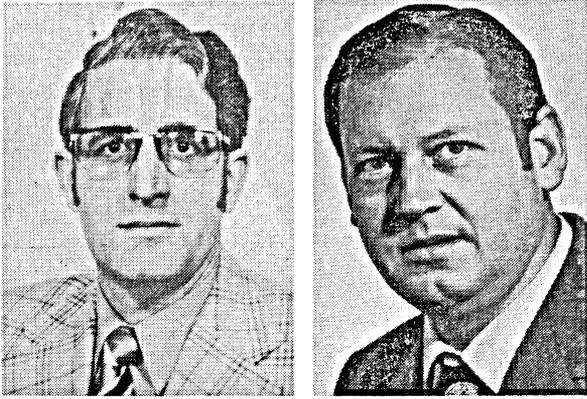


# A SYSTEMS APPROACH TO LOGISTICS



by  
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## 1. INTRODUCTION

The term logistics encompasses a number of activities which take place within an organisation. There is a tendency to control and administer activities separately (or in small groups), as a result of which cost efficiency is lost. The purpose of this article is to approach logistics as a system and thus to identify the interrelationships between the individual activities.

The authors of this article have tried to define logistics in its broadest possible sense, but it must be borne in mind that the activities forming part of a logistic system are directly related to the nature of an organisation's operations. The system discussed in this article must be regarded as a reference framework within which each organisation should define its own requirements and system. All systems must be aimed at certain objectives and these objectives must be in harmony with the overall objectives or mission of the organisation. One way of effectively achieving the objectives of a logistic support system is by making one person responsible for the disciplines and functions. This person should be in a staff position but should be senior enough to be in a position to give orders to persons in line positions.

## 2. THE ELEMENTS OF A LOGISTIC SYSTEM

In this section the elements or activities included in a logistic system will be briefly discussed. It is, however, not the purpose of the article to devote attention to the details of the various activities as a study of the literature on this subject will provide a comprehensive knowledge on these aspects.

Some of the elements may not be primarily related to logistics but may nevertheless form an integral part of the logistic system.

### (a) Transportation

Transportation concerns the physical movement or conveyance of products between the various points in the distribution channel. Transportation may be in the

*In hierdie artikel word Logistiek as 'n stelsel benader en daar word gepoog om die interverwantskappe tussen die individuele aktiwiteite te identifiseer. Die stelsel wat in hierdie artikel bespreek word moet as 'n verwysingsraamwerk gesien word waarbinne elke firma sy eie behoeftes en stelsel kan definieer. Die eienskappe van 'n logistiese stelsel asook die verwantskappe tussen aktiwiteite word behandel.*

form of road, rail, air, water or pipeline transport, or any combination of these methods. (1, p. 98). The most important factors to be taken into account are the cost of the service, the speed of service and the stability of service. It must, however, be borne in mind that transportation is not an objective in itself, but a means of achieving the physical distribution or logistic objective of the organisation.

### (b) Inventory policy

The purpose of an inventory policy in a logistic system is increased service to clients and consumers and not to serve as an aid to conceal administrative mistakes. It can also serve as buffer between the production and sales divisions.

### (c) Location of facilities

The location of facilities concerns the geographic siting of factories with reference to warehouses, and the siting of warehouses with reference to the market. Operational research techniques are very useful in the determination of the optimum location.

### (d) Information and communication

Colbert summarises the justification for the inclusion of information as an element of logistics as follows:

"... an organized method of providing each manager with all the data and only those data which he needs for decisions, when he needs them, and in a form which aids his understanding and stimulates his action". (2 p. 15-16)

### (e) Forecasting

Sales forecasting figures may be used as basis for the organisation's planning activities. For example, it can

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be used for determining buffer inventory, the location of facilities, production capacity and purchases.<sup>3</sup>

#### **(f) Purchases**

Purchases are the element in the logistic system which arises from forecasting and scheduling. The question with which the purchaser is confronted is whether to manufacture or to purchase a product. The amount purchased depends on other elements of the logistic system and on the rate of change to which the particular product range is subject.

#### **(g) Material management**

According to Bowersox material management is one of the main elements of logistics which can be related to physical distribution by means of logistic coordination.<sup>4</sup> Material management itself encompasses a number of elements.

Fearon defines material management as follows:

“Material management is the single-manager organization concept embracing the planning, organizing, motivating and controlling of all these activities and personnel principally concerned with the flow of materials into an organization”. (5 p. 33)

The following activities are included:

- (i) Material planning and control
- (ii) Inventory planning and control
- (iii) Materials research
- (iv) Acquisition research (vendor analysis)
- (v) Purchases
- (vi) Incoming traffic
- (vii) Receipts
- (viii) Incoming quality control
- (ix) Warehouse and storage control of inventory
- (x) Sale of refuse and surplus

#### **(h) Scheduling**

Purchases are related to the production phase by means of the scheduling process. A sales forecast is done of the expected sales per product over the long term and a master schedule is compiled on the basis of which the detailed short-term schedule, synchronising all the activities in preparation of production, is compiled.

