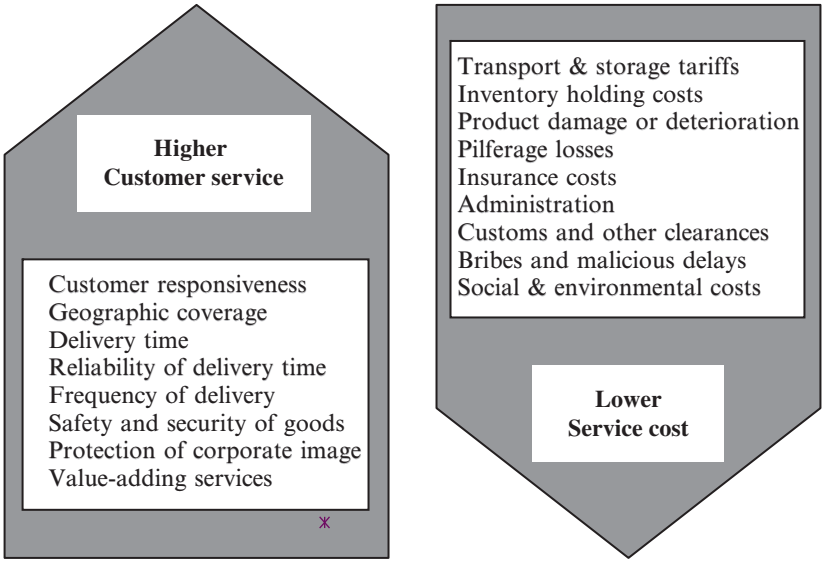


**Fig. 4.3** National logistics strategies (Amos 2007)

equal for different products (Fig. 4.2), calculating logistics costs is a good indicator to prioritize investments on reducing logistics costs in different products.

Different countries use different strategies to improve their national logistics systems and to be able to respond to logistical needs of different industry sectors. We can categorize these strategies into two categories: Lower service costs and higher customer service (Fig. 4.3). It seems that making successes in national logistics systems needs improvement in both categories, and neglecting each one of them leads to failure. Therefore, measuring logistics costs makes a proper index for strategic control (evaluating strategies), especially in lower service costs strategy.

We can see a global effort for calculating logistics costs in different countries and significant numbers of first world countries calculate their logistics costs yearly. But in spite of high importance of national logistics costs, this issue does not find appropriate place in literature.

## 4.2 Complexity of Calculating Logistics Costs

Calculating logistics costs in national level has more complexity than calculating these costs in a firm, although calculating logistics costs in a firm is complex too. Two significant complexities in calculating logistics costs are as follow:

(a) *Complexity in the process* surface means costs of whole flows of materials and information within the enterprise. This shows the complexity of calculating material and information flow in all stages in processes (Wajszczuk 2005).
(b) *Complexity of calculating depreciation* that means calculating the value reduction of all property and equipments involve in logistics activities (Wajszczuk 2005).

With respect to these complexities, calculating logistics costs exactly in national level is very hard or impossible. What we can achieve is the estimation of national logistics costs; and efforts should focus on reducing the error of this estimation. To estimate national logistics costs, countries should have reliable statistics in transportation and inventory parts. Without this information, estimating logistics costs is very hard and results are unreliable.

Another important issue is the point of origin and point of consumption in national logistics chain. As we know "Logistics management is… the planning, implementation and control of the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customer requirements" (CSCMP 2006). So, selecting the point of origin and the point of consumption could play an important role in complexity of calculating national logistics costs. For example, if we put the point of consumption on end consumer(s) (customers), we should calculate costs of transportation for each person from origin to destination in all parts of country, that is very hard. But if we put the point of consumption on retailers, we can calculate the costs with less complexity.

## 4.3 Components of National Logistics Costs

Before we describe the components of national logistics costs, let's talk about logistics main components. There is no standard for this issue, so we describe logistics components based on Rushton et al. (2006). Storage and warehousing, packaging and unitization, transport, inventory, information and control are the main components of logistics activities.

Different methods use different components for calculating logistics costs with a little disparity. Nevertheless, most of these methods consider transport, inventory and administration costs as their components. In coming sections, when we introduce the methods of calculation, we describe the components covered by related method too. In the present section, for better understanding based on Zeng and Rossetti's (2003) work, we define logistics costs component as: transportation, inventory holding, administration, customs, risk and damage, handling and packaging. Table 4.1 shows each part with related subparts and a brief description.

However methods used for estimating national logistics costs in countries usually divide logistics costs into more general components that almost include transportation, inventory and administration costs.

**Table 4.1** Components of logistics costs (Zeng and Rossetti 2003)

| Logistics cost category | Description |
|---|---|
| Transportation | • *Freight charge*. Cost incurred during delivery using various transportation modes<br>• *Consolidation*. The fee for combining small shipments to form larger shipments<br>• *Transfer fee*. Cost incurred during the transfer of goods between different modes of transportation<br>• *Pickup and delivery*. Transportation charges incurred between shipper's warehouse and air, rail consolidator's terminal |
| Inventory holding | • *Pipeline holding*. Holding cost during the transfer<br>• *Safety stock*. Holding cost of safety stock |
| Administration | • *Order processing*. Salaries of employees responsible for purchasing and order management<br>• *Communication*. Telephone, fax and information transfer related costs associated with international logistics<br>• *Overhead*. Rent paid by the international logistics group |
| Customs | • *Customs clearance*. Fee imposed by local customs to clear goods<br>• *Brokerage fee*. Charge levied by an agent acting on behalf of the shipper or the receiver depending on the delivery terms<br>• *Allocation fee*. Per house-bill |
| Risk and damage | • *Damage/loss/delay*. Percentage of the value of each unit shipped that will be lost, damaged or delayed<br>• *Insurance*. Min $25 or $0.50 per $100.00 insured value |
| Handling and packaging | • *Terminal handling*. Material handling fee charged by the transportation company<br>• *Material handling*. Cost of labor and equipment used to move goods within the shipper's or receiver's warehouse<br>• *In/out handling*. Material handling charge levied by the freight forwarder for use of its facilities<br>• *Disposal charge*. Fee for taking away an empty container from the receiver's warehouse<br>• *Packaging/supplies materials*. Cost of preparing goods for shipment<br>• *Storage*. Rental fee of the warehouse space |

**Table 4.2** Taxonomy of logistics costs (Logistics survey 2006)

| | | |
|---|---|---|
| *Overhead costs* | | |
| | • Stock keeping | • Lost sales |
| | • Cost of time | • Customer service level |
| | • IT-maintenance | • Non-marketable products |
| | | • IT maintenance/purchases |
| *Functional costs* | | |
| | • Transportation | • Packing |
| | • Goods handling | • Capital costs of equipment and facilities |
| | • Warehousing | • Administration |
| | • Fairway | |
| | • Documentation | |
| | • Communication | |
| | *Direct logistics costs* | *Indirect logistics costs* |

If we wish to divide logistics cost with respect to taxonomy of costs, logistics costs include four types of costs: Direct costs, indirect costs, functional costs and overhead or alternative costs. Table 4.2 shows these parts with related subparts.

