
A Research Seminar arranged by OECD and VTI, June 22-24, 1987, Svenska Mässan, Gothenburg

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Just-in-Time Transport: New Road Freight
Transport Strategies and Management:
Adapting to the New Requirements of
Transport Services, Part I

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INTRODUCTORY SESSION
ADAPTING FREIGHT TRANSPORT TO MODERN INDUSTRIAL LOGISTICS
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SUBJECT: Adapting freight transport to modern industrial logistics
REFERENCE: OECD Road Transport Research Programme, Group T 7

Modern logistics

1. The phrase "just in time" and references to the five Olympic-style zeros - zero stocks, zero delays, zero defects, zero failures and zero paperwork - reflect key concepts in a new form of logistics requiring more rigorous material and product flow management; it has stemmed partly, of course, from a concern to improve productivity, but chiefly from the increased importance of the competitive economy.

2. The mid-1970s, the end of the "thirty glorious years", saw a change from a supply-dominated economy, with a sellers' market in which all production was sure to sell, to a buyers' market such that, ideally, production should be restricted to what has been sold in advance. Existing production capacity is in excess of demand, and business undertakings can develop only with effective marketing support.

3. Without the former level of growth, it has become necessary to tempt the somewhat hesitant demand by diversifying the product range, which has meant alternative models rather than differences in functional characteristics. With markets becoming ever tighter, the important thing is to innovate continuously, marketing what in appearance at least are new products, within the required lead times.

4. The emphasis that firms are now putting on strategy reflects the idea that substantial advantages are to be gained by having an explicit procedure for formulating strategy: it ensures that all levels within a firm
are co-ordinated and oriented towards common goals, and it motivates the whole workforce to achieve a well-defined plan. The strategy formulation will probably not do justice to the complexity of modern organisation for the benefit of the pedagogical clarity of the message but the mobilizing effect of the strategy is considered valuable enough for this shortcoming to be acceptable.

5 Competitive strategy is a combination of the ends (objectives) that the firm is attempting to achieve and the means (measures) that it will use to achieve them. With respect to objectives, Porter identifies three main types of strategy for improving a firm's competitive position: domination by cost control, product differentiation and concentration on selected products.

6 Logistic quality of service is a commercial asset. For example, the objectives established by Bull for its new international spare parts store at the Paris Nord II centre were, firstly, to provide emergency service to customers in under 2 hours from 80 logistic centres throughout France and, secondly, to supply each logistic centre from the main store within 24 hours. This strategy was definitely a response to competition, because the quality of service was imposed by the main competitor, I.B.M., which dominates the market; nevertheless, costs must be controlled if a profit is to be made.

7 The new logistic policies relate to the central motivating theme of "just in time" operations (Just In Time/Total Quality Control or JIT/TQC to the initiated), which corresponds very closely to the concepts of taut flow lines or the five zeros (stocks, defects, failures, delays and paperwork). JIT operations contribute to flexibility by increasing the firm's ability to deliver extremely diversified products within competitive lead times. From a strictly financial viewpoint, the JIT objective can be expressed as the bestowal of added value on the material at the latest possible stage.

8 Those involved in a given flow of production are therefore compelled to have control over the quality of the information they receive so that they can reduce their response time, which must remain consistent with the final objective of satisfying demand while achieving lower overall distribution costs. The goods are coded (with bar codes now widely used) and their movements can be controlled in real time. They can thus "receive"
instructions and, as they progress downstream, they will transmit information about the various stages in their distribution, so that optimum logistic operations can be triggered. This will involve the development of data transmission systems with non-paper media and of value-added networks (which yield more than is fed into them).

9 There are essentially two types of value-added networks: first, those set up between companies, giving access to shared databases and services; and, second, those within a single company that provide access from the company's terminals to systems in all other companies with which it wishes to do business. To establish these networks, major projects are now being developed, for example the ODETTE programme for tele data transmission in Europe and, in France, the GALIA group for the improvement of communications in the automobile industry, which is modelled on the American Automotive Industry Action Group (AIAG). Freight carriers have already set up data processing systems that give customers access to the undertaking's central computer system for information on the whereabouts of their consignments. Similarly, equipment manufacturers for the automobile industry can find out the provisioning requirements in real time, by direct computer access. And, presumably, open-ended systems accessible to unidentified potential partners could also be set up.

10 Artificial intelligence and advanced EDP techniques will be providing many undertakings with highly sensitive data management tools, which will perform functions that could not hitherto be handled by automatic processing methods. Every undertaking has continuously to face the problems of matching resource allocation to the constraints, and here expert systems have two advantages: they can explore a large number of alternatives and they can be adjusted in real time to handle actual situations as they arise. Tools of this sort will therefore be used to support strategic decision-making and to demonstrate the advantages of recommended solutions to outside parties (bankers, staff, customers). They will be a logical extension of the present spreadsheets, whose drawbacks are that the man-machine interface is very meagre and that the reasoning that can be modelled is inadequate.

The effects of modern logistics on freight transport:

11 The implications for the transport industry of this new logistics relate, first, to quality of service requirements and, secondly, to the resources that will be needed in order to meet them. The ingredients of
quality of service are speed, punctuality, security and, henceforth, generation of data about such things as the whereabouts of goods in transit. Transport is now being integrated into the production process and becoming an industrial operation like any other. Renault 21 car bodies are delivered from Sandouville to Douai at the rate required by the assembly plant, with minimal stocks, and even bodies in transit by lorry are counted as part of total in-process inventory.

12 To take the automobile industry as an example, the inventory in transit by lorry represents about a day and a half's consumption, out of a target total inventory of about 10 days' consumption. Allowance must also be made for loading and unloading time in view of the greater number of packages in each vehicle, which is due to smaller consignment sizes; a 38-ton lorry may contain up to 200 packages. Close attention must be paid to the types of packaging and to the loading scheme.

13 Even aside from complex situations in which the carrier is made responsible for additional services such as handling, inventory management and order processing, and may even act as a physical distributor, it has become quite commonplace for a shipper to demand rapid notification of any incident that might jeopardize the delivery time, or to want immediate information about the progress of a consignment to be available at any time upon request.

14 Freight carriage has always involved transporting not just the goods themselves, but also a considerable amount of data in the form of documents which, except for the contract shipping bill, are not standardized. Consequently, any medium-sized road haulage undertaking, which nearly always has to work with other carriers, must cope with: i) very practical difficulties like reading documents of different types, which never display the same information in the same place, in order to draw up a company document containing the same information; and ii) very mundane difficulties like the mandatory five-year storage period for documents of different sizes, which must be easily accessible.

15 This situation is incompatible with modern logistics. The trend will be initially towards standardization and subsequently towards freedom from material media, and it will gain impetus from the increasing volume of international freight traffic. All the big road haulage firms, which are trying to achieve an integrated network, are computerized already. All the systems used allow a flow of information between firms without any need to re-enter data. Ultimately they will all provide for packages to be tracked through the network, and for a single data file to be established when each
package first enters the network. Some carriers have already set up, or are planning soon to set up customer terminals that are used not just to question the file, but also to prepare additional operations relating to the consignment.

16 Although most small and medium size undertakings (SMUs) are still insufficiently computerized, they appear to be catching up. In a survey by UFB Locabail it was estimated that the percentage of firms with 10 to 200 employees that had their own computers or access to a computer centre was 21% in 1984, 32% in 1985 and 44% in 1986. However, this computerization process must be co-ordinated, since it is vital for transport sector SMUs that cannot afford their own networks to be able to exchange data with one another in a standardized form.

Changes in the freight carriage trades

17 The concept of "just in time" implies that just the right quantity will be delivered at just the right time; by comparison with former practice, this means smaller consignments and more frequent deliveries or even delivery of one part at a time. However, it is a well-known fact that transport costs rise sharply when the full-load policy is set aside, and that the trend is towards unit loads of greater volume and, in some cases, greater weight; witness the appearance of oversize containers. This contradiction can be overcome, but there is a right way and a wrong way of doing so.

18 The wrong way is to choose a middle path between delivering a full lorry-load once a day, for example, and making four "just in time" deliveries per day, two of them with a half-empty lorry. The right way is to make deliveries to four different firms with a lorry that starts out fully loaded. This is a simplified example to illustrate the role of a freight carriage operator organizing deliveries from a logistic platform, with a network of consignors and consignees.

19 The "just in time" concept has to be used with care, for it generally leads to conclusions that are the opposite of what might be expected at first sight. For example, JIT might be thought conducive to greater integration of provisioning, production and distribution logistics; in fact, such integration is currently in question because it lacks flexibility. The line production model, requiring physical integration, is replaced by a non-material linkage rather like the Aramis system for automated urban transport, requiring a high degree of decentralization in the policies of general management itself, and not logistics management which has become a questionable concept.
The old dilemma, well known to railway operators, of whether to leave on time or fully loaded, is to some extent resolved by the increased flexibility of production facilities. The train can now leave at the best possible time, allowing for spot demand and the characteristics of supply, with optimization performed in real time at the marshalling yard of the platform. It might have been expected that JIT strategy, which subordinates transport scheduling to production and distribution schedules, would induce firms increasingly to handle everything themselves; in fact the large groups, from the automobile industry to Nesley, in other words the majority of multinational concerns, are adopting and increasingly systematic policy of subcontracting, albeit with strict specifications.

Two remarks can be justified by the cases examined. The first, by the shippers, is that the freight transport sector has not visibly been the source of any adjustment problems when production management techniques based on the "just in time" concept have been instituted; the sector has responded without any apparent reluctance to the faster movement of products in what is referred to as the pipeline from provisioning to production to distribution. The second remark, by the forwarding agents, is that this pipeline by no means implies a move towards vertical integration that would leave the transport sector with just the technical function of haulage; on the contrary, it adds new content to the freight transport trades, for those with the desired responsibility of organizing trade flows between firms.

Are there externalities?

The point has been made that any explicit strategy gives rise to a simplified formulation that fails to reflect the complexity of present-day organizations, for all subtlety is sacrificed to the concern for consistency and for workforce motivation. There is thus a danger of overstepping the optimum mark in a counter-productive desire to "go the whole hog", while passing the buck of any negative externalities to others. There is a genuine risk of this; witness the calls for perfect infrastructure and perfect winter maintenance, implying that road systems can operate with the regularity of railways. Freight is transported in "hidden time", departing at closing time and arriving before opening time with total dependability. How it is to be achieved is someone else's business!
23 There is indeed a risk of overestimating the benefits of JIT strategy, and of starting activities that are either too costly (financially and socially) or unsuitable (with too many platforms, for example). In this context, one can doubt the economic soundness of the satellite link between company headquarters and lorries on the road, which has been demonstrated by URBA 2000, the European Space Agency and a road haulage firm in the Pas de Calais; the lorries are equipped with a mini-terminal on which the driver receives telex-style messages. However, the risk is not a prohibitive one, for JIT is a management concept and not a test of investment options.

24 JIT is a management technique which is proving much less fragile than is suggested by its rendering in French as "taut lines of flow", liable to be tightened to the breaking point! Just-in-time deliveries and inventory reduction improve the readability of the production/distribution process; large stocks often hide functional shortcomings and introduce additional non-quality hazards because of the extra handling and storage they require. In fact, paradoxically, stock failures are in many cases less frequent than before, because the management chart is unencumbered and management itself more rigorous. JIT makes partnership a necessity and thus works fundamentally against passing the buck of externalities on to others, who will eventually rebel and jeopardize the smooth operation of a system which can tolerate no defects in the "pipeline".

25 "just in time" must be understood by reference to the market which opens the flow valve. All along the pipeline, from the supplier at the upstream end to the end user who purchases the product – a car, for example – the intermediate transactions between suppliers and manufacturers are paid for with "make-believe" cheques until the end user has made payment. For that matter, product diversification allows no other choice because the extras to be ordered, the colour of wool or the shape of shoe all depend on market demand; the response must be practically immediate or the sale will be lost to the competition. When a manufacturer in Kobe is competing with a factory in Lyon for a market in California, it is the overall efficiency of the pipeline, which depends on its weakest link, that will decide the issue.

The spread of modern logistics

26 Doubts have been expressed about the wisdom of spreading the new logistic methods and consequently increasing their relative importance in the freight transport market. One response would be to restrict them to
the automobile sector and the large-scale distribution sector, both of which
invested heavily at different periods: the former in provisioning logistics
after the latter had set the example by developing physical distribution
strategy about fifteen years ago. Another response would be to ignore the
structural fluctuations of supply and demand and to dream of abolishing
distances, thus putting an end to the seasonalness of natural product
supplies. That would be to forget the economic constraints that condemn
the greater part of humanity to malnutrition.

27 A more sensible reaction would be to make a distinction between the
logistics of bulk goods, which are subject to different laws (although smaller
consignments have hit the supertankers hard), and the logistics of general
cargo, which apply to manufactured products and non-perishable foodstuffs,
including cold chain goods. In this way we cannot fail to be amazed at the
extent of the JIT disease, which has taken on epidemic proportions; although
it is more likely a symptom of health than a disease. Unless there were to
be a disaster on the scale of a world war, an economy of scarcity is unlikely
to reappear on the markets, which are of course solvent.

28 The competitive economy imposes the need for marketing, and for ordering
triggered from downstream. The economic fashion magazines tell us to operate
with zero stocks. To take an example, one shoe manufacturer, who shall be
nameless (no free advertising), has reduced his inventory to the bare mini-
mum of one day's production. The keystone of his system is the collection
and application of data from the sales network; the system is based on short
runs, to comply with the whims of the female clientele, and its flexibility
is used to full advantage. Leather of the colour in Vogue is purchased on
a day-to-day basis, with zero response time. Similarly, in the hosiery trade
raw wool is dyed "just in time" to respond to the whims, or rather the
dictates, of the market. The system is first adopted with hesitation, but
once it has been tried, there is never any temptation to back out.

The role of data processing technology

29 Although JIT strategy did not originate with modern data processing
technology - punched cards had been used for a long time in the clothing
industry, and the "Kanban" label predates EDP - there can be little doubt
that data processing technology, and coded data transmission networks in
particular, have contributed much to the spread of JIT and will continue to
do so.
30 Standardization of the data transmitted, based on the minimum requirements for communications between two carriers (and not on aggregate desiderata, which sometimes make this sort of project uneconomical), is the most urgent and important activity for the future, especially for that of freight transport SMUs which can form networks only by joint action. France already possesses powerful, flexible means of communication and consultation in the Transpac and Teletel networks. What is now required is the use of international codes so that French carriers may swiftly be given the opportunity to extend their nationally-developed know-how to international markets, and thus gain a major competitive advantage in the European transport system which is scheduled to start in 1992.

31 Conversion of freight documents to non-material media is a natural complement to the establishment of communication networks. It does, however, raise legal and regulatory problems. The aim should be to avoid having a dual-flow system, with "useful" data distributed rapidly via the EDP network and used in preparing future operations, while "mandatory" data is recorded on printed forms. Lorry-borne data systems will complete the development and prepare the way for further applications leading to greater flexibility and to "real-time" management, sensitive to market fluctuations and to traffic conditions.

32 In the USA, the Electronic Data Interchange or EDI standards have been a great success. This system, introduced by the TDCC (Transportation Data Coordinating Committee) and ANSI (American National Standards Institute), provides not only for electronic mail but also for commercial exploitation of data by once-and-for-all acquisition and access to a supporting network. An organization with high quality of service and low costs has been built up on the basis of a multishipper, multicarrier network offering a wide range of consolidation/deconsolidation possibilities. Only by standardization can transport sector SMUs achieve a network of this kind; by pooling freight custom and available resources, a group of carriers can overcome disequilibria in space and time and optimize vehicle use. The EDIT system in France is unlikely to have as much success because it is overambitious and does not conform to international standards.

33 On a visit from San Francisco, John H. Robinson, President of the Harper Group, the second largest forwarding agents in the USA, told us of the strategic impact that the proliferation of data processing and communication
systems has had there. Like a giant predator in the competitive economy, he exploits technological rent to the full. One prerequisite for working in the Harper Group is a thorough knowledge of data processing technology, which has to be maintained by continuous further education. The former "freight forwarder", who was merely a forwarding agent responsible only for the means of carriage, has become an N.V.O.C.C., a Non Vessel Operator Common Carrier, an American version of our intermodal forwarding agent.

34 Once service can be provided where it is needed and when it is needed, it becomes possible to set up a world-wide "spot market" for transport, as the ship brokers have. The "intermodal operators" now have far wider scope for action because the upstream and downstream operations have been integrated and because they are able to overcome the apparent contradiction between smaller consignments and lower freight costs. This has been achieved largely by means of logistics platforms controlled on the basis of shipper and market data in a "value-added" network. Data processing technology may have seemed like a gadget at first, but when used wisely it has proved a trump card in the competitive economy.

35 The problems that arise in data processing belong to three main areas: i) data generation, which is expensive and so the need for repeating data entry must be avoided when possible; ii) data interchange, in which only the necessary data must be involved; and iii) the commercial application of data, the area in which software packages are used and the true sphere of activity for strategic EDP. The package market in the transport sector is very active and requires no stimulation. A recent logistics survey in the USA identified 348 software packages including 165 for microcomputers, 130 for minicomputers and 112 for main systems; so there is an abundance rather than a shortage of products.

36 With the interchange and commercial application of logistics data the consignor or the carrier, using a so-called "value-added" network, will be able to inform the consignee that the goods are on their way, so that he can make allowance for them, prepare for unloading and adjust his rounds, his manufacturing schedule, etc., well in advance and without any special data entry, simply by transmitting data already in the system. A proliferation of non-compatible systems, which will occur unless a co-ordination programme is set up very soon, would set back the development of open-ended value-added systems, vital to the future of service sector professions, for many a precious year.
Recommendations

37 Rather than coming out in favour of more or less government intervention or of some specified balance between regulation and deregulation, we shall apply JIT principles and say that there must be just as much intervention as is needed, where it is needed and when it is needed. We shall start with the responsibilities of central government departments and end with those of the freight transport professions.

38 The Direction des Routes (Department of Highways) should pay more attention to the consequences of the new production and distribution management methods, when establishing the criteria for investment options. We would in particular emphasize winter maintenance and the connection of industrial estates to the snow-cleared road system. The recent decision in France by the Directors of Highways, Road Safety and Traffic and the National Weather Bureau to provide a weather service to road traffic, as a priority sector like air traffic, is a step in the right direction.

39 Sophisticated control and monitoring stations are to be provided on suburban motorways, but the lack of skilled staff, especially during peak traffic periods, and grossly inadequate maintenance to complex equipment are making these systems, which are still in the "shake-down" period, ineffective. The tolerance allowed lorry drivers so that they can get home at weekends is benefitting foreign operators, who are running pirate trips while their French counterparts are grounded. Also, more advantage should be taken of combined transport schemes, which meet the requirements for hidden-time transport.

40 Data processing and telecommunications technology will absorb most of the public research budget. In Brussels, for example, there is the ESPRIT programme, its off-shoot DRIVE (Dedicated Road Safety Systems and Intelligent Vehicles) and the two Eureka projects called Prometheus, sponsored by the automobile industry and based on vehicle-borne hardware, and Europolis, sponsored by the electronics industry and using ground-based hardware. With these highly expensive projects there is a danger of putting the means before the ends, of basing projects on a superficial analysis of the needs to be met and making too little allowance for actual operating conditions and the problems involved in supplying useful, relevant data. They would no doubt achieve better results if there were more transport and less electronics about them. Care should be taken to ensure consistent component quality for any system in which many public and private partners are involved.
41 The first priority is to standardize coded digital data; and for this, international standards must be used. That will ensure that data can be decoded into the user's language and processed immediately for his professional purposes without having to be re-entered. Furthermore, this type of transmission is the basis for value-added networks, which SMUs must have in order to survive. The autonomy of small and medium size undertakings is fast disappearing; they have now to co-operate not only with their principals but also with their fellow operators. If there is no standardization there will be closed systems, with monopoly conditions around the large undertakings that have managed to set up networks of their own.

42 Conversion from transport documents to a non-material medium follows naturally from the establishment of communication networks. A good example is the COST 306 demonstration project initiated by the Scandinavians; it involves electronic transmission of all the documents required for an international transaction, including commercial, transport and customs documents, and could be extended to banking and insurance documents. Dual flows of data should be avoided, with non-mandatory useful data in one flow and mandatory but unnecessary data in the other; or rather, data useful for everyday operation, non-mandatory, and data useful for special circumstances or official demands, mandatory. Also, it is time the speed-time chart were replaced by a modern medium capable of rapid processing.

43 It would be desirable for an agency to be set up, under the CPT (Transport Productivity Centre) for example, to evaluate software packages and provide advice about them to transport sector undertakings. This would extend the CPT's present powers and institutionalize and support some activities it has already embarked upon. The aim should be to conduct comparative tests to determine the characteristics, advantages and drawbacks of each software package in each application, its most suitable spheres of application, its compatibility with other systems and so on.

44 The OEST (Economic and Statistical Monitoring Unit for Transport) should consider the feasibility of monitoring more closely the changes in logistic practice and their effects on freight transport. Conventional surveys provide little reliable information about activities such as consolidation/de-consolidation, fast parcel delivery and just-in-time transport. It seems likely that activities of this sort will become increasingly widespread,
ushering the transport sector into the third industrial revolution, that of data processing with all it entails, particularly as regards changes to the regulations. The current survey of shippers will provide some of the information that is missing.

45 In conclusion, mention should be made of the training and information activities already well underway in the Transport and Logistics departments of French technical institutes (IUTs), in the national schools of engineering and commerce, in universities, at the AFT and at Infotrans. These activities include both initial training and further education. At various events such as trade symposiums and scientific conferences, more attention is now paid to logistics and to the role of transport in improving the competitiveness of the economy. This will lead to an upgrading of the profession, which is vital if technological progress is to be put into practice.
How an Automaker's Computer Network Would Build Your Car

A value-added network, or VAN, would electronically link an auto company's dealers, parts makers, and other suppliers. When a customer orders a particular model or color, the dealer types the order into a terminal in his showroom. The VAN orders parts, schedules shipment from supplier to factory, and orders the assembly line to interrupt its routine to make the special order. The VAN also tracks the cash along the way.
HOW INFORMATION AND COMMUNICATION TECHNOLOGIES CAN ENHANCE INDUSTRIAL/TRANSPORT STRATEGIES

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How Information and Communication Technologies Can Enhance Industrial/Transport Strategies

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How Information and Communication Technologies Can Enhance Industrial/Transport Strategies

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Introduction

I am delighted to participate in your seminar and to discuss how information and communication technologies can enhance and support industrial and transport strategies. As we shall see throughout these three days, virtually every link in the chain from conception and design, to inbound logistics and manufacturing, to distribution, marketing and sales, and to after-sales service and maintenance is being profoundly changed by technology.

Perhaps the most compelling force underlying these changes is the requirement being placed upon firms to become more competitive in an extremely volatile economic and social climate. Better quality, lower prices, and improved service are demands being made by customers. To respond, companies are turning to new approaches which have acquired names like just-in-time transport, stockless manufacturing, zero-defects production, etc. The computer, in conjunction with new communication technologies, has become the key component for implementing these changes in the 1980s and 90s.

My assignment for this afternoon is to review those new technologies and to relate them to the theme of our seminar: just-in-time transport -- new road freight transport strategies and management. I plan to begin by summarizing some of our own research at the Kellogg School which is concentrating on the strategic uses of information technology in organizations in the U.S., Europe and Japan. This background will serve as the framework for examining many emerging strategic applications of computers and communications technologies in transport and logistics. I shall then close with a brief look into the technology crystal ball and try to predict how these developments will affect the strategies of organizations which will be using and providing road transport services in the 1990s.
Strategic Informatics

My own research has concentrated on what we have begun to call "strategic informatics," the application of information systems and information technology to assist organizations in gaining and sustaining a competitive advantage in their industries. An important goal of this research has been the development of a systematic method for helping organizations to examine and to assess their competitive environments, and to find and to implement appropriate information technology strategies.

One element of this methodology (which we call the Information Technology Strategic Assessment) is an in-depth analysis of the generic business strategies of the firm being studied. Other key elements are a detailed study and thorough evaluation of the so-called value activities of the firm, of the major actors in the industry (suppliers, customers, channels of distribution, and competitors), and of the numerous linkages which relate the activities of each actor in the industry with the firm itself.

I am also a member of a small group of researchers and practitioners called the "International Working Group on Strategic Informatics." Last December's meeting of the Group was held in Delft and featured several speakers who are studying the impact of information and communication systems on transport and logistics. Our colleague, Dr. Jacques van Rens, Director of Research at the Netherlands Institute of Transport, presented some very interesting observations from his own research into trying to understand and quantify the role of communications and information in transport and logistics. Dr. van Rens is attempting to incorporate information and communications-based variables into several existing logistics systems models in order to analyze and predict the impact of information on the production, labor, capital, inventory, transport, and distribution components of those models. This work appears to me as a very promising line of research and is very much related to the themes of this seminar.

Strategic Information Systems (SIS)

Much has been written in the last several years about the role of information technology as a strategic weapon of the organization. A cover of Business Week called it "Information Power." A Fortune article referred to such developments as "channel systems." Numerous case studies have appeared which illustrate how a company can use computers, communications, software, databases, fiber optics, robotics, artificial intelligence and other technologies to gain and sustain a competitive advantage. Let us call these applications "strategic information systems."
Before examining the development of such systems in transport and logistics, I would like to review the cases of a few successful companies which have applied information technology strategically, cases which by now have become classics.

Perhaps the most famous and certainly the most cited case of a strategic information system is American Hospital Supply (AHS). In the 1970s, this major producer and distributor of hospital products installed terminals in some 4,000 hospitals tied directly into the AHS's order entry system. These hospitals soon became almost exclusive customers of AHS because of the ease of communication with the company and the excellent inventory control information provided by the system, which is called "ASAP". The original system has now been upgraded to use microcomputer technology and bar-code scanning to facilitate inventory maintenance, expense and management reporting, direct computer-to-computer communication, and other features to assure that AHS continues to sustain its strategic advantages. When Baxter Travenol acquired AHS last year, it is reported that one of the major factors in the acquisition was AHS's expertise in SIS.

When speaking to the people who were involved in developing American Hospital Supply's ASAP system, we are told that the original motivation of ASAP was to develop a more cost effective and reliable method to process orders for AHS's thousands of products sold to hospitals. It was only after the substantial rise in market share, resulting from having terminals installed in customer sites, that people began to realize the real strategic significance of this innovation. And a SIS was born. Since then numerous other information systems have been been developed as strategic, e.g., systems which tie customers or suppliers directly to a company, and which make it very difficult for others to compete.

Another classic example is that of American Airlines (AA) which installed thousands of terminals in travel agencies connected directly to AA's reservation system called "SABRE". Thanks to reservation screens that were biased in favor of AA flights by their position at the top of each listing, AA was able to gain significant market share among agencies that installed SABRE. In addition, AA benefited from the detailed information gathered about the travel agencies and the travelers, resulting in the first "frequent flyer" program to be introduced into the airline industry. Besides revenues generated from increased market share, AA also receives $1.75 for each flight of competitor airlines that are booked on SABRE. As a result, each year the revenues generated by AA in providing information services to competitors results in substantial profits for AA.

United Airlines (UA) has developed a similar system called "APOLLO", and has retained significant market share as well. Even after American and United Airlines were forced by judicial action to provide unbiased reservation screens on their systems,
they still maintain a significant edge over other airlines which have their own computer systems or which use third-party supplied reservation services. Travel agents are now used to booking AA flights on SABRE terminals and UA flights on Apollo terminals. A sustainable competitive advantage has been gained through these very extensive and expensive information systems as both airlines continually enhance their systems with valuable features, such as new accounting and management reporting systems.

These have been examples of companies which gained a strategic advantage by strengthening their ties with their customers (the hospitals for AHS) and their main channels of distribution of their products (travel agents for AA and UA), and by making it increasingly difficult for their customers to buy their competitors' products. Another strategy which has been equally successful has been strengthening one's ties with one's suppliers, allowing for lower cost or higher quality production. One example of this strategy is Boeing Airplane Company.

A key element in Boeing's success is the extensive use of computer-aided design and computer-aided manufacturing (CAD/CAM) in their development and production of aircraft. A highly sophisticated and effective computer-based system assures that every Boeing product is documented fully with design, manufacturing and maintenance specifications and change orders as the aircraft progresses through its life cycle. Boeing now requires that its major subcontractors install Boeing's CAD/CAM systems so that engineers working at Boeing and at the subcontractors' plants can discuss design changes while looking at the same computer representation of the part in question. In this way, the quality and maintainability of the final product can be significantly enhanced. This has given Boeing an edge in selling its products worldwide.

From these examples, it becomes clear that the key characteristic of a SIS is that it responds to and reflects some element of the organization's fundamental business strategies. Professor Michael Porter of Harvard University has characterized such generic strategies as reducing the bargaining power of customers and/or suppliers by such methods as strengthening the firm's linkages with them, limiting entry of competitors into the industry or sector, reducing the possibility for product substitution, becoming the low-cost supplier of a product or service, creating and marketing a differentiated product or service, and/or establishing a significant niche for one's product or service.

Let us now examine a number of technology innovations which have been introduced into the road freight transport business, and analyze the strategic and management significance of these initiatives.
Information Technology in Road Freight Transport

A complete survey of technology in transport and logistics is obviously beyond the scope of my presentation. Instead I would like to cite a few areas of application which are particularly relevant to the generic strategies discussed above, such as linkages with customers and suppliers, cost, and differentiation in such areas as quality and service. They include:

- Integrated distribution/logistic management
- Electronic data interchange
- General transportation management
- Van lines management
- Vehicle tracking
- Other on-board technologies.

Integrated Distribution/Logistics Management Systems

One key technology which has been developed and which offers significant strategic advantage is the so-called integrated distribution/logistics system. Such systems recognize the key concept in modern logistics strategy, namely that one must look at the logistics system as encompassing the entire flow from order to delivery. Two existing systems can be described to illustrate this point.

