Topic B3

THE PARADOXES OF GREEN LOGISTICS

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1. INTRODUCTION THE ISSUE OF GREEN LOGISTICS

The two words that make up the title are each charged with meaning, but combined, they form a phrase that is particularly evocative. “Logistics” are at the heart of modern transport systems. The term implies a degree organization and control over freight movements that only modern technology could have brought into being. It has become one of he most important developments in the transportation industry. “Greenness” has become a code-word for a range of environmental concerns, and is usually considered positively. It is employed to suggest compatibility with the environment, and thus, like “logistics” is something that is beneficial. When put together the two words suggest an environmentally-friendly and efficient transport and distribution system. The term has wide appeal, and is seen by many as eminently desirable. However, as we explore the concept and its applications in greater detail, a great many paradoxes and inconsistencies arise, which suggest that its application may be more difficult than what might have been expected on first encounter.

We begin by considering how the term has been developed and applied in the transportation industry. Although there has been much debate about green logistics over the last ten years or so, the transportation industry has developed very narrow and specific interests. When the broader interpretations are attempted it will be shown that there are basic inconsistencies, or paradoxes, between the goals and objectives of “logistics” and “greenness”. We conclude by exploring how these paradoxes might be resolved.

2. DEVELOPMENT AND APPLICATION OF GREEN LOGISTICS

In common with many other areas of human endeavor, “greenness” became a catchword in the transportation industry in the late 1980s and early 1990s. It grew out of the growing awareness of environmental problems, and in particular with well-publicized issues such as acid rain, stratospheric ozone layer depletion and global warming. The World Commission on Environment and Development Report (1987), with its establishment of environmental sustainability as a goal for international action, gave green issues a significant boost in political and economic arenas. The transportation industry is a major contributor to environmental degradation (Banister and Button, 1993; Whitelegg, 1993). The developing field of logistics was seen by many as an opportunity for the transportation industry to present a more environmentally-friendly face. During the early 1990s there was an outpouring of studies, reports and opinion pieces suggesting how the environment could be incorporated in the logistics industry (Muller, 1991; Murphy et al,1994; Tanja, 1991). It was reported that the 1990s would be “the decade of the environment” (Kirkpatrick, 1990).

As we look back on the decade we can observe that interest in the environment by the logistics industry manifested itself most clearly in terms of exploiting new market opportunities. While traditional logistics seeks to organize forward distribution, that is the transport, warehousing, packaging and inventory management from the producer to the consumer, environmental considerations opened up markets for recycling and disposal, and led to an entire new sub-sector: reverse logistics. This reverse distribution involves the transport of waste and the movement of used materials. While the term “reverse logistics” is widely used, other names have been applied, such as “reverse distribution”, “reverse-flow logistics”, and “green logistics” (Byrne and Deeb, 1993).

Inserting logistics into recycling and the disposal of waste materials of all kinds, including toxic and hazardous goods, has become a major new market. There are several variants. An important segment is customer-driven, where domestic waste is set aside by home-dwellers for recycling. This has achieved wide popularity in many communities. A second type is where non-recyclable waste, including hazardous materials, is transported for disposal to designated sites. As land fills close to urban areas become scarce, waste has to be transported greater distances to disposal centers. A different approach is where reverse distribution is a continuous embedded process in which the organization (manufacturer or distributor) takes responsibility for the delivery of new products as well as their take-back. For example, BMW is designing a vehicle whose parts will be entirely recyclable (Giuntini and Andel 1995).

How the logistics industry has responded to the environmental imperatives is not unexpected, given its commercial and economic imperatives, but by virtually overlooking significant issues, such as pollution, congestion, resource depletion, means that the logistics industry is still not very "green". This conclusion is borne out by published surveys. Murphy et al (1994) asked members of the Council for Logistics Management what were the most important environmental issues relating to logistics operations. The two leading issues selected were hazardous waste disposal and solid waste disposal. Two thirds of respondents identified these as being of "great" or "maximum" importance. The least important issues identified were congestion and land use, two elements usually considered of central importance by environmentalists. When asked to identify the future impact of environmental issues on logistical functions, again waste disposal and packaging were chosen as leading factors. Customer service, inventory control, production scheduling – key logistical elements – were seen to have negligible environmental implications.

By the end of the 1990s, much of the hyperbole and interest in the environment by the logistics industry had been spent. A count of the number of articles with an environmental orientation in three journals between 1997 and 1998 revealed that they represented an insignificant proportion of all articles (see Table 1). Most of the articles that were identified as having an environmental content dealt with hazardous waste transport issues.

