A SIMPLIFIED CLASSIFICATION FOR FREIGHT TRANSPORTATION SURVEYS

(19 pages)

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ABSTRACT

The movement of goods is a type of movement that can be measured in many ways and by many means. The measurement of these movements is necessary to evaluate and assess the impacts of freight transport on multiple aspects. This paper reports on the classification of freight transport surveys in the context of comparing, inventorying and identifying the most important parameters of surveys and the most appropriate survey methods depending on the issues and consequent data requirements. While transportation stakeholders, policy and decision makers need freight information for better planning, this research was put ahead to help build a simple tool for them to use and find the right path to embrace for their data collection projects.

Keywords: freight, goods movement, data collection, collection method, transportation survey, survey tool, survey classification

CONTEXT

When it comes to mobility, either people or goods movements can be studied. Transportation planning has to come from the observations and forecasts provided by studies focusing on both objects.

In order to exercise better planning, decision making or analyses for the mobility needs of the population, as for people's and goods movements, we do need status reports, data treatments or, amongst many, modelling. All these requirements for a better moving future are feasible only if data is available for analysts, managers, stakeholders and decision makers. Therefore, data needs to be collected!

O-D surveys are often used among other tolls used to analyse people's mobility. For example, in the Montreal area, these types of surveys are conducted every 5 years since 1970, and their process has always been refined. O-D surveys allow transport planners to better understand how people move, and to plan more precisely for the future mobility needs.

As for goods movement, some surveys were conducted over time, but none to the extent of the O-D surveys on people's movements. Some useful studies can be found on the subject, but most of them are not renewed, so they do not last over time. Therefore, the comparability of such studies becomes really difficult. It is also difficult to identify the parameters leading to success from past surveys.

A data collection needs to be planned and organized ahead for it to be useful. The purpose of the data collection has to be well defined, and the results wanted have to be known and identified prior to the collection. All this preparation is needed for the collection to be well conducted and for it to be efficient.

When we look upstream to this process, we can identify the first step to better collect data: identify the data collection parameters that will lead to the success of this operation.

The surveys' classification tool aims to help data collectors during that first part of the process. It is common practice to review past data collection by others to identify parameters of success and successful methods for collecting the right data. This tool tries to regroup the information found on surveys reviewed in order to simply, quickly and efficiently compare them afterwards.

Literature review

Several authors think that we need to collect freight data more efficiently. As the efficiency of a data collection is function of the planning of the survey, it is relevant to check first what these authors have written about it.

In a large report on freight data collection in Canada, the Transport Association of Canada (Kriger & al., 2007) identifies the lack of comparability of different data sources as a challenge to meet. As part of the problem, they reveal that data sources aren't always compatible over many aspects: geographical zones, origin and destination information detail level and geographical system, measurement units, collection methods, poll base, objectives and data sources confidentiality. They also acknowledge the complexity of collecting and analyzing urban freight data, as they have witnessed that situation in Canada and some other countries and link that matter mainly to the lack of uniformity in their data.

Victoria and Walton (2004) also point out in a research report on data collection by Information Technology Systems that "metropolitan planning organizations will have to explore innovative and cost effective means to gather an understanding of freight movements", thus confirming that surveys need to be well planned to help these organizations achieve their objectives.

Roorda (2010) also identified some problems in data collections in a paper on data collection strategies. Referring to a patchwork of information that has been collected, he underlines the "lack of compatibility between data sources, lack of common definitions, overlaps and gaps between the content of surveys…" He identifies elements of a potential national "framework by which urban goods movement data collection is organized and harmonized." These elements are relevant to the research work presented in this paper, so they are stated below:

- Identification of the most important dimensions of urban goods movement that need to be addressed;
- Identification of performance indicators that reflect the goals, objectives, issues and policies related to urban goods movement;
- Identification of suitable high quality data collection techniques to measure indicators and provide inputs for modelling;
- Harmonization of multiple data collection techniques (addressing gaps and overlaps in the acquired data).

When it comes to the importance of comparing freight surveys, Browne, Allen and Attlassy (2007) mention the importance for other countries to compare their freight strategies to the cities of London and Paris. About what we're concerned, we know sometimes surveys can lead toward building a freight strategy, so it would be relevant to compare freight surveys in such a case.

