An innovative survey in the transportation and distribution sector

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An innovative survey in the transportation and distribution sector

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Introduction

In 1994 at Eindhoven University of Technology a project was begun; the BRAVO project. The objective of this project was threefold:

- (1) to integrate education and research by actively involving the students in the research;
- (2) to undertake multidisciplinary research with a team of scientists;
- (3) to actually improve the competitiveness of the Transportation and Distribution (T&D) sector in Noord-Brabant, a province in The Netherlands.

In the BRAVO project the T&D sector was split up into homogeneous segments. Next, for each segment, the key success factors were determined based on financial and operational data from 150 T&D companies. Based on these factors improvement projects have been started at 20 companies.

In order to be able to improve the competitiveness of the T&D sector the research was split into two projects:

- (1) an inquiry among shippers, to learn the requirements they impose on (logistic service) providers;
- (2) benchmarking among providers to find out the key success factors in the T&D sector.

The focus in this particular paper is restricted to:

- the way the BRAVO project is organized;
- the success factors of the BRAVO project; and
- the methodology applied in the BRAVO research, with special emphasis on the segmentation which is used in the benchmarking.

Conclusions are drawn in the final section.

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The organizational setting of BRAVO

The organizational structure for BRAVO (see Figure 1) contained five elements:

- (1) the steering committee;
- (2) the university coaching team;
- (3) the working group;
- (4) the project office;
- (5) the students.

Figure 1.
The organizational
structure for BRAVO

Below, each of these five elements will be described briefly.

The *steering committee* consisted of senior managers, directors and Civil servants. They represented providers, shippers, unions, regional and national organizations for providers, regional and national government, etc. The main function of the steering committee was to provide a link to industry and government. The national providers' organization (TLN) was part of the steering committee and proved to be very helpful in getting the co-operation of the transport and distribution companies.

The *university coaching team* consisted of professors from several disciplines such as logistics, management accounting and informatics. Their task was to assist the working group with their expertise on specific issues and to help to get continuous support for the project from the faculty.

The *working group* had two main responsibilities. First they set up the survey and, second, they prepared the students for this specific sector and coached them during the project. The working group consisted of six staff members from different disciplines. These staff members worked on average two-and-a-half days a week during a period of one-and-a-half years on this project.

The *project office* took care of all co-ordination, organization, sponsoring and communications.

The 19 *students* did all the interviews, cleaned the data, assisted in the analysis of the data and fed back the overall BRAVO results to the participating companies. After the survey each of them worked for seven months on an individual improvement project within a company, which resulted in their final thesis.

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Success factors for the BRAVO survey

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If other projects, similar to BRAVO, are set up in the future, it may be helpful to know which factors helped to make the project successful. Therefore, the success factors for BRAVO are discussed below. We distinguish success factors at three levels: the strategic, the tactical and the operational level.

The strategic level

At the strategic level the four main success factors were:

- (1) the organizational setting;
- (2) the focus on one sector only;
- (3) the focus on improvement;
- (4) the segmentation of the sector.

The organizational setting has been discussed in the previous section. It appeared that each of the five elements mentioned there was indispensable.

The focus on one sector only proved to be very helpful in order to get to understand the basic operations in the sector and to get in contact with so many companies. Due to the fact that the survey was restricted to road transport only, the national providers' organization was very co-operative.

The focus on improvement was very helpful in gaining the trust and co-operation of the companies. Especially in the small and medium-sized companies the directors are very busy. Therefore they are only too willing to spend time or money on research which clearly contributes to the improvement of their company.

The T&D sector is not a set of homogeneous companies. In order to get a valid comparison of "similar companies" in the benchmarking, a segmentation is crucial. To find the right segmentation may require quite some effort. The segmentation, which has been used in the BRAVO survey, will be presented in the next section.

The tactical level

At the tactical level it proved to be very effective to use the strengths of the faculty in the survey. In this particular case, the Faculty of Industrial Engineering and Management Science of Eindhoven University of Technology has its strengths in operations management and in staff members who specialize in different disciplines. Based on these strengths, the survey started with a thorough analysis of the operations, but also covered other disciplines such as marketing, informatics and social sciences. Also the segmentation of the sector

is heavily based on the operations: different operations lead to different segments.

Another important success factor at the tactical level is to find the right balance between teamwork and individualism, both for the staff members and the students. The staff worked as a team: during the entire project they decided together how to proceed and how to divide the tasks. At the same time, from the early stages on, there has been a clear focus on specific issues such as economics, operations, marketing, informatics and co-operation in the T&D sector. Each staff member was responsible for one of these issues.

