Evolution of Conceptual Approaches to Designing Business Logistics Systems

The origins of logistics activities are as old as commerce itself. In fact, some would argue that these activities predate even the earliest forms of organized commerce. For example, one set of authors maintain:

[Logistics] activities were carried out when man first began forming more goods than could be consumed at the point of formation. The first time that men transported the fruits of their labor from the point of manufacture, whether the lake shore, the location of a hunter's kill, or a crude stone mortar and pestle in a cave, logistics was born. Even though such goods may only have been passed among members of the same primitive family, the mere movement of meat, berries, or fish from the point of their original formation and collection constituted logistics.¹

While the existence of individual logistics activities is clearly thousands of years old, the specialized management of these activities in whole or in part by business firms is of a much more recent origin, dating back only about one century. Since that time the philosophies or conceptual approaches underlying the management of logistics activities have changed dramatically. This paper traces the evolutionary nature of these conceptual changes, especially in terms of their impact upon systems design. More specifically, the changing nature of systems design is analyzed over three broad eras or stages of logistics development: (1) a prelogistics era, (2) a logistics era and (3) a neologistics era. The prevailing or predominant conceptual approaches to systems design during each stage are identified and examined in depth. Past, present, and emerging trends in logistics systems design are introduced throughout the paper. When appropriate, literature sources and suggestions for further reading are cited. Finally, the implications of these design changes for practitioners and educators are discussed.

Prelogistics Era (Pre-1950s)

Any discussion of the prelogistics era is largely synonymous with the early history of industrial traffic management.² Full-time transportation specialists bearing the title "traffic manager" first originated in the latter part of the nineteenth century at the headquarters of companies in select major industries. It is speculated that this title was borrowed from the railroads since a number of lines in the 1870s and 1880s were known to have a similar job title in their formal organization.³

Generally the first traffic managers existed in companies, according to Taff, "where there were large-volume movements of freight and the transportation cost was an important factor in the total cost of the goods."⁴ By contrast, in smaller firms with relatively low transport costs, shipping clerks were responsible for performing any traffic activity that might have existed. Dur-
ing this era, emphasis was on designing optimal transportation systems as opposed to the truly comprehensive logistics systems we know today. Thus the management of logistics activities was on a very fragmented rather than an integrated basis.

Based upon a search of the literature, two prevailing conceptual approaches to systems design can be identified: (1) a modal rate approach and (2) a modal cost approach. Each approach is examined separately in the following paragraphs.

Modal Rate Approach

The emphasis under this approach was to design transportation systems that minimized line-haul transport rates. For all practical purposes these systems relied exclusively on rail transport, except in coastal areas and along inland waterways where water transportation also was available.

The traffic managers during this time were not really managers in today's professional sense. Instead they have been described as being more akin to "bargainers" or "lobbyists." Generally they were hired from the railroads largely on the basis of their connections in securing the most advantageous terms for the firm and the largest secret rebates.

It should be remembered that this was prior to federal regulation of transportation and that discrimination and other abuses were very widespread. With the advent of federal economic regulation in 1887, the traffic manager could no longer secure secret concessions from the railroads since rebates and other forms of discrimination were generally prohibited. This necessitated a change in the role of traffic managers from "bargainers" to "rates and routes" technicians, who were known primarily for their ability to read and deal with the many complex rail rate tariffs. The emphasis was still on minimizing rates, but within a tariff interpretation framework.

Modal Cost Approach

With the widespread development of nonrail modes after 1920, a shift in philosophy in terms of managing the transportation activity can be observed. Instead of designing transport systems which minimized line-haul rates, an attempt was made to design systems which minimized overall transport costs. In other words, traffic managers were now concerned with minimizing the costs of performing all aspects of transportation (regardless of mode) rather than simply minimizing the rates between origin and destination. Instead of focusing on just rates and routes, the traffic manager now had to be knowledgeable regarding cost and service options of new modes, new legal forms, various accessorial services, tracing and expediting, claims and claims prevention, private transportation operations, freight bill audits and investigations, packing, weighing, and loading operations, and so forth.

A major result was that the job of traffic manager became much more complicated and comprehensive in scope. This comprehensiveness was especially evident beginning in the 1940s and continuing until the present time when traffic management is recognized as a full-fledged component of the modern logistics system. A significant side benefit of this broader approach to the management of transportation was that it set the foundation for more ready acceptance of an even broader perspective during the logistics era.