This taxonomy is important because each type of these costs has a different behavior, and we should consider this behavior in cost analysis and corrective actions.

## 4.4 Factors Affecting National Logistics Costs

Quality and performance of logistics systems are different among countries. For example, In Namibia the costs of all trade-related transactions for a 20-ft full container, load container, including inland transport from the ocean vessel to the factory gate, amount to slightly more than $3,000; and in Georgia, to slightly less than $3,000. In Germany, these costs amount to only $813; and in Sweden, to a little more than $500 (Hausman et al. 2005). These disparities originate from factors that affect logistics costs. We introduce important factors affecting logistics costs below:

– *Geographical situation.* Logistics costs could increase or decrease in relation to geographical situation. Usually, countries that are close to ports, airports, economic hubs and logistically developed countries have better logistics systems with lower logistics costs. This is because of competition and adoption with environment. For example, logistics costs for importing and exporting the products are about 50% higher for land locked countries (Radelet and Sachs 1998).
– *Logistics infrastructures.* This area is about the development and maintenance of Logistics infrastructures to support full range of logistics services and transport modes. Distribution network and communication network are important components of this part. Singapore is a good example for this issue. in past

decades Singapore makes good investments on its logistics infrastructure that results in logistics excellence and costs reduction (Bookbinder and Tan 2003).

- *Human resource.* Availability of skilled labor as a strategic source can play an important role in promoting logistics activities and reducing logistics costs. This issue is more important in developing countries. It is interesting to know that one of the factors which led to increasing logistics costs in USA in 2005 was lack of vehicle driver (Cooke 2006).
- *Administration.* In most methods for estimating national logistics costs, share of administration costs is assumed to be 4% of total costs. But actually, this 4% has a significant effect on the remaining 96%. In fact for making logistics activities more effective and efficient that lead to cost reduction, we should use administrative tools. Correct administration prevents squandering resources and leads to saving. For example, executing petrol sharing policy in Iran, results in a daily saving of 20 million liters and an annual 3.7 billion $ cost reduction.
- *Technology.* Technology is an important factor in all parts of logistics. Sometimes, Technological development makes fundamental changes in logistics activities. In this area information and communications technologies (ICT) are more effective on logistics activities. In some cases, ICT omit the whole physical distribution network and make significant savings. Researchers believe that development in ICT is one of the reasons for reducing trend of logistics costs in past decades. They also believe that there is still greater potentiality in technology to further reduce cost in future.
- *Political and economical stability.* This factor can reduce or increase the risks and affect the insurance costs. So with respect to high number of logistics activities in national level, it can have a significant effect on logistics costs. In addition, political and economical stability can play an important role in attracting investment in national logistics activities. Moreover, instability in this area may result in industrial disputes and work stoppage that both result in an increase in logistics costs.
- *Business legal rules.* Customs, taxes and insurance laws are components of this part. Compatibility of these rules with logistics processes and activities could affect logistics costs.
- *Rate of interest.* One of the important macro economic indicators that can play an important role in logistics costs is rate of interest. This factor is more important in inventory costs because of direct relation between them. One of the factors that led to inventory costs increase in USA in 2005 of 71 billion $ over 2004, is growth of interest rate (Cooke 2006).
- *Energy price.* Global trend of increasing energy prices is another important factor that affects logistics costs. This increase especially in fuel prices that is used in logistics activities makes inflation in logistics costs, especially in transportation because of nature of its related activities. One of the factors that played an important role in transportation costs increase in USA in 2005 of 92 billion $ over 2004, was rise of fuel prices (Cooke 2006).

## 4.5 Logistics Costs in Agriculture

Agriculture is an important part of GDP in many countries. So, calculating logistics costs in agriculture is prominent. Also, Results of calculating agricultural logistics costs (Sect. 4.5.2) show this importance obviously. In this section we study logistics costs in agriculture based on Wajszczuk's (2005) paper.

### *4.5.1 Logistics Costs Components Including in Method*

Wajszczuk defines components of logistics cost as physical flow of material cost, inventory cost and information process costs. Table 4.3 shows these parts with related subparts.

We can calculate logistics costs as follows:

$$C_{\mathrm{L}} = C_{\mathrm{pfm}} + C_{\mathrm{inv}} + C_{\mathrm{inf}}. \tag{4.1}$$

**Table 4.3** Components of logistics costs in agricultural (Wajszczuk 2005)

| Costs of physical flow of material ($C_{\mathrm{pfm}}$) | Costs of inventory ($C_{\mathrm{inv}}$) | Costs of information processes ($C_{\mathrm{inf}}$) |
|---|---|---|
| Labor costs (also material and energy costs) | Costs of inventory leasing | Depreciation costs of property which is involved in logistical processes |
| Depreciation of information equipment | Labor costs | Leasing costs (lease for square, garages, internal ways) |
| Costs of telecommunication services | Costs of stock losses (losses during evaporation, going stale of stock, diseases, pests) | Labor costs |
| | Other costs (insurance, energy, cost of inventory capital) | Use costs of oil, materials and energy |
| | | Costs of transport external services |
| | | Other costs of flow (taxes and insurance of transport means, repairs and preservation of equipment) |

**Table 4.4** Comparison of logistics costs in agricultural vs. non-agricultural enterprises (Wajszczuk 2005; Skowroneki and Sarjusz-Wolski 1999)

| Elements of logistics costs | Share of basic elements in total logistics costs (%) | |
|---|---|---|
| | Investigated enterprises | Non-agricultural enterprises |
| Costs of physical flow of material | 86.5 | 40–50 |
| Inventory costs | 12.2 | 30–40 |
| Costs of information processes | 1.3 | 15–20 |

### *4.5.2 Result Analysis*

This method was used to calculate logistics costs in four great area rural enterprises located in Poland in 2003. Table 4.4 shows the achieved results in comparison with non-agricultural enterprises.