Marriott Corporation Integrated System: Marriott owns one of the largest company-operated hotel chains, as well as being one of the U.S.'s leading provider of food and beverages to airline passengers, and the operator or franchiser of several fast-food and family-style restaurants. The Marriott Distribution Company maintains two large warehouses in Jessup, Maryland and Dayton, New Jersey. These are fully automated warehouse/distribution centers, with computer-driven bar code labeling and reading, and materials handling.

The integrated system which runs on VAX minicomputers is tied to Marriott's corporate order entry system, with invoicing and accounts receivable modules integrated with the basic warehouse management package. The result is that once the order data is received in the system, all order fulfillment and inventory control is handled locally. This is, of course, essential in the food services business which is, perhaps, the forerunner to those industries which depend almost totally upon what we now call just-in-time transport and inventory.

The main features of the Marriott system include: orders stored online; FIFO inventory management using optional picking parameters, depending on order volume, special staffing situations, weather conditions, etc.; inventory restocking; receiving and putaway,; inventory control and replenishment; expected receipts reports, receiving worksheets,; random locator feature; picking and shipping;
truck scheduling; shipment confirmation and invoicing; and a corporate computer interface.

Abbott Canada's Integrated System: Abbott's system integrates order entry, inventory management, invoicing, warehouse management, order processing, and accounts receivable. Abbott Canada operates regional distribution/warehouse centers in Vancouver, Edmonton, Winnipeg, Toronto, Montreal, and Halifax, plus using a number of public warehouses distributed throughout Canada.

The Abbott system consists of: remote order entry; centralized pricing; automatic back order; automatic credit checking; online open order filling; picking and shipping parameters; traffic planning and control; same-day invoicing; inventory control and warehouse management; automated lot control, interface to distribution resource planning (DRP) system; and management reporting.

These two examples illustrate how computer and communication technologies have become the key component in providing "just-in-time information" in the entire chain from order to delivery. This theme of just-in-time information is repeated over and over again in the systems which are being introduced to support industrial and transport competitive strategies.

Electronic Data Interchange

One of the most talked about innovations in recent years has been the development of EDI, Electronic Data Interchange. Using EDI, the shipper and the carrier can use one complementary system to exchange and share pre-arranged, designated types of data between their two computers. The shipper inputs bills of lading, payment authorization information, and remittance advice data. The carrier inputs the freight bill and shipment status data. The eventual goal is to link all of the actors in the chain: manufacturers, distributors, freight carriers, public warehouses, and financial institutions. New electronic mailbox services are being developed by third-party suppliers to act as the communications interface among all of these actors and to help translate among the different document formats and protocols which are currently in use.

In order to create the necessary environment for EDI to become effective, an extensive world-wide standards effort had to be undertaken. These standards include the following areas: concepts, general programming, transaction sets, data segments and elements, and communications. In the U.S., the standards have been developed and promoted by the Transportation Data Coordinating Committee (TDCC), Washington, D.C.

Many carriers in the U.S. are now on EDI including, Pilot, Yellow, Roadway Express, Consolidated Freightways, and North American Van Lines. Many leading shippers, like JC Penney, K
Mart, General Motors, Ford, DuPont, and Shell Oil, are using EDI. Penney is reported to use EDI for 80% of its retail transactions.

Cost savings and customer satisfaction are the most cited benefits of EDI; the most important being the ability to respond to customers' inquiries quickly.

**General Transportation Management**

A wide range of information systems has begun to be introduced into the trucking industry for general management to improve productivity, service and profitability. One claim is that these systems can return as much as five to 20 percent in cost reductions or productivity improvements. But, perhaps the most important strategic impact of these systems is their ability to support the customer's need for service and quality. Six areas that can benefit from such automation are:

- **Routing systems**: to provide an opportunity to reduce the total miles driven for a fleet by establishing the optimum delivery and pickup sequences.
- **On-board computer systems**: to help fleets manage their operations to increase productivity and reduce fuel expenses.
- **Maintenance systems**: to provide needed policies, procedures and reports to help establish the maintenance department/cost center as a professionally run "business."
- **Accounting systems**: to reduce clerical costs and address management's need to know actual costs per mile and the costs and/or revenues associated with each account.
- **Freight management systems**: to enable fleets to monitor and control all aspects of their shipments, including the use of databases to reduce empty miles by providing load-matching information.
- **Communications systems**: to put the entire fleet and office operations in instant communications to trace or reschedule shipments, to take advantage of last-minute pickup opportunities and other applications.

**Van Lines Management**

Computer-driven robots are unlikely to replace packers or to load moving vans. Instead the focus will be on using information technology to make administrative functions more effective and efficient and to keep managers better informed. The computer will be used to rate and calculate charges, to print the freight bill, to record the appropriate accounting entries, to issue the invoice, and to provide management information.
Given the intense competition in the industry, there is a growing need for better costing information to help establish price guidelines and set profit goals. There is also a need for better exchange of information from agent to agent and van line to agent through a computer/telecommunications link. An integrated network of personal computers connecting agents with van line affiliates can provide such facilities. Future systems will be developed to improve communications with the drivers, such as on-board PCs to communicate with headquarters personnel, weather service stations, shippers and other computers. Additional longer-range developments in the industry include expert systems to handle routing, loading, dispatching, driver and delivery scheduling, etc.

Some observers in the moving business predict that the fundamental character of the industry will change drastically. Furniture will be manufactured with industry-standard tags which will identify weight, type and size, thus allowing the use of hand-held computers and wand readers to produce estimates and shipping documents.

The most important changes expected in the industry will take place in sales and marketing. The use of paper forms will disappear as briefcase computers are used by salespeople, and as computer terminals appear in the offices of national account customers.

Allied Van Lines has developed a computerized system called ALLFAX. ALLFAX is made up of five basic components which fit into a slightly oversize briefcase: a hand-held, large-memory computer, an optical scanning wand, an ink-jet printer, a data cassette drive, and a notebook filled with optical bar codes that correspond to every item normally found in a home or office. The ALLFAX system can thus generate a detailed listing of the materials and services that the moving company will provide and an itemized estimate that both the shipper and carrier can count on to be accurate.

Vehicle Tracking

By tracking vehicle movement either by satellite or by ground-based navigation transmitters, location systems report a vehicle's position to a central dispatcher. Such systems permit dispatchers not only to monitor their trucks' locations, but to give directions to drivers whenever and wherever they are needed. Alternatively, navigation systems installed within the vehicles themselves can guide the driver directly. Although still in their infancy, such systems offer a range of strategic advantages that are still to be realized. Among these are improved customer service, more flexible routing, and better fleet management. The technologies being used and under development are defined by the markets -- long-distance transporters and locally based fleets.
For long distance transporters, systems are being developed for relaying data via satellite between a fleet's terminal and its vehicles. The first satellite-location company in the U.S. is Geostar of Princeton, New Jersey. Their initial Link One system will use one satellite to relay raw vehicle position data, in addition to typed messages that are input by the driver, to Geostar's Princeton ground station. At the ground station, map position calculations will be made by computer and transmitted back to the vehicle's on-board terminal.

Although Geostar's current one-satellite technology can fix the position only to within one or two miles, many long-haul transporters believe that this is close enough. Currently there are orders from seven motor carriers to Geostar for more than 10,000 transmitters. The devices are priced at $2900 each, and Link One service will run $45 a month for one transmission an hour. Geostar's proposed two-satellite system is expected to be accurate to within 20 or 30 feet.

For local fleets, self-contained, dead-reckoning (inertial navigation) devices are being developed with all the sensors, hardware and software necessary to calculate its position located on the vehicle. Another technology uses special receivers that pick up radio signals from the Loran C (long-range navigation) network of beacons used extensively for marine and aeronautical navigation.

The only commercially available, dead-reckoning system now is Etak Navigator (Menlo Park, California). That system is aimed at the luxury and commercial passenger cars market. One thousand systems have been sold for "under $2000". The Etak Navigator consists of a dashboard-mounted video display, distance and direction sensors, a microprocessor, and a cassette database of digitized road maps. The system continuously updates a map display with the car's position in the center. Distance traveled is measured by sensors in the right and left wheels of the vehicle's nondriven axle, and direction changes are determined by an electronic compass. The display is updated every second. In addition, by accessing the databases's menu-driven index of street addresses, a driver can enter his or her destination and then see it indicated by a flashing symbol on the map. Etak says its dead reckoning system is accurate to 50 feet.

For local fleets, the next step is to transmit location data to the dispatcher. Etak plans to offer its Vehicle Finder, a multi-vehicle finder that consists of a dead reckoner and a modem which feeds position information to the vehicle's standard two-way radio. The dispatcher can transmit messages which appear on the vehicle's screen. Another Etak product under development is the Dispatch Manager: a workstation allowing dispatchers to plot individual routes and to give the drivers either printed route maps or electronic versions on cassettes.
A number of Loran-based regional location systems are on the market: "Automatic Vehicle Location", Motorola (Schaumberg, Illinois) and "Vehicle Tracking System", II Morrow (Salem, Oregon). The Loran receiver costs about $2000. The Motorola base station to receive and process position coordinates costs from $50,000 to $75,000, while II Morrow's sells for about $25,000. Motorola claims about 12 sales in its first year -- II Morrow about 20.

Nissan (Tokyo) has developed a Loran-based system for parcel delivery on irregular, unfamiliar routes. Their Delivery Navigation System includes a floppy disk encoded with the day's delivery list, sequence, and local maps. In the guidance mode, the truck's location is determined with a Loran receiver and shown to the driver on the color video monitor display inside the cab.

Most transport companies are waiting for more results before committing to a specific technology or supplier. So the strategic impact of these technologies is still in question.

Other On-board Technologies

A number of other electronic technologies are being introduced into the truck to help identify it, its size, its weight and its cargo, and to monitor its performance. One such development is the "Heavy-Vehicle Electronic License Plate (HELP)" which provides identification information automatically as the vehicle drives through a service lane. This electronic tag provides input to a host computer which can record time and date, road speed, gross weight, weight by axle, total length, and length between axles. In addition, the computer will match the truck's ID against previously recorded data to make sure that it is carrying the weight for which it is registered, that required permits have been obtained, that insurance and safety inspections are valid, and that all taxes and fees have been paid.

Numerous experiments with this type of system are being initiated in the U.S. and Canada. There are many nontechnical issues, such as privacy and the threat of constantly being tracked by "Big Brother", which have to be addressed before such systems enter wide-scale use. Such concerns are being addressed by pointing out the potential benefits to the truckers through improved fleet management. For example, in Oregon, the 20 companies which have trucks equipped with electronic tags are now being supplied with computer terminals that give direct access to all the data collected on their vehicles. Other potential benefits include minimizing delays at scales, allowing trucks to go through toll stations without stopping, locating stolen vehicles, tracking hazardous material shipments, and controlling access to high security areas.

Another technology consists of on-board trip recorders which function within so-called vehicle management systems (VMS).
These systems consist of on-board sensors and a driver input console to feed data to a trip recorder. Off-board equipment permits the extraction of data from the trip recorder and the use of a data link to transmit data for processing with PCs, minicomputers or mainframes.

The benefits of VMS include saving fuel, improving productivity, improving safety, and reducing maintenance costs. However, in 1985, it was reported that only 40,000 of the 1,000,000 most eligible vehicles in the U.S. were equipped with these recorders. Some of the reasons for the relatively minor penetration of the technology to date is uncertainty of the stability of the technology, coupled with the initial capital investment ($1,000 to $2,000 per vehicle), driver suspicion and opposition, lack of management commitment, need for education and awareness, and questions about availability and support. However, the competitive nature of the industry will mandate that companies install VMS to obtain more accurate and timely information on trips, preventive maintenance, fuel taxes, vehicle location, fuel usage, customs charges, etc.

Summary and Conclusions

There are numerous other information technology options that have not been discussed but which are now, or will soon become, important strategic tools of transporters, especially in their efforts to support just-in-time inventory policies of their customers. These include the use of:

* decision support systems and database management systems to assist in market analysis, rate setting, pricing analysis, bid development, cost/profit distribution, customer/agent documentation, as well as accounting, finance, legal, operations and personnel functions;

* expert systems and artificial intelligence techniques in fault detection and diagnosis, inventory forecasting and management, distribution planning, and credit analysis;

* optical disc systems and CD ROMs for storing enormous amounts of pictorial information or text for ready retrieval by computer; and

* interactive computer graphics systems with high resolution color images of actual road maps for vehicle routing.

The technologies discussed above and in the papers which are being presented in the seminar provide very effective support to the generic business strategies of both shippers and transporters. Some, like integrated distribution/logistics systems or EDI, can help tie a firm more closely to its suppliers and/or customers. Others, like general transportation management systems, support the strategy of becoming the low-cost supplier. A differentiation
strategy can be supported by the creative exploitation of vehicle tracking technology or computerized routing.

In each application the key strategic and management elements depend upon the effectiveness and efficiency of the use of information: its timeliness, its quality, and its availability. Information may originate from a salesperson's briefcase microprocessor, from a truck driver's input console, or from an electronic license plate. It may be transmitted by satellite, by leased telephone lines, or by a fiber-optics digital cable. It may be stored on bar-coded labels, on a videodisc, or on a floppy disk. It may be processed by an on-board microcomputer or by a headquarter's mainframe. It may be displayed on a dispatcher's color graphics monitor or on a warehouse pick order. Thus, there is no lack of technology to handle, communicate and display information. There is, however, the need to understand its significance, to relate its application to business needs, to promote appropriate standards, and to implement systems that people can use. That is the challenge that faces the road freight transport industry and that is motivation for much of the research that will be discussed here.

To close, I would like to look briefly into the 1990s. In five years Europe is to become a community without customs barriers. Enormous efforts are underway by governments, industries and companies to prepare for this new world of open-border transport. These efforts include the standards activities for electronically transmitted documents, the software and database developments that will support proper accounting and collection of enormous volumes of financial and trade data, the appropriate communications infrastructure to support EDI initiatives, and the whole range of electronic technologies which will enhance automated vehicle location, identification, safety verification, etc. In addition, regional information networks and utilities will evolve to handle the increased flow of electronic data which will accompany each shipment.

Executives and managers, whether elected officials or officers in private or public companies, will face this wide, almost bewildering, range of possible choices of technology and systems options, and of business strategies to exploit these options. The central question that these managers must ask is: How can we develop our own organization's strategy for using information and communication technologies effectively and efficiently, especially when confronted with so many choices and so many difficulties and uncertainties? It is my hope that through the use of systematic methodologies, like the Information Technology Strategic Assessment for developing and assessing alternative strategies, significant progress can be made. Also, we should remember that these systems and technologies will be used by people; therefore, the human dimensions of the problems cannot be ignored. But, that is a topic for another speech. Thank you.
References


FROM FORWARDER TO CO-MAKER
Mr J.M. Hardy, President
Frans Maas, Inc., Venlo, The Netherlands
1. Title and introduction.

The subject suggested by the Seminar organisers was: 'Point of view and needs transport operators'. From this we at Frans Maas derived a more appealing title: "From forwarder to co-maker".

Frans Maas is a multinational forwarding and transport company, based in Venlo, The Netherlands. Because we are a typical European company, I will present the financial figures about Frans Maas in ECU's, the European currency we all are going to use in a few years.

(slide 1. Turnover, assets, profits)
(slide 2. Personnel, Trucks, Trailers, Warehousing)

Among the companies who organise transport all over Europe, and not necessarily execute this by themselves, we belong to the top 15 in this part of the world. In this respect we are proud to represent in a way also the point of view our colleagues, such as Danzas from Switzerland, Nedlloyd from The Netherlands, Haniel from Germany and Ziegler from Belgium.

As you can see on the slide, 60% of our personnel is working outside The Netherlands in operational companies all over Europe. Between 1950 and 1980, the two brothers who owned Frans maas in that period, developed a network of some 100 offices in every major industrial area. This turned out to be of tremendous value in the information revolution starting at the end of the seventies. Nowadays most of the Frans Maas offices are linked with data communication, resulting in a better control of the goods flows on behalf of our customers.
2. JIT - cases.

Presently a fast growing part of our turnover is generated by JIT-projects, were our own software, the Frans Maas Tracking System (FMTS) is used. For Rank Xerox, DAF Trucks, General Electric Plastics, Océ Copiers and Philips, materials management (inbound) and/or physical distribution (outbound) are carried out on a JIT-basis. Two of our customers: DAF Trucks and Rank Xerox have won the yearly Logistic Award in The Netherlands.

This development has started in 1982/83 and now we have a shortlist of 10 to 15 new projects which have the potential to materialize in the coming 2 years.

There is quite a big difference between materials management projects and physical distribution projects. Basically materials management requires a more drastic change in the corporate organization of our customers and their suppliers.

JIT material management means that different flows of goods beyond one's control, have to be managed to a single destination. In case of the outbound flow of final product, we are able to control this flow from the origin, resulting in a relatively easier conversion to JIT-principles.

Let me explain in brief the characteristics of one of our more complicated and mature projects: Rank Xerox.

This company operates a large production plant for copiers in Venray, The Netherlands, employing some 800 people.

Some 80% of the cost price of a copier consists of parts and sub-assemblies, meaning that 80% of the assembly activities consists of logistics.
Starting point of the JIT program, is the Materials Requirement Program (basically a shopping list for a certain time period), which is fed into the Frans Maas system. Activated by this MRP, we collect the supplies for the RX assembly line all over Europe on an "ex works" basis.

In the meantime, the pipelines of goods on its way from a Frans Maas subconsolidation point to the plant, in the Netherlands are made visible by the Tracking System to us as well as to RX. By this way the plant can work with minimal inventory levels.

Since two years the distribution of finished copiers, from the Netherlands to the various operational companies in Europe, is also being carried out by Frans Maas. For this purpose we opened a 20,000 m² distribution center near the Rank Xerox plant, in order to handle the immense product flow.

The activity includes presently the supply of spare parts and modification Kits for the machines installed in the field. (slide 3. RX)
(slide 4. RX graph)
(slide 5. Results)

The results of this close cooperation between Rank Xerox and Frans Maas are rather spectacular and something to be really proud of. Since 1981 the production has almost tripled.
In the meantime the average inventory level has dropped to one third of its value in 1981 and still goes on reducing.
I think we may conclude that the JIT concept for Rank Xerox has contributed substantially to the successful struggle of survival against the severe competition from Japan on the European copier market.
3. Lessons from the JIT - experience.

In a period of 5 years a number of Frans Maas companies changed from a transporter of goods from A to B or the organiser of this transport, to a supplier of logistic services to industrial companies. The majority of our activities is still international forwarding, but the JIT-part of the turnover is growing rapidly.

In that field we are treated like any other supplier: we have to deliver on schedule over a longer period of time and our customers do require that we increase our efficiency constantly, not only for our own sake but also to reduce his cost. We are considered just like the supplier of let's say a complicated piece of equipment. Quality and reliability becomes the new issue and we are no longer cancelled in case the traffic manager can buy his transport cheaper at other sources.

The other side is permanent attention for things like know how, human resources, communication and software, rather than trucks, trailers and warehouses.

You will understand that these developments impose a tremendous change on the organization of our customer as well as on our own company.

The customer chooses for single sourcing, so to speak and the transporter has to interfere in the thinking of an industrial company who wants to upgrade its logistic performance. From this experience I will try to draw some lessons for the future.
4. The objectives of JIT Materials Management.

The flow of raw materials from the supplier to the production or assembly line, is called materials management in this presentation. What are the objectives of Just in time techniques in this field?

1. First to create the ability to react on short notice on market demand.

2. Second to create supply-batches which need minimal handling and storage cost.

3. Third to reduce inventories and logistic cost.

It goes without saying that the production of a ship or a big computer mainframe does not really need JIT-techniques. In these fields PERT-like methods are used mostly and common sense urges to order only what is needed for immediate use. But in case of large series of products, consisting of many assembly parts, the three objectives mentioned above can be realized with JIT. The copier industry shows us the following examples I mentioned already:  
- 80% of the costprice consists of parts,  
- 80% of the costprice is determined in the early phase of development  
- 80% of the assembly activities are logistics.

In this type of industry (automotive, electric appliances and communication equipment are other examples) the production cost can be reduced considerably with JIT.
What is the role of a transport and forwarding company in such a process of reduction?
It is our experience that industrial customer is almost completely occupied in restructuring his supplier base and finding new ways to deal with these companies. These are his prime activities when a JIT-program is being started up.

In the meantime, it will be highly appreciated if the forwarder sets up a system of pipeline control with the following stages:
- ex works pick up
- subconsolidation on hub points
- transport to the main consolidation point
- or, directly to the plant.

The pipeline has to be visible in a computer system, preferably on real-time basis, in a way that the stock in the pipeline is in fact at the disposal of the plant on short notice.

It does not need much explanation to understand that JIT-techniques on the collection side do not work on a stand alone-basis, JIT has to be an integrated part of a complete chain of activities.
(slide 6)

You can see easily that the transport part is loosing its relative importance in such a chain. And already you see the title of this presentation coming up: from forwarder to comaker.
5. The objectives of JIT Physical distribution.

By physical distribution or PD, we understand the flow of finished products from the production line to the final customer. In this field there are two main objectives to be achieved by JIT techniques:

1. Reduce or optimize the time between a sales order and the final delivery to the user.
2. Reduce the amount of stock and other distribution cost in the stage mentioned above.

The cost of distribution have been neglected for a long time. Only recently the manufacturing industry begins to realize that substantial economies will result, when the distribution cost are attacked seriously.

In the electronic industry for example, a recent study has revealed that the cost of PD are 7% to 15% of the market value, of the products and not 2% or 3% as many managers believed.

(slide 7 - Distribution diagram)

In the day to day business we see that the response time to a sales order is managed in almost any case, by keeping intermediate stocks in different stages of the distribution chain. Fluctuations are dealt with by these stocks, mostly at very high cost.

It needs little explanation to see that every manager, representing a link in the chain, requires a safety or "strategic" buffer in his stock-element. As a result the added total will exceed by far a normal value for a safety-margin.

Industrial companies who select JIT-techniques to solve these problems, choose in fact for a well organized product flow. A transport company can assist, or better initiate, by offering efficient handling of the products and reliable cycle-times for delivery as near to the end user as possible.
6. JIT - enablers.

By JIT-enablers we mean the conditions making the introduction of JIT techniques possible. When we deal with this subject you will realize that there is no longer a clear distinction between the industrial partner and the forwarding or transport company.

I will divide the JIT-enablers in a strategic part and a practical part.

Strategies:
1. Supplier base reduction.
   It is much easier to manage a flow of products from 300 suppliers than 3,000 suppliers.

2. Contracts for worldwide volumes.
   Within a period of say 6 months a fixed contract has to be agreed.

   Only when a supplier is not constantly traded off against the competition, additional efforts on top of price and quality are subject to discussion.

   Supplier participation during early product development and design.

5. Cost reduction by benchmarking and operations improvement and not by eliminating profit margins.

6. JIT manufacturing.
In the day to day practice, JIT-techniques are giving the best results under the following conditions.

1. On line/real time and realistic visibility of product flows from vendor up to and inclusive workstations in production areas. In terms of physical distribution: from the production line to the distribution point which is the nearest to the end user, still controlled by the manufacturer.

2. Powerful and user-driven materials requirement planning system:
   - interactive
   - using physical/financial product data
   - date driven
   - pull concept from final usage point

3. The vendors have to meet strict requirements:
   - 100% quality
   - 100% on time
   - in standard pack units at final station

4. The transporter / consolidator must be able to realize a good performance:
   - sub- to main consolidation point and vice versa
   - on line / real time visibility
   - consistent cycle times
   - buffer function
   - flexible (speed up / slow down)

5. The replenishment of the production line finally, must be automated in a way that the workstations initiate deliveries (pull concept, kanban).
7. Pipe line control

You have noticed for sure, that the new job to be accomplished by the forwarding and transport company in this game, is basically composed of three activities:

1. The handling of goods using modern techniques; meaning loading/unloading, storage, orderpicking, by- and repacking.

2. The monitoring and control of the products on their way to and from the production or assembly plant.

3. Support and initiative in the field of electronic data processing (EDP); basically the electronic control of the product flow.

These three activities are included in the term pipeline-control, because that is in fact the core of this new business for the forwarding and transport operators involved.

The needs for our industry can be logically derived from the points I have mentioned before. In fact the transport operators must be prepared to adapt the new way of thinking which enables the long term relationship with its industrial partners. This requires a completely different attitude and in that way a change in the company culture.

Our industry is known and is famous for its ability to organise things and react on very short notice. Now it is required to think more in terms of medium periods of time, meaning projects with a life cycle of let's say three to five years. This longer time horizon applies also to the time which is needed to acquire such projects.
To come back to the example of Rank Xerox and Frans Maas; it took us almost a year from the first contacts till the first shipments were actually on its way.

Later on we learned that this is a relatively short period because back in 1982 there was a strong need to survive for our customer and thus a firm pressure to get things moving.

Normally a pilot project on a small scale will have to prove that the advantages of JIT material management or distribution are existing in the daily practice of that particular business. A pilot project runs normally for 6 to 9 months. When a preparation time and an evaluation afterwards is added, a year is gone before one even realizes!

You will imagine that this requires a considerable change in our industry, where a bid or an offer completed and dispatched on Friday very often leads to the first business by the middle of next week.
Conclusions and needs for transport operators.

1. Change the company culture from the thinking as a transporter and forwarder to a co-maker for an industrial partner. This is the most important requirement. Without it, the rest of the conclusions have little value.

2. For a different objective, different personnel is needed. Numerous studies have revealed that the road transport industry employs on an average little personnel with a higher education. To understand the complex problems of manufacturing industry, a drastic upgrade of the personnel is a mere necessity. It is better to invest in people, than to invest in trucks, trailers and warehouses.

To indicate the skills which are needed, the following priorities may give you a lead:

- business economics and finance
- logistic engineering
- industrial engineering
- electronic data processing

Generally speaking, the skills used by the industrial partner are also badly needed by the transport operator.

3. Research and development in the field of electronic data processing (EDP).

EDP offers tremendous possibilities to control product flows throughout Europe and to facilitate the cooperation between forwarder and customer. At Frans Maas a network of interactive stations is being developed, which is linked to the systems of the customer. Also the use of barcodes to identify products is used, reducing mistakes as much as possible.
EDP development requires enormous investment in manpower and equipment. Here we see a role for the governments to stimulate the realization of a new and leading service industry in Europe. Is the combination of our transport know how with "state of the art" EDP techniques not a perfect subject for a new european development program?

4. You will not be surprised that my last conclusion refers to liberalization of the transport sector in Europe. The protection and strict national rules we see presently, cause an enormous waste in logistic cost.

In our opinion the ultimate goal, being trucks equipped with small computer terminals, rolling not a single kilometer unloaded, cannot be achieved without attacking the current nationalistic transport laws.

Frans Maas
Venlo, march 1987
Drs. J.M. Hardy
SESSION I: DEMANDS
LOGISTIQUE DE PRODUCTION, SYSTEMES D'INFORMATION ET TRANSPORTS DANS L'INDUSTRIE
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LOGISTIQUE DE PRODUCTION, SYSTEMES D'INFORMATION

ET TRANSPORTS DANS L'INDUSTRIE

Communication au séminaire de l'OCDE : "Just-in-Time transport : new road freiglet transport strategies and management : adaptivy to the new requirements of transport services.


Pierre VELTZ
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LOGISTIQUE DE PRODUCTION, SYSTEMES D'INFORMATION
ET TRANSPORTS DANS L'INDUSTRIE

1 - UN CONSTAT ET UNE HYPOTHESE

L'objet de cette note est de présenter sommairement les orientations théoriques et quelques résultats d'une recherche en cours sur le thème "logistique de production et systèmes de transport" (recherche portant sur le cas de la France, et menée pour l'instant à partir de l'exemple de l'industrie automobile et du poids lourd). On part d'un constat et d'une hypothèse principale.

Le constat est celui de l'attention croissante portée par les industriels aux paramètres de circulation des produits (avant, pendant et après l'élaboration des produits finis), et à une "fonction logistique", souvent encore émergente, qui assure la régulation de ces paramètres. Cette attention concerne simultanément les dimensions opérationnelles (recherche de productivité, baisse des coûts) et les dimensions stratégiques (au double sens : stratégie de production et stratégie de marché). L'évolution dans les pratiques économiques effectives se reflète aussi dans le champ de l'analyse économique, où s'amorce une convergence entre les disciplines académiques jusqu'ici séparées de l'économie industrielle, de l'économie des transports et des sciences de gestion. L'enjeu théorique est la réarticulation d'une économie de la circulation physique, qui s'était sans doute trop fortement liée à l'existence d'une branche "transport" empiriquement séparée, et d'une économie plus générale de la conception-production-consommation des biens industriels.

L'hypothèse principale est que la montée en puissance de la fonction logistique ne correspond pas simplement à un degré de rationalisation complémentaire qui viendrait se surajouter aux modes de gestion et de régulation existants. Elle est au contraire l'un des éléments principaux...
d'une refonte des modes de gestion-régulation de la production (d'un nouveau projet de rationalisation) qui résulte à la fois des mutations de la base technique de la production et des contraintes nouvelles imposées par les marchés. À cet égard, il nous semble pertinent de distinguer assez nettement deux "sous-systèmes logistiques" principaux dont les évolutions sont interdépendantes mais ne relèvent pas des mêmes analyses.