The operational level

At the operational level it became evident that university staff members do not necessarily have all the skills to run a project like BRAVO. In general they are experts in specific disciplines, but are less experienced in areas such as project organization, getting and keeping a group of people motivated, acquisition of sponsors and professional communication. These lacunae could be resolved by involving professionals on these areas. The project manager, e.g. Professor Sharman, is also director of an international consultancy company. The Project office manager was a former operations management student. She fitted in perfectly between the staff members and the students and provided excellent support in co-ordination and communication. A copywriter and other professionals were hired to assist the project team in the communication of the results to the sector and the press.

The survey method

As mentioned before, the BRAVO project consisted of two different surveys: a survey among shippers and a survey among logistics providers. Each of these surveys will be discussed below. The emphasis in the discussion will be on the methodology, which has been applied.

The survey among shippers

The objective of the survey among shippers was to understand the requirements of the providers' customers: what are these requirements and how will they change in the future?

For this purpose a questionnaire was drawn up. The questionnaire consisted of 52 questions. In total 315 randomly selected shippers were approached (see Figure 2). Of these shippers, 48 per cent were willing to answer the questions. Of these, 75 per cent already outsourced (part of) their logistics activities. The shippers who outsourced part of their logistics activities usually outsource their transportation activities (95 per cent of these shippers). Only a small percentage (6 per cent) outsourced value-added services (also known as VAS).

The survey confirmed that shippers will increase their requirements: 69 per cent of the shippers will demand better delivery times and delivery reliability. More (accurate) information is demanded by 45 per cent of the shippers.

Another important result from the survey is the fact that shippers do not usually outsource their entire package of services. For example, 36 per cent of all shippers have a need for transportation, distribution and warehousing activities, but only 7 per cent outsource this entire package. About 90 per cent of the shippers outsource (part of) their transportation and distribution activities, whereas roughly only 20 per cent outsource their warehousing.

The survey among providers

The objective of the survey among the providers was to find the key success factors for T&D companies.

Benchmarking has been used as a tool to achieve this objective. In order to benchmark the T&D companies, the following steps have been carried out:

- (1) segmentation of the T&D sector;
- (2) definition of performance indicators;
- (3) development of models for the relationship between operational or financial factors and the company's performance;
- (4) formulation of hypotheses;
- (5) design and testing of the questionnaire;
- (6) selection of the providers;
- (7) execution of the interviews;
- (8) data cleaning;
- (9) analysis of the data;
- (10) integration of results;
- (11) feedback to the companies;

- (12) implementation via improvement projects;
- (13) refinement of the benchmarking tool;
- (14) transfer of the tool to the national providers' organization.

These steps will be elucidated below.

Step 1: the segmentation

Segmentation is crucial for benchmarking: comparing apples and pears makes little sense. In order to find a good segmentation it is important to recognize that, in general, T&D companies have two basic operations: driving and (un)loading. Companies whose core operation is driving are quite different from companies whose core is (un)loading.

In most of the literature, the distinction is made between full truck load (FTL) and less than truck load (LTL) companies. Whether or not an FTL-company's core operation is driving depends not only on the load, but also on the length of the haul. If the load is only transported over a short distance, and if it takes a relatively long time to (un)load the goods, the core operation of such an FTL-company will be (un)loading rather than driving. Harmatuck[1] recognized this fact. In his comparison of 19 T&D companies he explicitly looked at operational factors such as the length of the haul. Ebner *et al.*[2] show that, in case of distribution other operational factors, like the time needed per drop, may be important.

In the BRAVO project a distinction has been made between "transportation" and "distribution". In "transportation" the core operation is driving, whereas in "distribution" the core operation is (un)loading. This has been operationalized in the following definition:

"Distribution" is defined as the set of trips, which satisfy at least one of the following characteristics:

- The loading plus unloading time is greater than 50 per cent of the loading plus unloading time plus the driving time.
- The distance between the first and the last stop of a trip is greater than 50 per cent of the total distance per trip.

The remaining set of trips is called "transportation".

From the BRAVO sample it appeared that the distance-criterion in the definition above is far more dominant than the time criterion.

Apart from transportation and distribution a T&D company may also offer additional services such as warehousing or value-added services (VAS). No need to say that the operations in warehousing or VAS are quite different from the operations in transportation or distribution.

Based on the notion that the operations are very different for each of these services, these services constitute the first criterion for the segmentation of the T&D sector.

Other criteria for segmentation, which were found in the literature are:

- the type of goods which are transported or distributed[3];
- the size of the company[4];
- whether or not the trucks cross the border[4].

In the BRAVO project the second criterion for segmentation was “the type of equipment used”. The basic distinction on the type of equipment in the T&D sector is between general purpose trucks and specialized trucks.

Specialized trucks can be split up again in specialized equipment for:

- Container transport;
- Transport of building materials;
- Bulk transport of food, agricultural or chemical products;
- Temperature-controlled transport;
- Other transport.

The reason for this second criterion for segmentation was the fact that operations and/or investments may differ between these type of trucks.