Wajszczuk (2005) compares his results with results of past researches on non-agricultural enterprises:

(a) The results of this research showed high share of logistics costs in total costs in comparison with non-agricultural enterprises. The index of share was 42.2%, whereas in non-agricultural enterprises it fluctuates between 20 and 30%.
(b) The results of this research showed high share of logistics costs in total selling and services value in comparison with non-agricultural enterprises. The index of share was 27.5%, whereas in non-agricultural enterprises it fluctuates between 12.1 and 5.8%.
(c) Share of physical flow of material costs in total logistics costs in agricultural enterprises was 86.5%, whereas in non-agricultural enterprises it fluctuates between 40 and 50%. The reason for this disparity could be explained with respect to high diversity and volume of agricultural products. Moreover, the selected enterprises have several branches with significant distance between them. we should consider that in agricultural environment we have small distances transportation on bad quality roads (mostly dirt roads).
(d) Share of inventory costs in total logistics costs in agricultural enterprises was 12.2% whereas in non-agricultural enterprises it fluctuates between 30 and 40%. That is to say inventory costs in agricultural enterprises is around three to five times smaller in comparison with nonagricultural enterprises. This can be a result of several circumstances. Firstly, in researched enterprises, majority of fabricated agricultural products can be characterized as raw materials for farthest processing and short period of freshness. Secondly, the enterprises want to get back their engaged capital very quickly in order to start the next productive cycle again. So, most of agricultural enterprises sell their products immediately. Based on this fact, one may hypothesize that an enterprise which is located in the supply chain "near the final receiver", has higher inventory costs because it must keep certain level of stock for assurance of liquid service of clients. Analyzed enterprises are placed at the beginning of such supply chain. Thirdly, currently, contrary to the past years, the agricultural enterprises purchase means

of production just before their use for production. In this way, the enterprise is limiting costs of engaged capital to minimum. This fact has caused that in analyzed enterprises some store surface not to be used fully. Such a situation is also a result of rules of the past economic system. Before 1990, the agricultural enterprises had to buy the means of production too early due to the general lack of such supplies and consequently store them for a long time. So, it considerably increased cost of storage.

(e) Information processes costs in agricultural enterprises are around 13 times smaller in comparison with nonagricultural enterprises. This is because of lack of investment in information processes in researched enterprises.

Based on above facts, we can say "there is a direct relation between volume and weight of products with logistics costs". Therefore, if the volume and weight of products increase, it results in a growth in logistics costs. As a result, in agriculture, mining and similar industries logistics costs are higher than information and service provider industries. The following figure shows this relation with respect to producer countries (Fig. 4.4).

These results show that logistics costs are more important in industries that produce heavy and bulky products (e.g. agriculture, mining and similar industries). They also show that investments in logistics activities in such industries could lead to more significant savings. This is an important issue that countries should consider.

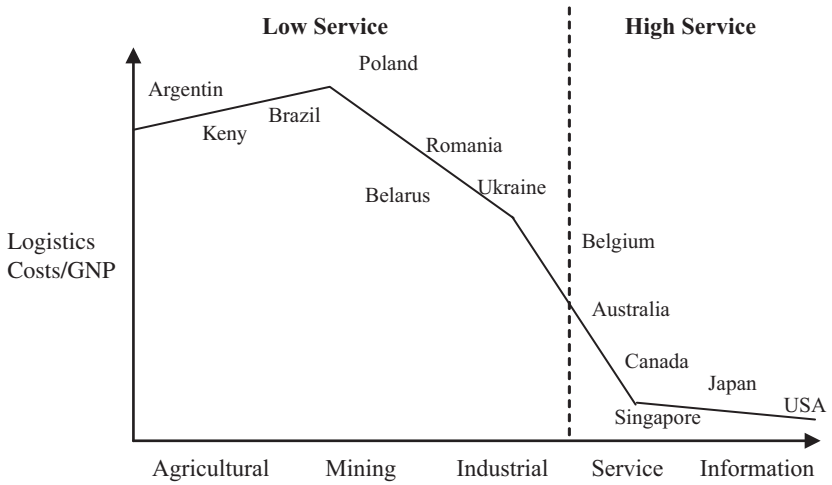


**Fig. 4.4** logistics costs with relation to industries and countries

## 4.6 State of Logistics in America

In this section, we describe the method used in USA for calculating national logistics costs.

### *4.6.1 Literature Review*

As noted in previous sections, calculation of logistics costs is a multidimensional issue. So, we see many improvements in the literature review of this subject. In the following, we will review this literature briefly.

The first published methodology for logistical cost assessment was presented by Heskett et al. (1973). They applied their methodology, estimating total logistics cost, to estimate USA market size. They introduced four types of commercial activities (Bowersox et al. 2003):

1. Transportation
2. Inventory
3. Warehousing
4. Order processing

Their methodology is summarized in the Table 4.5.

**Table 4.5** Estimation methodology proposed by Heskett et al. 1973; (cited by Bowersox et al. 2003)

| | | | |
|---|---|---|---|
| Transportation | Air carrier | Equipment | Highway |
| | Commercial[a] | Manufacturers | Automobile[b] |
| | General[b] | Motor vehicles and equipment[b] | Truck and trailer[c] |
| | • Oil pipeline[c] | • Other than motor vehicles[c] | Bus[b] |
| | • Water carrier | • Transit | Dealers, service stations[a] |
| | Inland[c] | Rail & trolley[b] | Repairs, garages, etc.[a] |
| | Ocean[c] | Repairs, garages, etc.[a] | • Railroad[a] |
| | Great lakes[c] | | |
| Inventory | • Farm[c] | • Manufacturers[c] | |
| | • Wholesalers[c] | • Retailers[c] | |
| Warehousing | • Public[c] | • Private[c] | |
| Order processing[d] | | | |

[a]Costs split between the two
[b]Costs related to just passenger
[c]Costs related to just freight
[d]Costs not available

Information concerning transportation costs were obtained from the Transportation Association of America and the Bureau of Labor Statistics. Inventory cost was estimated as the ratio of cost of the average value of inventory over 1 year. Public warehousing cost was estimated using the average valuation of $2 per square foot for basic warehouse space plus $0.25 per cubic foot for refrigeration space. Private space owned by retailers and manufacturers was estimated based on inventory value/space occupied ratio for wholesalers. The order processing cost, although proposed by the authors, was not estimated. Annual logistic cost was estimated as the sum of the noted cost components (Bowersox et al. 2003).

Then, Robert Delaney, based on this methodology, has estimated annual logistical expenditure, under the sponsorship of Cass Information Systems and ProLogis. His annual report, called "The State of Business Logistics in the United States" is the only long-running attempt to quantify logistics expenditure in the United States (Delaney and Wilson 2003). Which we will use them for our work in this chapter at the conclusion section.