Le premier sous-système est directement en contact avec le marché et régulé par l'aval : c'est le système de distribution, qui peut avoir une composante "stratégique" très marquée, et qui est aujourd'hui fortement transformé par les technologies d'information (cf. notamment en France l'usage croissant du vidéotex). Le deuxième sous-système articule la logistique interne au cycle de fabrication et la logistique d'approvisionnement (renvoyant elle-même aux cycles de fabrication des composants). C'est ce deuxième sous-système, plus complexe et dans lequel les aspects opérationnels et les aspects stratégiques s'entremêlent fortement, que nous étudions plus particulièrement. La tendance est, bien sûr, à la recherche d'intégration entre les deux sous-systèmes, se traduisant notamment par une remontée croissante du "commercial" dans la fabrication. Mais cette intégration reste limitée par une différence fondamentale, qui est aussi à la racine de notre distinction en deux sous-systèmes : c'est-à-dire l'inertie beaucoup plus forte et la complexité plus élevée des systèmes de production, comparés aux systèmes physiques de distribution (particulièrement à l'échelle de marchés géographiquement assez restreints comme ceux de l'Europe). Ceci est très visible, par exemple, dans l'industrie automobile, où l'on voit bien comment la logistique de production et la logistique de distribution continuent d'être séparées, à la fois dans les structures d'organisation (services distincts fonctionnant sur des modes distincts) et dans le système général de traitement de l'information. Ainsi, l'information provenant de secteur commercial est simplifiée et injectée à l'extrémité aval du système de production (chaîne de montage final), pour être ensuite réélaborée en fonction des contraintes internes extrêmement fortes, complexes et différenciées du système de production (montage, tolérances, pressions, mécaniques et composants). Et on voit mal comment une intégration informationnelle complète pourrait être réalisée.
sur un ensemble aussi large, où les délais de réponse et les paramètres de flexibilité sont aussi hétérogènes.

Nous nous concentrerons donc sur la logistique de production, en examinant successivement : la logistique comme composante d'un nouveau projet d'organisation de la production ; les grandes étapes d'émergence de la fonction logistique ; le rôle de l'informatisation ; la relation avec les systèmes de transport.

2 - LA LOGISTIQUE DANS LA RE-ORGANISATION DE LA PRODUCTION : UN NOUVEAU PROJET DE RATIONALISATION

Les principes et les modalités traditionnelles d'organisation de la production sont aujourd'hui mises en question de multiples manières. Distinguons deux grands types de problèmes :

a) Le problème de l'intégration des niveaux et des échelles de temps : l'organisation de la production industrielle s'est structurée surtout, depuis le grand mouvement de rationalisation du début du siècle, autour de fonctions spécialisées et autour de la recherche d'optimisations de caractère "local", davantage que "global". Or on s'aperçoit aujourd'hui que la compétitivité repose autant sur la bonne articulation entre les phases amont (recherche, conception, expérimentation : phases dont la part dans la valeur ajoutée s'accroît fortement du fait de l'automatisation plus forte des phases de fabrication et de la complexité des produits), les phases de fabrication et les phases de distribution que sur la seule productivité de la fabrication. De même, la maîtrise de l'emboîtement des échelles de temps (depuis l'échelle de la stratégie jusqu'aux diverses échelles opérationnelles) apparaît de plus en plus comme une clé majeure de la réussite, dans un monde de marchés turbulents.

b) Le problème de la hiérarchisation des paramètres d'optimisation (ou à moins de réglage) des diverses phases de la production. À cet égard, le
fait majeur est la mutation très rapide de la base technique (jusqu'ici fondée sur le couple homme-machine et sur une relation stable entre temps humain et temps machine, qui disparaît au profit d'une mise en parallèle du système humain et du système matériel, avec des modes de couplage extrêmement différents du couplage direct ancien). Cette mutation rend en effet caduques les modes instrumentaux et organisationnels de mesure de la productivité : c'est-à-dire, d'un côté, les outils traditionnels d'évaluation tels que les utilise le contrôle de gestion (outils largement fondés sur la comptabilité du temps de travail direct), et, d'un autre côté, le système organisationnel qui exprime la hiérarchie des indicateurs en hiérarchie des "fonctions".

Notre hypothèse générale est, en effet, que l'optimisation des combinaisons productives très hétérogènes qui sont celles de l'industrie (surtout dans les process discontinus) est un problème hautement complexe, et que le mode dominant de gestion de cette complexité a été (depuis Taylor, Ford et tous les grands organisateurs de l'industrie) celui d'une décomposition hiérarchisée des objectifs et des indicateurs d'efficacité. Ainsi, l'organisation traditionnelle de l'industrie s'est largement construite sur une prééminence de la fonction "métodes", et des indicateurs dont elle était porteuse (temps de travail direct, série économique de lancement et engagement des machines). Et c'est cette prééminence qui est aujourd'hui contestée, en particulier parce qu'elle s'accorde très mal avec l'évaluation de la performance des systèmes automatisés.

C'est donc par rapport à ces deux grands types de problèmes qu'il faut, à notre avis, comprendre le rôle croissant de la logistique. Ce rôle croissant est un élément de la refonte des structures d'organisation, et non pas seulement une étape dans une histoire linéaire et additive de la rationalisation. Il relève à la fois d'une perspective d'intégration, c'est-à-dire d'identification et de recherche d'optimaux de niveau supérieur aux optimaux partiels correspondants aux divers sous-systèmes et fonctions spécialisés, et d'un mouvement de déplacement dans la hiérarchie des optimaux partiels. Ces deux mouvements sont bien entendu convergents, mais la distinction est néanmoins importante (bien que parfois difficile à
faire empiriquement), car elle correspond à deux philosophies qui souvent s'entrecroisent et parfois s'affrontent : d'un côté, l'idée qu'on peut, en particulier grâce à l'informatique, élaborer des modes de régulation réellement intégrés et subordonnant l'ensemble des fonctions et sous-systèmes ; d'un autre côté, l'idée qu'il vaut mieux rester dans la ligne traditionnelle de l'histoire industrielle, en ne visant que des optimums partiels de premier rang, par rapport auxquels viendront s'ordonner ensuite des optimums de second rang.

C'est cette deuxième option qui, très clairement, inspire la philosophie japonaise du Just-in-Time, et les méthodes de type Kanban qui ont aujourd'hui un très grand succès en France. Réduites à l'essentiel, ces méthodes se résument en effet à ceci : on ne peut pas tout optimiser à la fois (engagement des machines, des hommes, vitesse de circulation des stocks, etc.) ; mais, contrairement à l'option "taylorisme" classique, il vaut mieux, pour l'efficacité globale, prendre comme indicateur de premier rang la réduction des stocks et privilégier un principe d'écoulement pièce à pièce, rendu possible par la réduction de temps de chargement d'outil et la perte de signification correlative de l'indicateur "série économique de lancement".

Soulignons enfin un point essentiel : dans les deux cas (logistique conçue comme un élément essentiel de projet d'intégration ; ou logistique conçue comme nouvelle fonction structurante dans ce système des compromis organisateurs de la production), l'enjeu principal n'est pas la réduction des coûts des stocks en tant que tels. Cet enjeu est certes important, mais il est second par rapport aux avantages indirects attendus d'une bonne gestion des flux : meilleure mise en tension des fonctions, élimination des régulations malsaines de l'"usine fantôme", etc...
3 - LES GRANDES ETAPES D'EMERGENCE DE LA FONCTION LOGISTIQUE

Le développement de la logistique de production, dont on vient de situer les grands enjeux, se situe en terme d'une évolution globale, qui a comporté en France trois grandes étapes.

- Dans une première étape (années 60), l'innovation vient des groupes de l'industrie de biens intermédiaires : industries de process, manipulant des flux continus et massifs, où le réglage des mouvements et des stocks est partie constituante de l'acte productif lui-même. L'application de la recherche opérationnelle facilitée par l'apparition des premiers moyens informatiques lourds, la recherche d'économies d'échelles pour répondre à une forte expansion donnent à cette période des formes spécifiques qui marquent l'évolution économique des années 60. Les zones industrielles portuaires et la mise en place de moyens de transport spécialisés étroitement maîtrisés par les chargeurs industriels illustrent un processus global où localisation des lieux de production et organisation des circuits d'approvisionnement, de transfert inter-site et de distribution vont de pair.

- Différée par le relatif "archaïsme" du secteur en France (où le petit commerce est resté, plus longtemps que dans d'autres pays, protégé), l'évolution touche ensuite la distribution commerciale, qui a en charge, à l'aval de la production, la circulation des marchandises : circulation marchande mais aussi, de façon plus ou moins liée, circulation physique. Outre la capacité d'achat et de vente, l'aptitude à collecter et à affecter spatialement au moindre prix et dans les moindres délais les produits de consommation devient un élément de compétitivité et de rentabilité essentiel des groupes de distribution. Dans le même temps, certains opérateurs constituent des systèmes de distribution physique aptes à traiter simultanément les produits issus de filières productives ou relevant de circuits de commercialisation différents. L'appareil de circulation des marchandises, équipements et procédures liés, devient susceptible d'une valorisation spécifique. Plus généralement, émerge la notion de
chaîne de transport, de plus en plus autonome à l'égard de celle de filière de production. Structurée selon une logique propre, la chaîne de distribution physique peut devenir un détourn efficace, voire obligé, pour les produits de certaines filières. Dans ces conditions, on constate la situation contraire de la précédente : c'est le capital commercial, et non industriel, qui est maître du transport et, par ce biais, fait remonter loin en amont son influence et sa domination.

- Plus récemment enfin, s'amorce dans les industries manufacturières le mouvement de la logistique de production (process discontinu), qui se traduit notamment par la mise en place de nouveaux systèmes de gestion de la production (MRF, flux tendus, Kanban, etc.), et dont on a, au paragraphe précédent, décrit les fondements théoriques. Le mouvement se développe surtout dans l'industrie automobile, dans d'autres industries de biens de grande consommation comme l'électronique grand public, mais il semble toucher l'ensemble de l'industrie, si l'on en juge par la multiplication des colloques, séminaires, publications. Pourquoi ce mouvement s'est-il développé surtout après 1980 ? L'explication ne tient pas seulement à des facteurs technologiques (le Kanban au Japon est très antérieur à l'automatisation). Mais les deux contraintes simultanées de la mutation technique, qui précipite la crise des systèmes de gestion traditionnels, et de l'aiguisement considérable de la concurrence, jouent un rôle déterminant.

Enfin, il faut noter que ce mouvement se combine avec une redéfinition en profondeur des relations entre les grandes entreprises et leurs fournisseurs ou sous-traitants. Dans l'industrie automobile française, par exemple, le taux d'intégration est traditionnellement faible (comparé à celui des USA notamment), les sous-traitants sont nombreux, dispersés et fortement dominés, dans un système de relations très instable. Or, de plus en plus, on note une extension vers l'amont des systèmes du type J.I.T, englobant les fournisseurs, extension qui s'inscrit dans une refonte plus globale de la sous-traitance : forte réduction du nombre de fournisseurs, accent mis sur les relations techniques et pas seulement commerciales, "partenariat".
Il résulte de ce qu'on vient de dire que le développement de la logistique n'est pas, pour l'essentiel, une conséquence du développement des technologies d'information (mise en réseau des moyens informatiques). Mais il existe évidemment entre les logiques économiques de la logistique et les logiques techniques de l'informatisation de fortes convergences. L'informatisation, en effet, est porteuse de puissantes dynamiques d'intégration, par interconnexion de systèmes disjoints, imposition de normes unifiantes, exigence de standardisation des nomenclatures et procédures. Ses effets majeurs vont ainsi dans le sens de la transversalisation, que recherche, précisément, la logistique. À l'inverse, les obstacles à l'informatisation (hétérogénéité des données et des procédures) sont aussi les obstacles au développement de la logistique. L'une comme l'autre, enfin, tendent à réunifier la commande des opérations matérielles de la production (basée sur des valeurs physiques) et la commande gestionnaire (basée sur des valeurs économiques), dans la mesure où les mêmes données alimentent, de plus en plus, les deux niveaux de traitement. C'est d'ailleurs pourquoi les formes spécifiques d'informatisation liées à la logistique et à l'ordonnancement apparaissent comme comblant progressivement l'espace intermédiaire entre l'informatique de gestion pure et l'informatique industrielle pure (commande des procédés).

Toutefois, cet espace intermédiaire est encore loin d'avoir disparu, et, sur le fond de la convergence générale évoquée, il est nécessaire d'introduire quelques distinctions.

a) La relation la plus forte et la plus directe entre nouvelles technologies d'information et logistique est sans doute celle qui concerne le "sous-système de distribution". À côté de formes classiques d'informatisation de la gestion des commandes et des livraisons, apparaissent de nouvelles formes qui tendent pour l'essentiel à réduire les délais et à élargir les champs de choix des consommateurs. Il serait très intéressant, à cet égard, d'analyser les usages proliférants du vidéotex public en
France, ainsi que certaines expériences particulières, comme celle de Citroën qui est en train de mettre en place un système télématicque ambitieux avec tous ses concessionnaires.

b) Du côté du sous-système "logistique de production", les choses sont nettement plus complexes. Après une phase d'engouement, suivie de quelques déceptions, pour les systèmes informatisés de gestion de production de type MRP, et après une phase de débats opposant la rusticité pré-informatique du Kanban à la fragilité des systèmes informatisés, le temps semble venu du pragmatisme, où les industriels recherchent les méthodes qui sont adaptées à la fois à l'état général de leur informatisation (une grande partie des difficultés rencontrées dans la mise en œuvre de systèmes MRP tenait à l'absence de préparation du terrain, à l'hétérogénéité des nomenclatures, des procédures, etc...) et aux contraintes techniques spécifiques de leur production, dans ses diverses phases.

On pourrait tenter une typologie descriptive de ces diverses formes de relation entre systèmes informatiques et "systèmes logistiques". Mais il nous paraît important aussi de réfléchir théoriquement sur la nature même des processus d'informatisation, et sur une typologie de ces processus référée non pas à leur morphologie propre, mais à leur insertion dans l'économie informationnelle d'ensemble de la production. Ainsi, il est clair que certaines mises en œuvre apparentement massives d'ordinateurs ne transforment que très superficiellement cette économie informationnelle, alors que des réorganisations qui se passent complètement de l'informatique peuvent la bouleverser en profondeur (c'est le cas dans une réorganisation de type Kanban qui transforme radicalement les modes de circulation et de traitement de l'information, et leurs feed-backs sur les opérations).

A cet égard, on peut noter l'existence de deux principes théoriquement opposés d'économie informationnelle, qui conduisent à des conceptions logistiques différentes (et qui bien entendu se combinent dans la pratique).
Le premier est le vieux principe organisateur qu'on retrouve périodiquement dans l'histoire industrielle, et qui repose sur la nondissociation de l'information et du processus physique dont elle procède et qu'elle régule. Ce principe est déjà celui de la chaîne fordienne d'assemblage, et de tous les schémas de recherche de fluidité par enchaînements locaux et liaisons techniquement contraintes des facteurs de production. On le retrouve dans le Kanban "sans papier", où l'extraction d'information est réduite au strict minimum pour enchainer de manière purement locale les opérations. Dans ce cas, aucune information centralisée et véritablement séparée du processus physique n'est produite, le système est auto-organisateur en ce sens que la régulation d'ensemble procède de l'addition de micro-régulations locales.

- A l'opposé, le principe de l'informatisation (même décentralisée) est, par définition, de séparer l'information du processus physique pour la porter dans l'espace symbolique homogène de la numérisation et du calcul, où les données peuvent être en toute liberté recombinées, avant d'être réinjectées comme commandes dans le processus matériel. De ce point de vue, il y a donc bien une opposition "théorique" entre MRP et Kanban, par exemple. Mais dans la pratique les deux principes se mêlent évidemment, et il est clair que la réussite de l'informatisation dépend largement de la pertinence des dosages qui sont opérés entre les avantages de souplesse et de robustesse des systèmes d'information fortement décentralisés et les possibilités de recombinaison et de calcul qui sont celles des ordinateurs (le degré de décentralisation des systèmes informatiques eux-mêmes étant, dans cet équilibre, un paramètre-clé).

5 - LES SOLICITATIONS DU SYSTÈME DE TRANSPORT

Le système de transport n'est qu'une composante du système de production-circulation des marchandises, dont l'intégration se renforce pour répondre aux nouvelles contraintes économiques et mettre en œuvre les technologies disponibles.
Tout en n'ayant pas d'autonomie économique, ce qui interdit toute approche purement sectorielle, le secteur des transports garde évidemment des traits propres qui le distinguent dans l'appareil productif : rôle de l'État qui assure, par le financement de ces biens d'équipement très lourds que sont les infrastructures, les "conditions générales de la production" ; conditions de travail de l'industrie des transports (l'itinérance, la mobilité spatiale du poste de travail), secrétant une culture professionnelle très marquée. Plus fondamentalement peut-être, la confusion du process de production et du process de consommation (qu'elle soit finale ou productive) du transport pose dans des termes particuliers la question de l'adéquation de l'offre à la demande, et induit une tendance structurelle à la surcapacité de transport.

De ce fait, bien qu'économiquement imbriqué dans la production et dans la circulation marchande, le transport reste organisationnellement à part. Non qu'il relève entièrement du "marché des transports", du transport public qui ne couvre qu'une part (majoritaire en tonnes-kilomètres, minoritaire en tonnes, en emplois, en nombre de véhicules) de l'activité des transports de marchandises. Mais les entreprises utilisatrices de transport, en position de "chargeur", peuvent, plus facilement sans doute que pour l'achat d'autres fournitures, arbitrer entre le "faire" et le "faire-faire" (make or buy), le compte propre et le compte d'autrui. Les barrières techniques à l'entrée dans le secteur des transport sont souvent relativement basses, l'internalisation est accessible. En revanche, la gestion sociale des spécificités du process de travail, la gestion économique des tendances chroniques à la surcapacité incitent à externaliser la production du transport, quitte à conserver le contrôle opérationnel des activités organisatrices du transport et, par ce biais, acquérir et exercer la maîtrise de l'ensemble des chaînes.

Quelles sont, compte-tenu des évolutions générales dans l'organisation de la production évoquées plus haut, les évolutions du système de transport et des sollicitations auxquelles il est soumis ?
a) Nouvelles conditions de mise en mouvement des marchandises

Réduction des stocks, réduction de la longueur des séries, flexibilité : tels sont, on l'a vu précédemment, les maîtres-mots du nouveau projet de rationalisation : leur corollaire est bien entendu la souplesse du système de transport. Simultanément, le déclenchement de la fabrication "au dernier moment" implique, pour garder des délais commercialement acceptables, une accélération de l'ensemble du cycle de fabrication et notamment des opérations de transfert qui s'y insèrent.

Ainsi, la taille des lots d'expédition d'une usine à l'autre, d'un fournisseur à un donneur d'ordre, tend à diminuer, et atteint moins souvent la taille d'une charge complète (camion ou, a fortiori, wagon ou rame ferroviaire). Il faut donc souvent arbitrer entre des objectifs contraires, tenter de concilier l'optimum de transport et l'optimum de la gestion de production dans son ensemble (autour de la logistique). Par exemple, il faut choisir entre la livraison "en droiture" qui accélère le mouvement et évite les passages à quai et le groupage qui assure une massification minimale des flux.

Les expéditions sont plus fréquentes et plus imprévisibles, les délais d'acheminement se réduisent. La flexibilité, maître mot de la fabrication, s'applique également au transport. Les transporteurs ont même l'impression que c'est sur eux que repose tout l'amortissement des aléas, le rattrapage des retards. A côté du coût de transport (évalué couramment à 40% environ du coût logistique), les exigences portent tout autant sur les délais et sur la fiabilité. Naguère presque exclu, le risque de rupture de fabrication par rupture d'approvisionnement est en effet désormais calculé, accepté et... vigoureusement combattu !

Les conséquences techniques, organisationnelles et économiques sur le secteur des transports sont nombreuses et profondes.
b) Techniques et organisations de transport

En termes de technique de transport, on observe tout d'abord une confirmation de la prépondérance de fait des techniques routières, même si des exemples existent de systèmes performants utilisant le rail ou le transport combiné. Ceci pose la question de l'aptitude de la SNCF à passer du statut de tractionnaire à celui de prestataire logistique.

La diminution de la taille des lots entraîne celle des emballages et celle de certains véhicules. Pour les liaisons inter-usines à l'intérieur d'une entreprise et pour les flux les plus réguliers, la tendance se confirme à la spécialisation des matériels de transport, jusqu'à renoncer à toute possibilité de fret de retour en dehors des emballages vides, ceux-ci constituant du reste un petit volant de manœuvre pour "lisser" les volumes d'expéditions.

Particiap à la fois de la "technique" et de l""organisation", la forme des circuits qu'empruntent les marchandises révèle les nouvelles rationalités à l'oeuvre, les compromis auxquels elles conduisent. Si la taille des lots est plus petite que naguère, leur fréquence plus grande, le groupage devient plus souvent nécessaire. Il peut prendre, chaque fois que possible, la forme du ramassage "au vol", un véhicule collectant quelques lots dans la zone du départ pour les délivrer à une destination unique après un trajet principal groupé. Symétriquement, d'autres circuits peuvent comporter une distribution fractionnée dans la zone d'arrivée, d'autres enfin combiner les deux opérations. Mais d'autres flux sont trop fragmentés par la taille, trop dispersés dans l'espace pour permettre ces organisations simples. Un passage par une plate-forme -pour le groupage en ce qui concerne les approvisionnements, le dégroupage pour la distribution- voire par 2 plate-formes, est inévitable.

Les approvisionnements et la distribution industriels tendent alors à se structurer à la manière de la messagerie, selon des organisations en réseau. Réseau au sens d'un ensemble de liaisons fixes reliant des noeuds, éventuellement hiérarchisés en noeuds principaux et noeuds secondaires.
Réseau également au sens d'un fonctionnement intégré en temps réel. Les passages "à quai", transit par une plate-forme-noeud du réseau, doivent être le plus bref possible : les liaisons sont coordonnées selon un système de correspondances assurant la connexion immédiate sur l'ensemble du territoire desservi. Ce dispositif se prête également aux relais entre chauffeurs, et donc au respect des réglementations sociales.

Les autoroutes sont les axes lourds de ce dispositif : sûres, en particulier pour les trajets de nuit (le "jour A au soir-jour B au matin" propre à assurer le transfert pendant les temps masqués de la production), d'accès facile pour des dépannages éventuels, hors gel (praticables toute l'année), elles permettent la ponctualité et la fiabilité requises. Pour redoubler de précautions, on affecte les véhicules les plus récents aux flux les plus tendus ; on envoie simultanément un ensemble chargé de pièces et un ensemble chargé d'emballages vides, celui-ci pouvant si besoin est remplacer celui-là. Sans doute indiscutables dans leur principe, pour des raisons d'encombrement et de sécurité, les restrictions de circulation ont des effets pervers quand elles s'appliquent différemment aux transporteurs nationaux et aux transporteurs étrangers.

Géographiquement, certaines régions périphériques ou enclavées, soumises aux barrières de dégel, et à vrai dire souvent moins développées sur le plan économique, sont moins bien desservies (Massif Central par exemple). On n'assiste pas toutefois à une tendance au resserrement spatial de l'appareil industriel, des donneurs d'ordres et de leurs sous-traitants (à la manière de "Toyota-City" au Japon). En période de restructuration, les relocalisations sont difficiles, et la gestion des flux tendus à l'échelle de la France et même de l'Europe, se révèle praticable (liaisons intenses et aisées entre la région lyonnaise et la région parisienne dans l'industrie du poids lourd par exemple).

La diminution des en-cours porte sur les stocks fixes et circulants. Le traitement des marchandises pour un passage à quai, qui prenait naguère 1 ou 2 jours, est réduit à quelques heures, voire moins d'une heure (au reste, la taille des entrepôts augmente moins vite que le volume du trafic
qu'ils traitent). Pour ce faire, il est indispensable que le mouvement des informations précède celui des marchandises : le contenu d'un camion (les lots, leur contenu, leur volume et leur poids, leur destination) doit être communiqué à la plateforme réceptrice bien avant que le camion n'y arrive pour que soit établi à l'avance le plan de dégroupage-regroupage assurant les correspondances et les distributions finales. La conception, la gestion et le contrôle des réseaux d'informations acquièrent une importance décisive quant à la mise en œuvre des réseaux physiques de transfert des produits. Les modalités techniques renvoient en effet à des modalités économiques, établissant des relations caractéristiques entre les divers agents concernés.

c) La gestion économique du transport

Les dispositions économiques présidant à ces nouveaux systèmes de transport ne constituent pas de véritables nouveautés, mais confirment et accentuent des tendances déjà à l'oeuvre et dont on peut désormais se demander si elles ne deviendront pas dominantes dans des pans entiers du système de production et de circulation.

La mesure et la prise en charge du coût de transport est un bon révélateur de ces mouvements. Naguère encore, de très grandes entreprises industrielles achetaient leurs fournitures "franco", comme font encore nombre de PME. L'organisation du transport était du ressort du fournisseur, et son coût indissociablement incorporé à celui de la marchandise. La règle désormais semble devenir progressivement celle de l'achat "départ usine" : c'est l'acheteur qui conçoit et paye le transport, selon un processus spécifique identifié et rationalisé en tant que tel (même si, comme on l'a vu, ce processus n'est nullement indépendant des contraintes d'approvisionnement et de production).

Les grands groupes industriels sont dotés de "services transports" chargés de la conception et de la mise en œuvre des flux. Ceci ne
signifie pas que le transport privé, pour compte propre, soit systématiquement préféré. On observe au contraire que, même s'il assure une part notable des liaisons "inter-sites", c'est-à-dire entre établissements de la même entreprise (flux lourds, réguliers, permettant l'utilisation intense d'un matériel très spécialisé), le parc propre (le "garage") a surtout une fonction de sécurité pour faire face à tout aléa. Une forte proportion des liaisons inter-sites et la quasi totalité des approvisionnements sont assurés par des transporteurs extérieurs, que ce soit sous le régime du transport public (messagerie, lots complets relevant de la TRO) ou du compte propre (pour l'essentiel, la location).

La manière dont sont établis les contrats de transport reflète la place qu'ils tiennent parmi les préoccupations de l'entreprise chargeur, de l'équilibre recherché entre centralisation décisionnelle et décentralisation opérationnelle. Le choix des transporteurs "agrées", la négociation des cahiers des charges et tarifs relèvent du service "achats" ou de la direction des transports du groupe. A ce niveau, entre en jeu tout le poids du chargeur, son aptitude à faire jouer à fond les possibilités de concurrence entre transporteurs sujets à la tendance à la surcapacité, tout en veillant à n'agréer que des prestataires qualifiés et fiables : il faut savoir jusqu'où ne pas aller trop loin... En revanche, le passage d'ordre relève du service "transports" de chaque établissement. Selon les cas, ces demandes de transport sont traitées au niveau central, agrégées et rationalisées (flux inter-sites), ou transformées en commandes fermes de transport et mises en œuvre au niveau des établissements (flux d'approvisionnements auprès de fournisseurs extérieurs).

Ainsi, le niveau central se charge de la conception d'une politique de transport adéquate à l'orientation générale de l'entreprise. Le niveau local, de sa mise en œuvre efficace : il s'agit d'assurer au jour le jour le meilleur groupage des lots pour utiliser au mieux les moyens utilisés, sous le régime tarifaire le plus avantageux.

Par exemple, le savoir-faire élémentaire d'un service transport consiste à traiter "sous TRO" un envoi sans retour, et sous le régime de la location 2 envois croisés permettant un aller et retour relativement équilibrés ; à
grouper dans le même véhicule 2 petits lots isolés pour accéder à la plage d'application de la TRO, etc. En combinant toutes les possibilités techniques et réglementaires (tarifaires), c'est une quinzaine de régimes de transport qui sont ainsi concurremment utilisés.

Plusieurs formules différentes sont utilisées, selon les entreprises, pour appliquer ces quelques règles que l'on vérifie de cas en cas. Dans certaines configurations, la direction des transports est externalisée en une filiale "indépendante", commissionnaire de transport, qui conçoit, exécute et fait exécuter par affrètement l'ensemble des expéditions que lui confie son chargeur (et actionnaire) principal. Mais le statut externe donne une plus grande souplesse, en complétant et diversifiant les activités, tout en instituant la fonction de circulation comme centre de profit, susceptible d'une rentabilité propre.

Entre l'internalisation et la filialisation, on rencontre aussi une formule intermédiaire, une filiale assurant non l'ensemble de l'organisation et de l'affectation des flux à des transporteurs affrêts mais la gestion d'un réseau public (pour compte d'autrui) de liaisons et de plateformes constituant un sous-ensemble du système global.

Quant aux transporteurs, on constate que les chargeurs tendent à restreindre le nombre de leurs affrêts : pour choisir les professionnels les plus fiables (capables de gérer seuls les aléas de leur ressort), alléger les coûts de gestion administrative, faciliter les possibilités de groupage des lots de petite taille. La concentration du secteur s'en trouve avivée, même si existent des collaborations entre PME.

L'évolution du secteur des transports sous l'influence des "flux tendus" apparaît donc intense. Mais elle n'entraîne pas de bouleversement, encore moins de rupture, dans une profession qui a souvent montré ses capacités d'adaptation.

Ces éléments descriptifs confirment que l'analyse économique des transports peut et doit s'opérer selon deux niveaux complémentaires et
distincts : les modalités techniques, organisationnelles, tarifaires d'une part ; les rapports de force globaux qui régissent ces modalités et leur donnent sens d'autre part : ce que nous avons déjà proposé d'appréhender en termes de "maîtrise des transports".

d) **Industrialisation du transport**

Un dernier point mérite d'être noté : c'est que, simultanément au resserrement de l'articulation transports-production, diverses évolutions convergentes rapprochent l'organisation interne du système de circulation de la morphologie *générale* des systèmes de production modernes : césure croissante entre fonctions de conception, de réglage opérationnel et d'exécution concrète ; internalisation des réseaux d'information, imposition de nomenclatures et de normes pour pérenniser des relations de domination commerciales ou techniques ; "mise en tension" des sous-traitants de transport analogue (et simultanément nécessaire) à la mise en tension des fournisseurs ; recherche enfin de compromis entre impératifs concurrents voire contradictoires, mise au point d'indicateurs pertinents à différents niveaux de localité ou de globalité d'appréhension des problèmes.
DESIGNING AND IMPLEMENTING JUST-IN-TIME LOGISTICS SYSTEMS

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Although just-in-time (JIT) logistics techniques have been applied in a variety of manufacturing systems, adapting traditional logistics operations to a just-in-time environment is a relatively new challenge. It should be remembered that these techniques were developed under different conditions and that many adjustments must be made before systems will work. Many Far Eastern JIT operations, for example, were designed to work with extremely short supply linkages between vendors and plants (often under one mile). Recent applications of JIT techniques in the United States, however, have often had to cope with supply linkages involving thousands of miles between vendors and plants. This difference alone has complex implications for the proper design and implementation of JIT logistics systems.