Logistics Era (1950s, 1960s, 1970s)

Logistics evolved as a separate business discipline after World War II and especially during the 1950s and early 1960s. A number of factors are commonly cited as having contributed to interest in and development of business logistics at that time. According to one set of authors, these factors included:

1. The proliferation of products that came about as a result of the acceptance of the marketing concept and the desire to segment markets;
2. The profit squeeze experienced in the late 1950s;
3. The existence of computer technology required to handle large volumes of data;
4. The growing acceptance of the systems approach as a method of management;
5. The application of mathematical techniques for solving business problems; and
6. The success achieved in military logistics managing transportation, inventory and warehousing systems.

An important observation is that prior to
the 1950s, various logistics activities such as transportation, storage, and inventory control generally were managed as isolated and separate entities. This precluded the synergism possible in a broader and more integrated approach. The first attempts at overcoming this myopic view are credited to a number of firms in the late 1940s and early 1950s, including Lever Brothers Company, H. J. Heinz Company, General Foods Corporation, and Whirlpool Corporation. It is in these firms that we witness the earliest inception of what may be described as the "logistics concept." The logistics concept has been described as "grouping together the business activities that relate to the flow of products and services for the purpose of managing them collectively." In most cases the initial grouping of activities related to outbound movements, and typically the additional responsibilities of warehousing, materials handling, and sometimes finished goods inventory control were assigned to a reorganized traffic department.

Fundamental to an understanding of the logistics concept is the use of a so-called "systems approach" to managing logistics. Indeed, it is this systems approach that explains why logistics is regarded as a relatively new business discipline (i.e., compared to production, marketing, finance, etc.) even though many of its individual activities have existed since the beginnings of commerce. A system refers to "an interconnected complex of functionally related components designed to achieve a predetermined objective." Under a systems approach the various logistics activities, such as transportation, material handling, packaging, inventory control, warehousing, and order processing, are viewed as elements or components of the system. An important consideration is that these elements are related and interdependent. This means that a decision made with regard to one element in the logistics system will affect the operation or performance of other elements. Perhaps most important, a systems approach attempts to optimize the overall system rather than optimize any single element or part of the system.

In summary, the most distinguishing characteristic of the logistics era related to the fact that instead of designing optimal transport systems as was the aim in the pre-logistics era, there was now an emphasis on designing optimal and comprehensive logistics systems. An analysis of the business logistics systems developed during the 1950s, '60s, and '70s reveals four major trends: (1) logistics steadfastly added activities over time to the extent that, by 1980, it encompassed a broader range of activities than ever before; (2) management of inbound flows (i.e., physical supply or materials management) as well as outbound flows (i.e., physical distribution) was now regarded as essential to comprehensive systems design; (3) systems developed during this time became increasingly more international in scope; and (4) there was rapidly increasing recognition and acceptance of the logistics function by top management.

Likewise during this era, three philosophies or conceptual approaches which guided the design of logistics systems can be identified: (1) the total cost approach, (2) the total profit approach, and (3) the total channel approach. These approaches are discussed in the following paragraphs.

**Total Cost Approach**

In the total cost approach the optimal system is defined in terms of lowest total costs. The primary emphasis is on cost-cutting with only secondary or implicit recognition given to service. Specifically, the total cost approach refers to minimizing the total expenditures for performing all the activities of the logistics system rather than minimizing the costs of any single activity. It generally assumes that the least total cost system will be consistent with some "given," or prespecified, service level.

An important aspect of the total cost approach relates to potential tradeoffs, that is, trading cost increases for cost decreases among individual system activities to bring about the lowest total cost for the overall system. A traditional example has been to tradeoff higher cost transport service for...
lower inventory and warehousing costs, resulting in lower total costs. The example represents what some would describe as "intrafunctional tradeoffs." These are tradeoffs that take place between and among the various activities within the logistics function itself. Of course, the aim of the logistics manager is ultimately to identify favorable tradeoffs whereby cost increases in a certain activity or activities are more than offset by cost decreases in other activities.

The origin of the total cost approach is frequently traced to a 1956 study on The Role of Air Freight in Physical Distribution by Lewis, Culliton, and Steele.14 The approach was used to illustrate that the high freight rates for air transport could be more than justified by tradeoffs in reduced inventory levels and lower warehousing costs.

**Total Profit Approach**

Under the total profit approach, the optimal logistics system is defined in terms of maximum profits rather than minimum costs. In other words, the decision as to which logistics system alternative is best depends on the profitability of the alternatives.

Probably the most serious shortcoming of the total cost approach was that it focused the attention of logistics managers on costs rather than profits. More specifically, the approach did not explicitly consider the impact of alternative service levels upon demand and hence sales revenues. In essence this meant that the total cost approach looked only at cost tradeoffs rather than tradeoffs involving costs and service.