Delaney uses three key components to estimate logistics expenditures (Bowersox et al. 2003):

(a) Inventory carrying cost
(b) Transportation cost
(c) Administrative cost

Delaney's methodology is summarized in Fig. 4.5.

The challenge in estimating global logistics expenditures is that a direct measurement or roll-up summation methodology is not applicable. Such a methodology requires detailed data on all logistical components. Although the data are available to varying degrees in most developed nations, they are not available in many other

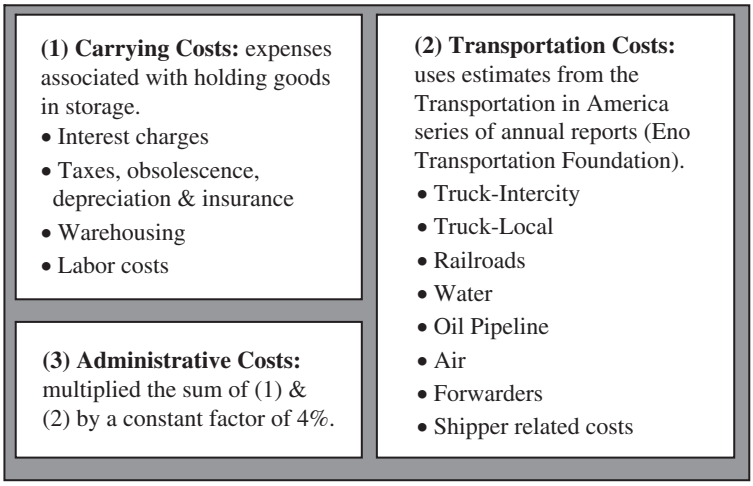


**Fig. 4.5** Estimation methodology proposed by Robert Delaney (Bowersox et al. 2003)

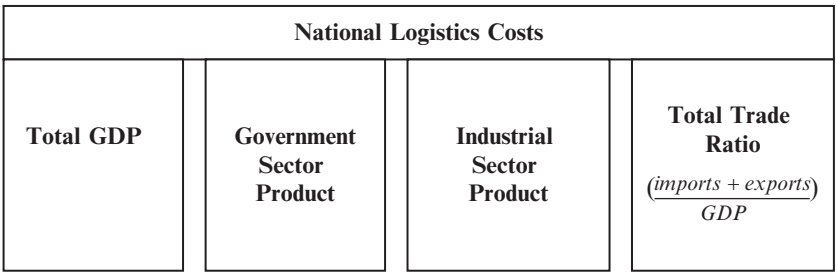


**Fig. 4.6** Estimation methodology proposed by Bowersox in 1992; (cited by Bowersox et al. 2003)

countries. A country-by-country estimation requires the use of available aggregate data across countries (Bowersox et al. 2003).

The first study to frame global logistics requirements was conducted by Bowersox (1992). He presented an estimation of global logistics costs based on four components (Bowersox et al. 2003):

(a) Total gross domestic production (GDP)
(b) Government sector product
(c) Industrial sector product
(d) Total trade ratio

The first and the fourth ones were included to size individual economies. And the rest of components were included to capture expenditures related to the logistics activities of transportation, inventory, and warehousing. Figure 4.6 depicts the methodology in a snapshot (Bowersox et al. 2003).

In this assessment, analyses were conducted aggregating the countries in seven regions (Bowersox et al. 2003):

– Europe (EC 1992)
– Pacific Rim (AFTA)[2]
– North America (NAFTA)[3]
– Eastern Europe and Middle East
– China and Southeast Asia
– Central/South America and Caribbean Basin
– African Nations

In a later study, Bowersox and Calantone (1998) refined the estimation method by introducing an artificial neural network model, Fig. 4.7.

This methodology expanded the scope of the previous approach by including infrastructure variables related to cost and information systems (Bowersox et al. 2003).

[2] Australian Federation of Travel Agents.

[3] North America Free Trade Agreement.

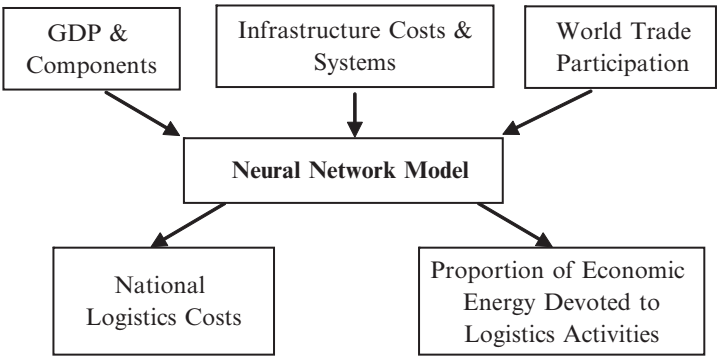


**Fig. 4.7** Estimation methodology proposed by Bowersox and Calantone in 1998; (cited by Bowersox et al. 2003)

### *4.6.2 CASS Methodology*

Now, let's go through a notable methodology which has been used in USA since 1973, called CASS.

In the remainder, we are going to explain several basic conceptual issues concerning the measurement of logistics activity, description of CASS methodology and Eno Transportation Foundation methodology for calculating transportation costs, as the CASS methodology relies entirely on this cost estimation methodology.

In the end, we suggest some potential improvements to the current procedures used to calculate logistics costs.

First, it must be mentioned that the name of this methodology, CASS, was derived from the name of a company which established the methodology: Cass Information System Inc. (formerly CASS logistics Inc.).

However, the sponsorship of execution of this methodology has recently moved from CASS to CSCMP[4], but the CASS methodology is unlikely to be changed.

Since comparison between logistics and GDP is the output of CASS, let's remind the concept of GDP.

Simply stated, GDP, is the total value of final goods and services produced for consumption within a country's boundaries in a given time period (usually a year).

$$\begin{aligned}\text{GDP} = {} & \text{private consumption} + \text{government consumption} + \text{investment} \\ & + \text{exports} - \text{imports}.\end{aligned} \tag{4.2}$$

The considerable point in the definition is that, GDP does not include intermediate goods and services. And this is an important point that we will refer to in the following sections.

[4] Council of Supply Chain Management Professionals.

On the other hand, estimation of logistics costs is not inherently related to GDP because it is neither a measure of how much of GDP is consumed by logistics nor is it a measure of how much logistics contributes to GDP.

Therefore, assuming the most commonly cited estimate of logistics costs:

- It is incorrect to say that logistics costs account for X% of GDP.
- It is incorrect to say that logistics contributes X% to GDP.
- To say that logistics costs are equal to X% of GDP is acceptable, but it is simply a statement of their relative sizes, not a statement of how much one is dependent on the other.

But somebody may ask "Why we compare logistics costs with GDP?" in other words, "What is the property of GDP which we choose for this comparison?"