Many attempts to implement JIT systems have failed to achieve promised returns because managers did not understand the requirements or plan effectively for the introduction of radically different logistics procedures. This paper argues that designing and implementing a just-in-time logistics operation requires both careful evaluation of program objectives and a well-founded development plan. Perhaps more importantly, managers should remember that JIT is not simply a fixed set of rules to be installed once and for all and thereafter to be left alone to run by itself. It is more like a philosophy that must permeate all aspects of the proposed operation and that must be both managed and maintained.

This paper outlines key planning techniques needed to ensure successful JIT logistics operations, and then examines two case studies documenting both inbound and outbound JIT systems. The paper concludes with a summary description of key success factors managers should incorporate into their JIT logistics system planning process. For this paper, JIT logistics systems will refer to expedited linkages inbound between worldwide vendors and U.S. plants and outbound between plants and customers, both of which are characterized by minimal
inventories and high delivery frequencies. Both the system planning and case study sections below will focus on long supply lines or delivery JIT operations involving transfers between modes.

**JIT PLANNING TECHNIQUES**

Successful JIT system planning needs to be done in two primary stages: conceptual design and implementation. The conceptual design stage involves determining key JIT system objectives, developing an overall plan for the system, and conducting an initial system test. The implementation stage involves gradual (phased) introduction of the JIT system and fine-tuning the operations to fit changing company and market needs. In addition, a bridge between these two stages is established by a systems test, which should be run in "near-laboratory" conditions to resolve potential problems as soon as possible.

**JIT Conceptual Design**

What JIT systems give in terms of efficiency, service, and savings, they demand in terms of precision and coordination. To make sure that provision for these qualities is built into the system as early as possible, management's design of a JIT logistics system should focus on four primary areas of concern:

- Suppliers and customers
- Third-party operations
- Information technology
- Management techniques

Each of these areas is discussed below. One theme underlying each of the topics is that to operate a smooth inbound or outbound logistics system, the company will require tight, strategic alliances with both outside the company—-with its suppliers, customers, and third-party operators—and inside the company, among cooperating functions. These alliances will in turn depend on entirely new communications methods and new management techniques, such as product channel management.

**Suppliers and Customers**

Strategic alliances with suppliers and vendors will demand increased information sharing and high operating standards. Under traditional logistics systems, uncertainties and
contingencies were covered for by inventory reserves. But in JIT systems, inventory is replaced by additional information. Much of this information will have to come from the company's trading partners. Fortunately, emerging information technologies, such as Electronic Data Interchange (EDI) are making more reliable data on worldwide product flows readily available to JIT system managers.

Once information sharing has established the foundation of a strategic alliance with suppliers or customers, the company must design operating standards for all materials flows or products moving via just-in-time logistics systems. Standards need to be developed for:

- "Zero-defect" quality-control procedures. If companies hope to minimize product channel "safety stock," over 99 percent of released material or product will have to meet quality standards set in advance. Normally, suppliers will develop procedures for inbound flows to a manufacturing facility, and the company will do the same for outbound distribution of product to customers.

- Product flow operating procedures. Vendors must have exact material requirements available for tender to carriers at the time promised. Similarly, companies must release customer orders in time to arrive exactly as required. Here it is important to note that negotiated (rather than imposed) operating standards generally work better in high pressure logistics environments.

- Problem resolution procedures. Many JIT logistics systems work well until the first problems arise; then they break down because no methods for resolving them had been planned or discussed. Partners in the alliance must develop appropriate communications channels, define alternative strategies (e.g., expediting material air freight if an enroute shipment is delayed), and set up mechanisms to correct mistakes (including penalty payment schemes).

Third-Party Operations

Alliances with third-party distribution companies (such as brokers, forwarders, carriers and warehouses) are critical to successful JIT logistics systems. As key linkages between suppliers, plants, and customers, third-party operators ultimately determine the success or failure of new JIT systems. Again, EDI flows between companies and third parties are important information sources and performance monitoring tools for JIT managers. Third-party distribution companies must also be made aware of all operating standards set between a company and its suppliers or customers. Failure to treat third-parties as equal partners in JIT logistics channels has often resulted in substantial down-stream operational problems.
To ensure full third-party participation and cooperation, managers must not only inform them of current JIT operating standards, but also negotiate to develop a third-party performance monitoring system. Because time is critical to JIT systems, third-party performance (e.g., on-time delivery, correct routing, product damage) must be monitored on a shipment-specific basis. Normally, carriers, forwarders, and warehouses are asked to provide the necessary data for company performance analysis systems. Third parties that consistently violate JIT system operating standards are quickly replaced with new service providers.

**Information Technology**

Information flows form the key link that makes possible the alliances among all participants in a JIT logistics system. Tracing the progress of multiple shipments on numerous carriers in various states of motion or rest requires a complex and integrated information system. Once internal (intracompany) and external (vendor, customer) data links required for JIT logistics system operations are identified and developed, sophisticated control and monitoring software has to be designed. Often, third-party data networks can be used to collect and disseminate shipment information worldwide. Often vendors and customers will have unique communication or data formats that require integration into the system.

Companies must develop in-house information management and analysis capabilities to support these systems. Using outside software or computer operations often produces unsatisfactory results. The initial investment, often in the millions of dollars, may be expensive, but is quickly amortized by the reduced inventory carrying charges in the JIT logistics system. Information technology will also be crucial to internal alliances between those responsible for purchasing, manufacturing, marketing, distribution, and other operations necessary for a successful JIT system. Exact production or customer requirements (e.g., shipment size, timing, and frequency) often change rapidly, requiring frequent alteration of system operating parameters.

**Management**

The integrated operations of a JIT logistics system call for integrated management procedures. Functional management techniques (i.e., dividing purchasing, distribution, and manufacturing into separate control groups) cannot easily evaluate the cross-group tradeoffs critical to realizing the potential savings from JIT logistics systems. Managers in functional environments focus on making decisions within a specific area (e.g., purchasing) that make sense for that area alone but may disrupt the smooth operation of a JIT system. For example, although ordering large quantities from vendors may result in
lower acquisition costs, these quantities may exceed the system's shipment requirements and result in excess channel inventories.

Managers who run efficient JIT logistics systems are increasingly turning to innovative techniques such as product channel management. Product channel management views the entire product acquisition or distribution process as a whole, from initial order entry through final customer delivery, with overall responsibility for product profitability placed within a single organization in a company. Rather than individually managing production or distribution activities, the product channel management organization evaluates cross-functional tradeoffs to maximize product flow efficiency. This new organizational approach is now being adopted by many U.S. corporations (for further discussion, see the author's paper listed in the bibliography).

System Test

The step between designing and implementing a JIT system is filled by a "test case" used to try out the system. Often involving only a single vendor or customer, one (or a few) products, and only a few receiving locations, the test case is designed to get the bugs out of the system before full-scale implementation. It is common that, as test results are analyzed, developers will make substantial changes in initial systems designs, leading to improved operations.

JIT Implementation

Because JIT logistics systems are designed for precision and flexibility, they can be considerably complex. Consequently, implementation of the system will require fundamental changes to existing inbound or outbound product distribution channels. To make the system manageable, companies will have to reduce significantly the number of vendors and carriers they do business with. The company's list of preferred partners should be limited to only those suppliers and third parties willing and able to consistently maintain high quality control standards. In spite of rigid up-front checks, managers should be prepared for a 25 to 30 percent annual turnover in vendors and third-party distribution companies.

Managers may still be unprepared for the amount of time needed to ensure that the operations proceed according to plan, especially since the implementation stage also marks the beginning of strict performance monitoring procedures. Managers should shift as much as possible of the burden of performance monitoring, reporting, and analysis to suppliers and third-parties. If they receive up-to-date data on current shipment or inventory status, they can delay or expedite movements to minimize stockouts or plant/customer shutdowns.
In addition to careful supervision of operations in place, the implementation phase requires constant evaluation of the overall success of the program. Compared to other, less complex, sourcing or distribution systems, the efficiency and profitability of JIT systems are much more sensitive to changes in vendors, shipping requirements, or shifts in carrier schedules. For example, shifting exchange rates can radically alter one's choice of countries for product acquisition. Sometimes, JIT systems become infeasible or too costly because of local customs or other regulations. Managers must ensure that sufficient flexibility is built into JIT logistics systems to allow for these and other, less predictable, changes.

CASE STUDIES

Two case studies will help to illustrate how JIT logistics systems are designed and implemented. The first involves a multinational computer manufacturer operating a JIT logistics system to source inbound plant materials. The second involves a domestic food producer using JIT logistics to consolidate outbound order deliveries to customers.

Multinational Computer Manufacturer

Following the Sperry-Burroughs merger, Unisys developed a just-in-time manufacturing operation at its Flemington, New Jersey, plant that allowed it to continue workstation production in the United States. Conceived and installed over a 18-month period, the system sources over 70 percent of its materials (e.g., electronic components) from the Far East to build over 90,000 workstations ($500 million in sales) for U.S. markets. In its first full year of operation, the JIT system resulted in:

- A 40 percent reduction in material sourcing
- A $2.4 million decline in shipping costs (while production rose 10 percent)
- A drop in material inventories from 2.3 months to 1.4 months of stock on hand.

Much of the operation's success has been due to the company's unique JIT logistics system. By following the basic planning techniques described in the previous section, Unisys has been able to guarantee the near-term future of the plant as a viable competitor with Far East producers. System development followed the pattern outlined above. It began with the careful selection of suppliers, essentially those vendors willing to pretest all materials to guarantee fewer than 1 percent defects. An in-house channel information system provided early warning notices on shipment problems or delays, allowing immediate
corrective action. Finally, management reoriented its thinking to control flows in a cross-functional environment, allowing flexible adaptation to changing requirements.

To develop the system, purchasing reduced its vendor list by nearly two-thirds, to 250 suppliers. About 100 are preferred suppliers, which means that Unisys "sole-sources" a product from the vendor, and the two work closely on quality engineering and design. Preferred suppliers' shipments must arrive on time and meet rigid quality standards. Unisys also helps suppliers establish quality compliance programs that meet Unisys standards. Since any JIT parts shipment defective by more than 1 percent could shut down the plant, suppliers must conform to the "zero defect" guidelines or incur substantial air freight costs from the Far East to move replacement materials to the facility.

To control the entire materials channel inbound from suppliers, Unisys controls all third-party distribution companies involved in the moves. Suppliers have the prescheduled shipment at their plants ready for pickup by Unisys' appointed carriers. Careful analysis of shipping schedules allows Unisys logistics managers to match shipments inbound from the Far East to liner company vessel sailings. Arrival at U.S. ports results in rapid transfer to domestic over-the-road carriers for rapid movement to the New Jersey plant. For many shipments, preclearance of customs results in minimal port delays.

To control the constant flow of JIT product, Unisys developed an on-line shipment monitoring system with EDI links to freight forwarders and carriers in both the Far East and California. Logistics managers tap into this network to determine exact cargo location and status. Problems are quickly identified and alternative delivery options evaluated. If the supplier or carrier is responsible for problems, it is required to expedite the shipment (usually via air freight) at its own expense. Last year, suppliers paid over $200,000 in additional freight costs to keep JIT shipments on schedule. Unisys is monitoring carrier and supplier performance on a monthly basis and using the results to scale down the preferred vendor and carrier lists.

To ensure that channel management would not be overly complex, Unisys reduced its carrier base from 120 to just eight carriers. Key decision criteria included price, ability to meet strict JIT delivery schedules, and willingness to support EDI linkages. Final carrier selection involves extensive negotiations, with Unisys presenting detailed performance requirements that must be met consistently.

To stay competitive with overseas producers, Unisys had to lower material costs by 40 percent on a year-to-year basis. Installing the JIT logistics and manufacturing allowed them to meet the goal, primarily through inventory reductions. In total, over $15 million in inventory carrying costs were saved.
- Customer orders and shipments will be consolidated.
- Delivery distances and time will be considerably reduced.
- As a result, overall customer service will improve dramatically.
- Warehouse-to-customer transportation costs will decline.
- The company's total transportation bill should remain stable.

These goals will be accomplished through a combination of a geographically balanced network of facilities and the JIT coordination of production, inventory, and transportation functions to meet the demand and customer service requirements of each specific full-service warehouse.

The ultimate driver of the CODS is customer service. The system is designed to keep each warehouse's inventory level of each SKU at the lowest level at which adequate customer service can be maintained. Stockouts in any one SKU in any one warehouse cause complete customer orders to be diverted to another warehouse. This increases certain transportation costs but is crucial if consolidated orders are to be maintained. Of vital importance is the company's information system support, which must be able to track customer demand, shipments, inventory levels, and production in order that logistics managers can properly react to the situation.

To ensure the success of CODS, the company has begun to implement changes in the following areas.

- Formal coordination procedures for daily production planning, plant-to-warehouse transportation management, warehouse inventory management, and warehouse-to-customer transportation management are being developed.
- Negotiations are under way to develop a small group of reliable and flexible carriers familiar with the CODS requirements.

In summary, the use of JIT procedures should enable this maker of frozen dinner entrees to dramatically increase customer service levels with little increase in logistics costs. As the company grows and geographic demand patterns change, the CODS's use of self-contained, full-service regional warehouses should enable it to expand without a major disruption of the rest of the system.
by reducing inventory to just over one month's supply—the majority of the 40 percent reduction in material costs. The Flemington plant expects even greater reduction in material inventory costs during the coming year. Further enhancements in the JIT logistics system will allow inventory on hand to be reduced to one month, resulting in millions of dollars in new cost savings. And all this is being accomplished with substantial improvements in defect-free product—99.4 percent in recent months, up from 80 percent before the JIT systems were installed.

Domestic Food Producer

A major producer of frozen dinner entrees that had experienced explosive growth found its physical distribution organization suffering from noticeable growing pains. Distribution practices that had been adequate when the company was younger were no longer completely satisfying customer needs, nor would they be able to do so in the future. The company's physical distribution system was organized around two East Coast production/warehouse facilities, which because of the need to realize scale economies were each dedicated to a different part of the company's product line. As the company entered new and more geographically dispersed markets (adding a new production facility in the West), and as customers in this food category became more demanding, the company found several problem areas emerging.

- Average lengths of haul for customer delivery were too high, on average over 1,300 miles.
- Driven by the high length of haul, transportation costs were greater than for competitors.
- Emerging customer service requirements were not being met:
  -- Customers desired consolidated product shipments
  -- Customers required more frequent deliveries
  -- Customers needed more reliable delivery schedules

As a means of providing customers with consolidated orders, reducing delivery times, and reducing delivery distances and costs, the company is developing a JIT consolidated order distribution systems or CODS. The system allocates product directly from the production line of one of three separate plants (each of which produces different parts of the company's product line) to three full-service regional warehouses. These warehouses ship products to customers in their regions.

The CODS will bring the company several substantial benefits:
Although many factors determine the fate of JIT logistics systems, the experience of companies at the leading-edge of JIT operations suggests three key elements common to success:

- Strategic alliances with suppliers, customers, and third parties. The delicacy of JIT systems calls not only for intensive management but also for cooperation between logistics partners, including data-sharing and enforcement of standards.

- A consistent plan of action. By developing and updating an operational plan for a JIT system, managers can ensure efficiency and reliability as well as correct for changing market or operational conditions.

- A top-notch information system. The management of JIT systems requires much more data than traditional operations. Additional internal and external linkages are needed to generate the required data. In addition, sophisticated analytical software must be developed to allow integrated product delivery channel management.

- A new approach to management. JIT systems require innovative, cross-functional management techniques. Only by evaluating tradeoffs within a delivery channel rather than within functions (e.g., warehousing) can efficient and reliable JIT logistics systems be developed.
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POTENTIAL FOR PERFORMANCE MEASUREMENT AND PREDICTIVE CAPABILITY INHERENT IN THE PHYSICAL CHARACTERISTICS OF SMALL SHIPMENTS

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POTENTIAL for PERFORMANCE MEASUREMENT and PREDICTIVE CAPABILITY INHERENT in the PHYSICAL CHARACTERISTICS of SMALL SHIPMENTS

By

John J. Mathews

HEADNOTE

What follows is a report of efforts to apply practical experience in time-critical freight-handling to the discovery of principles that may govern the productivity potential inherent in the physical characteristics of traffic, particularly of the type being increasingly generated by Just-in-Time constraints. The model attempting to describe the interrelationship among certain of those characteristics has shown promise, but needs extensive development.

BACKGROUND

Emergence of the just-in-time (JIT) doctrine for movement of goods inbound to manufacturers largely parallels what has been evolving for decades in the market-driven economies of the world for the movement of goods outbound from manufacturers to marketplace. Arrival time continues to become more critical, and economy of scale continues to be traded off for other advantages.

Even setting aside the phenomenal spread of time-sensitivity throughout the spectrum of consumer goods, it is instructive to recall the role played by commercial operators, like the author, in performing the later stages of moving those goods to market.

In macro-scale, outbound distribution may be seen as a continuum, but in actual practice the process usually entails a series of movements from production facility to consumer, successive movement-segments being punctuated at each echelon by progressively greater disaggregations of shipment-lot and progressively greater time-sensitivity.

If these perceptions are correct, this forum may afford opportunity to share field experience with analytical expertise in quest of principles applicable to managing the rising tide of small shipments.

That the tide is rising is beyond question. National Small Shipments Traffic Conference states that shipments under 500 pounds (227 kg) now comprise more than 95% of all American highway freight movements.

Transportation Policy Associates report that, even after excepting all traffic moved by specialized package-carriers, the average weight of shipments handled by U.S. general cargo truckers in 1985 was still only 821 pounds (373 kg).
Narrowly-specialized parcel carriers—United Parcel Service and Federal Express, for instance—can and do design plant, equipment, and method to handle only cargo of pre-selected characteristics. By contrast, however, general freight carriers are unremittingly confronted by traffic of all sizes, shapes, and other characteristics, and are thus compelled to address small shipments within the general flow.

The search for principles underlying the behavior of such traffic is, in the world of competitive for-hire hauling, obstructed by a natural reluctance by operators to share what may be perceived as proprietary information. Moreover, many commercial carriers and distributors—most, maybe—doubt that the variables affecting their handling performance can be comprehensively identified or exactly quantified.

Nonetheless, as a widely-circulated logistics journal has observed, "the key to productivity improvement [is] through conceptualized understanding..." 7/

INVESTIGATION

The concept sketched here began not as a scholarly undertaking but as a straightforward attempt to understand certain phenomena in order to apply the knowledge to productivity improvement. Resources being limited, and research expertise not available in-house, the investigation has developed in somewhat informal fashion through three stages:

Observation. Almost 40 years of involvement in the movement of large volumes of small-lot freight have afforded the author a natural vantage point.

Quantification. Data amassed in the regular course of business have been sifted to determine whether they would yield quantifiable trends or principles.

Modeling. Empirical method has been used over a period of more than ten years in quest of a model that describes the interrelationship of certain freight characteristics influencing handling efficiency.

From the outset, it was recognized that, to achieve focus, the investigation would have to be confined to reasonably homogeneous cargo being moved by a single method through similar facilities. Thus the data and conclusions presented here are derived only from carton goods being manually moved from dock-level inbound truck floor to dock-level outbound truck floor over a smooth, unobstructed surface under light adequate to facilitate easy reading of documents and labels.

Observation was further limited to freight arriving at the test sites in "truckload" lots, i.e., 10,000 pounds (4,545 kg) or more, for break-out into smaller lots for re-shipment. 10/
Observation

In large-scale cross-dock movements of small-assortment carton-goods, three phenomena are so apparent as to resist being overlooked:

1. Transloading operations accelerate as the package-count in a given tonnage diminishes. (Fewer pieces, less handling.)

2. Transloading operations accelerate as the number of sorts in a given tonnage (known also as break-outs or marks, i.e., groups of packages to be re-consigned) decreases. (The fewer sorts to be made, the less sorting time required.)

3. Transloading operations accelerate, again in terms of weight, as the density of freight increases. (Packages of equal size can be handled in much the same time despite significant differences in weight.)

These observations are, in American practice, in any case, regarded as common knowledge throughout the less-than-truckload trucking industry, at all levels of the worker-supervisor-manager hierarchy, and shape both expectations of productivity to be achieved and critiques of past performance. More formally, of course, the factors named above have been reflected for decades in U.S. ratemaking and freight classification.

Quantification

Productivity records generated in the course of day-to-day business afford a readily-available data base for confirming and quantifying the three tendencies enumerated above.

Statistics generated within the author's companies suggest that, when transload productivity is being measured in conventional terms, i.e., pounds per worker-hour, the greatest of the three determinants is density. For example, all other factors can remain constant, while a doubling of density commonly results in something approaching a doubling in the weight transloaded by a given number of personnel in a given span of time.

With respect to the remaining factors---weight-per-package and weight-per-mark---statistics generated within the author's operations consistently demonstrate that variations in weight-per-package have greater impact on productivity than do variations in weight-per-mark, and that, as noted above, variations in neither factor are as influential as variations in density.

Thus, with the initial observations confirmed and loosely quantified, the challenge is to ascertain whether there is a fixed---or, at least, approximately fixed---relationship among the factors that actually governs the productivity potential in any quantity of freight being transloaded.
Modeling

Early experiments with the data were inconclusive. It was only over time that it was recognized that some variables other than those under study were powerfully affecting what had been regarded as an acceptably homogeneous universe:

1. **Mark integrity and sequentiality:** The degree to which the inbound load conforms to the sorts to be made for re-loading. Some shippers are able to provide loads in which the integrity of marks (sub-consignments) is maintained, and a few shippers can even provide a high degree of conformity to the sequence in which the freight is to be re-loaded. More commonly, however, the inbound loading encountered is somewhat random.

2. **Document integrity:** Conformity of shipping documents with cargo. Not only are overages and shortages commonplace, but frequently the various documents pertinent to a load being received are inconsistent among themselves; freightbills disagree with bills of lading and/or manifests. Each reconciliation delays the transload process, in some recorded instances exceeding the time required to perform the physical operation.

3. **Package quality:** Adequacy of package construction and degree of uniformity. Merchandisers of so-called "promotional" goods are notorious for shipping product in containers that collapse during transit or otherwise fail to protect the contents from generally-accepted rigors of transportation. Moreover, departures from uniform shape rapidly diminish transloading speed. [17/]

Because these three variables dictate to so large a degree the productivity potential in a given load of freight, and because no means of assigning to them an objective index has been found, there is the temptation to abandon the search for a model interrelating the three factors originally observed---weight-per-package, weight-per-mark, and density.

What has encouraged us to continue the search---and invite wider participation---is the fact that wherever the second echelon variables remain constant, a surprisingly fixed relationship among the three originally identified does begin to emerge. (Table D)

It is this fact that prompts us to put forward the following concept.

The Model

The examination of data from almost 2,000 inbound loads, destined for more than 35,000 sub-consignees, and weighing more than 30,000,000 pounds (13,636,364 kg) suggests that the relationships among weight-per-package, weight-per-mark, and density, aggregated
to reflect their impact on transload productivity, can be expressed as

\[
\frac{(p^{1/2})(m^{1/3})}{d} = C
\]

where \( p \) equals weight-per-package, \( m \) equals weight-per-mark, \( d \) is the density in terms of decimalized National Motor Freight Classification 18/, and \( C \) is hundredweight handled per worker-hour.

For example, for Shipper 322 for 1986, \( p \) equals 20.0; \( m \) equals 1,412; and \( d \) equals .90. Thus

\[
\frac{(20.0^{1/2})(1,412^{1/3})}{.90} = 55.77, \text{ or } 5,577 \text{ lb/worker-hour}
\]

In this case, the year's actual production for the shipper was 5,506 pounds per hour, i.e., within 1.2% of the 5,577 predicted by the model.

In broad application, however as Table D demonstrates, the proposed model only suggests the general level of productivity that can be expected. This is in large measure because of the unquantified variables noted above, plus perhaps others yet to be discovered.

What is notable, however, is that for the traffic of any one particular shipper the model can be adjusted to become a useful indicator of changes in weight-per-package, weight per assortment, or average density, accounting for increases and decreases in handling productivity.

CONCLUSION

Until the second-echelon variables identified above—mark integrity and sequentiality, document integrity, and package quality—can be indexed to quantify their impact on the transload process, the proposed model is incapable of predicting transload productivity on traffic yet to be received.

Nonetheless, the frequency with which the model does approximate actual results on a particular stream of traffic encourages continued development of the concept. Moreover, the model has been found to be useful in accounting for productivity changes experienced in traffic already handled. 19/

There seems little question that development of a working model that yields not only objective performance measurement but also true predictive capability would represent a substantial break-through in management of the type of traffic often found in Just-in-Time operations.
1. In the market-driven economies of the world, fashion merchandise and popular music recordings sometimes approach the perishability of fresh fish. Furthermore, in markets influenced by television and other mass media, coordination of product arrival and advertising campaign is critical.

2. The author's operating companies perform what are known in the United States as "pool distribution," "break-bulk," or "cross-dock" services, i.e., receiving consolidated loads—predominantly of packaged consumer goods—typically with an aggregate weight per inbound load of 10,000 to 150,000 pounds (4,545 to 68,182 kg), and comprised of 150 to 3,000 cartons, to be sorted and re-shipped to 10 to 75 re-consignees. These re-consignees can be individual consumers, but ordinarily are retail stores or their wholesale. In any case, our companies normally execute the final handling and movement segment for which the manufacturer or merchandiser is responsible.


8. No clear definition of "small lot" has yet emerged, but Transportation in America (Note 5 above) encompasses all shipments rated under 10,000 pounds (4,545 kg) as "small".

9. Assisted only by handtruck or unpowered pallet-jack.

10. Productivity tends to be adversely affected when the inbound load from a single shipper falls substantially below 10,000 pounds (4,545 kg.)

11. In mechanized and automated operations, there may be no difference whatever in the time required to handle acceptable pieces of widely varying weights. In such operations, productivity is measured per piece rather than by weight.
12. See, for example, the publications of Rocky Mountain Tariff Bureau, P.O. Box 5746, Denver, Colorado 80217.


14. For convenience, the author's companies have gauged density not by actual measurement but by reference to the classification assigned. (See Note 13.) Classifications embody significant factors other than density, e.g., susceptibility to damage, attractiveness to theft, value, and risk to other lading. With certain exceptions, however, density tends to be the greatest determinant of classification. Convenience is afforded by the fact that the classification of any commodity is readily available. In the NMFC nomenclature, the factor becomes inverted, i.e., the higher the density, the lower the NMFC number.

15. Even in the manual operations considered here.

16. See Tables A, B, and C.

17. To be handled efficiently in handtrucked operations, packages need not be uniform as to size, but only as to shape, rectilinearity giving rise to ease of stacking and re-loading.

18. For purposes of this study, the NMFC has been decimalized: Class 100 = 1.00; Class 85 = .85; etc.

19. A significant change in any of the primary variables under study here will, almost without exception, be reflected in a productivity change from the norm experienced with a particular shipper's traffic. (See Tables A, B, and C.)

ABOUT THE AUTHOR

John J. Mathews is chief executive and controlling shareholder in three trucking, warehousing, and freight distribution firms in the U.S. Pacific Northwest. He is Vice-President and a member of the Executive Committee of American Trucking Associations, and is a present or past board member of more than a dozen corporations, industry groups, and public bodies. He frequently serves as a spokesman for trucking interests, and has delivered technical papers in both the U.S. and abroad.
TABLE A

EFFECT of WEIGHT per PACKAGE on HANDLING PRODUCTIVITY

<table>
<thead>
<tr>
<th>Average Weight per Package (in U.S. pounds)</th>
<th>Weight Actually Handled per Worker-Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2,000</td>
</tr>
<tr>
<td>20</td>
<td>4,000</td>
</tr>
<tr>
<td>30</td>
<td>6,000</td>
</tr>
<tr>
<td>40</td>
<td>8,000</td>
</tr>
</tbody>
</table>
EFFECT of ASSORTMENT WEIGHT on HANDLING PRODUCTIVITY

TABLE B

[Graph showing the relationship between average re-shipment weight and weight actually handled per worker-hour]

Average Re-Shipment Weight (in U.S. pounds)

Weight Actually Handled per Worker-Hour
TABLE C

EFFECT of DENSITY on HANDLING PRODUCTIVITY

Weight Actually Handled per Worker-Hour

National Motor Freight Classification (as an inverse index to density)
SUCCESS of MODEL in PREDICTING PRODUCTIVITY*
Quarter-by-Quarter, 1985-86

*Measured in U.S. pounds per labor-hour.

Dashed lines represent deviations for ten-member groups as a whole. Shaded areas represent deviations for individual group members.

TABLE D
IMPLEMENTATION OF MODERN MANAGEMENT STRUCTURE AND INFORMATION TECHNOLOGIES IN THE EUROPEAN ROAD TRANSPORT MARKET UNDER THE GUIDELINE OF THE COMMUNITY TRANSPORT POLICY - A THEORETICAL MODEL AND A RESEARCH AND DEVELOPMENT PROJECT FOR INTERNATIONAL FURNITURE REMOVALS BY EUROVAN AG

Mr. Horst-Hermann Binnenbruck, President of the Road Transport Committee of the REFA Bundesverband e.V.
Darmstadt, Germany
Implementation of modern management structure and information technologies in the European road transport market under the guideline of the Community transport policy - a theoretical model and a research and development project for international furniture removals by EUROVAN AG

Horst-Hermann Binnenbruck
President of the Road Transport Committee of the REFA-Bundesverband e.V., Darmstadt

GENERAL OBSERVATIONS, TENDENCIES AND PROBLEMS IN THE SECTOR OF GOODS TRANSPORT BY ROAD

Significant aspects of the recent evolution

Before considering the items, three aspects may arise:

1. International goods transports by road are still in expansion and grow faster than foreign trade. But there is a qualitative changing interior of the transport demand never been seen before, as a strong challenge to the transport management.