Ibeas, Moura, Nuzzolo and Comi (2012) are also concerned by the transferability of survey results "in order to improve their use". They also point out that we need to overview the possibilities of transferring lessons learned in one city to other cities. More importantly, "it is fundamental to have methods to allow an ex-ante assessment of policies and measures […] in order to make urban freight mobility more sustainable."

All these statements favor a better uniformity, harmonization, comparability and framework for freight surveys.

Finally, the World Bank, through its Transport Research Support, sums up the challenge faced when analyzing freight in their document on urban freight entitled *Freight Transport for Development Toolkit* (2009):

> "What is still missing from developing cities is a comparative basis, as surveys' methodologies are usually local and different from one another. In all cities, […] surveys are irregular overtime, making it difficult to draw historical analyses and projections."

Well, as for now and as surveys still differ from one another, the classification tool presented in the following pages targets that matter, to provide a start for a comparative basis and to somewhat get over their irregularities.

Methodology

Freight transport surveys treat multidimensional parameters which can differ from one survey to another. First, we need to identify and explicitly describe the dimensions that can be reached in any way during the process of any survey on freight transportation.

Then, for each dimension there is, the parameters that can be evaluated or assessed by the survey are then identified and explicitly described as well.

Finally, the parameters known for each dimension can then be included in a classification table to visualize the whole survey experiment parameters. Therefore, this single table forms a classification tool resuming and describing a survey experiment. Applying the tool to several survey experiments consequently allows identifying, evaluating, assessing and comparing surveys on the same basis.

Examples of freight data collection can afterwards be taken into account to verify if there would be any changes or addition that could be made to enhance the data collection process and make sure it will be fitted to the data needs.

SURVEYS' CLASSIFICATION

Through reviewing papers and several documents describing experiments of data collection, we have found it difficult to compare and evaluate the different types of data collection presented. It was also a tough task to point out the specific characteristics, goals and objectives of these experiments. It seemed like each one had particular parameters that made the collection exclusive. So we found out it was a hard task to regroup a lot of data collection experiments under a single basis. Thus, we thought about first regrouping the survey parameters and see what could come out of that exercise.

Tool basis for survey classification

The foundation for this project came from a tool developed by Trépanier & Morency (2008), as a suggestion for classifying surveys conducted in a specific region. They did a great job surrounding the aspects of the survey for which they reviewed. Therefore, we used that classification table as a reference to extend the classification system for every possible freight transport survey.