Or another question may be "Why preceding interpretations were incorrect?" and "Isn't it necessary to have comparisons in these ways?"

To answer these elegant questions, notice that the difficulty in comparing logistics with GDP is in the way "logistics" is classified and calculated. Which elements are included in the estimation of "logistics" can significantly change the meaning of any comparison.

In our CASS methodology we focus on the concept of macroeconomic logistics costs, which is more useful for national decision-makers. So, we should choose a macro-economical indicator. But there are so many other macro-economical indicators other than GDP, such as GNP[5], PPP[6], etc. Why don't we use them? Because GDP is more common and governments prefer to estimate it more precisely for different purposes.

About other questions we say that: One way to evaluate logistics relative to GDP is to determine how much of GDP is consumed by the logistics activities or the total final demand for logistics by all user categories (consumer, government, business, and net export). This comparison says nothing about the contribution of the industry to GDP rather than to determine the level of final demand that logistics requirements generate. This calculation of logistics must only include purchases that are not consumed by the production of services that ultimately contribute to GDP. This measure of logistics is not currently available. Furthermore, the usefulness of such a measure is not readily apparent (MacroSys Research and Technology 2005).

Another way to evaluate logistics relative to GDP is to determine how much the logistics industry contributes to GDP. To make this comparison, one must determine the level of added value generated by the industry. Such a metric would be desirable because it would be a statement of logistics' contribution to GDP. Importantly, intermediate goods are not included in GDP. As a result, this is a difficult comparison to make. One must determine which of the many goods and services purchased by logistics firms are consumed in the production of the goods and services produced by the firms. The difference between the two equals the industry's contribution to GDP. The required calculation is a two-step process. The first is to develop a clear

[5] Gross National Production.

[6] Purchasing Power Parity.

boundary separating logistics activities from other business activities. Within the established boundary (as drawn in this report or as employed in the CASS methodology) the second challenge is to estimate value-added from both outsourced logistics activities (i.e., transportation and warehousing industries) and from in-house logistics activities. The transportation element of logistics is measured in this manner by the TSA[7]. However, there is currently no comparable measure of other logistics activities. As such, there is currently no means of calculating the contribution of logistics activities to GDP from a value-added perspective (MacroSys Research and Technology 2005).

Finally, one can calculate the amount firms spend on logistics activities fairly easily (as CASS does) and compare that number with GDP. The problem is that this cost calculation contains (a) intermediate goods and services, and (b) internal business operating costs unrelated to logistics. When firms outsource logistics activities, they purchase not only the services produced by the logistics providers, but also the intermediate inputs used in the production of the services. When firms run in-house logistics operations, their "logistics costs" also include internal business activities and purchases that are not strictly logistics functions.

Furthermore, logistics costs include inventory-carrying costs, which include opportunity cost of capital, which is not a component of GDP (MacroSys Research and Technology 2005).

Now we turn to the description of CASS methodology.

As mentioned before, CSCMP define logistics as "that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements."

Remember that Heskett first introduced the concept of macroeconomic logistics costs and developed a methodology to measure them which becomes a base for CASS methodology. However, CASS' estimates, published in its "Annual State of Logistics Report", have been most frequently cited by government agencies and trade associations. As one United Nation's document states, the CASS report "has taken on oracle status in the profession and statistics in it are often cited in federal government reports (MacroSys Research and Technology 2005)."

Based on MacroSys Research and Technology (2005), according to this definition, logistics includes all activities concerning the movement and storage of goods between the point of origin and the point of consumption of the goods. Furthermore, logistics includes freight movement and excludes people movement, although it must be recognized that the overall logistics does involve passenger movement, which will be discussed more lately.

Where is the "point of consumption?" Should the point of consumption be extended to households? In other words, should the movement of goods such as that from a grocery store to a private kitchen be part of the logistics chain? Obviously, such movements require the same kind of inputs, individually at a much smaller

[7] Transportation Satellite Account and the U.S. Transportation Satellite Account was designed to produce estimates of all transportation operations for all modes.

scale of course, as those between wholesalers and the grocery store. Both require loading, transporting, and unloading the goods. However, since much of the goods movement to households is carried out by households, and household activities are not treated as part of the national production process in official economic accounting systems such as the US National Income and Products Accounts and the US Input–output accounts, treating household logistics activities as part of the overall logistics chain expands the production boundary and causes problems of consistency and comparability with official economic statistics.

One way to avoid this difficulty is to limit the measurement of logistics to business logistics only. And in fact, CASS' methodology includes only the logistics costs for the US business system. Furthermore, the CSCMP definition may be interpreted to cover only business logistics because it refers to the supply chain, which normally does not include household activities. Clearly, the final stopping point of goods movement in business logistics is not always consumption. The inbound movement of goods to retailers is often the last leg of goods movement for business logistics, yet retailers are not the ultimate consumer of the goods. Although the movement of goods from retailers to the final point of consumption by households creates real value to consumers, this kind of value creation is not counted in current economic accounting methodologies. Instead, it is treated as consumption. In other words, value-addition in current economic accounting only happens in the business sector. Therefore, to achieve clarity, the definition for business freight logistics should refer to the last point of value-addition rather than the point of consumption.

Whereas consumer transportation of goods from market to household is properly excluded from logistics activities, merchandise home-delivery on behalf of sellers is part of the production and logistics chain. To exclude the former and include the latter, business logistics may be better defined on the basis of who performs certain activities rather than where those activities are performed. To the extent that supply chain management refers to business activities only, the CSCMP definition of logistics on the basis of supply chain management is sufficiently clear for delimitating where business logistics starts and ends.

As cited in previous sections, cost items according to our purpose of calculation, vary from one definition to another. So, based on the aim of CASS methodology which focused on comparison of logistics costs with GDP in macroeconomical level, it defines three broad cost components comprising the business logistics system. They are inventory-carrying costs, transportation costs, and logistics administration costs.

Measuring inventory-carrying costs and transportation costs, however, is not straightforward because both involve substantial amount of in-house operations.

In-house operations refer to those business operations that a company conducts to provide services for its own use. In contrast to the services from for-hire operations that are bought and sold in market-places, in-house operations are provided and consumed internally without market mediation. Some internal operations should be included because they are either the same kind of activities as external logistics or the natural and immediate extensions of external logistics.

It is a well-known fact that much of the trucking and warehousing operations in the US are in-house operations. Therefore, measures of transportation and warehousing costs should cover services from both for-hire and in-house operations. It is important to note that the for-hire cost should be the total price charged to the service users, not the cost to the carriers providing the services. The full cost of in-house services should include an imputed return to capital as well as the costs of intermediate inputs, labor compensation, and capital consumption.