2. The general reduction of working hours sets adaptation problems over all and pushes constraints to rationalize not only production and sales departments, but also wareholdings and transport inputs. Such a evolution assists the concentration of producing and supplying of goods, and the small and medium-sized road haulage has to go into a process of structural adaptation, immediately.

3. There is a widespread influence of data communication and data processing technologies in the whole industry to use their assets for monitoring the flows of materials, products and sales informations from the place of the producer to the place of the consumer, completely. This impact promotes the input of more transport capacity on own account and reduces the employment of transport capacity in hire and reward.

All these tendencies are going to involve the factor "time" as a very stressed quantity in the logistic systems.
As the logistic development grows, individual timetables for carry out and delivery of goods expand more and more on the sides of the shippers and suppliers, especially in the fields of road transport whose lorries and trucks have been always needed for operations. As well in the sector of short-haul logistics as in the international long distance haulage, the operations have to be taken as little time as possible.

The acceleration of the flows of goods throughout a slowly growing economy in Europe, open to the neighbouring economic zones, will require more vigilance by trade organisation, but not in order to try to modify national transport and foreign trade policies or interventions, rather than to develop new mechanisms at the level of Europe as a whole.

The challenge of the transport demand

These general tendencies seem to take the time requirements as a tension for the road haulage to search new, better ways of organizing transport utilization. Delivery on time is on the top of the services offered by various sectors of international road transport operators including the direct door-to-door-delivering for all of private householders which is increasing rapidly (see schema 1 on this page).

Schema 1: Evaluation of the advantages of the services offered by various sectors of international road haulage (in % of replies given by 461 hauliers in 24 European countries)

<table>
<thead>
<tr>
<th>Service criteria</th>
<th>Road hauliers Transport Commissioners Forwarding Agents</th>
<th>Transport on own account</th>
<th>Combined Transport (Road/Road, containers, Rail/Road)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery on time</td>
<td>99%</td>
<td>85%</td>
<td>85%</td>
</tr>
<tr>
<td>Transport prices</td>
<td>66%</td>
<td>75%</td>
<td>72%</td>
</tr>
<tr>
<td>Speed</td>
<td>75%</td>
<td>80%</td>
<td>65%</td>
</tr>
<tr>
<td>Suitable Vehicles</td>
<td>58%</td>
<td>60%</td>
<td>65%</td>
</tr>
<tr>
<td>Rolling stocks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No transshipments</td>
<td>71%</td>
<td>77%</td>
<td>70%</td>
</tr>
<tr>
<td>No fixed timetables</td>
<td>55%</td>
<td>54%</td>
<td>52%</td>
</tr>
<tr>
<td>Safety</td>
<td>67%</td>
<td>60%</td>
<td>67%</td>
</tr>
</tbody>
</table>
It is clear what the topic of "just-in-time-transport" really means: the time needed to complete the delivery task has to be minimized. Just-in-time-transport should become the normal case of logistic service, since the time intervals of providing the customers are going shorter and shorter, and there is no difference between the national and international transportation, and also no influence to hinder this evolution of demand quality.

Consequences of the transport demand evolution

To realise the time claims of the transport demand it seems to be necessary to consolidate the base of the recent system of information exchanging which is normally used by the actors.

The recently used technologies like phone, telex or teletex seem to be not sufficient enough to fulfil all the time requirements of the different sides of logistic partnership. They cannot couple up directly the informations handled by data processing or prepared for data stocking and data transformation. But this is needed to set up the base of logistic controlling which is evident for a real time monitoring of material and information flows.

At least, the usually introduced information technologies seem to be too expensive in comparison with modern electronic data transfer, too susceptible to individual mistakes, and too slow in case of automatical data captures.

The natural consequence of such a situation can only be to try to link all of the logistic partizipants like hauliers, forwarding agents, transport commissionars, shippers or customers into a workable communication system which is able to open the simple utilization of the modern information technologies.

But that means, really, that the co-operation between companies have got to be the most important principle.

Indeed, I think, that we must take all attention to the possibilities of co-operating in the fields of transports. It is consequently the best starting point to give supports to all initiatives by which the co-operation idea is even promoted. To organise the best utilization of the time budgets available in the fields of transports, all logistic partizipants have to exchange their time instructions in good time, and for that the international interchanging of informations and data should be not more a untackled problem.

THE INITIATIVE OF IMPLEMENTATION OF TELECOMMUNICATION INTO THE FIELDS OF INTERNATIONAL ROAD TRANSPORT

Improving the co-operation efficiency

To tackle the logistic challenge and to get the connection to the market developement, the EUROVAN AG has decided to initiate the
implementation of telecommunication into her own coordinating system. What does that mean? Who is EUROVAN AG?

Co-operation by cartel

EUROVAN AG is the European co-operating group of 76 forwarders and transport operators who operate in 16 countries of Europe with their own vehicles. It is a joint-stock company. The shareholders are the members themselves. The co-operation system is privately regulated by so-called "Bye Laws", based on the joint-venture contract.

This private regulation determines that all of the members have to announce each international removal to the central bureau for registration into the coordinating system. The central bureau is seattled at Rotterdam and leads the coordination of the co-operating EUROVAN-members. It clears the best routes and timetables for transportations on road, and coordinates the orders into an optimal trip schedule, always by an intense communication with those firms who are specialized and preferred for executing such an optimized international transport.

The central service contains not only trip coordinating, but also assurances in all of European countries. The accounting of prices among the members is in accordance to the antitrust and competition legislation of the different European countries.

Market representation and marketing effects

The aims of the EUROVAN-system consider a squeezing of costs in preparing and executing international transports, and also a better covering of the customer's requirements as a matter of urgency as follows:

1. empty running in furniture removals should be avoided
2. optimal planning of trips and routes should be achieved
3. the yield of vehicle turnaround and the distribution of journey should be improved.

The benefits of the alliance lie in the common market representation and in some marketing effects which found a commercial and technical strength of capability to organise road transport trips perfectly.

At present time, the EUROVAN-group is only working together on the field of furniture removals, but it is not excluded to extend the co-operation system into the general cargo business or bulk carriage. Therefore, the conception of this international cartel is of some essential importance as a practical experiment and as an exemplary model for the rest of road haulage.

Recent performance

Yearly, round about 8,000 transport jobs are announced to the coordinating centre at Rotterdam, normally by telex. There, the
orders are going to be cleared concerning the routes, delivery time, transport capacity needed, less-than-truckload-operations, pre- or posttiming of loading, legal regulation etc. After this clearing, the optimized international trips will proposed to 3 or 4 companies who could be able to make the proposal completely. These information are going by phone or telex. If a EUROVAN-member accepts a proposal, he recalls it to the central bureau on the same way by phone or telex.

In face of modern communication system, this procedere is very awkward, expensive and full of little personal and technical mistakes which cannot been lost. The recent system of information exchanging is rather underdeveloped and restricted in regards of the time requirements in the transport demand.

Future system

For the next future, the booking of orders and the coordination procedere of international trips shall take off into a framework of an international telecommunication mail-box system which is based upon the data transformation infrastructure of public services. It shall be the easy beginning of a computer-based information clearing and interchanging system which are performable to support the individual disposals of the single company (see schema 2 as follows):

Schema 2: Rough Schedule of the EUROVAN-information system

The preliminary scheme intends a simple formular for the participants of the information and coordinating system like the usual master plan for interchanging relevant data of freight exchanges between organised, interested actors (see the scheduled masks on the next page).

Take a EUROVAN-member a trip proposal out of the information system, he must use the booking mask and has to confirmate the order of taking off to the central bureau by announcing this confirmation into the set of booking data. The circle of clearing and coordinating the transport co-operation disposals is closed.

The logic of processing the information flows

The planning and processing of this information exchange is very simple for the users. They have only to follow the prepared map
of the menus showing in the graphic design on this page.

All participants need only a personal computer or a normal BTX-terminal, and, if wanted, a printer to share the electronic tele-communicated information meals.

The network for the transformation of the information is the public phone network of the post offices. At starting, the central bureau take off the coordinating services still without a special computer base. Regarding to the very different situations of the structure of the road haulage in the European countries, it is not reasonable to set up a computer performance with an integrated quality in the middle of the coordinating system. This component is the subject of another plan, a research and develope-
ment project which has the intention to promote the co-operation in the fields of road transportation and which must tackle also the problems of the small and medium-sized structure of the road haulage.

PLAN OF MORE INTERACTIVE COMMUNICATION

IMPROVING THE MANAGEMENT STRUCTURE OF THE ROAD HAULAGE AND SUPPORTING THE CO-OPERATION BASE BY COMPUTERIZATION OF THE TRANSPORT DISPOSITIONS

Small business is of problematic, but indispensable nature

The efficiency of the modern communication technologies is not always attainable in the whole section of road transport. There are many serious opinions articulating that the advantages of co-operation and communication systems can only be tackled by the larger companies who handle a great deal of transport orders and who have the connections to the shipper for keeping the benefits in the long run. Small firms with small business and a small capacity frame seem not to be able to get the same benefits than the larger ones.

I do think so. There are lots of advantages for the small businesses companies, and they can also gain the positive effects of using information technologies. They have an original claim of partizipating the modern communication system, because the transport users need the small, flexible operators, their existence is indispensable. The question, I think, is not entitled if there is a future of the small and medium-sized hauliers, but how to get the initiatives for creating a new structure of applying the modern technologies.

The possibilities of interactive communicating systems

In the general state of being, three effective feasibilities are put forward to build and set up workable electronic data communication systems in the world of logistics:

1. Alternative I: all of the partizipants use the same configuration of hard- and software components, so that data exchange and information interchange can been captured and transferred on the base of a compatible network with unified modalities.

2. Alternative 2: all of the partizipants use an interlinking technology like "front-end-processor" installed before the own inhouse-system, so that data and information flows can enter or depart on the equalised base of processing.

3. Alternative 3: All of the partizipants use the adapted services of a central and neutral communication house based upon the public infrastructure of the post offices. Different structure of data and information flows can always been handle by clearing or preparing the sets of data or special information sending to logistic service positions. By data and information clearing the management of firms can also be supported without any competition.
Scheme 3: Comparison between the recent and the future system of data and information exchange of EUROVAN-registrated members

**Today**
- **Partizipant**
  - Announcing
  - Inquiries
  - Booking
- **Transfer**
  - by phone
  - or telex
- **Central Bureau**
  - Manual capture and control of information
  - Manual disposition
- **Partizipant**
  - Booking
  - Confirmation

**Tomorrow**
- **Partizipant**
  - Announcing
  - Inquiries
  - Booking
- **Data transfer by telecommunication**
  - Computer-based mailbox
  - Manual disposition
  - Computerized capture and control of information and proposals
Schema 4: Global configuration of an interactive communication structure for the road haulage in logistics

Frame: A clearing house system based on telecommunication offers the possibilities of management services and opens the supports to a better organization of road transports.
claim. Therefore, it seems to be opportune to involve plans for discussion the best way of finding the promotion to realise a global system of adapting the modern communication technologies by clearing house system. (See schedule on the next page). This system should be built up in co-operation with all of companies whose matter of concern is to get the efficiency of a better transport organization by freight-or capacity- or service-exchange.

The main task would be to found the corporation for the private clearing services and management supports at the stage of international transport interests. To get a starting point, the EUROVAN AG has prospected to promote such a plan at European level.

This plan of a research and development project comes out of the analysis results that the management structure of the most companies of road haulage is full of weak spots (see schema 5).

**Schema 5: Locating weak spots in the transport management of road haulage with international activity - for example: Germany**

<table>
<thead>
<tr>
<th>Executives</th>
<th>Management</th>
<th>Equipment Management</th>
<th>Production</th>
<th>Transport</th>
<th>Transshipment</th>
<th>Finance</th>
<th>Account</th>
<th>Personal</th>
<th>Sales</th>
<th>Marketing</th>
<th>Figures</th>
<th>Administration</th>
<th>Data Processing</th>
<th>Communication Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies</td>
<td>c</td>
<td>mni</td>
<td>s</td>
<td>s</td>
<td>s</td>
<td>s</td>
<td>mni</td>
<td>mni</td>
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<td>mni</td>
<td>mni</td>
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</tr>
<tr>
<td>Planning</td>
<td>c</td>
<td>mni</td>
<td>ni</td>
<td>c</td>
<td>c</td>
<td>c</td>
<td>mni</td>
<td>mni</td>
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<td>Organization</td>
<td>c</td>
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<td>s</td>
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<td>mni</td>
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<td>Personal Management</td>
<td>s</td>
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<td>s</td>
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<td>ni</td>
<td>mni</td>
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<tr>
<td>Control</td>
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<td>mni</td>
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<tr>
<td>Information</td>
<td>s</td>
<td>ni</td>
<td>s</td>
<td>c</td>
<td>ni</td>
<td>mni</td>
<td>mni</td>
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<td>mni</td>
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<td>mni</td>
<td>mni</td>
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</tbody>
</table>

\[c=conception needed \quad s= satisfactory regarding requirements \quad ni= needs improving \quad mni= major needs for improving\]

The management is not fit in all executive fields of transport undertakings. The weaknesses assume greater importance when the carriage of goods forms part of a transport chain and when decisions concerning the rationalization of production or operating
processes are accompanied by other decisions relating to the logistic innovations or conceptions of the clients. Under this perspective a general strategy seems necessary to promote the qualification of the transport management. EUROVAN AG has asked the European Commission of the Community for a financial assistance to improve the management structure by a development of better using the communication technologies. This research program contains following objectives and considerations:

Objectives: - to link the specialised transport demands and the supplies of international goods transports by road into a clearing framework supported by privately arranged communication system at European level, considered and tested in the field of furniture removals between "EUROVAN"-members and other system participants on a computer-based mailbox stage, respectively in the frame of the telecommunication technologies.

- to facilitate the dispatching and coordinating of international transport operating by jobbed informations and data interchanges.

- to improve the internal management structure of the firms by introducing and using new methods of planning and routing of capacity using of the truck-fleets in short-haul logistic and in long distance transport sector.

- to standardize some basic elements of interlink-communication-system at European level in order to make systems accessible to all road transport users of international trade.

Promotions: - Co-operation in free responsibility by exhausting the positive effects of optimized international trips

- Time saving on part of transport operators by putting faster services

- Contribution to saving energy

- Low costs management strategies

- Integrations of mobile communication terminal into optional network

- Open the transport market for the communication technologies

The pilot project of EUROVAN AG consists several steps into a systematical management structure of the individual world of the heterogeneous structure of road haulage. The past and recent successful co-operation between the EUROVAN-members allows to believe in such a system which helps the companies to be profitable.
IMPROVED ROAD STANDARD AND BUSINESS EFFICIENCY
Mr Johnny Lindström
University of Gothenburg
School of Economics
IMPROVED ROAD STANDARD AND BUSINESS EFFICIENCY
Johnny Lindström

Abstract

The interest of industry in rationalization of material flow has increased. In this study this interest is shown to lead to a.o. that guaranteed arrival times are the decisive transport-economic factor.

The potential of reducing capital tied up in Swedish industry is essential. A reduction in lead time of only one (1) working day releases 3.2 billion SEK or approximately 4 % of the tied up capital. It is quite feasible that reduction of lead time of one day can be achieved with an improved road standard. One basis is that it is the risk of delay in the goods transport that is decisive.

As the administrative systems develop, the operational elements (a.o. transportation) will be linked more closely together. The greatest rationalization gains through reduced lead times are also achieved with better administrative systems. One of the results will be that the safeguards will for the most part disappear. The effects of road standard improvement can probably contribute to a reduction in tied up capital of more than one day.
IMPROVED ROAD STANDARD AND BUSINESS EFFICIENCY

Johnny Lindström *)

BACKGROUND AND AIM

The development of transportation and priority for road projects

The society is changing rapidly in many respects. In industry, increased specialization, large scale operation and internationalization can be distinguished as a clear trend through the last decades. Physical distribution plays an increasingly important part in these changes.

Increased goods transportation in Sweden is characterized by the fact that over the last 20 years the volume transported by road has quadrupled while the corresponding value for railway transportation is less than double.

The aim of the study

In recent years the interest of industry in rationalization of material flow has increased. Accompanying this there has been a discussion as to whether an improved road standard would contribute to higher efficiency in the industry. The basis of this study was to illustrate in which way road standard can be expected to be of importance for companies material flow rationalization.

A further aim of the study has been to illustrate the economic impact of lead times changes in vertical market systems.

Working method

Development in the field of material flow has been analyzed through text study and discussions with leading people in industry. Rationalization potential has also been assessed from official statistics based on industry’s tied up capital.

DEVELOPMENT TRENDS IN INDUSTRY

Means of rationalization

The last decades have been characterized by the fact that the means of improving companies’ profitability have changed from the basic aim of cost rationalization to an increased orientation towards material flow. This has its origin in an overall view of the distribution chain and its control, i.e. material administration (MA) of business logistics (1). The reduction of capital tied up through the increased turnover of tied up capital has grown in importance as a means of improved efficiency.

A reason for this change has been the more widely use of return on assets (ROA) as a main tool for management control instead of the traditional profit control approach.

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VTI MEDDELANDE 537A
The Just-in-time concept

An approach that has come more to the fore in recent years is the concept known as just-in time (JIT) (2). The JIT approach is not limited to production in just one's own company but covers the whole vertical flow. One way to look on the JIT-approach is to study the way of eliminating risks for disturbancies in the material flow.

![Fig. 1. Material flow in one manufacturing unit.](image)

The "old way" of reducing these risks has been to allocate buffer stocks (see fig. 1). These stocks has later on been reduced or eliminated. Instead has the industry worked out the technique of using an "intra-flow" approach. This could be designed by line production or by using effective system for internal production control.

This development has than given the situation described in figure 2.

![Fig. 2. Material flow in manufacturing units.](image)

In this approach the emphasis has been on reducing the risk of disturbancies between the companies. The first step of reducing the risk was to build up stocks. Now the primary interest will be to use an "inter-flow" approach.
The JIT-approach and transportation

The impact this change of systems will have on the transports is shown in figures 3 and 4.

Fig. 3. Schematic description of the flow between two manufacturing units.

The figure 3 will in a schematic way show the processes between two production units. As could be seen in the figure the flow of goods will pass at least two stocks and several types of handling processes. In many cases will also terminal stops and terminal handling be a part of the transport. In a JIT-approach the handling will be reduced, e.g. quality control process will be reduced because of a better cooperation between the seller and the buyer.

Fig. 4. Schematic description of the flow between two manufacturing units with a JIT-approach.

The new situation is described in figure 4. In the figure it could be seen that leadtime for the transportation perhaps will be a little shorter in absolute numbers.
The main difference from the figure 3 is, however, that the time for transportation relative to the total lead time is quite different. In a JIT-system the disturbances in the transportation will have an immediate effect on the total lead time. The main reasons for this is: (1) the time for transportation relative to the total leadtime is greater and (2) the slacks in the total leadtime is reduced (close) to zero.

The slacks mentioned above appear today everywhere in the material flow. The control systems are today under rapid improvement in the industry. This development will give the best contributions in the aspiration of reducing the total leadtime. This could be summarized as in figure 5.

![Diagram showing the potential leadtime in the material flow.](image)

**Fig. 5. The potential leadtime in the material flow.**

**RATIONALIZATION POTENTIAL**

**Transportation costs**

One way of describing transportation costs is to assess their share of the total price of the product. A cost calculation of more interest, however, should be obtained if all MA-related costs are studied instead. These often form a considerable share of the total price of the product.

A study of capital tied up in Swedish industry (3) shows that the total material flow costs in Sweden amounted to 85 billion SEK in 1980, of which external transportation accounted for 29 billion (34%). These figures could be related to the GNP as 18% resp. 6%. The study also shows that the total capital tied up in material flow can be calculated to be 286 billion SEK.

Transportation costs apparently play a minor part in relation to the total MA-costs. There is, therefore, probably only a limited possibility of influencing the total costs for a product by tackling the transportation costs. The relation should instead be that the transportation itself also influences the other MA-costs. A "more correct" means of rationalization could therefore perhaps be to increase the transportation costs and as a result reduce the other MA-costs even more.
Tied up capital

Of the above tied up capital in industry (286 billion SEK), 146 billion SEK was in goods. Table 1 below summarizes the distribution of this capital over different types of stock. The table also shows the mean turnover rate for certain stocks.

Table 1. Mean values of stocks and turnover rates in Sweden in 1980.
(Source: Ågren, 1983)

<table>
<thead>
<tr>
<th>Stock</th>
<th>Goods value</th>
<th>Turnover rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>billion SEK</td>
<td>times/year</td>
</tr>
<tr>
<td>Industry's</td>
<td></td>
<td>number of days</td>
</tr>
<tr>
<td>goods in</td>
<td>22.0</td>
<td>6.6</td>
</tr>
<tr>
<td>Industry's</td>
<td>28.0</td>
<td>10.4</td>
</tr>
<tr>
<td>products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wholesale</td>
<td>24.2</td>
<td>6.3</td>
</tr>
<tr>
<td>Retail</td>
<td>13.3</td>
<td>7.5</td>
</tr>
<tr>
<td>Subtotal</td>
<td>87.5</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>58.7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>146.2</td>
<td></td>
</tr>
</tbody>
</table>

Using the values in the table and the turnover rates, an assessment can be made of the effects of changes in flow times. The changes in turnover rate can themselves be caused by a number of factors. The greatest potential today is, as mentioned above, probably on the administrative side. As the administrative systems are developed, operational elements will play increasingly important parts. The potential for increasing turnover rates from the present position is estimated to be great. For this reason it is of interest to assess the amounts that can be released through increased turnover rates.

Table 1 shows four stock groups, together tying up approx. 87 billion SEK. A reduction in lead time for these of one (1) working day releases 3.2 billion SEK or approximately 4% of the tied up capital. The capital released can be presumed to be used for other productive investments in industry. At a return on investment the capital reduction for 1 working day in 1980 was equivalent to a saving of about 500 billion SEK per year. The calculations are, however, based on mean values, which are not directly applicable to single industries. To assess the relevance for individual industries, tests were carried out in associated industries.

The conclusion is that the value of the capital reduction of 3.2 thousand billion SEK (a cost saving of 500 billion per year) could be used as an approximate value for obtaining a reduction of 1 working day of lead time for each of the four stock types. It was used to achieve this lead time change should today primarily tackle the administrative systems. An assessment of rationalization potential through experience indicates that a lead time change of 1 day is too pessimistic an estimate. Shortened mean lead times of up to four or five days should not be impossible to achieve.
CAPITAL RATIONALIZATION AND ROAD STANDARD

The influence of road standard on industry

This research clearly indicates that development towards the JIT approach is proceeding rapidly. The effects of this will be shown in several ways, among them being higher transport frequency and smaller quantities per transport. The shorter lead times aimed at are also combined with measures for guaranteeing arrival time. All these measures put great demands on transport safety. By the beginning of the 1990's the approach should already be so widespread that transport disruption has a great effect on tied up capital. The very risk of such disruption means that the need for safeguards can be seen.

The calculation, detailed above, is based on the supposition that lead times in industry are shortened by one working day. Against the background of the aim of this study, the following question must be put, "Can a reduced lead time of one day be achieved with an improved road standard?" The answer to this question must be that it is quite feasible.

One basis is that it is the risk of delay in the goods transport that is decisive. The trend towards stock reduction leads moreover to the demand for quick, precise transportation increasing in future. Many companies centralize, e.g. their European stock in one place. This also influences the risk of delay because of road conditions, since the customers are still spread around and competition does not allow a level of service with a longer total supply time.

To summarize, the assessment is that the approximate values calculated are rather for cautious estimates than for high values. The effects of road standard improvement can, on average, probably contribute to a reduction in tied up capital of more than one day.

Road works priority

The risk of transport disruption occurring through road standard is not today estimated to be great since various forms of safeguard exist. As the administrative systems develop, however, the operational elements (a.o. transportation) will be linked more closely together. The greatest rationalization gains through reduced lead times are also achieved with better administrative systems. One of the results will be that the safeguards will for the most part disappear. In this situation even today's traffic disruptions present problems.

For example, a deterioration in road standard through reduced maintenance (including winter road maintenance) compared to today, would have a negative effect on tied up capital. The necessity of a uniform road standard over long distances has also been made clear. A short stretch of road of lower standard decides the choice of both vehicle (loading capability) and packaging. There can further be difficulties in time planning, i.e. the delay risk. New investment in the road network should therefore be systematically made in "weak links" in the first place.

The European interstate highway E6 is crossing Sweden along the west-coast. Its total length in Sweden is around 500 km. From south and 360 km north E6 has a good standard (mainly divided highway) except of 30 km long distance in the middle. To upgrade this "missing part" of
the E6 to divided highway would have cost approx. 350 billion SEK 1980. In comparison, it can be stated that the estimated annual cost reduction of 500 billion SEK in 1980 is equivalent to the investment for building approx. 46 kilometers of divided highway. In 1984 there were approx. 900 km of such roads in Sweden, with 60 km completed between 1980 and 1983.

Another type of improvement of importance for capital tied up in industry is the development of fixed links with Denmark. A published report (4) states the cost of building a bridge between Malmö and Copenhagen to be between 2.86 and 4.7 billion SEK, depending on the type of bridge. If these amounts are calculated to the 1980 level, the approximate value of 3.2 billion SEK in 1980, calculated above, falls exactly between the cheapest and the most expensive bridge.

A further effect of the reorientation taking place may be an increase in traffic intensity through more closely scheduled transports. This in turn puts demands on guaranteed passability on tight stretches such as through roads in densely built-up areas. This type of situation, with uncertain passability also leads to a "need for compensation" in the form of increased buffer stocking.

In future we can assume a higher level of product processing in our country. This will mean high capital value in products and accompanying high costs for tied up capital. Furthermore, production is often in several stages in a number of places, which means that capital tied up through uncertain delivery can accumulate to relatively long times. The apparently marginal effect of road standard on tied up capital in industry today, will, thus, in the not too distant future, become an important factor.

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This article is a shorten version of: Johnny Lindström, Vägstandard och näringslivets lönsamhet, Gothenburg Chamber of Commerce 1984 (In Swedish).

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SESSION II: ORGANISATION AND INFORMATICS
THE PLACE OF ROAD TRANSPORT IN JUST-IN-TIME LOGISTICS
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University of Aix-Marseille, France
The development of logistics over recent years in French industry has responded to a dual concern on the part of firms to adjust to the constraints of differentiation in demand and to control the changes thus imposed in production systems.

Indeed logistics, the technology of controlling flows of goods by means of a real time flow of information, offers a tool which is perfectly adapted to a context of competitiveness geared to "just in time" production: ability to meet ever shorter delivery dates offers an extra advantage to industrialists engaged in fierce competition. The result is the development of a mode of production geared to continuous, unbroken flows of goods (the "just in time" concept, kanban ....).

Logistics has a dimension which involves not just adjustment to the differentiation of demand, but also anticipation of demand. Piloted by the output of real time information downstream of production, it engenders an overall cohesion of production systems in the face of flexibility in every direction (differentiation of products and production conditions).

for the monitoring of production and distribution operations, even supply operations (cf the development of the bar code in industry).
In this context industrial firms today tend to integrate transport into their production systems and to demand a higher standard of quality in the services offered: meeting delivery dates, flexibility in distribution frequencies, real time transmission of progress information on transport operations.

Since production systems are unable today to achieve a simultaneous increase in product movement and production speeds (= control of production flows), this role may be delegated to transport because it is suitably placed to regulate flows of goods according to the needs of industrial logistics.

1. Logistics, the key to controlling a "just in time" production system

The development of logistics in French firms responds to this dual constraint of adjustment to and anticipation of demand:

1) The shortening of delivery dates is forcing firms to produce "just in time" by single unit process feed\(^1\).

There is thus a need to adjust production cycles down to the level of commercial cycles. But what do we find here? While it may be impossible to predict the quantities of products which will be in demand (excessive randomisation of the market), it is possible to gain a better appreciation of sales frequencies: taking as a reference point the time interval between two sales of a single product, it seems probable that this interval may be repeated (with downward or upward variations).

\(^1\) Only those parts are fed into the production process which are needed for the assembly of the products ordered.
This interval separating the two sales is then regarded as the imperative delivery date. This method has a forecasting aspect, but it is corrected in that by logistics: by means of real time feedback from demand logistics provides downstream pilotage, enabling the production cycle to adjust to fluctuations in delivery dates.

2) In its constant effort of adjustment to delivery dates logistics must, in order to lower the production cycle to the level of the commercial cycle, bring about cohesion in the operations or phases making up the product cycle. To this end it sets circulation standards (grouping of products with similar delivery dates). In so doing, it coordinates productive operations (their activity rhythms) by means of a continuity of product circulation (achieved by product grouping).

The cohesion of production operations (constructed around the continuity of product circulation) constitutes the essential tool of delivery date anticipation (speed of adjustment of the production system).

From this point of view anticipation downstream does not diminish the effects of diversity in production but brings about the integration of that diversity in the continuity of production cycles.

Logistics establishes simultaneity between information flows and production flows by adjusting product circulation speed and production speed.

This is why we define logistics as the key to regulating production systems by the anticipation of fluctuating demand:

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1 By production cycle we mean the totality of phases or sequences necessary for the design, production and handling of products.
1. It maintains, even increases, the degree of repetitivity of final demand by grouping products according to delivery dates.

2. It establishes simultaneity between demand and the production process by rearranging the operations of the production system.

Logistics thus introduces a new form of anticipation different to that based on the reduction of variety upstream of the production systems. Developing from a downstream piloting process, it rearranges the production system in its entirety (in the transverse direction) and constructs a continuity of production cycles commensurate with the diversity in demand.