In addition the total cost approach generally assumed a given or prespecified level of service. Unfortunately, however, the approach did not answer the questions of what this given level of service should be or how it should be determined. Frequently the given level of service simply meant duplicating the service level of a competitor or competitors. Ideally logistics managers should be interested in identifying the best or ideal service level to maximize system profits rather than rely on a level of service which is only vaguely defined and is likely to place limits on profitability.

It was primarily because of such limitations that a total profit approach was proposed which was simultaneously cost- and demand-oriented and which sought the greatest spread between sales (i.e., total revenues) and costs (i.e., total costs). Grabner and Robeson expanded upon this approach somewhat by developing a return-on-investment model. In addition to evaluating the impact of alternative service levels upon demand, the model takes into consideration the differing levels of capital investment required to implement alternative systems as well as the timing of cost and revenue streams generated by each system.

Finally, while the total profit approach has been limited by the difficulties inherent in measuring the effects of alternative logistics service levels upon demand, the literature suggests a number of methods for determining a sales-service relationship. Generally these include buyer surveys, before-after experiments, and game playing or simulations.

**Total Channel Approach**

By the latter part of the logistics era a more external perspective with regard to designing logistics systems was beginning to emerge. For lack of a better name, it can be labeled the total channel approach. Prior to this time emphasis was on managing the logistical activities involving one's own firm, with relatively little attention paid to the logistical functions performed by distribution and supply channel members. In contrast, under a total channel approach interorganizational or interfirm tradeoffs involving cost and service must be evaluated. Theoretically the optimal logistics system is defined in terms of maximum interfirm profits for the performance of all logistics activities on a channel-wide basis. In a practical sense it is more likely that only several channel participants will be in-
The logic or rationale for an interfirm approach to logistics problem solving has been stated aptly by Shapiro and Heskett:

Although most American managers readily accept (in theory, at least) the need for careful and conscious coordination of the logistical activities that take place within the firm, the maximization of total channel benefit is often an alien idea in a system where arm’s length, frequently adversarial relationships between channel partners are the traditional norm. Yet, in the same way that the optimization of one set of variables within the firm’s logistics system without the explicit consideration of their impact on the rest of the system may lead to a lower level of overall systems performance, so it also is that optimization of one firm’s logistics system without the explicit consideration of the impact of its logistical policies on its channel partners may lead to a lower level of overall channel performance.19

When interorganizational logistics cooperation is observed in actual practice, it generally takes on one or more of the following forms:

1. The coordination of policies and practices to enable cooperating channel members to perform their existing logistical functions more effectively.
2. The shift of logistical functions and responsibilities from one institution to another in a channel.
3. The creation of joint-venture or third-party institutions to eliminate duplication of the performance of logistical functions in such channels.
4. The vertical integration of channel functions which are currently performed by different organizations.20

These forms are based primarily upon institutional rather than technological change. This reflects the view that certain technological developments relating to logistics appear to be “topping out,” at least temporarily, and that there are likely to be greater gains in productivity as a result of institutional modifications.21

Overcoming the problem of functional duplication among channel members also has been discussed by a number of writers as part of the so-called “concept of shared services.” This concept was described by Cavinato as “a promising cost-saving idea whereby two or more firms cooperatively establish and use joint warehouse, transportation and/or other logistics facilities, or one firm performs a full range of logistics services for others.”22 Similarly, Friedman states that “it involves a basic switch from reliance on private distribution systems to reliance on comprehensive systems of shared facilities and services.”23 Activities identified as the most likely candidates for a shared distribution approach are transportation, warehousing, and distribution communications (with an emphasis on order processing).24

As is the case with most system-design approaches, the implementation of a total channel approach is fraught with potential obstacles. In general these obstacles center around three parties—management, labor, and government.25 All too frequently rigid and antiquated management practices, resistance by labor unions, and restrictive regulatory policies (including the antitrust laws) have worked to discourage widespread channel coordination.

NEOLOGISTICS ERA (1980s AND BEYOND)

Beginning in the 1980s, a different era or stage of logistics development was beginning to emerge. It may appropriately be described as a neologistics stage or “second-generation logistics.” Basically, it is characterized by a desire to broaden the systems perspective beyond strictly logistical activities and interests.