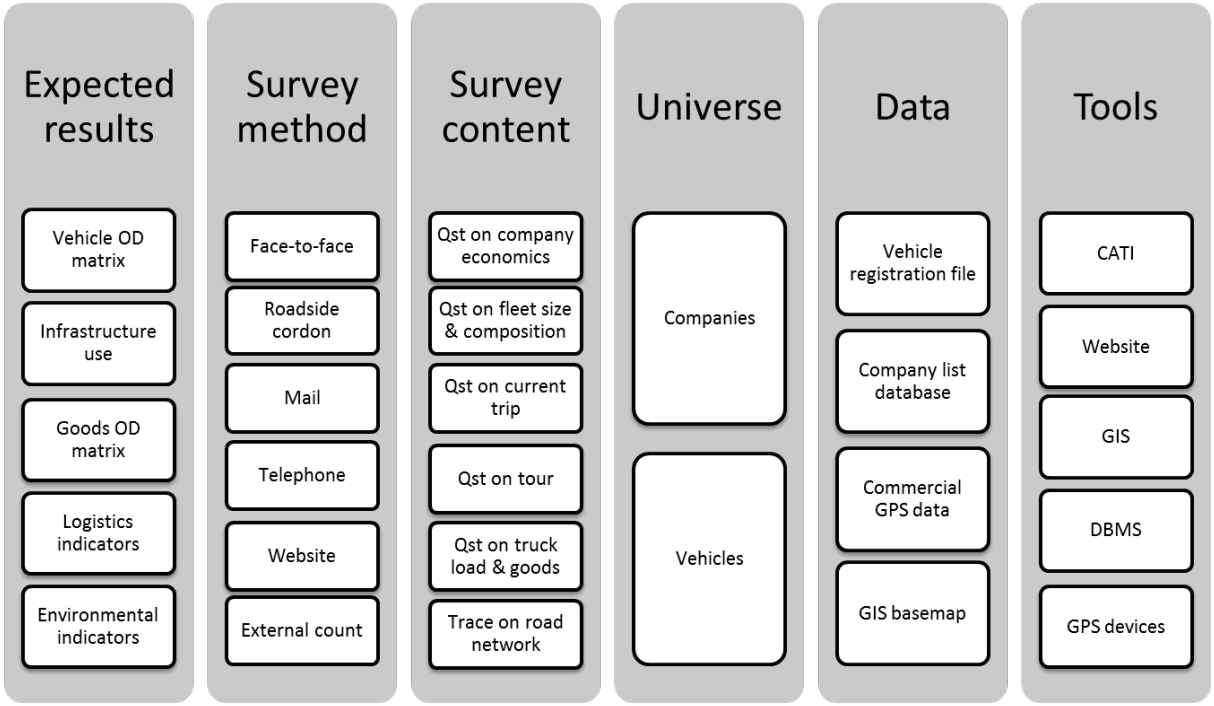

Figure 1 – Survey classification tool (Trépanier & Morency, 2008)

Conceptual model of the freight transportation survey

Trépanier & Morency (2008) also presented a conceptual definition of road freight transportation by assessing a series of supply chain elements separated in three categories, such as transportation operations (A), road network (B) and industrial activity (C). The relations between different components within the supply chain are presented in Figure 2, as part of an object-oriented model. This model is made to support the classification tool by linking the objects part of the classification tool one to another.

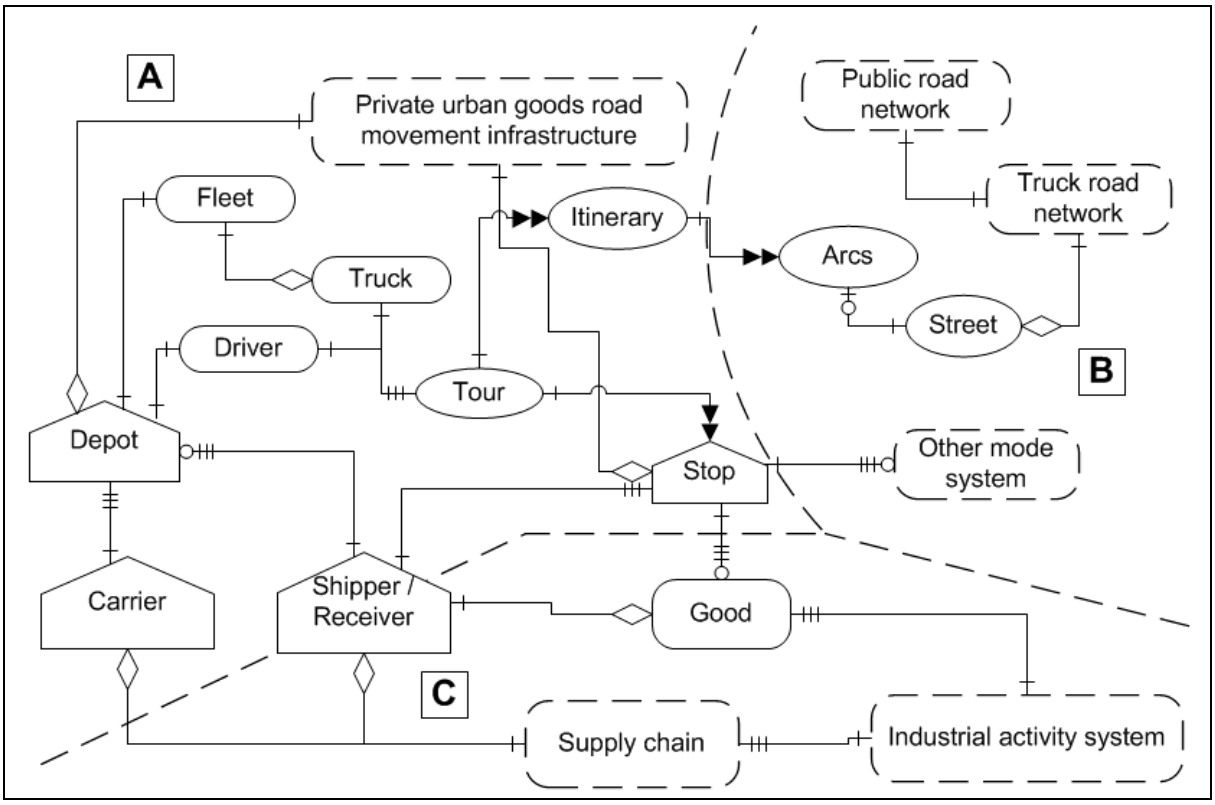

Figure 2 – Object-oriented model of road-based freight transportation (Trépanier & Morency, 2008)