This new mode of anticipating demand has two consequences:
- segmentation of production systems based on series of operations.
- efficiency of production systems in terms of controlling the availability of production capacities.

1.1 The segmentation of production based on series of operations

Confronted with a gradual destabilisation (depending on economic sectors) of production segmentation with production series unable to respond to the logistical dictate of a reduction in production cycles, it becomes necessary to propose a framework of analysis which can guide us through the present complexity of changes in industry.

For this reason we propose the following framework based on the adjustment of production to the product grouping set by circulation logic (logistics).

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1 which are characterised by a technological explosion (development of information technology and electronics in the workshop), raising questions for production management.
<table>
<thead>
<tr>
<th>Logistical chain</th>
<th>Production segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- physical circulation of the products</td>
<td>- production flow</td>
</tr>
<tr>
<td>- circulation standards</td>
<td>- efficiency standards</td>
</tr>
<tr>
<td>- grouping of products by delivery dates</td>
<td>- composite lots of different products</td>
</tr>
<tr>
<td>- introduces cohesion into production operations</td>
<td>- differentiated production technologies</td>
</tr>
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</table>

**OBJECTIVE =**

Reduction of production cycles by developing circulation conditions in production.

Indeed logistics, by setting circulation standards (grouping of products by delivery dates), compels the production segments to bring their operations into cohesion on the basis of **homogeneous conditions of product circulation**. As it has to deal with composite lots of different products by a variety of technologies (the diversity of products to be dealt with leads to a mixing of distinct production lines, hence to the grouping of different technologies on a single production line), the only alternative open to production is then to adjust production capacities to workloads (heterogeneous groups of products). In this situation, what criterion can be applied in the segmentation of production, in other words the homogenisation of production into autonomous segments?
We propose the following hypothesis:

The arrangement of production by circulation logic results in segmentation based on the degree of availability of production capacities (homogeneous conditions of product circulation).

The development of "just in time" production (consequence of a considerable shortening of delivery dates) gives rise to the systematisation (in the firms concerned) of single unit process feed. This involves a desynchronisation between operations and processes (absence of any fixed assignment of operations to processes). Two situations may then arise, in which pride of place is given:

- either to a reduction in production cycles (single unit feed), to the detriment of any stability in the process (= links between processes);

- or to the rate of process utilisation, to the detriment of any medium-term adjustment in the process.

In order to combine reduction of production cycles with rate of process utilisation, it is necessary to reconnect operations and processes.

Once it is no longer possible to lump products together in homogeneous production series (same production constraints), it becomes vital to lump operations together in homogeneous series (same circulation constraints).
1.2 Controlling the availability of production capacities, a criterion of production efficiency

The aim is to group products by operation in accordance with the principle of similar delivery date, which involves a certain mixing of product cycles for each type of operation, because products belonging to different production series are, according to this principle, assigned to common operations (cf table).

Each operation or type of operation is then linked to a certain number of processes in such a way as to combine this lumping together of goods flows with single unit feed. Thus families of processes are set up for each type of operation.

The synthesis of these two movements oriented towards products and processes consists in grouping them around series of operations, coordinating the demand for stability in links between processes with that for a reduction in production cycles.

<table>
<thead>
<tr>
<th>PARTS</th>
<th>OPERATIONS</th>
<th>WORKSTATIONS</th>
</tr>
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<td>1</td>
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<tr>
<td>2</td>
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<tr>
<td>3</td>
<td>3</td>
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<tr>
<td>4</td>
<td>4</td>
<td>4</td>
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</tbody>
</table>

SYSTEM SETTING UP SERIES OF OPERATIONS ON THE BASIS OF THE UNITS / WORKSTATIONS COMBINATION
In other words the grouping of processes (or workstations) according to type of operation makes it possible continuously to adjust the availability of production capacities to workloads (products grouped by delivery date), thanks to:

- a reduction in the number of processes (or workstations) used, because they are more interchangeable.

- an increase in the utilisation rate or loading rate of each of these processes.

From this point of view, since the volume of production is determined by what takes place downstream (logistics), the main concern is to reduce the amount of capital tied up in the production phase by grouping processes or workstations in families.

The logistical control of industrial flows (= arrangements for grouping products in circulation) brings about a change in transport in terms of the management of the loading units (pallets, containers) in circulation available for the grouping of products according to delivery deadline.

2. Road transport within the logistical dynamic

The success of an industrial process organised on a "just in time" basis is directly linked to the reliability of the transport chain, also organised according to the "just in time" criterion, which supplies it (with components and materials) and distributes its output (delivery of finished products), to the extent that storage capacity upstream and downstream of production are minimised, even eliminated. This leads us to present a key observation:

1 Characteristic of a flexible system of production geared to the simultaneous production of several different products.
A classical statement on transport is that it is a service which cannot be stocked and which must be produced and consumed at the same time. In fact the "just in time" production model tends to promote the elimination of any form of storage. Thus what transport has always regarded as a penalising constraint becomes one of the major objectives of the total distribution-production machine. This convergence of fact highlights the astonishing (too long ignored) modernity of the transport sector and its compatibility with the other sectors of activity.

Transport, road transport in particular, by working its way into the very heart of the processes of production and distribution of goods offers scope, if it is able to offer unstinting efficiency (in cost and quality of service), for exploiting the highly innovative organisational and industrial option of "just in time" production.

2.1 The objectives of road transport faced with the challenge of real time production concepts

Road transport, in its "pure" form or in its mixed form as combined road/rail transport, has to enable industrial logistics to achieve in an optimum manner two conflicting objectives:

- **continuity** in the flow of products in order at all costs to avoid a break which would be penalised downstream by a cascade of excess costs arising from the immobilisation of all the production capacities in the chain;

- **fluidity** in the disposal of products in order to reduce to a strict minimum the level (and cost) of excess capacity (stocks, transport, production capacity etc), which nevertheless continue to be required for the "just in time" process to function.
Faced with the challenge of real time production, which we would prefer to describe as zero time production, road transport must of necessity achieve the following three priority objectives:

- **Punctuality** of transport: to make deliveries to the receiving plant, which is operating at zero stock levels, neither too late (production halted) nor too early (no goods inwards stockpiling facilities) and, for the same reasons, to get products moving as soon as they leave the line;

- **Rapidity** of transport (to minimise capital tied up in stocks of high-value goods);

- **Reliability** of transport (the cost of interruptions in the supply of a "just in time" production line bears no comparison with the cost of a transport service, even when it is of very high quality, hence costly). From this point of view it seems to us that combined road/rail technology offers scope for achieving the highest possible degree of reliability by combining the advantages of the two modes of transport, rail (safety, keeping to a timetable, exact times of arrival and departure known, speed) and road (door-to-door, even workstation-to-workstation), and the specific nature of combined transport (separation between the carrying vehicle and the container, regarded as a mobile appliance for transport, handling and storage capable of being positioned in direct contact with assembly or packaging lines).

### 2.2 The investment necessary for road transport

The integration of road transport into "just in time" logistics involves it in very considerable specific investment.
The transport carrier must, in our view, undertake massive investment\(^1\) in the computerisation of his entire transport chain to enable it to be integrated into the logistical networks, which are themselves highly automated, of his shippers. The systematic coding (by bar codes) of each package or loading unit makes it possible to direct them, to follow them and to locate them without delay, provided each link in the transport chain is properly equipped. Thus, by grafting an information chain onto the transport chain, the carrier can at any time detect an incident and warn the dispatching and/or receiving firm and/or his operations centre of it in real time, so that a rescue operation can be launched immediately. This means that forwarding and receiving stations, staging posts in transit and the trucks themselves must be equipped with means of receiving and transmitting and sometimes even processing data\(^2\). From this point of view there is no difference in principle between a flexible production system, automated and controlled upstream and downstream (integration of logistics and production organisation, cf §1 above), and a transport chain integrated by logistics into a "just in time" process.

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1 in data processing hardware, software and packages for the management of information relating to goods in circulation: organisation of trips for possible updating in real time, management of stocks, management of vehicle parks, management of information relating to the preparation and execution of transport operations etc.

2 In this connection, certain systems planned or already in operation show great promise:
- the LOCSTAR system for locating mobile units and for transmitting short messages by satellite, currently being developed by the Centre National d'Etudes Spatiales and the Centre de Productivité des Transports is set to enter service gradually at the end of this decade. It is comparable with the American system GEOSTAR, used in particular by the trucking firm RYDER, which has installed a terminal (in-cab computer + equipment for data transmission) on each of its long-distance road tractors (several thousand machines!) and at its seven hundred or so freight terminals, all of them linked to a coordination centre.
- another system, with greater message transmission capacity, is planned jointly by the European Space Agency and URBA 2000; it should go into experimental service in 1987 (6 trucks fitted).
- the cellular mobile telephone system RADIOCOM 2000, already in partial service, will cover 85% of French territory in 1990.
Just as important is the investment in freight terminals which the road haulage operator needs to undertake in order to cope under optimum conditions of cost and level of service with the "just in time" transport operations which will be entrusted to him. He can then take on:

- the grouping by delivery dates of items collected from suppliers and subcontractors, followed by their paced dispatch as full loads to the receiving plants "just in time". These loads are homogeneous since, although the grouped products are all different, they carry the same requirements in terms of the availability demanded by the consignee. The loading units chosen all tend to be pallets and/or containers or pallet containers and, conversely, the packagings for the items loaded must be scaled-down sub-assemblies dimensionally compatible with the pallets and containers.

- the reception of the items, then their distribution to workstations. The best developed example we know of is that of BUICK CITY (cf Annex 1).

2.3 Some disquieting aspects of the "just-in-time" concept for the future of road transport

Bearing in mind the scale of the financial commitment required of the road haulage operator if he is to take up the "just in time" challenge, we might ask a few questions on the future of road transport in this particular context.

- To what size must a company grow before it can put together and market a "just in time" transport service? Problems of know-how and investment capacity impose severe limits on the chances of small and medium-sized transport firms if they remain alone. In addition we know that industrial organisations operating by "just in time" methods are mainly high-volume shippers whose logistical decisions are taken at a high (national and, increasingly, European) level: would they not seek road haulage partners operating on a scale comparable with their own?¹.

¹ This affords opportunities to road haulage firms able to draw upon a national or European network and to combined transport operators if they are able correctly to interconnect the European rail networks and to coordinate the involvement of carriers located at the ends of the different routes.
- What kind of qualifications must the transport firm maintain? "Logistical" qualifications are still rare among transport operators ... 

We should like to end with two points:

. The competence and technical expertise of the transport operator are tending to become increasingly geared to the development of aptitudes in the management of an information system and a communications network which will pilot and follow the flow of goods in transit.

. The transition to transport supply conditions in which quality of service takes precedence over cost constitutes a major strategic reorientation for road haulage operators and will require a veritable cultural transformation in a sector known to be traditionalist in outlook - a transformation which, we believe, many will not be able to embark on.
ANNEX 1

Excerpt from No 5 (September 1984) of the Bulletin of the Directorate for Socio-Economic Research of the Quebec Transport Commission, article by Mr Serge Lebrun.

Since this article was written, the Leaseway Corporation has been bought by a transport operator from the south of the United States.

The LEASEWAY TRANSPORTATION CORPORATION of Cleveland is building a 150 000 sq ft highly automated terminal at Flint to serve Buick City, a new car-making complex planned by Buick Motors, a subsidiary of General Motors.

Buick City is an original, completely integrated complex for the manufacture and assembly of cars and has been designed for the production of the models Sabre from Buick and Delta 88 from Oldsmobile. These cars will be built in their entirety, from raw steel to finished product, starting in summer 1985.

According to Leaseway, three quarters of the parts required for the production of the cars will be transported via the new Flo-thru terminal.

The term "Flo-thru" denotes a continuous synchronised movement of parts: this type of movement is the trade mark of this installation. Thanks to equipment handling technology, the terminal will enable Buick to reduce its inventory, hence its costs, without compromising the quality of the finished product or the flexibility of its operations.

The Flo-thru terminal is designed to receive and dispatch parts for the assembly of cars and to deliver them to specific points in the assembly sequence according to need.

Leaseway Transport and Buick will follow the movements of parts from the manufacturers' plants to the terminal. They will be loaded in reversible containers specially designed to shorten discharge times.
At the terminal itself the individual parts will be loaded onto an automated loading-discharging line made up of remote-controlled systems, laser readers and a series of sophisticated robot-cranes. Computerised monitoring systems will guide each stage and will supply the information required, both for production planning and for stock control.

All parts will be grouped in special containers according to destination on the assembly line. Leaseway trucks will deliver the loads to the nearest platform to the point in question. Leaseway will make 234 deliveries per day per point, moving 1500 containers per hour or 2.3 million lbs of car parts per day.

Because of the siting of the terminal a few minutes away from the assembly centre, Buick will be able to produce to very short component availability times. In order to exclude any error in transit between the terminal and the assembly plant, the Leaseway drivers will be required to check all the labels with the aid of a bar-code reader when the containers are delivered.
ANNEX 2

Recent publications of the authors on the subject:


ORGANISATION OF ROAD TRANSPORT FROM TERMINALS AND
COMBINED TRANSPORT ACCESSIBILITY
Mr. Patrick Niérat, INRETS, Arcueil, France
Introduction

Rail-road combined transport is often connected with just-in-time thinking about company strategies. Punctuality, speed, low rates are usually pointed out among the advantages of this technique. We would like to look at the last point in order to specify in what places, in what conditions combined transport is actually more competitive than road transport.

Two methods give responses: monographic analysis focused on variations between enterprises and inside enterprises; theoretical describing of the diversity of the context of the firm. We selected this second way and built indifferent modal choice places, where each mode provides the same cost. Aiming at caricature, theoretics become independant of realities, but set off its most intensive characteristics.

We worked on the Paris-Avignon transport link. The two cities are 686 kilometers far from each other. It is one major European freight traffic axis. In France, it is one of the most performant combined transport links.

After a short methodological part, introducing the "funnel theory", we will give findings about intermodal and road competition.
CHAPTER 1: THE FUNNEL THEORY

Each theory is simplifying. Its interest is to draw from ordinary assumptions, principles and references useful for phenomenon understanding.

Our problem is: a road haulier has to drive a semi-trailer from A to the consignee placed in C. To do this, he may drive it by road or give its useful element, a swop body, to a combined operator. Then it will be carried to a terminal placed in B, from which a truck will move it to an unloading location. The question is to find all the places C which can be joined by combined transport at a lower cost than by an all-road transport.

So, two places are fixed:
- A, sending origin,
- B, terminal used.

Let us assume that truck operating cost is a linear function of distance, that trucks are driven in a completely homogeneous space, a uniform plain in which they have equivalent easiness any way they go. \( d \) is the distance from A to B.

In such conditions, we can write road cost from origin A as:

\[
C_A + w_A z
\]

where \( C_A \) is a variable part of road cost,
\( w_A \) unit kilometrical cost in A,
\( z \) distance run.

The geometrical figure described by this cost function is a cone. Its top is right above A location. Here is the minimum cost, \( C_A \). The funnel picture symbolizes its shape.

Railway transport leads to many terminals (station, intermodal terminal) at a cost equal to the sum of all those of the different operation necessary to go there. From this place, freight is carried by road and general cost takes multidirectional funnel shape right above B location. \( C_B \), minimum cost, includes transport cost to go to B and fixed operating cost of the lorry that realises the last trip. The general cost is then:

\[
C_B + w_B r
\]

where \( w_B \) is unit kilometrical cost in B,
\( r \) end run.

To find indifferent modal choice places is the same as describing C locations, respectively \( z \) and \( r \) far from A and B, where the two costs are equal. They are on the funnel intersection.
By inserting two parameters, \( k \) and \( w \), we can concentrate all conditions that give the same indifferent modal choice places.

\[
w = \frac{w_B}{w_A}, \text{ unit kilometrical cost ratio,}
\]

\[
k = \frac{C_B - C_A}{w_A d}, \text{ ratio of the fixed operating cost difference to kilometrical part of road transport from A to B.}
\]

All the possible intersections are obtained by resolving the following equation system, where \( r \) and \( \alpha \) are polar co-ordinates in B, AB (from A to B) reference.

\[
(1 - w^2) r^2 + 2 (\cos \alpha - k w) d r + (1 - k^2) d^2 = 0 \quad (1)
\]

\[
r \geq -\left(\frac{k}{w}\right)d \quad (2)
\]

The reader interested by resolving this problem can see report number 2. We will just give here some interesting findings for the following statement.

We will pay our attention to a couple of \( w \) particular positions: first \( w = 1 \), when kilometrical costs in B (for short distance travel) equals those in A (for long distance transport); then \( w = 2 \), when road shipment kilometrical cost around terminal is twice as expensive as all-road shipment kilometrical cost. First figure shows market area's distortions with \( w \). When growing, \( w_B \) makes an increase of \( w \) and a decrease of combined transport market area. When \( w = 1 \) and \( k \leq 1 \), the market areas' border is an hyperbola. All the places beyond terminal find in combined transport the cheapest route.
The second figure is assigned to variations of $k$ when $w$ remains unvariable (here $w = 2$). With the growing of $k$, the combined transport market area is reduced. When $k = 1$, it just contains the terminal, when $k \geq 1$, road has transport monopoly.
CHAPTER 2 : ESTIMATION OF TRANSPORT COSTS

On this basis, we have to define $C_A$, $C_B$, $w_A$ et $w_B$. Their estimation lay down methodological choices. Let us assume for road cost that:

- it is independent of weight carried,
- we may use information about long distance runs to estimate short distance road costs, suppose we ignore specific charges of long runs as transfer bonuses,
- on long distance runs lorries use to realise an integer number of runs each week.

$C_A$ includes all fixed road costs assigned to the lorry that will be driven from sender to consignee.

$w_A$ is unit kilometrical cost of this lorry; all fixed terms are ignored.

$C_B$ sums up the costs of all the operations necessary to go to terminal. They are held as fixed charges from the time the semi-trailer is left into the road hauliers' hands. They are:

- road haulage from sender to departure terminal,
- handling costs of departure and arrival terminals,
- supply of wagon costs, rail traction costs, understructure maintenance costs;
- It also includes fixed road costs assigned to the lorry that will be used from terminal to consignee.

$w_B$ is unit kilometrical cost (fixed costs excluded) of this last lorry.

In order to simplify the problem, we shall assume that the sender is on departure terminal. So, road haulage costs from sender to departure terminal are supposed to be null.

In another connection, we focused our analysis on road haulier choice. To make his choice, he has in his possession two data: his lorry operating costs and the rate books of multimodal operators. We draw the same parallel between rate books of Novatrans, a French combined transport operator, and road costs adjusted from a periodical investigation of French Ministry of Transport (DTT - 1). So, the cost of all railway operation (traction, handling, ...) is described by rate. Rate is a function of gross weight of transport, which
includes swap body weight (4 tons). All costs and rates are expressed in April 1984 French francs (F).

For road cost, expenses from DTT's investigation may be classed in three groups: fixed costs, kilometric costs and personnal costs. Their sum is total cost $C_g$:

$$C_g = U + V n + W k$$

where $C$ is annual shipping cost, $n_k$ number of drivers, $k$ annual number of kilometers run, $U$ annual fixed costs, $V$ annual cost per driver, $W$ unit kilometric costs.

Annual fixed costs (U) include:
- Capital depreciation costs (semi-trailer and tractor) - 17.191 F.
- Lorry and freight insurances - 23.772 F.
- Annual transfer bonuses (just for long distance) - 27.404 F.

Annual cost per driver (V) includes wages 84.273 F and social fares 43.132 F.

Unit kilometric cost (W) covers fuel, lubricating oils, tyres, maintenance and motorway tolls per kilometer. It is equal to 2.77 F/km. Fuel represents more than half: 1.43 F/km for 2.5 kilometers per liter.

You will see, we did not speak of structural firm costs that are part of operating balance. They are as high as 100.000F per year. We think indeed this expense is connected with one operation, independant of means used to do it. So, we ignored it.

We have now to compute $C_A$ and $C_B$. They are the total amount of annual fixed costs that may be assigned to the run. The non-kilometric part of $C$ is to be reported to an annual activity, the annual number of trips, which we reckon by supposing 48 annual working weeks and an integer number of trips (t) each week for long-distance transport. For transport around terminal, we will take 240 working days per year and a daily number of round trips equal to n. For each case, only one man will drive the lorry.

$$C_A = \frac{U + V}{48 \ t} ; \quad \text{road part of } C_B = \frac{U + V'}{240 \ n}$$
TO SUM UP:

<table>
<thead>
<tr>
<th>All-road transport</th>
<th>Combined transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w_A = 2.77 \text{ F/km}$</td>
<td>$w_B = 2.77 \text{ F/km}$</td>
</tr>
<tr>
<td><strong>To compute $C_A$:</strong></td>
<td><strong>To compute $C_B$:</strong></td>
</tr>
<tr>
<td>$U = 68,367 \text{ F}$</td>
<td><strong>Novatrans rate (F HT):</strong></td>
</tr>
<tr>
<td>$V = 127,404 \text{ F}$</td>
<td>136 F/day for swap body</td>
</tr>
<tr>
<td>1 driver</td>
<td>$U' = 68,367 \text{ F}$</td>
</tr>
<tr>
<td>48 working weeks</td>
<td>$V' = 100,001 \text{ F}$</td>
</tr>
<tr>
<td><strong>Assumptions:</strong></td>
<td>1 driver</td>
</tr>
<tr>
<td>. 5 trips per week</td>
<td>240 working days</td>
</tr>
<tr>
<td>. 2 round trips per week</td>
<td>then 702 F/day</td>
</tr>
<tr>
<td>. 3/5 of the week assigned to the round trip</td>
<td><strong>Assumptions:</strong></td>
</tr>
<tr>
<td>. 1 round trip each week</td>
<td>. $n$, integer number of round trip</td>
</tr>
<tr>
<td></td>
<td>. Road haulage costs from sender to departure</td>
</tr>
<tr>
<td></td>
<td>. terminal are null</td>
</tr>
</tbody>
</table>
CHAPTER 3: ROAD TRANSPORT FROM TERMINALS AND MODAL CHOICE

The efficiency of road transport from terminal is a determining factor of combined transport competitiveness.

We will deal with this subject and look at a railway trip from Paris to Avignon. Along this link of 686 kilometers, let us assume that a lorry runs two round trips each week. The gross weight of goods carried will be 20 tons (swop body and goods weight). With these assumptions, we will try to find in what conditions road has transport monopoly and when there is a combined transport market area.

The main question is road haulage from terminal. We have to specify how the different kinds of end organisation may be described with k and w parameters. Two examples will show us which part of the 702 FF for daily road fixed cost is to be assigned at each run.

In the first example, we have a conventional organisation. Driver has to go and leave three swop bodies with different consignees. They are placed in $C_1$, $C_2$ and $C_3$, respectively $d_1$, $d_2$ and $d_3$ far from terminal (figure 3).

Figure 3:
Road leg organisation

![Diagram](image)

The elementary round trip consists in driving swop body to consignee, staying there time enough to unload it, going back to terminal with the empty swop body.

During this day long, the lorry will have run $2 (d_1 + d_2 + d_3)$ kilometers, three round trips or six trips. Its daily operating cost is $702 + 2 w_B (d_1 + d_2 + d_3)$. As one trip out of two is with an empty swop body, we will assign at each loaded trip:

$$\frac{702}{3} + 2 w_B d_1$$

So, take care that $d_1$ is tied with $2 w_B$.

The second example looks like the first one. This time, unless you go back empty, swop bodies are loaded for the return trip. Then, at each loaded trip, we have to assign: $702/6 + w_B d_1$. 

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When we generalize these two examples, we have for \( n \) round trips around terminal:

- when one trip out of two is loaded \( \frac{702}{n} + 2 w_B d_1 \)
- when all trips are loaded \( \frac{702}{n} + w_B d_1 \)

So round trip number and loaded trip number both characterize road leg organisation.

**TO SUM UP:**

<table>
<thead>
<tr>
<th>All-road transport</th>
<th>Combined transport</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No unloaded trip around terminal</td>
</tr>
<tr>
<td>( C_A = 1020 \text{ F} )</td>
<td>20 tons Novatrans rate ( 2487 \text{ F} )</td>
</tr>
<tr>
<td>1 driver</td>
<td>Swop body ( 136 \text{ F} )</td>
</tr>
<tr>
<td>2 weekly round trip</td>
<td>( C_B = 702 \text{ F} ) (Non-kilometric part of road operating cost only)</td>
</tr>
<tr>
<td>( w_A = 2.77 \text{ F/km} )</td>
<td>( w_A = 2.77 \text{ F/km} )</td>
</tr>
<tr>
<td>Paris-Avignon 686 km</td>
<td>( w_B = 5.54 \text{ F/km} )</td>
</tr>
<tr>
<td>( C_B = 2487 + 136 + 702/2n )</td>
<td>( C_B = 2487 + 136 + 702/n )</td>
</tr>
<tr>
<td>Road haulage costs from sender to departure terminal are null</td>
<td></td>
</tr>
</tbody>
</table>

So when every second road leg is unloaded, \( w \) equals 2, and 1 when all trips are loaded.

We are now allowed to calculate \( k \) values in terms of \( n \), the number of round trips around terminal and in terms of \( w \). We get table 1.
Table 1: k value, in terms of w, in terms of road leg numbers for a 20 ton load

<table>
<thead>
<tr>
<th>w</th>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1.03</td>
<td>0.94</td>
<td>0.91</td>
<td>0.89</td>
<td>0.84</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1.21</td>
<td>1.03</td>
<td>0.97</td>
<td>0.94</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Remember road has transport monopoly when k ≥ 1. It appears so that combined transport is uncompetitiveness

. when all road legs are loaded but the company is not able to organize more than one daily round trip.

. when every other road leg is unloaded but the company realizes less than three daily round trips.

The figure 4 maps down market areas for three daily round trips.

Figure 4: Market areas in terms of road leg organization for a 20-ton load (3 daily round trips)

Road leg organization plays a prominent part in modal choice. It fixes the market area of each technique, both in shape and surface.

The most propitious circumstances for combined transport are when all road legs are loaded. Its market area is then bound on sender’s side, but has no limit on the other side. Anyway, the requested round trip number sets
distance limit. Here maximal distance is determined by three daily round-trip constraint.

Less propitious circumstances for combined transport are when every second road leg is unloaded. In addition to round trip number, its market area is very small and bound any side we go. See also, terminal is not placed at the geometrical center of its market area. The nearest bound place is between sender and terminal.

We may conclude:

. that market areas mainly depend on road leg organisation,
. the combined transport situation is the more propitious as road leg organisation nearly looks like all-road one's.
. that market areas depend on load weight. the greater it is, the less it weighs.

This third point is a consequence of railway rates that grow with weight.

From the two first points, we may give a few thoughts about combined transport accessibility. Some of them affect techniques, others companies.

As far as techniques are concerned, we know that container road haulage more often is very unfavourable. Terminals are used as container storage platforms and containers are carried to customers in terms of necessity. It is unusual that the same container can be carried full to the customer and return with new freight: the general rule is one empty run out of two. So, according to that and to the necessary unloading time, the only improvement possibility seems to multiply the round trip number of each vehicle, in leaving containers with customers and trying better to combine their management and forwarding.

For the road haulier swop bodies, companies generally carry them away in the morning and bring them back with another load in the evening. More trips are loaded and lorries may be used for another task all the day long. So, the swop body market area is often larger than the container one.

As far as road hauliers are concerned, combined transport accessibility depends on both geographical and organisational criteria. Its market area is function of road leg organisation.

For a 20-ton gross weight load, a company that does not carry more than two daily freights (eg one arrival and one departure), has no access to combined transport. Road craftsmen whose daily volume is less than one unit belong to this case. You will see that an association of two craftsmen does not give freight enough neither!
Combined transport accessibility is based upon rational road leg organisation, freight volume and location compared with the terminal. Other parameters of company flow between the two cities are also to be considered. They are load weight and empty ratio for long-distance trips. This last parameter is a lack of balance indicator for the company traffic on the study link. As we have done before, it is possible to estimate and compare costs of all the round trip from Paris to Paris. Let us assume the lorry is either empty either loaded with a given weight. Then we may search for the empty ratio from which combined transport will be chosen for a round run. We obtain the figure 5, drawn for a couple of consignee places: just terminal \((k = 1)\) and \(k = 0.9\) indifferent modal choice places.

**Figure 5**: The traffic characteristics of combined transport and road haulage

For a given road leg organisation, we have a curve that divides into two parts traffic characteristics: road haulage, heavy loads on balanced links; combined transport, light loads, lack of balance links.

The better road leg organisation, the more numerous combined transport traffics.

The farther from terminal the consignee, the less numerous combined transport traffic characteristics: the lighter loads and the more lack of balance links.
Conclusion

The funnel theory brings forward two major factors that determine combined transport accessibility.

The first of them has a spatial nature. Road leg organisation and its efficiency cause the market area of combined transport. It appears great activity volumes are propitious to combined transport use, that without volume enough, all-road haulage is always the most competitive run.

The second of them is connected with the traffic of the company. Its characteristics, average run-load weight and empty long-distance ratio, have an effect upon modal choice. They play inverse to what is usually known, unless it would be in variance with statistical data. These two traffic characteristics have indeed never been studied both in the same time. Anyway, it is a direct consequence of the sensitiveness to weight of Novatrans rates. But each railway rate gives a predominant part to weight. So it would be very interesting to study other rate systems in consideration of their market area effects. One of the assets of the method is it is being able to give the spatial consequences of parameter variations.

After all, we only have taken cost into consideration. The finding validity is so limited to the companies in which this criterion is the strongest one. Of course, other criteria may co-exist, but that is another story!

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COMBINING THE TRANSPORT AND THE STORAGE FUNCTION
BY CONTAINERS

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COMBINING TFK TRANSPORT AND THE STORAGE FUNCTION BY CONTAINERS

by L. Künzer and Dr. C. Seidelmann, Frankfurt am Main

The Basic Economics

The combination of storage and transport by use of one vehicle is not an entirely new idea in logistics. Since many decades, the railway companies offer to their customers the possibility to get a specific waggon into their private sidings some days before the transport will be performed or to retain the waggon some days after its arrival in the private siding.