For example, the unloading of a tiptruck will be very different from the unloading of a general purpose truck loaded with pallets. Moreover, a fully isolated truck with a climate control system is more expensive than a general purpose truck.

So, in the BRAVO project the following segmentation is used (see Figure 3).

Many T&D companies offer several services to their customers, and not just one. This implies that the benchmarking should not be done at the company level. Rather, for the purpose of benchmarking, the company should be split up in (artificial) segments, where each segment refers to one service with one type of equipment. The financial (excluding overheads) and operational data should therefore be split up into data per individual segment.

Figure 3.
The BRAVO
segmentation

At the end of the BRAVO project an evaluation of this segmentation was made. It appeared that the distinction between the services was very useful. Different services lead not only to different performances (see Figure 4), but also to different operational key success factors. In general transportation (i.e. transportation with general purpose trucks) for example, a key success factor is "the percentage of non-empty driven kilometres". Within general distribution there are other key success factors, such as "the number of stops per trip".

Figure 4.
The average
performance for
transportation,
distribution and
warehousing/VAS

The second criterion for segmentation, the "equipment used", did not lead to large distinctions in performance. Unfortunately there were too few data available on "specialized equipment" to determine the operational key success factors in those segments and to see whether they differ from the ones in "general purpose equipment". Although there is no formal evidence for the correctness of this part of the segmentation, it should be mentioned that T&D companies with general purpose trucks felt comfortable that they were not mixed up with companies (or segments) with specialized trucks.

By analysing the collected data, it was found that a more detailed segmentation may be beneficial. Within the segment "general transport", for example, the distance per trip appears to have impact on many financial and operational characteristics.

Companies within general transport which drive, on average, fewer than 500km per trip differ from the ones which drive more than 500km per trip. The differences are, for example, in average wages per driver, average turnover per hour and the number of trucks in this segment. Apparently "crossing the border or not" is not the decisive factor (T&D companies in Brabant are within 100km of the border); rather the distance per trip is important. A possible explanation

for this might be the fact that, if drivers drive a long distance per trip, they have to stay away from home for at least one night, resulting in, for example, additional expenses for meals and higher salaries.

Also within “general distribution” a further sub-segmentation may be beneficial. The analyses showed that the sub-segments “dropweight per stop less than 2,000kg” and “dropweight per stop more than 2,000kg” had both a different average performance and different values for many operational characteristics such as loading capacity, time needed per stop and number of stops per trip.

When the results were presented to the companies, they replied that another major distinctive factor within general distribution might be whether the distributor is a subcontractor for another large T&D company, or whether he works directly for a shipper.

Finally, the impact of the size of the company on the performance has been investigated. It could not be concluded that bigger companies perform better or worse. They do, however, have different characteristics. Their overhead, for example, measured by the support staff (in full-time equivalent) as a percentage of total personnel, is relatively very high.

Also, the degree of automation is higher in a big T&D company compared to a small T&D company.

Steps 2 to 5: performance indicators, models, hypotheses and the questionnaire

After the segmentation, performance indicators have to be defined. The benchmarking is done both at the segment level (for relevant financial and operational characteristics) as well as at the company level. The additional comparison at the company level is needed, since the overhead is not taken into account at the segment level. Overhead costs, like the expenses for office personnel, automation, marketing, etc. could have been split up and divided over the segments, but only in a relatively arbitrary way.

In the BRAVO project three scores have been defined: two at the company level and one at the segment level. The performance indicator at the segment level, called the “BRAVO 3 score”, is meant to compare how the segments perform on their operations. It is defined as:

$$\text{BRAVO-3 score} = \frac{\text{turnover per segment}}{\text{relevant costs, which can be allocated to the segment}}$$

Next, a model has been made, which shows how this performance indicator relates to several financial and operational factors.

The models for transportation, distribution and warehousing and VAS are all different. In Figure 5 part of the model for transportation is depicted.

These models (amongst other things) have been used to set up hypotheses. Examples of these hypotheses are:

Figure 5.
Part of the model for
transportation

- (1) The load factor is a key success factor in general transport.
- (2) The percentage of non-empty driven kilometres is a key success factor in general transport.

Based on the BRAVO data, hypothesis 1 had to be reformulated and hypothesis 2 was accepted.

Based on (among other things) the hypotheses, the questionnaire has been worked out. The purpose of the questionnaire was to collect information on the status quo of the sector as well as to collect information which could be helpful in finding the key success factors in the T&D sector. In total more than 100,000 data were collected.

The questionnaire covered the following chapters:

- General classification;
- Segmentation;
- Financial data;
- Operational data;
- Marketing and personnel;
- Relationships with shippers and other providers;
- Automation;
- Impression of the interview.

In the chapter on operational data, e.g., in the sub-section “transportation”, the following questions (among others) were asked:

- What was the total amount of kilometres driven?