Proposed tool

The proposed tool of classification for surveys or data collection comes from the specific characteristics found in several experiments described in the literature. The table, of course, can always be refined, by adding of modifying parameters that are being used for conducting data collections, either from a common practice that was unknown to the authors, from innovations in technologies or methods used, or any other change or improvement made to data collections worldwide.

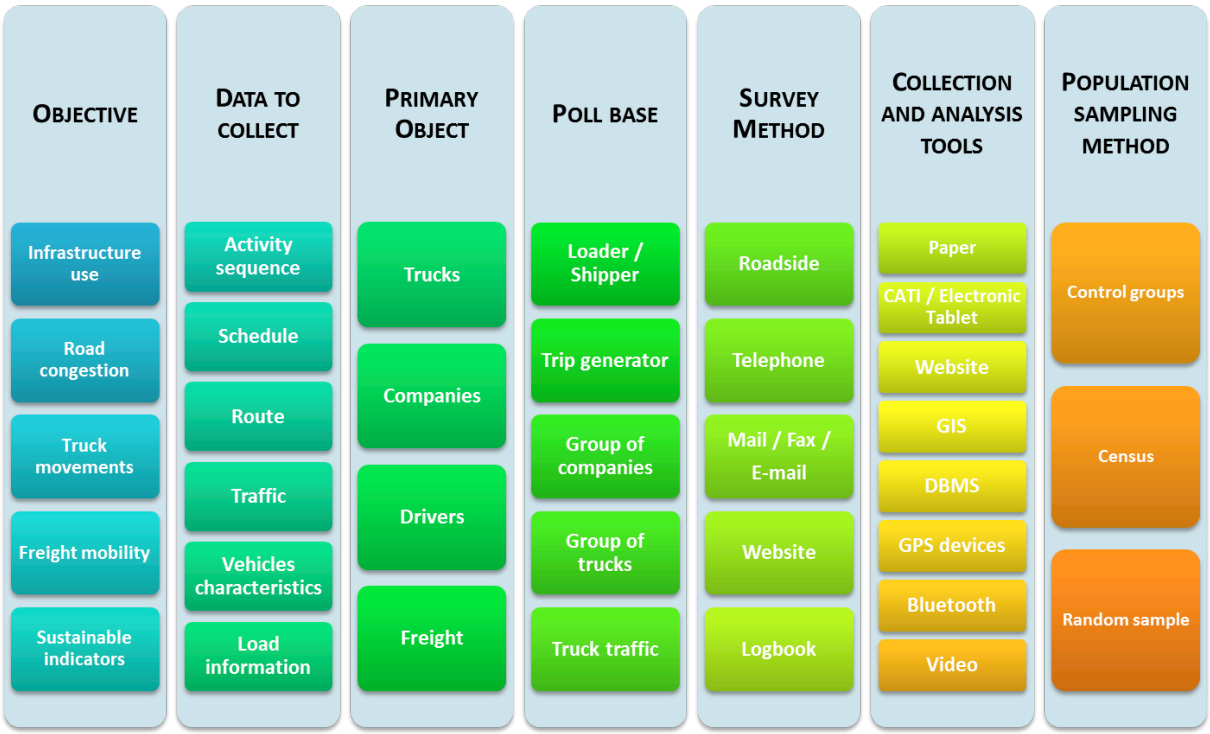

Figure 3 – Survey classification proposed tool

Freight transport surveys treat multidimensional parameters which can differ from one survey to another. First, we need to identify and explicitly describe the dimensions that can be reached in any way during the process of any survey on freight transportation.

As you can see above, the table regroups several parameters under 7 different dimensions that are part of almost any data collection: objective, data to collect, primary object, poll base, survey method, collection and analysis tools and population sampling method. You will find below a description of every dimension followed with a table showing definitions for each parameter that is part of a dimension.

