Transportation planning : recent developments in the Netherlands

TRANSPORTATION PLANNING: RECENT DEVELOPMENTS IN THE NETHERLANDS

C. Bernhard Tilanus, Eindhoven

Abstract
In their Golden Age, the seventeenth century, the Dutch were the freighters and traders of Europe. They still are, to some extent. Then with ships, now with trucks.

This paper is an introduction to the section on Logistics and Traffic. Logistics has been restricted to physical distribution, which is logistics external to the firm. Traffic concentrates on transportation planning and vehicle routing. The Netherlands were canvassed more actively than West Germany, therefore the survey focuses on recent developments in transportation planning in the Netherlands.

Topics addressed are: the infrastructure for transportation planning, location-allocation case studies, algorithms for vehicle routing, and software packages for transportation planning.

1. Introduction

> "The Low Countries have as many ships and vessels as eleven kingdoms of Christendom, let England be one. They build every year near 1000 ships, although all their native commodities do not require 100 ships to carry them away at once."
>
> Walter Raleigh, "Observations touching trade and commerce with the Hollanders, and other nations, presented to King James. Wherein is proved that our sea and land commodities serve to enrich and strengthen other nations against our own", between 1604 and 1616. Quoted in C. Busken Huet, The Land of Rembrandt (in Dutch), Tjeenk Willink, Haarlem, p. 187.

In the seventeenth century, the Hollanders were the freighters and traders of Europe. But free trade was soon curbed by nationalist impediments, like Cromwell's Act of Navigation.

Today, there exists a foundation called "Holland Distribution-Land". Why? Because the Dutch still are traders and distributors, but legal obstructions in the European Community still abound and should be abolished (Van der Padt, 1986):

- Rotterdam is world harbour number one;
- Schiphol Airport is the fourth, and fastest growing, airport in Europe;
- the Netherlands have a 35 per cent share of total European inland shipping;
- the Netherlands have a 72 per cent share of non-bilateral, cross-EC, road transport;

Operations Research Proceedings 1987

- the Netherlands have a 75 per cent share of bilateral, Netherlands-Germany road transport - but this would have been 10 per cent higher if Germany had given more trip authorizations!

Thus there is a strong Dutch drive away from bureaucracy toward liberalization:

- early 1984: truckers blocked the Brenner Pass and the Mont Blanc Tunnel, as a retaliation against an Italian customs strike;
- May 1985: the European Court of Justice ruled that EC ministers should liberalize EC transport as yet, which they had been obliged to do as early as 1970;
- 1987: the average time loss for a truck border passage:
  * between the Netherlands and Germany is 45 minutes,
  * between Belgium and France is 2 hours,
  * between Austria and Italy is 6 hours;
  the costs of truck border passages in Europe (paper tariffs) are estimated at Dfl 100 million per diem;
- 1 January 1988: Benelux, Germany and France introduce the Single Administration Document (SAD); SAD replaces 30 different customs forms - but SAD still has 30 appendices!

This paper serves as an introduction to the section on "Logistics and Traffic." What do we understand by these terms? According to Oxford Advanced Learner's Dictionary of Current English, logistics is "supply, distribution and replacement of materials and personnel, e.g. for the armed forces", and traffic is "(1) (movement of) people and vehicles along roads and streets, of aircraft in the sky (2) transport business done by a railway, steamship line, airline, etc. (3) illicit trading". In the armed forces, personnel may be regarded as a peculiar kind of material (cannon-fodder: "men regarded as expendable material in war"). At any rate, I would like to drop "personnel" from the concept of "logistics".

For this section, it is appropriate to restrict the meaning of "logistics" still further, viz. to external logistics ("supply, distribution and replacement of materials outside the firm or organization"), since there are several other sections covering most of the internal logistics ("supply, distribution and replacement of materials within the firm or organization"), for instance the sections on:

- Production Planning and Inventory,
- Flexible Manufacturing Systems,
- Combinatorial Optimization.