While the cost of transportation measures the cost of goods movement, the cost of warehousing does not fully capture the cost of goods storage. Clearly, warehoused goods tie up capital, and capital is costly. Moreover, businesses may suffer losses as materials in storage may experience obsolescence, physical deterioration, and loss in value. Also, businesses have to spend money to insure goods in storage against accidental losses such as those due to natural disasters and fire hazards. Based on these considerations, an inventory-carrying cost is often measured to include costs of interest, taxes, obsolescence, depreciation, insurance, and warehousing.

While how much of a certain material a business decides to keep in warehouses may heavily depend on transportation system performance, inventory-carrying costs may change independently for reasons completely unrelated to transportation. Costs of interest change in response to fluctuations in interest rate. Insurance costs depend on the level of insurance premium. Even the level of inventory itself may be determined by factors outside transportation and logistics management such as business cycles.

A business may experience an unexpected increase in inventory due to an economic slowdown, no matter how well it manages its logistics operations. Factors such as these do not constitute a valid argument against the inclusion of inventory-carrying costs in total logistics costs, but they do indicate that certain price and business cycle variables need to be controlled if the resulting logistics cost measure is utilized for trend analyses.

There are internal business operations that are immediate extensions of transportation and warehousing and therefore should also be counted. These include industrial traffic management, loading and unloading by shippers, inventory planning and analysis, and support by central distribution staff.

Yet another problem in defining logistics, is the question of how much intra-plant activity should be included as logistics activity. For example, goods are moved around within the business establishment where the goods are to be retailed. This is relevant, because extensive intra-plant movement of materials may cause a significant increase in the estimate of total logistics costs, depending if the activities are included as logistics. In some literature on business logistics management, production scheduling, materials handling, purchasing, order processing, and market forecasting are included as business logistics activities, where materials handling is basically intra-plant material movement. Although these activities affect the movement of goods and level of inventory, they are not themselves intrinsic to goods movement and inventory management. The literature and practice of macroeconomic costing of logistics seems to indicate that the costs associated with these functions should not be counted as logistics costs. For example, the Heskett

approach and the CASS methodology both exclude many of those internal business activities. For Heskett, such exclusion may be because his approach was originally developed to measure the macroeconomic costs of physical distribution.

The reason for the exclusion of these cost categories from the calculation of logistics costs relates to the purpose for which logistics costs are being defined, measured, and analyzed. Within an individual firm, for the purpose of planning and managing business operations, logistics may well be defined to include everything that is involved in physical supply, physical distribution, and intra-plant materials movement. For a manufacturing company, for example, anything that is not general administration and direct manufacturing operations may be counted as part of the company's logistics operations. It is certainly useful and necessary for the firm's management to know how much it costs the company to move things in and out and get them to the right spot in right quantity at right time. However, this cost information is less useful outside the firm (other than to its competitors.) Specifically, the cost information based on this broad concept of logistics is of little consequence to public decision-makers because it contains many elements on which public decisions have no effect. For instance, an inefficient plant layout that hampers intra-plant material movements will cause the firm to incur costs, no matter how efficient the highway system or trucking operations are. Therefore, information on the internal logistics costs of a business enterprise is largely irrelevant to public decision-makers.

Of course, cost measurement or any other measurement efforts by the government sector are not necessarily all for the purpose of public decision-making. A logistics cost measure that includes all intra-plant material movement may be useful for some purposes, but the logistics cost measure exclusive of intra-plant material movement has its own value, and is perhaps more valuable to decision-makers in transportation.

The questions and discussion above define in theory the proper boundary of business freight logistics for the purpose of calculating national logistics costs. As determined, many internal business activities should be excluded from the calculation. However, the boundary must be cast to include specific cost items. Unfortunately, the exclusion of certain internal business operations is easier said than done. A certain level of arbitrariness in drawing the cut-off line is unavoidable. However, the consequence of this arbitrariness to the final estimates of overall logistics costs is likely to be inconsequential so long as the list of internal operations included does not get too long.

Now, let's explain more about each component of logistics costs in CASS methodology. The main components are: inventory-carrying costs, transportation costs, and logistics administration costs.

#### 4.6.2.1 Inventory Carrying Costs

Inventory carrying costs include the cost of money (opportunity or interest), ad valorem taxes, insurance and shrinkage. Inventory carrying costs vary with the level of

inventory stored. They can be categorized into the following four groups: (1) capital costs, (2) inventory service costs, (3) storage space costs, and (4) inventory risk costs.

- *Capital costs for inventory investment.* Holding inventory ties up money that could be used for other types of investments. Consequently, a company's opportunity cost of capital should be used to reflect accurately the true cost involved. All inventory carrying cost components must be stated in before-tax numbers, since all the other costs in the trade-off analysis, such as transportation and warehousing, are reported in before-tax dollars.
- *Inventory service costs.* Inventory service costs consist of taxes and insurance paid as a result of holding inventory. In general, taxes vary directly with inventory levels. Insurance rates are not strictly proportional to inventory levels, but are related to the value of inventory over a specified time period.
- *Storage space costs.* Storage space costs can be incurred at four types of facilities:
  - Plant warehouses
  - Public warehouses
  - Rented (leased) warehouses
  - Company-owned (private) warehouses
- *Inventory risk costs.* Although inventory risk costs vary depending on the company, in general, they include charges for: obsolescence, damages, pilferage and relocation. The cost of taxes, and obsolescence, depreciation and insurance are estimated according to the Alford-Bangs Production Handbook formula. In this formula obsolescence accounts for nearly 40% of total inventory carrying costs, thus demonstrating the challenges facing inventory managers in the world of fast cycles and just-in-time procurement. Total warehousing cost estimates encompass both public warehouses and private warehouses operated by manufacturing and distribution companies. Public warehousing costs are obtained from the public warehousing services data reported by the Commerce Department's Census Bureau. Private warehousing costs are independently obtained by CASS. Relocation costs are incurred at the transshipment of inventory from one warehouse location to another to avoid obsolescence.

#### 4.6.2.2 Transportation Costs

Transportation costs include carriers' charges for all modes, including trucking, rail transport, water and oil pipeline, and both international and domestic airfreight transport, as well as freight forwarding and shipper-related costs. The freight transportation costs in the CASS report account for the largest portion of logistics costs. These estimates are based on the annual Transportation in America report published by the Eno Transportation Foundation. Of total transportation costs, trucking costs dominate the United States business logistics system, accounting for more than 80% of the nation's freight bill. Shipping related costs include the loading and unloading of transportation equipment, as well as traffic department operations.