Table 1

Journal	% of articles environmental
International Journal of Physical Distribution and Logistics Management	1.7
Logistics Spectrum	1.2
Logistics Focus	4.8

This suggests that at the beginning of the 21st Century the logistics industry in general is still a long way from being considered green. Reverse logistics has been its major environmental pre-occupation. While this is an important step, recycling being one of the important elements in sustainability, many other environmentally significant considerations remain largely unaddressed. Are the achievements of transport logistics compatible with the environment?

3. THE GREEN PARADOXES OF LOGISTICS IN TRANSPORT SYSTEMS

If the basic characteristics of logistical systems are analyzed, several inconsistencies with regards to environmental compatibility become evident. Four basic paradoxes are

discussed below.

3.1 Costs

The purpose of logistics is to reduce costs, notably transport costs. In addition, economies of time and improvements in service reliability, including flexibility, are further objectives. Corporations involved in the physical distribution of freight are highly supportive of strategies that enable them to cut transport costs in the present competitive environment. The cost-saving strategies pursued by logistic operators are often at variance with environmental considerations, however. Environmental costs are often externalized. This means that the benefits of logistics are realized by the users (and eventually to the consumer if the benefits are shared along the supply chain), but the environment assumes a wide variety of burdens and costs. Society in general, and many individuals in particular, are becoming less willing to accept these costs, and pressure is increasingly being put on governments and corporations to include greater environmental considerations in their activities.

Although there is a clear trend for governments, at least in their policy guidelines, to make the users pay the full costs of using the infrastructures, logistical activities have largely escaped these initiatives. The focus of much environmental policy is on private cars (emission controls, gas mixtures and pricing). While there are increasingly strict regulations being applied to air transport (noise and emissions), the degree of control over trucking, rail and maritime modes is less. For example diesel fuel is significantly cheaper than gasoline in many jurisdictions, despite the negative environmental implications of the diesel engine. Yet trucks contribute on average 7 times more per vehicle-km to nitrogen oxides emissions than cars and 17 times more for particulate matter.

The external costs of transport have been the subject of extensive research. Recent estimates in Europe suggest that annual costs amount to a figure between 32 and 56 billion ECU (EU 1996). Cooper et al (1998) estimate the costs in Britain at 7 billion ECU, or twice the amount collected by vehicle taxation.

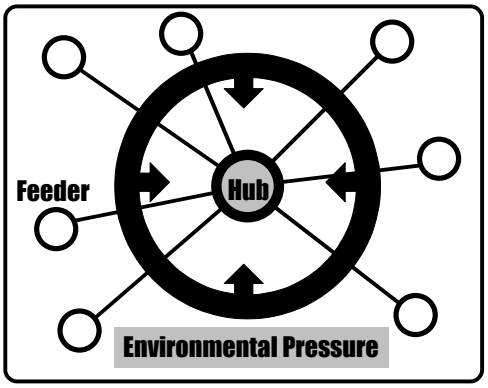

Figure 1: Hub-and-Spoke Network and the Environment

The hub-and-spoke structure (Figure 1) has characterized the reorganization of transportation networks for the past 20 years, notably for air and rail and maritime freight transportation. It has reduced costs and improved efficiently through the consolidation of freight and passengers at hubs. Despite the cost savings in many cases, the flows, modes and terminals that are used by pursuing logistical integration are the least sustainable and

environmentally friendly. The hub-and-spoke structure concentrates traffic at a relatively small number of terminals. This concentration exacerbates local environmental problems caused by freight, such as noise, air pollution and traffic congestion, notably at the urban level (Hesse, 1995).

In addition, the hub structures of logistical systems result in a land take that is exceptional. Airports, seaports and rail terminals are among the largest consumers of land in urban areas. For many airports and seaports the costs of development are so large that they require subsidies from local, regional and national governments. The dredging of channels in ports, the provision of sites, and operating expenses are rarely completely reflected in user costs. In the United States, for example, local dredging costs were nominally to come out of a harbor improvement tax but this has been ruled unconstitutional and channel maintenance remains under the authority of the US Corps of Army Engineers. In Europe, national and regional government subsidies are used to assist infrastructure and superstructure provision. The trend in logistics towards hub formation is clearly not green.