When thinking of the subject of external logistics, many think of the sub-subject of transportation planning, and many even think of the sub-sub-subject of vehicle routing and scheduling. This is apparent from the contributions to this section.

Transportation planning is a lively subject nowadays, cf:

- in 1984, in the 26th International Meeting of The Institute of Management Sciences, the stream "Routing" got the highest average attendance in 40 streams;
- 1-2 June 1987, a special conference on "OR in Transportation" (NOAS '87) was held in Copenhagen;
- 16-19 June 1987, the "Third EURO Mini Conference on Transport Planning and Traffic Control" was held in Hercenovi, Yugoslavia;
- this section is the largest section of this conference, comprising 21 papers running in a stream from the first to the last session.

Why transportation planning is a lively subject, will be supported in Section 2 by an example. A survey of the papers on Logistics and Trafficfrom the Netherlands, to be presented in this conference, will be given in Section 3.

2. A problem and a conclusion

In the village where I lived as a boy, twice a day a horse-cart came along the single road collecting milk-cans for the local milk-factory. No vehicle-scheduling problem there!

Today, one dairy concern, DMV-Campina, processes all the milk produced in an area of about one quarter of the Netherlands, South of the river Meuse. The milk is collected (Bocxe and Tilanus, 1985):

- from 450,000 cows
- on 9000 farms
- for 14 plants
- by 250 tankers
- once every two or three days.

In that same area, in 1948, there were 41,000 farms and 119 independent factories. Between 1948 and 1983, milk production in that area increased five-fold, milk production per farm increased twenty-fold, and milk processed per dairy plant increased forty-fold. DMV-Campina has a large-scale, multi-depot vehicle-scheduling problem and the scale is ever increasing.

Vehicle scheduling is done in part by hand, in part, since 1975, by IBM's VSPX package. In 1982, Bocxe and Tilanus (1985) evaluated the nine vehicle-scheduling packages then available on the Dutch market, and found them all unsatisfactory to solve DMV-Campina's problems with VSPX, viz.;

- small changes in data input generating completely different routes, causing unwanted "unrest" with the farmers;
- bad scheduling of arrival times at the plants;
- no automatic assignment of farms to firms, hence no solving of the multi-depot problem;
- no scheduling of trailers as mobile depots; etc.

All programs in 1982 were batch programs. Since then, almost all newly developed software is interactive, often with visual display as well.
(I have been informed that professional route planners do not care for visual display of routes!) DMV-Campina is still busy developing satisfactory, interactive vehicle-scheduling software.

The persistent existence of this vehicle-scheduling problem and its increasing scale illuminate why transportation planning is such a lively subject nowadays.

Large scale is an important factor ("problem too small-scale" can be the cause of failure of projects, see Tilanus, 1985). A counter-example may illustrate this. At Van Gend & Loos, the largest transporter of goods in the Netherlands, transportation planning is done by hand. The computer is used for administrating the planning. The procedure is as follows. Van Gend & Loos has a 48-hours delivery service: the orders are received, say, today; the goods will be collected in one of fifteen regional depots tomorrow; inter-depot transportation will take place tomorrow-night; and the goods will be delivered the day after tomorrow. About 80 per cent of nightly inter-depot transportation is by fixed truck line service; 20 per cent is variable and planned by hand. Apparently, the

scale of the problem at Van Gend & Loos is not yet large enough to necessitate computer scheduling!

From the growing scale of transportation problems we may conclude that interest in transportation planning will remain lively in the future.

3. A survey of contributions from the Netherlands

When organizing the section on Logistics and Traffic, I canvassed the Netherlands more actively than Germany. Therefore, only a survey of Dutch contributions is presented. They may be representative of ongoing developments.

First of all, there is the infrastructure. Data bases, etc., form the infrastructure of transportation planning, as roads form the infrastructure of transportation. We have the papers:

- "Scheduling the construction of Dutch roads", by G.T. Timmer;
- "The handling of road network data", by J.M. van Rooijen;
- "A method for data collection for car navigation", by B.J. Beers;
- "The problem of "fuzzy" constraints in computerised planning", by P. Klapwijk.