Total transportation costs include costs for both primary and secondary transportation. Primary transportation is the movement of finished goods from plants and vendors to warehouses. Primary transportation costs include costs for replenishment movement from plants or distribution centers to other plants or distribution centers, and inbound freight on purchased finished goods movement to plants or distribution centers for resale. Secondary transportation is the delivery of finished goods to customers. Secondary transportation costs include payments to carriers, pickup allowances, truck or rail equipment and operations costs, and freight allowed. Freight may originate in plants, distribution centers or terminals.

Anyhow, eight items which Eno methodology calculates are (MacroSys Research and Technology 2005):

- Intercity truck
- Local truck
- Railroads
- Water
- Oil pipelines
- Air
- Forwarders
- Shipper related costs

Each item will be estimated based on spread statistics of formal organizations such as Federal Highway Administration for intercity truck's statistics.

#### 4.6.2.3 Logistics Administration Costs

Logistics administration costs include indirect management and support staff, which comprises central distribution staff, planning and analysis staff, and the traffic department staff. Computer software and hardware cost allocations are another important distribution expenses. Such costs are included in the appropriate cost categories; with any remainder, considered as part of administration costs.

Logistics administration costs are set at 4% of sum of the inventory-carrying costs and transportation costs, in line with the methodology that has been consistently employed since the data series was first published in 1973.

However, we shouldn't forget that unless Administration costs are only 4% of total logistics costs, but improving the methods of doing them would result in deep effects on total logistics costs.

The details of these cost components and the CASS methods for measurement are included in Table 4.6.

At last and in order to improve measure of logistics costs we suggest three recommendations (MacroSys Research and Technology 2005):

1. The prices of the goods in inventory should be held constant to allow inventory levels to be estimated in constant dollars. This is a standard practice applicable to all other logistics cost items. Without controlling price effects, inventory level fluctuates even if the real inventory level does not change.

**Table 4.6** Cost components and CASS methods of measurement (MacroSys Research and Technology 2005)

| Cost components | CASS methods of measurement |
|---|---|
| *Inventory carrying costs* | |
| Interest | Annualized commercial paper rate |
| Taxes, obsolescence, depreciation, insurance | Alford-Bangs production handbook formula |
| Warehousing | Expenditure on public warehousing from census |
| *Transportation* | |
| Intercity truck | Eno estimates |
| Local truck | Eno estimates |
| Railroads | Eno estimates |
| Water | Eno estimates |
| Oil pipelines | Eno estimates |
| Air | Eno estimates |
| Forwarders | Eno estimates |
| Shipper related costs | Eno estimates |
| Logistics administration costs | Imputed at 4% of total logistics cost |

2. The level of inventory can be smoothed over time to lessen the effect of cyclical changes. An unexpected economic slowdown usually pushes up business inventory causing an increase in inventory carrying cost, other things being equal. Likewise, an unexpected economic upturn causes inventory to go down. While the resulting level of inventory carrying costs can still be usefully measured, its changes are not good indicators of whether the underlying logistics system is working better or worse. A moving-average or some other time-series processes may be applied to the inventory data so that a more persistent trend can be identified.
3. The interest rate used to estimate the inventory capital costs should be held constant. While the tax rates and the insurance premiums can both change, the CASS estimation does not individually utilize tax rate and insurance premium data. Interest rates are also relatively more volatile. Fluctuations in interest rates directly result in changes in the inventory-carrying cost even if the underlying logistics system stays unchanged. For a trend analysis, interest rates should be held constant.

#### 4.6.2.4 Conclusion of State of Logistics Survey in America

In order to see the use of CASS methodology practically, we will review the state of logistics in US, mainly reports of year of 2006, according to 17th Annual Report of State of Logistics reported by CSCMP.

Total business inventories rose dramatically in 2005, which could have happened because of two reasons:

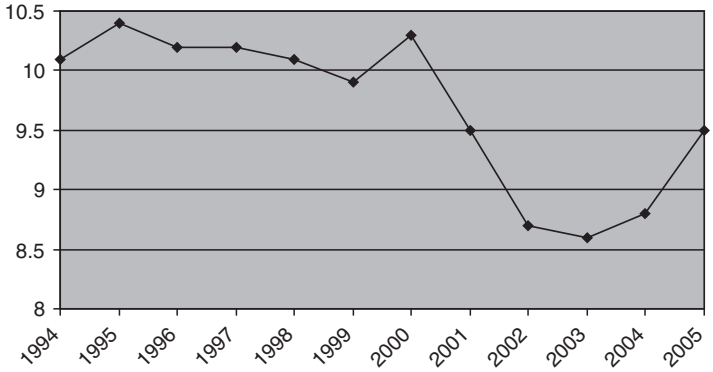


**Fig. 4.8** Logistics costs as a percentage of GDP (Cooke 2006)

1. Raising trend of interest rate in order to control inflation caused by energy costs. (It's obvious that many factors motivate energy costs to increase in recent years, such as war of Iraq, internal changes of Iran which have deep effects on global decisions).
2. Storing more goods by companies in order to response to longer, often unpredictable transit times.

Interest rates have begun to climb back up and this, also combined with bigger inventories, pushed inventory carrying costs to new highs. It has two main reasons:

1. Increase of fuel cost
2. Shortage of labor, especially driver

Figure 4.8 depicted that US business logistics costs were equal to 9.5% of nominal GDP in 2005. By the way, comparing the statistics of 2004–2005 illustrates that transportation costs rose 14.1% in 2005, the single largest rise and now account for 6% of nominal GDP. Costs were up for virtually every component of business logistics costs. In the beginning of 1980s, legal barriers of transportation industry have diminished and caused decrease in costs which result in a decisive competition between rival companies. In this way, we see a declining trend since 1980s–2003. But economical growth in 2003 locked in to rising demand for transportation industries then cumulating in inventory stocks and high interest rates causing a rising trend since 2003.

So we can conclude that the economy is still growing and freight shipments are forecast to increase at double digit levels. We are hampered by inadequate and aging infrastructure and in need of strong national leadership to focus on solving the tough capacity problems facing out transportation network. Embracing security as a core business function will enable firms to gain measurable bottom line benefits while mitigating the need for a plethora of invasive government practices (Cooke 2006).

## 4.7 State of Logistics in South Africa

After becoming familiar with CASS methodology which is used to calculate the US logistics costs, now it's time we studied methods of determining the costs in under developed countries.

We chose South Africa for this purpose, because we have two formal reports on state of logistics survey for South Africa at hand for years of 2004 and 2005.