- What was the total amount of empty-driven kilometres?
- What was the average (tonnage) load factor?

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Note that the latter question is derived from one of the aforementioned hypotheses. The questionnaire was tested before it was used in the benchmarking.

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Steps 6 and 7: selection of the providers and execution of the interviews

About 150 providers agreed to participate in the BRAVO project. Roughly speaking, a provider had on average two segments (in most instances in practice the companies were not formally divided into segments: the figures from the administration had to be split up by the respondent). Figure 6 shows how the number of respondents (on segment level) is divided over the segments.

Figure 6.
The number of respondents per segment

The providers were not selected randomly: only members of the national providers' organization were selected and particularly the medium-sized companies. Figure 7 classifies the T&D companies based on size (number of trucks) and shows the total number of T&D companies in Brabant and the number of respondents in the project (in comparison to the USA, the T&D companies in The Netherlands are very small).

The providers were visited by a team of two students. In most cases the respondent was the owner of the company. The interview took about two-and-a-half hours on average. Naturally the length depended very much on the number of segments in which the provider was active. It took the students considerably

Figure 7.
Classification of the
T&D companies in
Brabant, based on size,
and comparison with
the number of
respondents (as a
percentage of the total
number of T&D
companies in a
particular size-class)

more time to get all the information: they spent about two days per company. This time was needed for travelling, interviewing, cleaning of the data, and most of all, collecting the operational data. In most companies the financial data are registered formally. Only a few T&D companies, however, systematically collect operational data. Therefore it was decided not only to ask the provider for an estimation on these data, but also to take a sample to verify this estimation.

The students asked (among other things) for a sample of tachograph discs. Back at the university they analysed these tachograph discs and were thus able to find a second estimator for operational data such as average speed, average distance per trip, average time per stop, average time between two stops, etc. In total over 3,000 of these tachograph discs were analysed manually by them.

Steps 8 and 9: data cleaning and analysis of the data

After the collection of the data, they had to be checked. There were four ways to check the quality of the data:

- in the questionnaire some consistency checks were built in;
- the results of the students on operational data could be compared with the estimations of the provider;
- after each interview the students were asked to give a qualification for every chapter in the questionnaire;

- the data could be compared with data from other companies to see whether there were any outliers.

It was decided, in case of inconsistent data, to ask the students who interviewed the provider to get in touch with him again or, if this was undesirable, to make the best possible judgement. Particularly on the operational data the providers, when asked again, normally did not know better than their first estimation and intended to rely on the results from the sample. The quality of their estimations on the operational data appeared to be quite good for “transportation”. For “distribution” it appeared to be more difficult for them to make accurate estimations. This confirms that, in general, most of the providers do not measure and control their operational factors explicitly. The chapters of the interviews, which were qualified by the students as being of insufficient quality, were left out from the analyses.

Correlation analysis was one of the tools used to see which financial and operational factors were critical for the success within a segment. The hypotheses were used to determine which factors should be compared first with the BRAVO-3 scores at the segment level. After testing the hypotheses extra analyses were executed to find additional key success factors. The results of all analyses are reported in the paper of Van Donselaar *et al.*[5].

In the correlation analysis it appeared that outliers may have a strong impact on the results. In Figure 8, for example, one observation differs very much from the rest. Simply using correlation analysis here will lead to the conclusion that there is no relationship between the two variables. If the outlier is omitted however, there might exist a relationship. It was decided to leave out clear outliers from the correlation analysis.

Figure 8.
An example of an outlier

Steps 10 to 14: integration and feedback of the results, implementation, refinement and transfer of the benchmarking tool

The results from the analysis of the data were combined and integrated into a storyline, which could be communicated to the sector.

The individual companies got a specific feedback report in which their performance was compared to the performance of other T&D companies. Also a report was made which summarizes the conclusions for the sector as a whole. The basic message from this report has been presented to the sector in a meeting, attended by 200 persons (mostly owners/representatives of T&D companies).

The first part of the BRAVO project showed which factors are critical for success. The next step in the BRAVO project was to investigate in 20 companies *how* the key success factors could be improved. Each student was assigned to one company (or a group of companies) to work on this for seven months. The results of this part has been communicated to the sector by means of a symposium.

The final step in the BRAVO project is the refinement and transfer of the benchmarking tool to TLN, the national providers' organization. TLN wishes to use this tool to advise 2,000 of its members on how to improve their competitiveness.

Conclusions

The integration of research, education and knowledge-transfer to industry has proved to be successful. In particular the focus on one specific sector of industry helped to understand the business and to win the co-operation of the companies. In order to benchmark these companies in a meaningful way, segmentation is crucial. In the BRAVO project segmentation was based heavily on the operations. Furthermore, different operations led to different key success factors. Therefore it is essential in the benchmarking to split up each company in segments, where each segment is focused on one type of operation.

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