The actors involved in logistical operations have a strong bias to perceive green logistics as a mean to internalize cost savings, while avoiding the issue of external costs. As pointed out earlier, a survey among the managers of logistical activities pointed out that the top environmental priority is reducing packaging and waste (Murphy et al 1994). Managers were also strongly against any type of governmental regulation pertaining to the environmental impacts of logistics. These observations support the paradoxical relationship between logistics and the environment that reducing costs do not necessarily reduce environmental impacts.

3.2 Time / Speed

In logistics, time is often the essence. By reducing the time of flows, the speed of the distribution system is increased, and consequently, its efficiency. This is achieved by using the most polluting and least energy efficient transportation modes. The significant increase of air freight and trucking is partially the result of time constraints imposed by logistical activities. The time constraints are themselves the result of an increasing flexibility of industrial production systems and of the retailing sector. Logistics offers door-to-door (DTD) services, mostly coupled with just-in-time (JIT) strategies. Other modes cannot satisfy the requirements such a situation creates as effectively. This leads to a vicious circle (Figure 2).

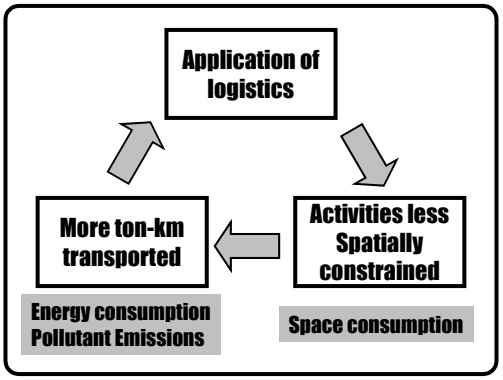

Figure 2: Environmental Vicious Circle of Logistics

The more physical distribution through logistics is efficient, the less production, distribution and retailing activities are constrained by distance. In turn, this structure involves a higher usage of logistics and more ton-km of freight transported. There is overwhelming evidence for an increase in truck traffic and a growth in the average length of haul (Cooper et al, 1998), and although McKinnon (1998) has suggested that JIT is not *greatly* increasing road freight volumes (italics added), it cannot be considered a green solution. The more DTD and JIT strategies are applied, the further the negative environmental consequences of the traffic it creates.

3.3 Reliability

At the heart of logistics is the overriding importance of service reliability. Its success is based upon the ability to deliver freight on time with the least threat of breakage or damage. Logistics providers often realize these objectives by utilizing the modes that are perceived as being most reliable. The least polluting modes are generally regarded as being the least reliable in terms of on-time delivery, lack of breakage and safety. Ships and railways have inherited a reputation for poor customer satisfaction, and the logistics industry is built around air and truck shipments... the two least environmentally-friendly modes.

3.4 Warehousing

Logistics is an important factor promoting globalization and international flows of commerce. Modern logistics systems economies are based on the reduction of inventories, as the speed and reliability of deliveries removes the need to store and stockpile. Consequently, a reduction in warehousing demands is one of the advantages of logistics. This means however, that inventories have been transferred to a certain degree to the transport system, especially the roads. This has been confirmed empirically. In a survey of 87 large British firms cited by McKinnon (1998), there had been a 39 per cent reduction in the number of warehouses and one third of the firms indicated an increased amount of truck traffic, although the increase was thought to be small in most cases. Inventories are actually in transit, contributing still further to congestion and pollution. The environment and society, not the logistical operators, are assuming the external costs.

Not all sectors exhibit this trend, however. In some industrial sectors, computers for example, there is a growing trend for vertical disintegration of the manufacturing process, in which extra links are added to the logistical chain. Intermediate plants where some assembly is undertaken have been added between the manufacturer and consumer. While facilitating the customizing of the product for the consumer, it adds an additional external movement of products in the production line.

3.5 E-commerce

The explosion of the information highway has led to new dimensions in retailing. One of the most dynamic markets is as e-commerce. Even if for the online customers there is an appearance of a movement-free transaction, the distribution this transaction creates may consume more energy than other retail activities. The consequences of e-commerce on Green Logistics are little understood, but some trends can be identified. As e-commerce becomes more accepted and used, it is changing physical distribution systems. For instance, UPS was handling in 2000 about 9 million parcels a day created from e-

commerce. The standard retailing supply chain coupled with the process of economies of scale (larger stores; shopping malls) is being challenged by a new structure. The new system relies on large warehouses located outside metropolitan areas from where large numbers of small parcels are shipped to the separate online buyers. This disaggregates retailing distribution, and reverses the trend towards consolidation that had characterized retailing earlier. The result potentially involves more packaging and more tons-km of freight transported, especially in urban areas.