### *4.7.1 South Africa's Methodology*

The multiple perspectives considered by the state of logistics survey include established areas of research, such as cost-modeling, transport economics and supply-chain analysis, as well as emerging research areas, such as the role of logistics in economic development. The research methodology reflects this holistic approach and the relative maturity of these research areas. A more formal and quantitative approach is adopted for the development of the cost of logistics, while a more qualitative and exploratory approach is applied to the small business and economic development perspective.

For the purposes of model development, logistics is considered to be that part of the supply-chain process that deals with the transportation, warehousing, inventory carrying, administration and management of physical products between the primary point of production and the point of delivery to the final consumer (or last customer in the supply chain whenever products are not delivered to consumers). Per definition this excludes the cost of passenger transport and the cost of transport, storage, packaging, handling, etc. of mail and luggage, as well as the storage and movement tasks that occur during the production process (The second annual state of logistics survey for South Africa 2005).

### *4.7.2 Conclusion of State of Logistics Survey in South Africa*

Based on annual reports on state of logistics survey for South Africa, 2005, in the first State of Logistics Survey in 2004, the need for measurement and revitalization of basic infrastructure in South Africa's dual economy was accentuated. The process of addressing these needs has started with the release of the National Freight Logistics Strategy, which delineates a comprehensive development framework, as well as Spoor net's growth plans for recapitalization.

*The global context – the case for developmental logistics*. Currently, the world's focus on logistics issues is divided with the first world caught in a three-way paradox, i.e. to:

- Continue the efficient development of their economies and therefore logistics systems
- Contribute to sustainable development globally and stimulate global growth, poverty alleviation and open access, which require a different approach to global logistics

– Provide homeland security against perceived terror threats, which will tax logistics systems even more and bring new and unexpected inefficiencies into the system

These paradoxical themes are all related to developmental logistics. The global village made competition difficult for the third world, but at the same time, enabled it to catch up with the first world in new and important ways.

These issues point towards a need for structural change to existing logistics systems that will improve efficiencies, while also enabling international access between the developed and developing world and between first and second economies locally (The second annual state of logistics survey for South Africa 2005).

*A macro-economic perspective.* South Africa's 2004 production and imports increased by 7.4% on the 2003 volumes. While transport costs increased by 11%, the overall logistics cost remained flat at 15.2% of the GDP. In absolute terms, the biggest cost driver is transportation, rising by about R13[8] billion in the freight sector. The gap between road and rail corridor freight transport has widened even further during the past year, compounding the structural inefficiency in the economy. The good news is that the declines experienced by rail between 1997 and 2003 have been halted, with rail maintaining similar tonnage levels over the past 2 years. However, the challenge facing the economy remains: while rail focuses on reversing historic trends, growth in tonnage available for transport is still captured by road. The structural changes required and indicated for developmental logistics are still South Africa's biggest challenge. Efficient long-haul corridors are required, Alongside a focus on greater access for the second economy through focused investments (The second annual state of logistics survey for South Africa 2005).

*Industry innovation*. The surveys in South Africa reflect the supply-chain challenges and innovations of the chemicals, processed foods and logistics service provider industries. The nature of supply-chain innovation reflects the varying levels of supply-chain maturity across the industries, as well as the fundamental challenges experienced by these industries. The high level of supply-chain maturity of the bulk chemical industry is reflected in the move to cross-industry collaboration to improve the utilization of the national logistics infrastructure. In the highly competitive cost-sensitive industries, such as processed foods, firm-level innovation to reduce costs dominates, sometimes at the expense of channel-level innovation (The second annual state of logistics survey for South Africa 2005).

*Government service delivery*. The supply challenges faced by government in delivering services to its citizens are illustrated in an overview of the National Health Care System, where the need for inventory management is identified as the key challenge (The second annual state of logistics survey for South Africa 2005).

The need for expanding small business support initiatives to include all the aspects involved in establishing channels to market and in developing supply chains is obvious. A comprehensive range of SMME[9] networking and logistics interventions is required on a large scale. Innovative solutions to the integration of small and large businesses in a supply-chain context are emerging (The second annual state of logistics survey for South Africa 2005).

[8] South Africa currency is Rand. 1 South Africa rand = 0.140313 US dollars.

[9] Small, medium and micro enterprises.

## 4.8 Conclusion

As noted before, global trends show that all the countries all over the world, especially developed countries are going forward to implement and also improve their methodologies calculating logistics costs. Results of these calculations show that logistics costs comprise proportion of GDP (Table 4.7). So efficiency and effectiveness of logistics activities could be an important competitive advantage and also a strong infrastructure for economical growth.

In other words, logistics costs measurement is a proper indicator for the past and future states of logistics. One should never forget that measuring logistics costs is not a goal but it is a proper indicator for monitoring and evaluating national logistics.

Another remarkable point is that current methodologies are needed to improve more, calculating more precisely in today's complicated and competitive world. So countries should invest more on this issue according to different countries experiments.

Finally, we could summarize our suggestions in some research priorities:

The improvements made in the performance of the national logistics system needs to be rooted in multiple-perspectives research, ranging from a macro-economic view to the reduction of the logistics divides between the first and second economies. This requires a research agenda to be developed to continuously provide quality information that can be integrated to support both strategic and operational decision-making with respect to these varying perspectives. To this end, it is proposed that research is focused on the following areas (The second annual state of logistics survey for South Africa 2005):

- Structural inefficiencies in the logistics system
- Logistics modeling with both a macro-economic and industry focus
- Strategies for improved supply-chain efficiency

**Table 4.7** Logistics costs as a percentage of GDP (Transport & Logistics in the Internet Age: International Summit 2001 cited by Amos 2007)

| Country | GDP in US$ million | Logistics in US$ million | % of GDP |
|---|---|---|---|
| Mexico | 334,729 | 49,753 | 14.9 |
| Ireland | 67,392 | 9,611 | 14.2 |
| Singapore | 94,063 | 13,074 | 13.9 |
| Hong Kong | 153,068 | 20,992 | 13.7 |
| Germany | 2,352,472 | 306,264 | 13.0 |
| Taiwan | 273,440 | 35,686 | 13.0 |
| Denmark | 174,237 | 22,440 | 12.8 |
| Portugal | 101,182 | 12,871 | 12.7 |
| Canada | 585,105 | 70,191 | 12.0 |
| Japan | 4,599,706 | 522,982 | 11.3 |
| Netherlands | 392,550 | 44,495 | 11.3 |
| Italy | 1,214,272 | 137,027 | 11.2 |
| UK | 1,151,348 | 122,344 | 10.6 |
| US | 7,576,100 | 795,265 | 10.5 |

– Strategies for reducing the logistics divide
– Logistics for improved government service delivery.

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