This desire for a broadened perspective was primarily in response to some dramatic as well as unprecedented changes and uncertainties in the external environment. For example, according to LaLonde, “Changes in growth prospects, resources, pace of technological change, competition, and inflationary impact have changed the ground rules for business planning and execution.”26 Similarly, Bowersox notes, “The 1980s were ushered in by massive uncertainty and the most extensive economic decline since the early 1930s.”27 He cites “the cost and availability of capital, energy, inflation and productivity, transportation deregulation, and multinational requirements” as uncertainties impacting upon logistics operations in the 1980s and beyond.28

Closer inspection of these external
changes and uncertainties yields the following conclusions. First, because of the pervasive nature, broad scope, and potential ramifications associated with these changes, it is apparent that no single functional area or system in the firm (including logistics) typically possesses the necessary resources and capabilities to respond effectively alone. Instead a concerted effort involving a more broadly defined system is required. In other words, broader systems are required to respond to today’s broader and more complex problems and issues. Secondly, the design of broader systems will require the talents of management generalists with a global view of the enterprise and its environment rather than narrowly defined functional specialists.

Due to the rather brief history of the neologistics era, there is as yet no conceptual approach to systems design that would be regarded as predominant. For the most part, a total channel approach continues to reign during the initial part of this era. One approach that appears to be rapidly emerging, however, is what might be labeled a “total enterprise approach.” It views the logistics function as a critical subsystem or component of the overall firm system. As such it gives explicit consideration to company-wide considerations in addition to strictly logistics considerations. To some extent company-wide considerations have always played a role in logistics systems design; often, however, these considerations were implicit and secondary in nature rather than guiding precepts as envisioned under a total enterprise approach.

Beyond the total enterprise approach, it appears too difficult to predict with any degree of certainty what prospective conceptual design approaches might look like. The one trend that appears obvious, however, is that in the future even more broadly defined systems will be proposed. However, these broader systems bring with them increasingly difficult implementation problems. Increasingly the role of the logistics manager will be how to best “fit” the logistics function or subsystem into these more broadly defined overall systems.

**Total Enterprise Approach**

Under this approach the logistics function is viewed as a potentially positive contributor to the firm’s overall success. Rather than designing a system that is optimal from a logistics point of view, the approach advocates designing logistics systems (in reality, subsystems) that are optimal and compatible in terms of total enterprise goals. Theoretically, this means that logistics systems should be defined in terms of maximum profits for the overall firm rather than maximum profits contributed by logistics as a separate system entity.

In this regard the total enterprise approach recognizes the fact that logistics is only one component or part of the overall firm system just as is the case with other functional areas such as marketing, production, and finance. Following the logic of a systems approach, the aim is to optimize the overall system rather than to optimize any individual component or subsystem. This means that more explicit and careful consideration must be given to the “interfunctional tradeoffs” involved in a design decision. In some cases, for example, it may be necessary to suboptimize the logistics function by sustaining higher costs in logistics for reductions in production and marketing costs in order to ensure optimization for the total enterprise.

An additional characteristic of the total enterprise approach is that it emphasizes the role of logistics considerations in the formulation of corporate strategy and specifically in strategic planning. As such the approach recognizes logistics systems as important potential sources of competitive advantage to the firm. Regarding this potential competitive advantage, one set of authors state:

Viewing an enterprise as a total system of goal-directed action is essential to maximize competitive impact. Within the enterprise the logistical system is essential. Those enterprises that develop a strategic logistical posture gain a competitive advantage in cost and service that is difficult to duplicate. Because of the potential permanency in competitive advantage, a great deal more attention to logistics is being incorporated in strategy planning.
A critical question remains as to how to ensure that logistics considerations will be incorporated into corporate strategy planning. Prior to the latter part of the 1970s, logistics planning tended to be primarily short-run operational planning. In contrast, the role of logistics in strategic planning (including preparation of contingency plans) appeared to be minimal. While operational planning is obviously necessary, many firms recognized that it was not sufficient by itself in a highly volatile environment. Hence the interest in strategic planning, which is concerned with a firm’s long-range future and its overall strategy for growth. This planning tends to be top-management oriented, comprehensive, and takes into consideration the firm’s environment as well as the organization itself. To ensure the factoring of logistics considerations into corporate strategy and planning, Heskett recommends the following: To employ logistics as an effective competitive lever and as a significant component of strategy, management must take two actions. First, it must adapt logistics programs to support ongoing corporate strategies in the short-term. Second, it must factor logistics into the design of business operating strategies on a continuing long-term basis.