In both cases, the shipper or consignee has the possibility to use the waggon that has been the transport vehicle as a short time storage unit.

The development towards road transport as the dominant mode of today has changed these patterns entirely. The truck and its driver want immediate loading or discharge. They are not willing to wait hours, and not at all days.

While the railway companies have kept their loading and discharge scheme, road transport gained severe economic advantages by its demand for immediate handling of the truck:

- quick turn-round of equipment, resulting in
- better use of facilities (more mileage per truck and per driver).

On the other hand, railway achieved some advantages in competition by the offering some time delay until the waggons have to be returned; some consignees prefer to have at least a certain percentage of all goods arriving in waggons. Because the waggon does not insist in immediate discharging, they can have their handling personnel at free disposal: Whenever a truck arrives, it is discharged immediately, and when no truck has to be handled the staff can care for the discharge of the waggons. But the price that railways have to pay for this competition advantage is relatively high: less turn-round of equipment resulting in low vehicle use.

In normal case, the use of a vehicle as a short-term storage unit is too costly to pay off. A road truck or a specialised waggon could have value of 100 000 US$. This would result in daily average interest cost of almost 15 US$ when interest rate has to be calculated in the range of 10% per year. If depreciation and costs of the waiting driver is added, this truck as a short-time storage unit will certainly create bills of more than 100 US$ per day - and this is in most cases much more than the
possible positive results of this operation.

The arrival of containers and swap bodies in inland transport has changed these patterns thoroughly. This is a result of the change in economics of the transport operation: The relatively costly unit "truck + driver" is separated from the relatively cheap unit "load carrying device". So, the load carrying device can wait for discharge at the consignees place at a fair lower per day rate than any costly vehicle could. This gives in the logistical system the possibility to have the consignments arrive prior to their use, without the need to provide a storage activity. The items just remain in the load carrying unit, i.e. in the container or swap body that has been removed from the vehicle, and there they wait for use in the production line.

Some examples for this concept and its working in practice:

Newsprint is delivered to the printery in containers. The containers are separated from the delivery trucks at the ramp of the printery. They are kept at this place for several days, and whenever the printery needs a new roll of newsprint this is taken out of the container. When the containers are empty, they are returned to the transport company.

Containers carrying multiple sets of sanitation facilities are transported to a large construction site and put down there. Whenever a set of such materials is needed as the building work progresses, it is removed directly from the container.

A chemical plant routes the containers that later on will carry their export loads to overseas destinations on their empty run towards the factory. On this way these containers pass at the packaging material plant and load empty packages for the chemical plant. When arriving in the plant, they are put down and function as a short time storage facility for packages. When they are empty they are taken to the ramps and loaded with export goods.

Just In Time Versus Container

All three examples show the supply side. In all three cases, the just in time logistics have been achieved by introduction of a short time storage function provided by the container. So, this solution is clearly an alternative to just in time supply with daily delivery of the items needed in the production line.

This deliberation leads to the question whether it pays off to use such compromise system in supply logistics or whether it would be more economic to take the more fundamental solution in just in time supply and organise a daily delivery. There are two major reasons why such a
container based system might be more economic than a system based on daily delivery.

One of these reasons is to cover the safety aspect. A logistical system that is based on a daily delivery of supply to the production line is highly vulnerable to disturbances and frictions that cannot be completely excluded. If the supply of one day does not arrive in the morning, the production line is set out of work while most of the costs are continuing. Such a short time friction can be caused by extreme weather conditions or by a strike in the transport industry. A container-based system with its supply for several days at hand will not be that difficult to manage as a system based on daily supply.

The other reason is concerned with transport costs. The just in time delivery includes a trend to smaller consignments. While in the conventional systems the logistic management ordered a relatively large quantity - in many cases a full carload - of supply material, the just in time supply management needs only considerable small quantities to be delivered each day.

This creates a trend towards smaller consignments in the transport industry. In transporting such smaller consignments, higher costs per tonne carried and handled are involved, compared with the transport of full carload size consignments. The system of daily supply delivery will create higher transport costs than a system with large amounts being supplied into a buffer stock.

The cost disadvantage involved by this has even increased in the past years. Studies performed by the West-German chemical industry have demonstrated clearly that the average cost level of small consignment transport has been increased by a far higher speed than the cost level of large consignment transport. If this trend continues in future, the logistic management will not only have to face higher transport costs when shipping in smaller consignments, but a more than proportional increase in these costs. In consequence, a steadily increasing part of the savings created by just in time logistics will be offset by transport cost increase. This has created deliberations whether there is a possibility of getting the advantages of just in time supply combined with a transport system based on larger consignments.

The answer is the combining of transport and storage function by use of containers. All three examples mentioned above show clearly that a safe daily supply can be achieved together with a transport scheme based on full container loads and a logistical system that does not need a buffer stock.

Insofar, the combination of storage and transport function by use of containers is a way of compromising between a system based on daily delivery of small quantities and a system that maintains buffer stocks.
Cost Evaluation Schemes

Any container or swap body based distribution system has, of course, to prove that it is more economic than the conventional distribution patterns. The German Society for Study of Combined Transport (Studiengesellschaft für den kombinierten Verkehr) has compiled an evaluation scheme which allows a precise cost comparison of such systems against conventional distribution patterns.

The transport industry has achieved considerable cost savings by use of containers and swap bodies for transport purposes. Containers and swap bodies can create further cost savings in the company internal logistics, as well. The question to be answered is: What amount of additional cost savings can be achieved by use of containers or swap bodies in the distribution system if additional logistical functions are added. These additional functions mean an integration of transport, distribution and storage functions, including the shipper's and the consignee's logistical organisation.

This cost evaluation scheme consist of three steps:
- analysis of the present state of distribution patterns,
- analysis of changes in cost (savings versus additional costs),
- decision making taking into the account the cost comparison.

Analysis of the Present State

Selling organisation:
- delivery volume per customer,
- delivery frequency per customer,
- desired delivery reliability per customer.

Questions: Will this customer accept a delivery pattern that is based on container loads which might imply a change in volume per delivery and in delivery frequency? What amount of additional costs at the consignees side will be created by such a change? If this would imply larger storage capacity at the consignee's plant: Can the container take over the function of additional storage space?

Production line:

Do the normal production lots fit into the changed order and transport volumes? If changes are necessary: At what costs?
Handling and storage:

What savings in handling and storage can be achieved if the production line is organised that way that it ends directly in the container? Or - on the other side of the transport line - : If the production supply can be directly taken out of the container? What amount of buffer stock operations can be avoided, and what cost savings can be derived by this?

Information and communication:

Distribution systems which include container and swap bodies often will imply improved systems of information and communication to integrate the functions of order processing, vehicle loading, transport, and storage.

Truck fleet:

If the company owns a delivery truck fleet and performs the transport operation as own account transport, an additional cost comparison will be necessary to evaluate whether the change to third party transport, e.g. to a container operator, gives additional savings.

Evaluation of Change of Cost Patterns

When the analysis of the present state and the possibilities (and, of course, limitations) for a change of the distribution systems towards the use of containers and swap bodies has been completed, the implication of such a change to the costs of logistics must be evaluated.

This will be a relatively simple activity, compared with the difficulties of a normal business cost analysis. In this case, only the cost changes have to be counted. There is no necessity to elaborate amounts in total cost figures. The basis of the decision will be a comparison of the additional costs created by the change against the cost savings that can be achieved.

So, a difficult and expensive total cost analysis can be avoided, and many of the incertitudes involved in such an analysis do not appear.

This cost change analysis has to cover all departments that are involved in logistical activities:

- sales and forwarding department,
- storage and depot administration,
- handling systems and material flow,
- production,
- truck fleet,
- information and communication system.
This task is best achieved by use of check lists that give a systems approach to the cost comparison. Such check lists have been developed by our Society, containing some 30 pages of questions to be made and items to be analysed.

In the end, there will be a list of cost saving items and amounts, and a list of additional costs and their amount. Based on this analysis, the final decision can be made whether it is worth while for the company to change towards a distribution system based on containers or swap bodies, or whether another logistical systems gives a more favourable economic solution.
RADIO-DETERMINATION SATELLITE SYSTEMS LOCSTAR/GEOSTAR
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RADIO-DETERMINATION SATELLITE SYSTEMS

LOCSTAR/GEOSTAR

ABSTRACT

CNES has proposed to set up a Radio-Determination Satellite System (RDSS) covering the International Telecommunications Union's Region 1 (Europe, Africa, Middle-East). The system, known as LOCSTAR, will be capable of position location to an accuracy of between 10 and 100 m. Provision will also be made for an alphanumeric two-way message service between mobiles and their home base. These services will be available to several hundred thousand subscribers in Europe from 1990 on, with a subsequent extension, around 1994-1995, both to a larger number of users and to a larger coverage area (including Africa and the Middle-East).

Key words: radio-determination, radio-location, radio-navigation, position determination, navigation, positioning, mobiles.

INTRODUCTION

CNES has been active in the field of satellite location systems virtually since its inception in 1962. One will recall the EOLE project used to locate a fleet of drifting balloons; the Dioscures and later the AEROSAT Programs which, though not followed through, were aimed at the civil aviation market; the currently operational ARGOS program which provides a worldwide platform location and data collection service, and the equally operational SARSAT-COSPAS system which relays alert and location data concerning persons in distress to suitably located search and rescue services. Continuing technical progress and the growing demand for this type of service suggest that the coming years will see the setting up of operational radio-determination systems using geostationary satellites capable of meeting the needs of a very large number of users (mobiles) in fields as diverse as: monitoring, fleet management, traffic control, navigation, data collection, etc.

SYSTEM DESCRIPTION

The LOCSTAR system currently under development, for Europe-wide coverage, draws upon existing technical know-how (patents, test results, etc.) and commercial know-how (demonstrations, etc.) gained by the US GEOSTAR system and the current status of which will be described later on.
The LOCSTAR RDSS system will perform three main functions:

- radio-location (or positioning): the base knows the position of the mobile;
- radio-navigation: the mobile knows its own position;
- message service: mobile and base exchange alphanumerical messages of limited length (about 100 characters).

The system comprises three segments:

- the space segment (two or three geostationary spacecraft) with the "Receive" packages, which relay signals transmitted by mobiles to the Central, and a "Transmit" package which relays signals transmitted by the Central to mobiles;
- the user segment, or the set of all LOCSTAR terminals (or transceivers) mounted on mobiles. Standard transceivers will be of low-cost design. The system capacity will be several hundred thousand transceivers (about 500,000) per beam;
- the LOCSTAR Central, or central ground control segment, comprising Transmit/Receive ground connection stations, satellite ground control center, position computation and message processing center, and data distribution network interconnecting this segment and the different home bases (each managing its own set of mobiles).

**OPERATING PRINCIPLE**

The LOCSTAR operating principle for the position determination of mobiles is based on the measurement of propagation times of the signals (and then of the distances) between the mobiles and the satellites.

If the mobile's altitude is known, then two range measurements (one by each of two satellites) yield two coordinates (latitude and longitude) to a location accuracy of about 10 m for an altitude error of less than 5 m.

If the mobile's altitude is not known, then three measurements (one by each of three satellites) yield three coordinates (latitude, longitude and altitude) to a location error of about 100 m.

In the most general case, the altitude is supplied either by the mobile itself (e.g. aircraft altimeter) or by the home base (digital terrain model, giving altitude of either terrestrial or marine mobiles) so position calculations can be performed using two range measurements provided by two satellites.

Each mobile is allocated a unique identification code.

A complete transaction (interrogation/response/position, determination/message and position transmission) lasts less than one second.
RADIO-DETERMINATION SATELLITE SYSTEMS

OPERATION PRINCIPLE

L1 = 6525 - 6541.5 MHz
L2 = 2483.5 - 2500 MHz
L3 = 1610 - 1626.5 MHz
L4 = 5117 - 5183 MHz
OPERATING FREQUENCIES

Within the framework of international radiocommunications regulations, operating frequencies have yet to be allocated to RDSS services. In the United States, the Federal Communications Commission (FCC) recently allocated operating frequencies and issued permission for services to start to the GEOSTAR system. The World Administrative Radio-Conference on mobiles WARC-Mobile - scheduled for September 1987 in Geneva - is expected to examine the problem of worldwide frequency allocation for radio-determination services.

USERS

It is estimated that the system will be able to accommodate over 500,000 simultaneous users within the "footprint" of a given beam, assuming a traffic rate of one transaction (location/message service) per hour.

The number of users that can be accommodated depends, however, on the average length of exchanged messages. The currently envisaged maximum has been set at about 100 alphanumeric characters.

Thanks to the extensive use of integrated circuits, it should be possible to produce transceivers featuring low power consumption, small overall size and low cost. This is expected to render the services accessible to all types of mobiles, including trucks, trains, automobiles, general aviation, pleasure boats, fishing boats, etc.

At the other end of the chain, we find the mobile's home base. Typically, such bases will be operated by organizations responsible for an entire fleet of mobiles. The link between the Central and the bases passes via conventional telecommunications links (telephone, telex, packet-switched data networks, etc.).

SERVICE ZONE

The service zone of the first system to be deployed - LOCSTAR 1 - will cover in 1990 all of Europe. The satellite payloads will be relatively compact and consume little power; it should therefore be possible to include them, as "Add-on packages", in the payloads of host spacecraft already either planned or in production.

Later, as the number of system users increases, it will become necessary to cover Europe with several beams, and so multiply system capacity. Further, it is also planned that the service zone be extended to cover Europe, Africa, and the Middle-East. These increases in capacity will call for the deployment of dedicated spacecraft forming the LOCSTAR 2 system.
**APPLICATIONS**

The potential applications of the LOCSTAR RDSS system are many and varied. Broadly, these applications can be categorized in the following ways:

- according to the type of mobile (aeronautical, terrestrial, or marine);
- according to the type of service (location, navigation, mobile-to-base or base-to-mobile message services, etc.);
- according to the type of function performed (security/control/monitoring, traffic regulation, routing/guidance, fleet management, etc.).

The main potential applications of the LOCSTAR system include:

- navigation, positioning,
- fleet management,
- emergency location,
- traffic information, traffic monitoring and control,
- guidance to a given point,
- message services, including the transmission of telemetry, commands, remote control commands, etc.
- alarm, alert and warning functions,
- monitoring of dangerous, high-value, and other special cargoes, etc.

Clearly, the list is far from exhaustive.

Market studies already completed have identified strong potential demand for radio-determination services (essentially positioning and ancillary message service), suggesting that it should be possible to capture a portion of the market corresponding to between 300,000 and 400,000 users over the period 1990-1995.

**LOCSTAR DEVELOPMENT SCHEDULE**

It is planned to set up in 1987, a new French company, to be known as LOCSTAR. The company's share capital is offered to European shareholders from fields of activities including: space industry, electronics, telecommunications organizations, road transportation, railways, shipping companies, airlines, automotive industry, financial institutions, etc.

In addition to offering greater capacity and wider coverage, the LOCSTAR 2 system will ensure continuity of service and meet the demands of a growing market toward the middle of the next decade.

A critical milestone in the setting up of this new service will be as already said the September 1987 Mobile-WARC conference which will deal with worldwide RDSS frequency allocation.
CONCLUSION

The demand for mobile radio-determination services is currently very strong. Further, if one compares the situation in Europe with that in the United States where mobile services are more highly developed, there seems no doubt that the proposed LOCSTAR RDSS service will satisfy a real need and that it can therefore be expected to meet with rapid success in Europe.

No other existing or currently planned system offers the same set of simultaneous functions, namely location, navigation and message service. Also, of the different systems offering one of these three services, each is characterized by lower performance, higher cost, or more limited coverage.

CURRENT STATUS OF THE GEOSTAR SYSTEM

The GEOSTAR Corporation was founded by Dr. Gerard O'Neill in February 1983 to develop and operate a Radiodetermination Satellite Service (RDSS). The GEOSTAR System will establish a new, patented position determination and two-way message transfer communications network serving users in the United States, Canada and the Caribbean Basin by linking a computer center ("GEOSTAR central") to user terminals by two-way digital communications directly through satellite relays. The GEOSTAR System will provide the first position determination system offering precision, full-time operation and complete coverage of the continental United States and what the Company believes will be the first completely portable nationwide two-way communications system. GEOSTAR System services will include navigational guidance, interconnections with other telecommunications systems and data bases and emergency service to small, relatively inexpensive user-operated terminals. The Company's initial phase of service will offer the first nationwide communications link from mobile users to their central control sites.

Briefly, the current status of GEOSTAR's business is:

. By the third quarter of 1987, GEOSTAR will offer its first commercial service which will provide a one-way flow of data (including positioning information about mobile users anywhere in the continental United States) from a user terminal to GEOSTAR Central for transmission to the user's central control site.

. The satellite relay for the initial GEOSTAR service is currently scheduled for launch by ARIANESPACE in July 1987 and a second back-up satellite relay is scheduled for launch in September 1987.

. GEOSTAR Central for the initial GEOSTAR service has been constructed and successfully tested.

. SONY Corporation of America and M/A-COM Telecommunications, Inc. have developed production models of user terminals for the initial GEOSTAR service.
The Company is prepared to commence initial service upon the successful launch and operation of a satellite relay.

The Federal government has awarded a contract to the Company for development work relating to miniaturized user terminals for the full two-way GEOSTAR System, under which the government has authorized expenditures in FY 1987 of $3.2 million, with an option of the government to purchase up to 5,000 user terminals. The Company has subcontracted most of the work for FY 1987 to MOTOROLA.

The Company has entered into an agreement with Mobile Communications Corporation of America (MCCA) which is one of the largest non-Bell mobile communications services companies, and its affiliate, National Satellite Paging, Inc., to provide a combination of initial GEOSTAR service and NSP's nation-wide paging service. That combined system would represent an early entry version of a two-way position reporting and message transfer system.

The Company has contracted for the major elements of its full two-way GEOSTAR service, and has entered into agreements with GTE Spacenet and RCA Astro Electronics for the space segment.

The Federal Communications Commission has granted the required regulatory approvals for the deployment of initial and full two-way GEOSTAR service.

The Company has received firm purchase orders with down payments from 18 different customers for approximately 5,000 user terminals for initial GEOSTAR service commencing third quarter 1988 at a price of $2,900 per terminal.
INTERROGATION-REPLY PRINCIPLE

1. The central station interrogates the mobiles
2. The mobile units reply to the central station which identifies and locates them
3. The position and the message are transmitted to the mobile units
4. The mobile's allegiance is established
INFORMATION ON TRAFFIC AND WEATHER CONDITIONS: TECHNIQUES FOR DETECTION AND DISSEMINATION

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INFORMATION ON TRAFFIC AND WEATHER CONDITIONS
TECHNIQUES FOR DETECTION AND DISSEMINATION

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1. INTRODUCTION

Philosophy and methods of Just-in-Time are based on the idea to manufacture and deliver final products and work-in-process inventory as requested which means "just in time". It is the objective for Just-in-Time to minimize the flow times of the manufacturing process. On the one hand, this involves a reduction of inventory (stocks), i.e. a reduction of capital binding; on the other hand, it involves an increased flexibility regarding changed market conditions.

To achieve the desired results it has to be strived for a comprehensive optimization of the complete manufacturing process of production and delivery of final products and work-in-process inventory. One of the sections of this complete manufacturing process is the transport of final products and work-in-process inventory on the road.

When studying the specialist literature concerning Just-in-Time, however, it will be noticed that transport on the road is scarcely mentioned. Probably it is presupposed that governmental authorities are to be held responsible for that field respectively that the existing traffic infrastructure can still facilitate the required capacities. But analyses of the working times of lorry drivers (according to an investigation of the University of Groningen, lorry drivers work non-stop 12 hours a day and 75 hours a week in the average) and of causes for accidents (e.g. the accidents during fog in last winter caused by lorry drivers which drove at 80 km/h by 20 metres' visibility on the Autobahn) show that freight transport on the road is carried out under high pressure. Thus, freight transport on the road is a rather sensitive section in the control cycle of the complete Just-in-Time manufacturing process.

To facilitate an optimization of that section, above all better, more comprehensive and more topical information on traffic situations are needed – possibly even for a prognosis period of time. Information is needed concerning traffic conditions (traffic volumes, temporal and spatial distribution, accidents,
congestions) and weather conditions respectively road conditions. Information on that should enable to determine the optimal time and the optimal route for a transport.

The following comments are based on knowledge about two different fields of activity:

- By order of the Federal Minister of Transport and the Federal Minister of Research and Technology, programmes and projects are being carried out at present to examine the facilities of traffic management and to improve traffic information services. It is the objective to increase traffic safety, to reduce the energy requirement as well as impacts on the environment and, above all, to use the existing road network in a more intelligent way.

- A system for freight transport purposes is being developed which by using modern telecommunication technologies is supposed to lead to an improvement of the conditions especially for smaller and medium-sized entrepreneurs. One aspect here is the provision of traffic information for the enterprises.

2. METHODS OF TRAFFIC CONTROL AND TRAFFIC INFORMATION

2.1 GENERAL ASPECTS

There are different methods to influence and to inform the road users. Traffic control and information systems are fundamentally distinguished according to the following attributes:

- static
- optical
- roadside
- collective

- dynamic
- acoustic
- on-board
- individual

In the past static control and information systems were generally sufficient; today, however, dynamic control methods are used more and more. Dynamic traffic management and control systems can be adapted to the respective situation and they provide more topical information to the drivers. Improvements in detecting traffic situations and weather conditions as well as the growing capacity and availability of computers have led to the fact that dynamic traffic control systems can work more and more as automatic systems with permanent detection as well as with central control mechanisms.

The single components of those systems are part of a control cycle. This control cycle involves the following components:
- road (driver, vehicle, weather conditions)
- detection systems
- transmission systems (transmitting from the road)
- computer control centers
- transmission systems (transmitting back to the road)
- control devices (information output)
- road.

In principle, the mode of operation of those automatic traffic control systems is described in the following:

- The traffic situation and weather conditions along the road are permanently measured.
- The collected data are checked and transmitted to a central computer.
- The computer works out forcastings and specifies - based on an algorithm - how to make sure an optimal traffic flow as well as it indicates optimal routes in the respective situation.
- A comparison between the ascertained optimal state and the actual state allows to compute correction factors.
- The correction factors are converted into control and switch impulses which means changed information for a certain road section with the aim to cause drivers to change their driving behaviour or their route or to postpone their trip.

Additionally, all the systems can also be manually controlled respectively be manually provided with further data.
It should be emphasized that all kinds of traffic control and information systems - no matter whether they provide optical or acoustic information, whether information is given by changeable message signs, monitors, or printers - operate in the described mode.

Therefore, it can be derived that the implemented infrastructure (detection systems along the road, data transmission systems, computers in the control centers) and the collected data can simultaneously be used for different systems and that it should also be possible to transmit information directly to the offices of manufacturers, forwarding agencies, shippers and road hauliers.

2.2 INFORMATION ON TRAFFIC CONDITIONS

Detection and collection of data on traffic conditions are carried out partly automatically and partly manually. In automatic detection, inductive loop detectors are mostly used. By means of these detectors, the number of vehicles, traffic composition (share of lorries) and speeds can be recorded. Then, the data will be transmitted to a control center where - on the basis of those data - the traffic conditions will be analysed. Two simple examples can explain that: If such a great number of vehicles is detected at a cross-section that the capacity limits of the road are nearly reached, traffic incidents must be expected resulting from excessive traffic capacities. Or if the measured speeds decrease considerably, one can infer an incident, e.g. an accident, from that.

Manual detection is mainly done by the police. The patrol cars transmit observations from the road to the control center by wireless radio. There, the data are checked and - if necessary - measures will be taken and those radio stations will be informed which disseminate traffic information within the ARI-system in the German area.

Up to now, automatic detection systems have mainly been implemented in network areas near bigger cities. At present, the network of detection sites is being extended. Until recently, automatically detected data only served the control of variable traffic signs, i.e. mainly changeable guide sign systems and changeable speed indications. Recently, a further use for information has been found with the ARIAM-system (see chapter 2.3).

Traffic Control By Changeable Guide Signs

In case that there are alternative routes, the optimal route is calculated on the basis of the recorded data and traffic will be diverted at the intersections by means of changeable guide signs. There are some of these systems working in Germany:
- in the Rhine-Main area (Frankfurt - Wiesbaden - Darmstadt)
- in the Ruhr Area/Westfalia (Münster - Dortmund - Wuppertal)
- in the area Koblenz - Montabaur - Bonn - Köln.

Traffic Control By Changeable Speed Indications

The real speeds are measured and - possibly under consideration of data on weather conditions - an optimal speed will be indicated. In this way, the traffic flow will be harmonized and - if necessary - it will be warned against dangers. Several systems are in operation respectively are planned:

- A 8 Stuttgart area
- A 8 Bad Reichenhall area
- A 46 Wuppertal - Düsseldorf area
- A 5 Frankfurt area (planned)
- A 43 Bochum - Recklinghausen area (planned).

In addition, several congestion warning systems are existing.

2.3 ARIAM - A TECHNIQUE TO IMPROVE RADIO TRAFFIC INFORMATION

Today, most of the vehicles are equipped with an on-board car radio. In Germany and some neighbouring countries, this fact has been used for years: radio traffic information has been disseminated by the driver-radio-information system ARI (Autofahrer-Rundfunk-Informationssystem). Covering the total Autobahn network, the police has built up a nationwide organisation for data collection. So, the radio stations can be provided with most topical information which is broadcast about every half an hour (in case of serious incidents also at once). The weak point of the ARI-system, however, is often the long period between the occurrence of the incident and the broadcasting of a corresponding message by relevant radio stations. An essential cause is that even today disturbances are still detected and reported more or less by chance and that the further processing is mainly done manually. The topicality can be considerably improved by automatic incident detection and automatic composition of suitable reports which allow for direct broadcasting. The ARIAM-system (Autofahrer-Radio-Information aufgrund aktueller Meßwerte = driver-information on the basis of current measurements) fits in very well with that objective in which existing systems (detectors, computers, programmes) can be used - possibly supplemented by further detection sites and algorithms - to detect incidents automatically, to draw up reports and transmit them. In future, the radio stations will be equipped with monitors on which they can receive the automatically drawn up reports at once. Given these means, the still existing weak points in ARI should be sorted out to a great extent. The ARIAM-method can also be integrated very well into the future radio-data-system RDS.
In a similar way as the radio stations are provided with most topical reports, the teletext system (TV-based information system) and the viewdata-system (telephone-based information system) could be provided with messages. Both systems are already used for information on incidents going on for a longer time. For the Viewdata system, a conception has been developed how this system could also be used for short-term topical messages.

2.4 INFORMATION ON WEATHER CONDITIONS

General information on weather conditions is disseminated by radio, TV, the teletext-system and the Viewdata system. In addition, meteorological offices provide information via automatic telephone services. Automobile associations do also inform about weather conditions, especially about road conditions and whether alpine passes are passable or not. The detection of weather conditions and the drawing up of forecastings for general weather information is done by the meteorological offices of the German Meteorological Service.
The following data on weather conditions are of main interest for road traffic matters:

- heavy rain (aquaplaning)
- snowfall
- ice
- fog
- smog.

Drivers mainly receive information on weather conditions which are relevant for wider areas by radio. The radio stations disseminate this information by means of the ARI-system. In addition, the ministries of transport and the highways departments ordered to install local automatic detection and information systems in especially endangered regions.

**Fog Detection And Warning Systems**

At some places of the Autobahn network where fog occurs more often and unexpected - often locally limited - and where accidents occur frequently, so-called fog warning systems were installed. Such systems are installed near München and Stuttgart, on the A 7 at Kassel and the A 45 at Hagen.

By means of appropriate sensors, the range of visibility is permanently measured. On the A 45 at Hagen, for example, they installed 8 of such detection systems on a route of 15 km with a total of about 50 variable signs. The recorded ranges of visibility will be compared with threshold values by a computer in the control center. If the range of visibility decreases, changeable message signs along the route will be switched on and, if necessary, yellow flashing warning lights, too. In the route sectors before the endangered places further changeable message signs are installed which allow speed indications. If fog arises, a so-called "speed funnel" (a chain of variable signs to cause speed reduction) can be initiated in which speed indications drop gradually every 1 kilometer (100, 80, 60, 40 km/h).

In many cases, changeable message signs can also be used to indicate other information. Thus, they can be also used, for example, to keep certain lanes clear so that gritters or breakdown services can go unhindered or faster.

**Ice Detection And Warning Systems**

The system mainly consists in three components:

- sensors and electronics for analysis (measuring site)
- data transmission and receiver system
- data evaluation and indication system in the control center.

By means of several different sensors which are installed
into the road surface itself and in a certain distance from the ground the following parameters can be determined:

- air temperature
- temperature of the road surface
- humidity
- road surface conditions (wet or dry)
- remaining quantity of salt or defroster.

Data are recorded at the measuring place and transmitted to the control center. There, calculation will be done, forecastings or trends will possibly be determined, and indications will be given in numerical or graphic form on the monitor. If a certain threshold value is exceeded, an additional warning signal will be given.

The systems mainly serve the operation planning and the alarming of gritters and winter services. In some cases, defroster sprinkler-systems are coupled directly to the ice detection system which will automatically be activated when the threshold value is reached.

In the end of 1984, 31 ice detection and warning systems with 55 measuring sites and 5 automatic defroster sprinkler-systems were installed in the FR Germany.

In some route sections of the Autobahn network, ice can be indicated by changeable message signs if need be.

**Early Snow Warning Systems**

The device measures permanently the humidity respectively the precipitation and the air temperature so that it can calculate the probability of snowfall. If the calculation results correspond to given threshold values, an optical or acoustic signal will be activated in the control center. This equipment is often used in the railway where it automatically activates the points' heaters.

3. **FURTHER DEVELOPMENT AND INTEGRATION OF SYSTEM**

The question is now how the development will go on and how the above mentioned components and systems can be integrated into an overall system.