Case studies make up the meat of transportation literature. They show what the problems are and what approaches to solve them are followed in practice. We have the following case studies:

- "A strategic model for the solution of the location-allocation problem of a major oil-company", by C.F.M. Stokx;
- "Location of Rotterdam fire stations", by J. Schreuder;
- "Geographical market segmentation", by C.J. van der Plas, G.J.R. Förch, G. van der Hoek, H.W. van den Meerendonk, J.J. Remmerswaal;
- "Aircraft-stand allocation at Schiphol airport: Problem description", by J.I. Spilker;
- "Aircraft-stand allocation at Schiphol airport: A decision support system", by K. Anthonisse, B. Lageweg;
- "Aircraft-stand allocation at Schiphol airport: An optimization procedure", by K. Anthonisse, B. Lageweg.

Finally, at several universities and in software houses, work is done on developing new algorithms and software packages. Not all are represented (e.g., Fleuren, 1986). Some are presented in the section Combinatorial Optimization (see below).

The savings algorithm still plays an important part here (Paessens, to be published). One reason that DMV-Campina did not want to consider a package based on the sweep algorithm, was that they had invested 2Λ man-years constructing a road network database consisting of 9760 nodes and 13,953 links.

We have the following theory and software papers:

- "A location-routing problem", by J.A.M. Beulens, A.W.J. Kolen;

- "Tourenplanung mit einem personal computer", by W.G. Kolenbrander;

- "Transportation planning - as easy as 1-2-3", by H.J.J. Uyttenhove;

- "Local search for constrained routing problems", by M.W.P. Savelsbergh (in section: Combinatorial Optimization);

- "New exact and heuristic solution methods for the vehicle routing problem", by A.W.J. Kolen (in section: Combinatorial Optimization).

4. Round-up

A working group of the Netherlands Society for Logistics Management (NEVEM, 1985) made a checklist of items constituting vehicle scheduling problems, indicating whether they are easy, not-so-easy, or difficult to implement in algorithms and software. At first, it was thought that all items could be attributed to three basic entities:

- objects, to be transported;
- addresses, from, to, or through which the objects are to be transported;
- means, i.e., vehicles, by which the objects are to be transported.

After a while, other basic entities were added, like a (road) network, chauffeurs, trailers. Classification of vehicle scheduling problems proved to be a bigger problem than it first seemed. Ronen (to be published) distinguishes 65 characteristics for a classification of vehicle scheduling problems. He concludes that there is a vast variability in truck routing and scheduling problems.

From this vast variability of vehicle scheduling problems, which is quite unlike "pure" mathematical problems like the LP problem or the traveling-salesman problem, we conclude that there is a vast amount of work to be done, developing algorithms and programs as well as applying them, which will keep many people busy for a long time to come.

References

Bocxe, M.A.G., and Tilanus, C.B., (1985) "Testing vehicle scheduling programs for milk collection", European Journal of Operational Research 20, 25-33.

Fleuren, H.A., (1986) "Trip generation in a set partitioning approach for vehicle routing and scheduling", Twente University, Enschede.

NEVEM (Netherlands Society for Logistics Management)(1985) "Automated route planning: Results of NEVEM working group" (in Dutch), The Hague.

Padt, A. van der, (1986) "Entrepreneurship at the European level" (in Dutch), lecture held at Eindhoven University of Technology, Faculty of Industrial Engineering and Management Science, 30 January 1986.

Paessens, H., "The savings algorithm for the vehicle routing problem", to be published in European Journal of Operational Research.

Ronen, D., "Perspectives on practical aspects of truck routing and scheduling", to be published in European Journal of Operational Research.

Tilanus, C.B., (1985) "Failures and successes of quantitative methods in management", European Journal of Operational Research 19, 170-175.