Objective

Description:
The objective is why the survey is being conducted. It is the cause for which the people in charge need the data. It also defines the parameter to measure, study, analyze or verify.

The number of possible objectives may vary depending on the changing needs in goods mobility.

Table 1 – Definitions for parameters referring to the objective

Infrastructure use	To determine what use is done by the trucks for a section of the road network.
Road congestion	To determine to what extent a section of the road network is congested.
Truck movements	Seeks to know the usual sequence of truck movements and the spatial and temporal characteristics of these trips.
Freight mobility	Seeks to know the origins and destinations of freight carried by the trucks. The characteristics found on the freight seek to identify the consumer markets influencing freight movement by trucks.
Sustainable indicators	Seeks to develop sustainable indicators from the collected data. It will give an estimation of the extent of a phenomenon regarding freight transportation by trucks.

Data to collect

Description:
This is the data to be obtained by the survey. These types of data will eventually help to achieve the objectives.

The type of data to collect is usually directly related to the objective pursued. Therefore, as stated in the objective description, it may vary depending on the changing needs in goods mobility.

Table 2– Definitions for parameters referring to the data to collect

Activity sequence	Locations (or points) where the truck has stop during its trip.
Schedule	Temporal characteristics of the truck trip. Including any constraint, change, restraint or other related to the time length of the trip, the arrival or the departure of the truck.
Route	Routes (highways, roads, streets) used by the truck for its trip.
Traffic	Truck traffic count for any given point, road, place or perimeter.
Vehicles' characteristics	Any characteristic regarding the vehicle, and its link with any other movement feature.
Load information	Any characteristic regarding the vehicle load, i.e. what it is carrying.

Primary object

Description:
It is the object targeted by the desired analyses and studies.

The list of parameters is determined by the objects that can be studied or analyzed. At this moment, these are the only known targeted objects for freight transport surveys. It is worth mentioning that the "freight" parameter includes the trailer in a general way, because it is less common for surveys organizers to focus their attention on the trailer itself.

Table 3– Definitions for parameters referring to the primary object

Trucks	Straight truck, tractor or van, etc.
Companies	The company carrying the freight.
Drivers	The truck driver for the purpose of the survey.
Freight	The freight carried when the truck is surveyed.

Poll base

Description:
It is the base that will indicate which group will be surveyed. These groups have the required data. Usually, we have to focus on only one of these groups, since it appears difficult to link data provided by more than one group at a time.

It is important to point out that the pool base is not the universe. The universe would include all the targeted objects of a category, as the poll base only refers to the base used to precisely define the freight actors to be surveyed. A respondent therefore can be part of several poll bases, but will only be surveyed for the poll base wanted by the data collection (*ex.:* the universe of freight companies, the poll base of the grocers' group of companies).

Table 4 – Definitions for parameters referring to the poll base

Loader / Shipper	Organizations responsible to ship the freight.
Trip generator	Any organization which generates or induces truck trips by its activities or by the nature of its activities.
Group of companies	Companies within any group that is accessible to the investigator.
Group of trucks	Trucks within any group that is accessible to the investigator (ex.: registration files, license plates …)
Truck traffic	Trucks traveling on the road(s) where a survey is under way.

Survey Method

Description:
It is the interaction method allowing collection of the data. Several methods could be combined depending on the purpose of the survey.

The survey methods have been commonly known for a while now, but it is likely we could see additional survey methods emerge for advances in information technology and the respondents' ease with these new emergent technologies.

Table 5 – Definitions for parameters referring to the survey method

Roadside	Gather data from observations or information collected from the side of the road, on one or multiple locations.
Telephone	Collect data by phone. Many telephone technologies can be employed. Still, data has to be transmitted by phone.
Mail / Fax / E-mail	Data requested beforehand to the respondent received by mail, fax or e-mail. Data can be arranged in many ways.
Website	Collect data by linking the respondent to a website, where he will be able to provide the requested data, and from where the investigator will receive the data usually already arranged.
Logbook	When the respondent provides the investigator with a register in which its data are written and from which the investigator will extract relevant information. The logbook could exist on paper or any electronic form.

Collection and analysis tools

Description:
These are the technologies employed along the survey process to carry out and/or facilitate the survey and to achieve the objectives.

The range of tools is as wide as information technology goes for data collection and analysis.