#### **(i) Order processing**

The placing of an order is the result of a sales action. The important aspect of this sales action is the information which results from it.

#### **(j) Service**

Service is a relative concept which should be quantified. Management is expected to determine the policy and objectives of the organisation's service.

Maximisation of a service presupposes maximised inventory carrying cost and transportation cost. A compromise must be reached between the total cost elements and the expected service level.

#### **(k) Maintenance**

The purpose of maintenance is to ensure the serviceability of materials and equipment. In this regard liaison with the scheduling-, inventory-, and need planning and the budget activities of the organisation is important.

#### **(l) Container packaging**

Bowersox describes the concept as: “The term container is employed to describe all grouping of master cartons for purposes of handling and transport”. (4 p. 273) As far as packaging is concerned the important element is economic unit packaging which facilitates storage and handling of inventory, and thus reduce the total distribution costs.

#### **(m) Storage**

Storage is concerned with the physical layout and method of storage in a warehouse. The arrangement within a warehouse may be done according to one of the following methods:

- (i) according to popularity
- (ii) according to volume
- (iii) according to a “cube-per-order-index” which is a combination of (i) and (ii).

#### **(n) Handling**

Physical handling encompasses the handling of inventory as from its arrival at the warehouse, and its storage, to its removal to the shipping point where it leaves the warehouse. Optimum storage is of considerable importance to the handling process.

#### **(o) Provision**

Provision is a concept which is often found in the military logistic system. This term implies the provision of materials, products, parts and services to those points where a need for any of the above-mentioned exists.

#### **(p) Item identification**

In any logistic system all forms of material and inventory are identified according to a specific method in order to avoid misunderstandings which may in some cases be a matter of life and death.

#### **(q) Personnel**

Those members of staff who must be scheduled for normal production and maintenance comprise the personnel who forms an integral part of the logistic system.

#### (r) Training

The training of personnel to do specialised tasks must be regarded as part of the logistic system as it has a bearing on the availability of manpower.

#### (s) The distribution channel

There are two main reasons why the distribution channel must be regarded as part of the logistic system, namely:

- (i) A distribution channel consists of vertically linked organisations who coordinate their efforts in order to achieve a communal competitive objective. Heskett refers to this interrelationship as a 'super organisation'.<sup>6</sup>
- (ii) The more intermediators there are in such a channel, the greater the possibility of duplication of effort and the higher the total distribution costs will be.

### 3. THE CHARACTERISTICS OF A LOGISTIC SYSTEM

#### (a) General

Any new system is initiated by an external stimulus which has identified some or other gap. The stimulus in the case of a logistic system is a disproportionate rise in costs which, in turn, influences the service rendered to clients. Businesses can no longer increase prices to counteract inefficient performance within the organisation themselves. In order to maintain the return on investment (ROI) introspection must be done and weaknesses rectified.

#### (b) Strategy and policy

The strategy planned for the logistic system must be reconcilable with the organisation's overall strategy. The following will give an indication of what is meant by the formulation of a strategy for logistics:

- (i) Where must warehouses be located to be in conformity with the marketing strategy?
- (ii) What will the policy be with regard to the location of inventory? One such a policy will be to stock slow moving inventory in the factory; medium moving inventory on a regional basis; and fast moving inventory in all the different warehouses.
- (iii) What will the policy be with regard to the classification of inventory — according to turnover or price?
- (iv) Whether to buy or to manufacture an article is a strategic decision.
- (v) The long-term capacity plan compiled for the production division is based on the strategic decisions and limitations within the firm.
- (vi) Market segmentation and client selection are strategic decisions influencing the distribution activities.

With a comprehensively formulated strategy as guideline, the determination of objectives may be undertaken.

#### (c) Objectives for a logistic system

The first and most important requirement the objectives of a logistic system must comply with is that they must form an integral part of the overall objectives of the organisation. Objectives must be stated explicitly and unambiguously and should preferably be expressed in qualitative terms, e.g. 'maintain a client service of 98%'. If objectives are not stated very clearly the system designer may find that some of the system's functions are suboptimised at the expense of others. Unfortunately objectives are at times in conflict with one another, e.g. maximisation of service, vs minimisation of costs. Many organisations achieve their objectives by making use of mediators. In such cases the organisation and its mediators form a super organisation<sup>6</sup> and has a competitive objective. In general, the objectives of the logistic system design can be summarised as follows:

- (i) Maximisation of service
- (ii) Minimisation of total system costs
- (iii) Maximisation of feed-back information

#### (d) System requirements

The systems approach requires all the relevant factors, elements and activities to be approached as a single entity. The aim of this approach is the control and integration of dissimilar functional activities by means of one comprehensive logistic support system.