Table 2: Paradoxes of Green Logistics

Dimension	Outcome	Paradox
Costs	Reduction of costs through improvement in packaging and reduction of wastes. Benefits are derived by the distributors.	Environmental costs are often externalized.
Time / Flexibility	JIT and DTD provide flexible and efficient physical distribution systems.	Extended production, distribution and retailing structures consuming more space, more energy and producing more emissions (CO2, particulates, NOx, etc.).
Network	Increasing system-wide efficiency of the distribution system through network changes (Hub-and-spoke structure).	Concentration of environmental impacts next to major hubs and along corridors.
Reliability	Reliable and on-time distribution of freight and passenger.	Modes used, trucking and air transportation, are the least environmentally efficient.
Warehousing	Reducing the needs for warehousing facilities.	Inventory shifted in part to roads (or in containers), contributing to congestion and space consumption.

How green are logistics when the consequences of its application, even if efficient and cost effective, have led to solutions that may not be environmentally appropriate?

4. DISCUSSION AND EVALUATION

Our overview suggests that green logistics is still a long way from being achieved. The environment is not a major preoccupation or priority in the industry itself. The exception is where reverse distribution has opened up new market possibilities based upon growing societal concerns over waste disposal and recycling. Here the environmental benefits are derived rather than direct. The transportation industry itself does not present a greener face, indeed in a literal sense reverse logistics adds further to the traffic load. The manufacturers and domestic waste producers are the ones achieving the environmental credit.

It is not a question of whether or not the logistics industry will have to present a greener face. Pressures are mounting from a number of directions that are moving all actors and sectors in the economy in the direction of increasing regard for the environment. In some sectors this is already manifest, in others, such as the logistics industry, it is latent. The issue is when and in what form it will be realized. Three scenarios are presented and discussed. While not mutually exclusive, they each present different approaches and implications.

First is that government action will force a green agenda on the industry, in a top-down approach. Although this appeared as the least desirable outcome from the survey of logistics managers (Murphy et al 1994), it is already evident that government intervention

and legislation are reaching ever more directly over environmental issues. In Europe there is a growing interest in charging for external costs, as the EU moves towards a "fair and efficient" pricing policy. Cooper et al (1998) estimate that this could bring about a rise of 20-25 per cent in transport costs. While there is some evidence that price elasticity is low in the logistics industry, around -0.1 (Bleijenberg 1996), the extent of the impact is more likely to be determined by how quickly the tax is applied. A sharp increase in costs could have a more serious impact than a more gradual, phased-in tax. In North America there is a growing interest in road pricing, with the re-appearance of tolls on new highways and bridges built by the private sector, and by congestion pricing. As yet there have been no studies of the effects on the logistics industry, but higher road costs are a clear outcome of policy intervention.

Pricing is only one aspect of government intervention. Legislation controlling the movement of hazardous goods, reducing packaging waste, stipulating the recycled content of products, the mandatory collection and recycling of products are already evident in most jurisdictions. Indeed, it is such legislation that has given rise to the reverse logistics industry. Truck safety, driver education, limits on driver's time at the wheel, are among many types of government action with a potential to impact the logistics industry.

A difficulty with government intervention is that the outcomes are often unpredictable, and in an industry as complex as logistics, many could be unexpected and unwanted. Environmentally inspired policies may impact on freight and passenger traffic differentially, just as different modes may experience widely variable results of a common regulation. Issues concerning the greenness of logistics extend beyond transport regulations. The location of terminals and warehouses are crucial to moving the industry towards the goal of sustainability, yet these are often under the land use and zoning control of lower levels of government whose environmental interests may be at variance with national and international bodies.

If a top-down approach appears inevitable, in some respects at least, a bottom-up solution would be the industry preference. Its leaders oppose leaving the future direction to be shaped by government action. There are several ways a bottom-up approach might come about. As demonstrated by the example of reverse logistics, these occur when the business interests of the industry match the imperatives of the environment. One such match is the concern of the logistics industry with empty moves. McKinnon (1998) reports that improvements in fleet management and freight distribution in Britain between 1983 and 1993 reduced the proportion of empty moves by 11 per cent, which, *ceteris paribus* cut CO2 emissions by 720,000 tons per year. With the growing sophistication of fleet management and IT control over scheduling and routing, further gains are achievable.