The Federal Minister of Transport has recently decided that the total Autobahn network should be equipped with a network of detection sites. The traffic situation will be permanently recorded at about 3000 places. The recorded data will continuously be transmitted to traffic control centers. The FR Germany is to be subdivided into about 10 regional areas (which
will more or less correspond to the Land boundaries) and each regional area will have a traffic control center at its disposal. There, traffic data will be collected and stored so that they can be used for local control measures (e.g. for changeable sign systems) or be made available to other information systems. About 100 million DM will be put at the disposal for these measures.

In a further step and based on that, radio traffic information services will be improved by the gradual implementation of the ARIAM-system in all traffic control centers. By these means of communication, the regional radio traffic information services of the ARI-system will, then, be provided continuously with topical traffic information. This data bank could also be used for the radio-data-system RDS. But it can be supposed that a general provision with RDS-receivers will still take quite a long time so that for that period ARI and RDS could be used simultaneously.

In a further step, then, an integrated traffic information system is to be developed. Within the scope of a research project, it has been suggested to connect the above-mentioned regional traffic control centers among each other in a data network, to design a central traffic data bank system to connect the media to that data bank. So, it would be facilitated that beside the radio the teletext-system and the viewdata-system could also be provided with traffic information.

For the viewdata-system, an overall conception "traffic information" has already been developed. The provision with data on topical traffic and weather conditions should be carried out by means of the above-mentioned central traffic data bank system. So, in future, forwarding agencies, shippers and road hauliers can get information via open public information systems. It is also conceivable that a direct access to a data bank system can be created. Then, appropriate data could directly be taken into the own data stock and optimal plannings of routes and times could be carried out in the own data processing system under consideration of current data on traffic and weather conditions.
JUST-IN-TIME TRANSPORT BY INFORMATION CLEARING AND DATA EXCHANGE MANAGEMENT AND COMPUTER-BASED COMMUNICATION SYSTEM

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Just-in-time-transport by information clearing and data exchange management and computer-based communication system

by

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THE EXAMPLE

This example of a commercial communication system is founded on a normal case of transport service demand in Europe. It stands for the reality of high quality of data exchange programs standardised between the partizipants, implementated for fulfilling logistic aims, and realised by medium-sized firms of road haulage and by a service centre for data processing.

THE RESPONSIBILITY

The automobil producer ADAM OPEL AG who has factories in Spain, Belgium, Great Britain and Germany was asking for a better controlling system of the car delivering in Germany, some years ago. Just-in-time-transportation was wanted for all of cars outbouned from the european factories. All of the cars produced in Spain or Belgium or in Germany, and some of car components produced in Great Britain, should been delivered under a perfect controlling of car's informations and delivery timetable, every-time and everywhere.

The aims and tasks of that demand can be described as follows:

Each car, if produced in Spain, Belgium or Germany, should be under a logistic controlling. Time of transportation, time of waiting and time of handling are to be minimized during the carry out operation.
All informations concerning the state of car delivering have got to be actualised at any moment.

The controlling of timetable should be supported directly by computer facilities for getting a complete and actual reliability of all data and informations of car delivering at every hour and for every place.

For each european factory, only one enterprise should handle the delivering orders and informations, and should also hand over the cars preparing the transport operations.

Everyone of the delivering enterprises should be in the position everytime to get, respectively to take over the state-information of all of the outbound transports from every factory. The reason is to develop a workable co-operating among the delivering enterprises so that everyone is able to look at the relevant technical and commercial informations of delivery orders. The conditions of this frame are strictly defined as described as follows:

- as soon and quickly as possible
- without any doubts and mistakes
- with all advices for dispatching the delivery operation how necessary
- at the place where the informations are actually needed
- in a workable manner for all kind of captures, especially for data captures by inhouse-computer-processing of the partizipants
- everyone of the delivering enterprises who did not have any computer system should get one at low-cost-level.

Seven german forwarding and transporting companies took up this responsibility and realised a complete data interchanging system, only in 6 months. They founded a carry out company for this special responsibility, only for delivering cars from the ADAM OPEL-factories, and developped with GSI/Datel Corporation and its Computer Accounting Centre a communication application which covered all demand points. The costs for that plan and system configuration were only 60,000,-- DM.

THE SYSTEM CONFIGURATION

Network outfit

One of the basic problem was to configure a network of communication links between all of the partizipants and more than 20 offices in Germany. Half the companies were not equipped with electronic data processor- or linkable computer systems. Other companies used software-systems which were not capable to go conform with the new requirements of data exchange operations. Another problem was given by car distribution: some places were
very often frequented, other places not. Therefore, some places needed a small frame for data processing and electronic communication, other a larger capability.

For all of these problems, an overrunning solution was not thinkable, and experiences of such a complicated responsibility were never been gained before. At least, the created solution which was found out was built on the principle of data clearing by combined communication. That does mean the service of a data and information clearing house which couples up the technical, informational and commercial works of communication by own adapted services. The GSI/Datel Corp. put into her commission a complete framework for data transformation interior of Europe, and was at disposal of the carry out company of the transport firms. By the new conception, it was possible - to adapt the different structure of the sets of data among the participants
- to adapt different software lines
- to stock informations and sets of data for everyone of the co-operating companies
- to transfer data in Germany and Europe on the same network
- to take off data processing for the participants, and to support the marketing of the customer's software
- to give statistical service for all of the participants.

This new conception brought a very high level of data and information exchange with a high priority for a quickly data transmission in long distances, and with a high priority for data interchange among the delivering companies.

Organization

The information and data flows are organized as follows: the factory as the producer sends all carry out information to the central computer service of ADAM OPEL AG at Rüsselsheim (see map on the next page). At this computer centre all data and informations of outbound orders and produced cars will be collected there. From this centre, all sets of data and information are going directly to the central computer of the "clearing house" GSI/Datel Corp. at Darmstadt. Both computer are conducted by direct line. The transferred informations contain all delivering instructions, for example the number of production typ, kind of model, wheels, delivery region and place, the name and address of the supplier, the transport operator etc..
The communication system frame for car delivery of a transport co-operating group in Germany

COMMUNIKATION AG
In the "Clearing house", the transferred sets of data and information are decoded by various key-tables and schedules. That is what we call "data clearing" and what is the reason for the name "clearing house". To all cleared sets of data, some special advices and instructions are added for the information handling by the dispatching, controlling, or accounting so that they are completed for a perfect trail of timetable monitoring.

After clearing, the completed sets of data are going to the enterprise determined for delivering by the car producer. This data shipment is bite-sizedly prepared for the receivers, and is also available for other participations of the carry-out organization.

The clearing house is open 24 hours per day and 365 days per year. The participated forwarders use the service for their own delivery management, i.e. for optimizing the needed transport capacity, the warehousing time, the performance intensity etc.

Each movement of data processing is controlled by a special registration service. The kind of data movement, the day and the day-hour are put into the set of data itself as a separated detail. The status of data transformation is always visible by this information detail.

This special monitoring service of data transmissions supports the general aim to control the information flows from the producer to the receiver, at every time of data exchange.

In the overall view, the communicating and monitoring system consists of six stages as shown in the next schema:
### Arrival at destination rail station

Transmission of the data of the dispatched car loadings i.e. re-loadings of cars to the clearing house. At the same time, announcing the arrivals of the cars to the computer centre at Rüsselsheim, directly.

### Stand-by operating of the cars for delivering or re-expedition by the delivering enterprise

Recalling the readily retrievable informations of the completely dispatched deliveries on time incl. printing of the delivery notes.

### Unloading resp. re-loading of the cars at place of hand over for delivering

Transmission of the hand over confirmation from the railway station to the clearing house by the delivering enterprise.

### Delivery to the supplier and hand in

Transmission of the hand over confirmation to the producer at Rüsselsheim.

---

Results of computer-based communication system

The results of such a computer-based communication and data management system can be resumed as a successful project:
The monitoring and controlling of the data exchange and the information flow are given as possible at every step of the transport operations as well in the clearing house as in the computer centre of the car producer. All relevant information are readily retrievable.

- when the cars are been handled for outbound transportation
- when the cars are handed over from the transportation system for long distances, at the factory
- when the new cars are arrived at the destinated railway station
- when the cars are in stand-by-positions for unloading or reloading operations
- when the arrived cars are dispatched for delivering or further distribution
- when the cars are loaded on distributing vehicles
- when the cars are delivered and handed in to the suppliers.

By this clearing house services system supporting the co-operation of the delivers and forwarding undertakings, the logistics of the car producer are evidently and contiously improved. The management structure has got a new quality of pre-timing planning the transport operations. The situation before and after using the data communication and clearing services makes it clear:

<table>
<thead>
<tr>
<th>Significant points of the advantages of the data clearing and communication system of GSI/DateiCorp.</th>
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<tbody>
<tr>
<td><strong>Situation before</strong></td>
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<tr>
<td>Many forwarders handled the car deliveries uncoordinately</td>
</tr>
<tr>
<td>No optimal utilization of working time, less individual and personal services, less qualification of just-in-time-delivering</td>
</tr>
<tr>
<td>High costs level of data and information exchanges, a great plenty of phone calls, telex, and reclamations</td>
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</tbody>
</table>
High quota of mistakes | Low quota of mistakes
---|---
No announcing concerning the status of car delivering and of being on time | All information of car delivering status including state of timing for the producer and the carry out under takers.

The computer centre of ADAM OPEL AG is always in the position to recognize and to control - the wanted timetable of car deliveries - the non realised delivery times - the times of running - the stand-by postions of transported cars - the qualification of the staff

and to evaluate the quality of all of the service performances.

The most effect of such a co-operating system by computer-based communication system is that many information can go to the next partizipating co-operator on a good time. This pre-running of informations accelerates the putting on and stand-by planning of performance so that the operations can be done like easy.

THE FUTURE ASPECT

The recently reached point of the developement of a workable communication system is the starting point of a further implementation of computerized information exchanges. The partnership of the seven enterprises and the car producer wants to go in a greater frame of communication services. They plan to extend the data processing and interchanges also to freight accounting crediting stocking, supplying administrations and to statistical evaluations, as the scheduling of this planning is shown on the next schema.

The clearing house principle coupled up with the possibilities of inhouse-system demonstrates a very succesful way of using the advantages of modern communication technologies and of executing the advantages of more co-operations in the medium-sized world of road transport.
The scheduled relations of information flows of the system as a whole

<table>
<thead>
<tr>
<th>Communication Fields</th>
<th>Producer, Factory</th>
<th>Data Clearing House</th>
<th>Transport Operator</th>
<th>Forwarder</th>
<th>Supplier</th>
<th>Bank</th>
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<td>Delivery orders Announcing</td>
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<td>Confirmation of commission</td>
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<td>Hand over confirmation outbound</td>
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<td>Priorities of deliveries</td>
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<td>Reclamations</td>
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<td>Freight accounting</td>
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<td>Accounts of service</td>
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<td>Freight controls</td>
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<td>Creditings</td>
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<td>Cash flow</td>
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<td>Tarification</td>
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<td>Statistical evaluation</td>
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JIT IN PRACTICE. EXAMPLES OF CAR INDUSTRY
AND DELIVERY OF LARGE STORE SCHEMES
Mr G. Hazle, Director
B.R.S. Midlands Ltd., Derby, Great Britain
In this paper, we plan to talk about our experiences as a transport supplier working under the demands of JIT. We shall describe the operations and the demands placed upon us by two of our major client accounts - Ford Motor Company of Great Britain, and Mothercare, a high street retail chain majoring in babywear and children's clothing. We shall attempt to describe our adaptation to these demands and the needs which we have found necessary.

1. BRS

BRS is a national UK transport operator and supplier of transport and distribution services to many major companies and organisations in the UK. Prior to 1982 it had been in the state sector, but is now the largest subsidiary of the employee owned National Freight Consortium.

The company's traditional markets and concentration of activity had been on haulage for hire and reward. A large market place and demand for haulage could afford unspecified and non-allocated fleets which were made available only to respond to the day to day demands of customers own, manual, traffic delivery scheduling. The system was only geared towards transport as a "restocking" resource which could be selected at will and which responded mainly to the needs of manufacture. This market has shrunk as the emphasis has swung increasingly to transport influence coming from the end user - retailer, buyer etc. and the increasing importance of dedicated, managed fleets.

2. FORD

This is not strictly a "just in time" operation but an ex works consolidation scheme in which the buyer, in this case Ford Motor Co., chose to purchase and influence the transport of vehicle parts from suppliers to assembly plants.

BRS Midlands operates the Phase 1, Midlands ex works area (the largest in the UK), begun in 1982/3. In this operation, parts from 350 suppliers across the Midlands of England are collected daily for consolidation at BRS' own consolidation centre at Birmingham. From there trunk services supply Ford assembly plants in the UK on a nightly basis.
This scheme achieved the following objectives for Ford:

- Reduced transit times
- Daily or multi-daily deliveries at low cost
- Computerisation of in transit data
- Reduction in the number of vehicles delivering to plants and receiving stores
- Inbuilt ability to pick up from peripheral suppliers by extension to collection rounds, and lower rescheduling costs
- Centralised control of Freight movements
- Increased control on damage liability
- Application of controls to packing specifications
- Concentration of purchasing power
- Increased ability to control inventory

Through computer links, Ford parts demands are translated to order pick up requests from suppliers to BRS Consolidation centre. BRS makes these pick ups, sorts to trunk services at Birmingham and despatches overnight to each plant. Transit times are around 14-16 hours and always less than 24. In addition, a parts tracking system identifies and locates material at any stage in the chain. Measurement of performance is quick and simple. If we don't get the parts to the plant, the assembly line stops!

3. MOTHERCARE

In this, new (1986) example, BRS operates within a stockless, warehouse to shop delivery system. Turning over all high street store space to selling area meant finding a transport system and a contractor who could supply stores and replenish shelves on demand.

Introduction of EPOS (Electronic Point of Sale) reordering systems ensured that orders could be quickly made available. The BRS system, however, had to guarantee 24 hour delivery to all UK Mothercare stores, however small the drop.

In this case, it is the vehicle and equipment design which provided the system solution. A system of drawbar combinations with demountable box bodies, operating with a system of regional outbase locations ensured that local van delivery to shops could be achieved for small orders anywhere in the UK on a next day scheduled basis. The kind of traffic flow projected had suggested that a networked or parcels operation would be required. However, such a "common user" operation cannot give the reliability created by dedicated equipment and schedules.
This system identifies the increasing need for the transport supplier working under a JIT system to have the kind of resources (eg regional outbases) to ensure that a total solution which combines specially designed equipment, regional locations and dedicated management can be provided.

4. CONCLUSION

The practice of JIT transport, particularly where this directly reflects a user's demand for improved service, lower stocks etc, can have very different effects, as seen in the examples, but some characteristics emerge as common:

- Dedicated management: although the JIT demand increases the likelihood of a need for dedicated vehicles and resources, there is an absolute demand for dedicated control and management systems. There is an increased "tenseness" built into the transport process which requires more than resource allocation and minimising downtime or slack. The process is "paced" and the concentration on service quality, leadership etc are the management tasks. Only companies with these capabilities can take such operations to their portfolio.

- Resource Reliability: coupled with the management attention towards service and leadership, each of the examples given above needs absolute reliability of resources. This holds true whether these be vehicles and equipment, computers etc or the road system which is our factory floor. We must have the ability to schedule and predict departure and delivery times with an accuracy still not available. In both examples, however, the need for reliability has contributed towards an increased sophistication in driver communications and tracking - in Ford's case by in cab radio telephones; for Mothercare, a vehicle operating sensor system which tracks all the data of the vehicle in operation.

BRS Midlands supplies these transport services in partnership with the users who are its customers. The confidence of a term relationship, and of a dedicated, guaranteed supply makes a JIT system possible. Leadership, and the people on whom it depends do the rest.
ACTUAL "JIT" PICTURE IN JAPAN'S PD INDUSTRY
Mr Toshiaki Nojiri
Nittsu Research Center, Inc., Tokyo, Japan
ACTUAL "JIT" PICTURE IN JAPAN'S PD INDUSTRY

TOSHIAKI NOJIRI
(NITTSU RESEARCH CENTER, INC., Japan)

1. Introduction

"Just in Time" (JIT) as an epochmaking production control means established in Japan is generally understood to be a system of feeding a producer with any necessary kind of materials in any necessary quantity whenever necessary. The "JIT" concept, represented by Toyota's "Kanban System", is applied to minimize inventory cost in production control. Today, typical automobile manufacturers use the JIT system so many manufacturers are adopting it.

Due to the current progressive maturing of our economic society or our consumer market, there is a growing trend among Japanese consumers away from materialistic wealth toward spiritual values. Their spending is therefore likely to become stagnant. Moreover, the diversification and personalization of consumer needs amid such a trend has come to conspicuously shorten the service life of each and every commodity. All this means that our market, long content with mass-produced goods of a rather limited variety, has come to find itself called upon to supply an increasingly wide variety of goods if in somewhat more limited quantities.

Under these circumstances, producers here are faced with the possibility of huge stockpiles of unsold goods on hand unless they mend their old ways of mass-producing goods with undue heed to their variety. More often than not, many a business here has come to find it imperative to employ a JIT program in order to minimize its excessive stocks on hand. In fact, such is already the case even with smaller retailers. They are, invariably called on to keep on display short-life goods of a vast variety well suited to widely differing customer needs. They are bound to fail to register a turnover quick enough without adopting a JIT program.

Under such circumstances, not only such merchants as wholesalers and retailers but also various physical distribution (PD) businesses, including transportation companies and packing-and-crating businesses are beginning to adopt a JIT program amid what may well be described as a PD-cost saving race.

Outlined below in this article is the current JIT picture of the PD industry in general, and that of the trucking industry in particular. Let us note that the availability of a highly advanced information system is a vital prerequisite to a successful attempt to develop a JIT system by any PD business.

2. JIT and PD

As mentioned above, a vast change is being brought about in the production and PD activities of manufacturing businesses as a
result of the metamorphosis of the nation's industrial structure. And the resultant trend towards lighter, thinner, shorter and smaller products for "variety maximization" purposes. In other words, many such businesses are finding it necessary to build up a new operational system which can directly respond to market requirements through a "produce-to-order arrangement". Also a system under which they can readily reflect any fresh consumer need in their merchandise development and their production plans.

Also essential is a new PD system which will enable them to reduce their stocks to a minimum.

Constant progress towards this end has led to attempts to make the utmost use of the JIT concept to make the PD system still more efficient in terms of both costs and performance.

Specifically, efforts are being made to reduce the gap between consumer needs and production planning so as to reduce stocks to the bare minimum. Also in terms of how market information can be made more speedily obtainable and usable through such a system.

For industrial products such as automobiles, apparel, foodstuffs, sundry goods and business machines, the JIT concept is already taking the shape of a concrete PD system with the aid of different data communication know-how. Physical distributors serving the manufacturing shippers of such products are faced with a strong demand to establish yet more efficient JIT transportation services. The Japan Trucking Association, for instance, learned through a survey of manufacturing customers made in March 1986, that between 70 and 80 percent out of the surveyed were calling on physical distributors to improve their delivery deadlines and lead-time length. That is in the face of a growing number of emergency orders these manufactures needed help to cut down their stocks and to establish computerized production-sales links. It is primarily by trucking businesses that all these highly sophisticated PD needs on the part of manufacturing shippers can be satisfied.

Among different means of overland transportation, the truck has been playing the principal role in Japan since as early as the 1960s. This role has gained great importance since Japanese National Railways (JNR), whose cargo handling volume peaked in 1964, began to lose ground in the latter half of that decade. The truck's dominant position remained unchanged even in the wake of either of the two successive world-wide petroleum crises of 1973 and 1978 despite their revolutionary impact on our economy. In recent years, as much as 90 percent of the nation's annual total tonnage of cargo transportation by land has been accounted for by trucking. (see chart 1)

Also noteworthy is the fact that the truck has come to be adopted as the key means of land transport for more and more categories of goods essential to the national well being. According to fiscal 1985 figures, the weight carried by the truck accounted for 99.9 percent of sundry daily necessities, 95.1 percent of vegetables and fruits, 94.1 percent of processed foodstuffs, 94.0 percent of metal products, and 90.2 percent of textile industry products. It is thus no exaggeration to say that today, the truck is the most important means of transportation to national life.
The truck's flexibility in deference circumstances and its marked manoeuvrability are factors behind its unchallengeable position as a land transport means. But there is also no mistaking the fact that the truck owes what it is today to the tireless endeavors of individual trucking businesses to constantly improve their services in terms of both soft-and hard-ware so as not to fail to measure up to our economic society's ever-changing requirements and their customers' increasingly varied needs.

Such endeavors by the Japanese trucking industry today are taking on a wide variety of new forms and shapes in the face of the manufacturing industry's accelerated trend towards wider product variety. This is as a result of extensive application of the JIT concept and know-how.


In response to the fast multiplying and increasingly sophisticated needs of users, the trucking industry has been developing a variety of new services designed to handle different cargoes of a fast dwindling volume but of a quickly widening variety on a 'Just-in-Time' basis.

(1) "Takuhai" Service
"Takuhai" (small-package service) or household cargo forwarding is one of such services.

The history of the service in question is traceable to the general household's transportation need involving small-package cargoes. Today, however, commercial PD needs related to small-lot consignments of local business concerns are already accounting for more than half the total volume of "Takuhai" service cargoes. As will be clarified below, those in service as "Takuhai" cargo forwarders are already primarily intent on meeting such customers' JIT transportation needs by introducing still better structured JIT service network.

Until recently no cargo originating in separate households had been regarded as a promising income source for transportation businesses in view of the high costs and thin profit margins involved. Today, however, small-package cargo forwarding is becoming a very valuable new transportation service for its operators as well as for its users. (See Chart 2)

Including the simplicity of its service tariff and the convenient locatability of its terminal agents, various factors can be cited to account for the rapid growth of this service. However rapidity and reliability are considered as by far the two most important points for it.

Specifically all the principal "Takuhai" service operators have built up a nationwide forwarding system linking any two given points in Japan within 24 hours (next day service). This is with the aid of such cargo-terminal facilities as a high-speed cargo sorting apparatus and radiophonic systems commanding all trucks on the road. Moreover, a cargo tracing system designed to readily respond to inquiries or
complaints from users is maintained to further improve the accuracy and reliability of "Takuhai" services. Already in Japan, 40 transportation businesses are providing a household cargo forwarding service with the cooperation of 107 associates and handling some 620 million pieces per annum of "Takuhai" service cargo. By all indications, this new service has fulfilled all basic requirements on the part of users. Requirements such as reasonableness of rates, high degree of rapidity reliability and accessibility. The service will continue to prosper along with various other related new transportation services.

In terms of "rapidity", incidentally, some "Takuhai" services are already provided on a "deliverable within 6 hours" (same day service) footing. With other services being provided on a "deliverable at any designated time" basis, household cargo forwarding is taking on more and more advanced aspects.

(2) Delivery Agency Service

Another instance of trucking businesses' JIT practice can be found in their so-called "delivery agency service". The service in question consists of a systematic commodities supplying arrangement between a single appointed physical distributor, on the one hand, and a department store, supermarket or any other store retailing a wide variety of merchandise in large quantities, on the other. This purpose of enabling the latter to collectively and exclusively receive from the agency all its commodities supplies in the necessary quantities whenever necessary instead of calling on individual wholesalers to supply it with all its widely varied merchandise. Under such an arrangement, it is also possible for individual mass-retailing establishments to leave their appointed PD agents in charge of price-tagging, commodities inspection and assortment, and various other merchandise dressing chores. In other words, the physical distributors active as delivery agents are now helping establishments keep abreast of ever-changing shopping trends on the part of their customers and facilitating their "lead-time" cutting efforts through yet more timely assortment of goods.

So physical distributors serving as delivery agents are thus capable of providing a comprehensive PD service far superior to their original cargo transportation function and, their client establishments are drawing from that service a great benefit in the form of reduced warehousing costs. For instance, a certain Tokyo department store is reported to have cut down on their inventory cost burdens by more than 20 percent by cashing in on a delivery agency service system.

"JIT" as a production control system is already well established among a number of shipper businesses and some automakers are especially noted for theirs. Since much is already known about such businesses' "JIT" arrangements, no further references are to be found here.

Incidentally, in order for a trucking business to successfully embark on such a JIT transportation undertaking as "Takuhai" service or a delivery agency service, there must, first of all, be made available for it a data processing system using various information equipment. Outlined below are some such systems and equipment.
(i) VAN (Value Added Network)
Systematization of information has been greatly accelerated since the recent development of the so-called conversion software known as the VAN service. This is instrumental in making instantly communicable to each other any two computers or their respective terminals that operate with different software. Today, the service in question is performing its data converting role in a wide variety of ways ranging from packet and facsimile transmissions to a telephonic circuit closed to two given parties.
It is by making active use of the VAN service that cargo tracing, cargo data collection, message interchange and various other information activities of local trucking businesses have been made possible. It is also possible for a single transportation business to provide such an advanced service as a nationwide rapid "Takuhai" service by building up common information networks such as the VAN between similar businesses.
More and more shipper businesses are letting their respective VAN-using trucking agents additionally perform various office work on their behalf. This is because by making use of their trucking agents' VAN, many shippers here are able (1) to cut down on their order-receival and acceptance paper work, (2) to save much of their communication expenses for order-receival and acceptance, (3) to lessen their given lead-time requirements, (4) to compile orders' data into trade statistics for the evaluation of different outlets for their merchandise and (5) to facilitate the discharge of their shipping and forwarding responsibilities and release themselves of their inventory controls, merchandise dressing and other PD-related chores.
All this should enable trucking businesses to enjoy a stabilized patronage while further improving their services for customer benefit. (See Chart 3)

(ii) MCA and AVM
If any transportation businesses is to ensure a high degree of door-to-door collection/distribution service efficiency with respect to a dwindling quantity but widening variety of commodities, it is absolutely necessary to equip each one of its trucks with wireless communication apparatus.
In fact, the number of trucks with such a radio has been steadily increasing in recent years. As a result, the range of frequencies available for such wireless apparatus has narrowed considerably, particularly in urban districts. MCA, short for Multi-Channel Access System has been to deal with this problem. The system in question went into operation in Tokyo and Osaka in 1982. With its complete immunity to outside interference, its relatively limited susceptibility to poaching, and the fact that an MCA license is more easily obtainable than any other commercial wireless license, the number of MCA operators among trucking firms has increased very rapidly, particularly since 1984.
Some trucking MCA users, however, are no longer content with this system's service as a mere vocal communication means. They have thus
combined it with their house computers into an automatic cargo booking command setup designed to additionally and simultaneously transmit nonvocal cargo information data to and from individual trucks out on the road.

Furthermore, AVM, short for Automatic Vehicle Monitoring, which is also finding its way into trucking businesses, is intended to make it possible to deal promptly with unexpected urgent, unexpected orders from casual customers. Since individual trucks' whereabouts and space utilization condition can be conveyed using this system, any demanding shipper requirements are now negotiable not only with utmost accuracy and speed but also with utmost cost efficiency. (See Chart 4)

4. Poor Road Conditions - Negative JIT Service Factor

JIT transportation services have so far fairly well measured up to customers' needs and expectations. This is due to their providers' tireless efforts to further improve their systemized activities, including their cargo data processing operations, as seen above. However poor road conditions a major threat to their sustained success, have tended to thwart continued growth. Not only in Tokyo and Osaka but also in pivotal cities in other parts of the country, there remains unsolved a chronic problem of road traffic congestion. This not infrequently renders it impossible for trucks to move from one given point to another within a pre-calculated or pre-fixed space of time.

5. Conclusion

It is clear that in Japan united efforts for the enhancement of PD efficiency and rationality have been made by both shippers and trucking businesses. Already such efforts have resulted in the establishment of various PD systems based on the JIT conception.

Any transportation business about to start a JIT transportation service will find it necessary not only to build up a cargo information system but also to procure such facilities as terminals and warehouses and such equipment as automatic cargo sorting apparatus and retrieval machines. Such a major task cannot be achieved without a vast fund-raising capacity and such other fundamental factors such as managerial and engineering capability.

Such a transportation business will have to be prepared to tackle such problems as (1) how to secure a proper service frequency. Or how to finance an adequate number of vehicles and drivers without raising its service rates to cover any increases in operating costs. (2) How to deal with the growing labor resentment over the undue length of driving employees' working hours. (3) How to minimize the risk of penalty payments for inability to see a consignment delivered at the appointed time and place.

Any of these problems could take on serious proportions for the existing as well as for the future JIT services and will probably have to be tackled in much more concrete terms in the years ahead than hitherto.
Chart 1
Medium-Wise Breakdown of Cargo Transport Tonnage &
Distance in Japan in Fiscal 1985

Railway Cargo 1.8%
Coastal Shipping Cargo 8.1%
Cargo for Business Use 33.8%
Trucking Cargo 90.1%
Cargo for Non-Business Use 56.3%

Railway Cargo 5.1%
Air Cargo 0.1%
Coastal Shipping Cargo 47.4%
Trucking Cargo 47.4%
Cargo for Business Use 31.5%
Cargo for Non-Business Use 15.5%

5.8 Billion Tons
434.4 Billion T/KM

Chart 2
Small-lot Cargo Handlerings in Number
in Millions of Pieces


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General Conception of VAN-Using Trucking Company's Delivery Agency Service

Chart 3  Flow of Cargo and Cargo Data from When Order Received to When Cargo Delivered

Order Receiver's Distributor Center  →  Cargo  →  Order Issuer's Premises

Notes: While the flow of cargo data is shown in solid lines that of cargo itself is shown in dotted line.

Chart 4  In Case Custodial, Shipping, and Dispatching Responsibilities Rest with Trucking Company

Wholesaler 1  →  Trucking Company's Data Center  →  Mass-Retailer A
Wholesaler 2  →  Mass-Retailer B
Wholesaler 3  →  Mass-Retailer C
Wholesaler 4  →  Merchandise Dressing Process
Wholesaler 5

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