Any system consists of the following five parameters: inputs, processing, outputs, feedback, and limitations. On the basis of these five parameters the following steps can be identified in the development of a system:

- (a) factorising of the strategic situation
- (b) the conversion of key factors into activity needs
- (c) grouping of tasks into work units
- (d) the allocation of certain tasks to the mediator
- (e) the determination of appropriate structural relationships.<sup>7</sup>

The above analytical approach by Berg is recommended when doing an overall examination of the system. As far as the design of the system is concerned, the problem should be approached as a single entity whereas the solution of the problem should be undertaken in phases. In this regard the analytical approach suggested by Christopher<sup>8</sup> seems a more realistic approach when it comes to the actual design of the system:

- (a) analysis of the problem
- (b) development of a conceptual model
- (c) testing of the model
- (d) proposal of a new model
- (e) application of quantitative techniques.

In Christopher's article certain steps, which are regarded by the authors as essential in such an analytical approach, are not explicitly mentioned. They are:

- (a) the acceptance of the conceptual model by the user
- (b) the development of alternative models or solutions from which the user may make his choice
- (c) comparisons between the alternative solutions should be stated in quantitative — preferably monetary — terms
- (d) the implementation of the system.
- (e) the final acceptance of the implemented system

The object of the logistic system is to integrate dissimilar functions and disciplines. When designing such a system, it is therefore important to seek synergistic advantages, and to determine what the implications of a decision taken with regard to one element would be for other elements and to consider the decision in the light of these implications.

After having discussed the general system requirements, we should now look at the characteristics of a logistic system. Christopher quotes Geisler and Steger<sup>9</sup> for this purpose:

- (a) Logistic systems consist of many interactive elements.
- (b) Certain elements of a logistic system are affected by coincidence, risk, unpredictability, etc.
- (c) Some of the activities of a logistic system are subject to a time factor.
- (d) Logistic systems require resources.
- (e) Logistic systems require policy, regulations and problemsolving ability in order to operate effectively.
- (f) Logistic systems make use of information and data.
- (g) Logistic systems must have objectives.
- (h) Logistic systems are affected by, and in turn affect other systems.

The success of any system depends on the accuracy and the method of recording data and on the flexibility and susceptibility of the system with regard to feedback on the information. Data recorded as history are applied, by means of quantitative methods, to determine future tendencies.

Finally, it must be mentioned that the computer has become an essential management aid without which no system of the scope of a logistic system can function effectively.

#### 4. THE RELATIONSHIP BETWEEN THE LOGISTIC ACTIVITIES OF THE GENERAL LOGISTIC SYSTEM

##### (a) General

In this section Figure 1 will be discussed. This diagram illustrates the interaction and reconcilability of the various elements, as well as the direction of flow and nature of the information. In each square in the diagram a circled figure is added in order to facilitate reference in the discussion, e.g. 5 will refer to production division. The double-lined square indicates

the system boundaries of a firm which purchases raw materials and parts for its production division and handles its own marketing by making its product available to different users and market segments via various mediators.

##### (b) Forecasting and scheduling

This part of the discussion will be based on Holstein's article on integrated production planning and control.<sup>10</sup> As marketing forms part of the hypothetical firm's activities, the firm's market research division should do the necessary sales forecasting. 1 This forecast, for which various techniques are used (e.g. article (3)) now serves as basis for the long-term capacity plan 2.

The long-term capacity plan is used to determine whether existing production facilities will be adequate to cope with the load over the long term, and whether sufficient capital will be available should any expansion have to be considered, and to compare the results of these with the information on inventory 9 and people 21

On the basis of 1 and 2, as well as forthcoming orders from clients 13, 9 and 5 as inputs, a master schedule 3 is compiled. A master schedule is a rough estimate of time schedules for the production of the final product and may be purchasers' first indication of whether additional raw material or parts will have to be purchased. With 3 as basic input a short-term schedule 4 may be compiled. The master schedule will only give an indication of the components while it will be necessary to break up components into individual parts, to be obtained from manufacturing, for the short-term schedule. The purpose of the short-term schedule is to introduce factors such as the actual capacity of machines, people 21, time, etc. as elements of the scheduling process.

The whole process depends on how well the sales forecast was done. The compilers of the forecast must take the development of the product's life cycle into account.

##### (c) Material management

As soon as schedules 2, 3, and 4 have been compiled they are compared with the current inventory position 9 of the organisation's raw materials and parts. If the inventory appears to be insufficient, or drops below the re-order level, an order is initiated at the purchases division. This division will do a supplier's analysis of every item to ensure that the parts purchased are obtained as economically as possible without causing over-capitalisation of inventory to become a possible danger.