Two additional factors have provided extra impetus for a total enterprise approach: the widespread introduction of microcomputers and the impact of modern communications technology. Both allow unprecedented opportunities to coordinate and integrate logistics operations with the overall operations of the enterprise and channel. In addition, these changes permit the utilization of “information tradeoffs” in decision making. Much of the potential associated with these tradeoffs is based on the fact that the costs of information (i.e., acquisition, storage, processing, and dissemination) have decreased substantially over the past decade. As such, tradeoffs or substitutions of greater information for lower inventory, transportation, and production requirements have become extremely attractive as well as profitable in recent years.

**Conclusion**

This paper has traced dramatic changes in conceptual approaches to systems design over three broad eras of logistics development. A comparison of these eras and the nature of conceptual approaches within each is presented in Table 1. Current conditions can be characterized as constituting a neologistics era that is likely to prevail for the foreseeable future. This is an era of unprecedented and accelerating change in the external environment. As a result, more creative approaches to the management of logistics activities will be required.

Likewise, during these three eras, we witness the continual broadening of the systems perspective—from a transportation perspective to a logistics perspective to an enterprise perspective. Even broader perspectives may be envisioned in the future, although implementation difficulties may prove prohibitive. Increasingly the challenge to logistics managers will be how to best “fit” the logistics function or subsystem into these more broadly defined systems.

Several concluding comments concerning possible uses of the paper’s contents are in order. For educators, the outline of conceptual approaches summarized in Table 1 represents a pedagogical framework for discussing past, present, and future trends in logistics systems design. As is the case for most pedagogical aids, this framework should be utilized with care. While general trends in design approaches are fairly discernible, the specifics of a given approach may be subject to considerable debate. This appears to be especially true for the total enterprise approach discussed within the ambit of the neologistics era.

For practitioners, the paper presents a comprehensive overview of conceptual design approaches. As such it provides benchmarks for comparative purposes as well as representing a potential source for new systems design concepts and strategies. The intent is not to espouse a particular approach or approaches to systems design. Rather it is to make managers...
TABLE 1
COMPARISON OF LOGISTICS ERAS AND CONCEPTUAL APPROACHES

<table>
<thead>
<tr>
<th>Era and approach</th>
<th>Nature of the job</th>
<th>Nature of the design task</th>
<th>Nature of basic tradeoff</th>
<th>Prospective for broadening systems</th>
<th>Systems design criteria</th>
<th>Degree of implementation difficulty</th>
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<td><strong>Prelogistics</strong></td>
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<td>Modal rate</td>
<td>Technician</td>
<td>Designing transport systems</td>
<td>Rate tradeoffs</td>
<td>Rates</td>
<td>Minimum rates</td>
<td>Low</td>
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<td>Modal cost</td>
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<td>Transport cost tradeoffs</td>
<td>Looking beyond rates</td>
<td>Minimum overall transport costs</td>
<td>Low</td>
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<td><strong>Logistics</strong></td>
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<td>Total cost</td>
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<td></td>
<td>Intrafunctional tradeoffs</td>
<td>Looking beyond transport costs</td>
<td>Minimum total costs</td>
<td>Moderate</td>
</tr>
<tr>
<td>Total profit</td>
<td>Management specialist</td>
<td>Designing logistics systems</td>
<td>Cost-service tradeoffs</td>
<td>Looking beyond total costs</td>
<td>Maximum total profits</td>
<td>High</td>
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<tr>
<td>Total channel</td>
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<td>Interfirm logistics tradeoffs</td>
<td>Looking beyond the firm</td>
<td>Maximum profits channel-wise contributed by logistics</td>
<td>Very high</td>
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<td><strong>Neologistics</strong></td>
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<tr>
<td>Total enterprise</td>
<td>Management generalist</td>
<td>Fitting logistics subsystems into broader systems (e.g., the enterprise as a system)</td>
<td>Interfunctional tradeoffs</td>
<td>Looking beyond the logistics function</td>
<td>Maximum profits for overall enterprise</td>
<td>Very high</td>
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</table>
aware of each of these approaches and to stimulate further discussion and thought regarding their potential use and implementation.

Indirectly, the paper also provides practitioners with a view as to the changing nature of the logistician’s job, from technician to management specialist to management generalist. Just as the transport technician designed the early systems of the prelogistics era, and the logistics specialist was responsible for systems design in the ’50s, ’60s, and ’70s, so too will the logistics generalist have a very prominent role in designing broader-based systems in the later 1980s and beyond.

ENDNOTES

4 Taff, p. 2.
8 Heskett, Ivie, Glaskowsky, p. 38.
21 Heskett, pp. 124-126.
28 Bowersox, pp. 26-27.


For example, see Bowersox, Closs and Helferich, pp. 12-14.


LaLonde, P. 58.