Less predictable, but with a much greater potential impact on the greenness of the industry, are possible attitudinal changes within logistics and without. These changes are comparable of that which has already occurred in recycling. There has emerged striking public support for domestic recycling. Although this has been mandated to some degree in some jurisdictions, the mantra of the three R's (reduce consumption, reuse, and recycle) has achieved unparalleled popularity. This has been extended by some firms in successfully marketing their compliance and adoption of green strategies. Firms have found that by advertising their friendliness towards the environment and their compliance with environmental standards, they can obtain an edge in the marketplace over their competitors. A comparable situation has been investigated in the context of the logistics

industry by Enarsson (1998). He argues that purchasing departments become a critical point in the move towards applying green logistics. Traditionally, price and quality characteristics formed the basis of choice, but because environment preservation is seen as desirable in general, greenness can become a competitive advantage. Ultimately, pressure from within the industry can lead to greater environmental awareness and respect. Companies that stand apart will lose out because purchasers will demand environmental compliance.

Somewhere between the bottom-up and top-down approaches are the moves being implemented with environmental management systems. Although governments are involved in varying degrees, a number of voluntary systems are in place, notably ISO 14000 and EMAS (Environmental Management and Audit System). In these systems firms receive certification on the basis of establishing an environmental quality control tailored to that firm, and the setting up of environmental monitoring and accounting procedures. Obtaining certification is seen as evidence of the firm's commitment to the environment, and is frequently used as a public relations, marketing, and government relations advantage. Decisions to proceed with a request for certification have to come from the highest decision-making levels of corporations, and involve a top to bottom assessment of operations. This represents a fundamental commitment of the corporation to engage in environmental assessment and audit that represent a significant modification of traditional practices, in which efficiency, quality and cost evaluations prevailed. So far, there has been no research into the compliance of logistics firms with ISO 14000, although several large corporations with in-house logistics operations such as Volvo, have been studied (Enarsson 1998).

Skeptics could argue that the paradoxes discussed in this paper make it impossible for the logistics industry to become any greener than it is today. The internal inconsistencies between the goal of environmental sustainability and an industry that gives undue preference to road and air transport could be seen as being irreconcilable. Yet internal and external pressures promoting a more environmentally-friendly logistics industry appear to be inexorable. While we have identified three possible directions by a greener logistics industry may emerge, it is probably more realistic to consider that elements of all three will help shape the industry of the future. These three scenarios drawn from the paradox of green logistics yields significant insights about the interplay between transport and environment. These insights in turn point to broader policy orientations.

A healthy environment is critical for efficient transport and transport, through its capacity to open markets and promote economic growth is essential for effective and lasting environmental management. But the growing internationalization of trade has broadened the concept of logistics to global logistics. Globalization and global logistics has in many instances harmed the environment by encouraging governments and firms to compete on the international market by lowering environmental standards in certain countries while maintaining higher standards in rich countries. As a result, there has been growing support for environmental initiatives undertaken at the international level and an increasing reliance on local communities to address environmental problems as the underlying environmental issues differ between and within countries. Therefore, the successful implementation of green logistics must come from the complex interplay of both global and local environmental governance to strengthen state efforts. Indeed, the most important policy recommendations, implementations and operationalization of green logistics that would work occur at the local level. Obviously, international trade is not more harmful to

the environment that regional or local trade, but proper assessment of green logistics must be integral. Most scenarios on the future of world trade and freight transport rest on multimodal infrastructure sharing and rising energy consumption. Therefore, there is a need to promote a regional approach to green logistics. The idea is not for smaller and more frequent shipments, which would result in more trips by smaller vehicles, but rather to reduce the number of trips. The objective is to minimize movements through land use policies that reduce the level and geographical separation of industrial activities. While the extent to which regions contribute to logistics is unclear, their role is often crucial to enable decisive and effective action to protect the environment. Since the conflict between economic significance of logistics and the impact on the environment is first and foremost a political topic, green logistics will most effectively be implemented in settings with strong institutional factors responsible for enforcing and monitoring environmental sustainability. Therefore, further government intervention promoting greater environmental regulation appears inevitable.

5. CONCLUSIONS

Global, continental, national and local environmental legislation is already taking hold. For the most part this legislation is popular, and while there is considerable industry resistance to increased regulation, the scientific and popular evidence of environmental problems is mounting. Concerns over congestion, land take, environmental degradation are forcing legislators to be seen to be doing something, even if the full impacts remain unclear. At the same time, individual logistics firms are finding a match between environmental considerations and profitability. It is becoming acceptable within the industry to adopt green measures. Sometimes they reduce costs, but more often than not they lead to more intangible benefits such as image and reputation enhancement. It is here that environmental management systems, such as ISO 14000, may offer opportunities to green the logistics industry.

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