Purchases then places an order at the recommended supplier 12 for delivery at the raw materials warehouse. When delivered the raw material is handled according to the prescribed procedure 22

for receiving goods — which includes quality control — whereupon it is arranged in the warehouse, ready for use by the production division.

Depending on the agreement between the supplier and the firm, it may happen that the firm itself is responsible for transport from 12 to 22. When the short-term schedule is to be carried out, the necessary requisitions will be made to the warehouse and inventory will move from 9 to 5. At this stage the material management function ends and the production function comes into operation. Control must be exercised over the intermediate inventory 23 (inventory of work in progress) during the production process, particularly when it comes to the planning and determination of expected dates of delivery to clients.

#### (d) Physical distribution

The physical distribution function comes into operation as soon as the end products leave the production floor and arrive at the factory warehouse as inventory 6. Orders from clients arrive via route A, B, C, D, or 13. These orders are processed 7 and referred to 6 and 8 to be carried out.

At 8 it may be necessary to pack mass inventory in smaller amounts and to arrange for shipment to clients. Routes 8 to A to 20, or 8 to B to 14 to 20, etc. represent different distribution channels that may be followed. In order to transport inventory from 8 via D to 16 to 18 to 19 to 20 various different methods of transport — road, air, rail, water — may be used and 19 and 20 may even be situated in another country. It may mean that the distribution function of the logistic system has to make provision for operation at an international level. In such a case standard container packaging may be ideal.

The production division must receive feedback on aspects such as consumer figures, as significant conclusions may be drawn from such information.

Physical distribution is therefore concerned with the move-store-handle-pack-transport aspects of a product until it reaches the consumer. It is not sufficient to control a product only until it arrives at warehouse B. At this stage it is still the firm's responsibility as it is still moving along the channel and the firm must therefore persist in finding the most economical way of moving the product from 15 to 17 to 20. Even when the product has already reached the consumer valuable information can still be, and should be derived from it in order to maintain a good aftersale service. Inventory handling, order processing and transport arrangements occur at every mediator — warehouses, wholesalers and retailers, and it is therefore important, when locating warehouses, to take the market being served into consideration.

#### (e) Logistical coordination

Logistical coordination is the process whereby material management and physical distribution are linked to form the total logistical system. According to Bowersox there are two main reasons why these two functions should be coordinated:

- (a) Because of the large degree of interdependence between material management and physical distribution, which may be utilised to the advantage of the firm;
- (b) coordination between the incoming and outgoing flow of goods is strongly recommended.

This coordination effort will largely eliminate the grey area that exists between material management and physical distribution. Additional advantages may be derived by applying quantitative techniques. As the firm expands the need to eliminate the grey area between material management and physical distribution becomes greater.

In conclusion it may be mentioned that it is possible to coordinate feed-back information to make it available for the purposes of material management and scheduling.

#### (f) Summary

Figure 1 illustrates how the logistic elements will function in a general organisation. The importance of the feed-back of information cannot be over-emphasised as this aspect determines the success of any system.

## 5. CONCLUSION

It is essential for any organisation to eliminate duplication of effort and cost. For this reason the systems approach is of prime importance. Organisations should coordinate their efforts with other firms, whether a state department or a private concern. In an era where costs play an ever-increasing role, growth through productivity, which may lead to a reduction in costs, should be encouraged.

This new concept cannot be forced into operation. The logistics manager is confronted by the very important task of training employees at all levels of the organisation. He must realise that he will have to cope with the RC factor (resistance to change). He will, however, have to persevere in his efforts to sell this new concept to top management. Any new system is doomed to failure if it does not enjoy the full support and cooperation of the highest level in the organisation.

These concepts will have to be applied on a broader level outside the organisation boundaries. This implies that the distribution concept will have to be developed to encompass:

- (a) the distribution channel of the firm
- (b) national distribution systems
- (c) international distribution systems.



Expansion to these levels will be accompanied by many problems. One of the most important problems to be solved is that of standardisation, and the first aspect to be standardised is the definition of logistics. It would be useless to try and standardise if the basic concept is not a universally accepted norm. The authors of this article tried, in a previous article, to consolidate the various approaches.<sup>11</sup>

In conclusion the following quotation may be appropriate:

"In war, mistakes are normal; errors are usual; information is seldom complete, often inaccurate and frequently misleading. Success is won, not by personnel and material in prime conditions, but by the debris of an organization worn by the strain of campaign and shaken by the shock of battle. The objective is attained, in war, under conditions which often impose extreme disadvantages. It is in the light of these facts that the commander expects to shape his course during the supervision of the planned action".<sup>3</sup>

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<sup>3</sup> Quotation from H E Eucles, taken by the authors from: SOUND MILITARY DECISION, U S Naval College, Newport, R.I., 1942, p. 198.