Table 6 – Definitions for parameters referring to the collection and analysis tools

Paper	Filling out paper questionnaires.
CATI / Electronic Tablet	Electronic tool allowing easier data entries.
Website	Website designed to collect the information needed.
GIS	Geographic information system helping to analyze collected data on plans or maps.
DBMS	A Database Management System allows to select the information needed from multiple or large databases. It eases the data integration from different sources into a whole common database.
GPS devices	The Global Positioning Systems allows locating a truck in time and space and this data can be stocked in order to analyze it afterwards.
Bluetooth	The Bluetooth technology allows recognizing a signal when a device enters a Bluetooth pickup range.
Video	Video images provide information on different situations (accidents, traffic count, congestion, violations, license plates, etc.) that occur where cameras are installed.

Population sampling method

Description:
It is the way used to find the sample that can provide data.

As for freight transportation, sometimes due to reluctance from various actors to give access to their data, other times due to various different factors, the most common method would be “random sample”, since the whole population cannot be identified most of the time. A census is, as a result, not very common practice for sampling.

Table 7 – Definitions for parameters referring to the population sampling method

Control groups	A sample accessible or available for the survey purpose, but of which we do not know its representativeness.
Census	Complete population of a universe. For a census to be conducted, the universe has to be known.
Random sample	Could be random or stratified random. If it is random, the sample represents the respondents who accept to participate in the survey. If it is stratified random, the targeted groups would have been fragmented, but the response within these groups remains random.

APPLICATION

We applied the classification tool to several freight survey or data collection experiments to show its potential for analysis.

We used 12 examples of data collection or survey experiments conducted around the globe to demonstrate the use of the classification tool. You will find in the next subsection a short analysis for every example. Presented next is the global analysis of these examples, showing the potential comparative analysis of the application of a survey classification tool.

The first two examples come from survey experiments for which we analyzed data for multiple research purposes. The next 6 examples come from the literature, either papers or reports published about the experiments.

The first example illustrates the parameters defining the survey called “Trucking survey” conducted by *Transports Québec (MTQ)* and *Transport Canada (TC)*. This example represents the 2006-2007 survey, although the “Trucking survey” was also conducted in 1999, 1995 and 1991.

As for the second example, it illustrates the parameters defining a survey called “License matching cordon survey” conducted by a group of transportation students at *École Polytechnique de Montréal.*

This survey aimed to determine the potential of a license matching cordon survey to estimate the truck movements generated by and the greenhouse gases therefore produced by the activities at the *Université de Montréal*.

Here is a table summarizing the other 10 papers found in the literature for comparison and analysis purposes.

Table 8 – Summary of papers used for examples

#	Paper / Report Title	Author(s)	Institution
1	*We're really asking for it: Using surveys to engage the freight community*	C.T. Lawson A-E Riis	*U of Albany* *Portland St. U*
2	*Urban freight in Dublin city center, Ireland: Survey analysis and strategy evaluation*	C. Finnegan H. Finley M. O'Mahony D. O'Sullivan	*Trinity College Dublin*
3	*Urban Freight Mobility: Collection of Data on Time, Costs, and Barriers Related to Moving Product into the Central Business District*	A.G. Morris A.L. Kornhauser M.J. Kay	*City U of New York* *Princeton U* *Montclair St. U*
4	*Survey Methodology for Collecting Freight Truck and Destination Data*	K.L. Casavant W.R. Gillis D. Blankenship C. Howard Jr	*Washington St. U* *The Gillis Group* *The Gillis Group* *Washington St. DOT*
5	*Establishment-based survey of urban commercial vehicle movements in Alberta, Canada*	J.D. Hunt K.J. Stefan A.T. Brownlee	*U of Calgary* *City of Calgary* *City of Edmonton*
6	*Comparing GPS and Non-GPS Methods for Collecting Urban Goods and Service Movements*	S. McCabe M. Roorda H. Kwan	*U of Toronto*
7	*Truck Trip Data Collection Methods (Strategic Freight Transport Analysis)*	E. Jessup K.L. Casavant C.T. Lawson	*Washington St. University* *U of Albany*
8	*Commodity Flow Survey*	N/A	*BTS / USDOT (RITA)*
9	*Transport de marchandises en ville: Enquête quantitative réalisée à Bordeaux*	D. Patier J.-L. Routhier Ch. Ambrosini	*LET (France)*
10	*Business and site specific trip generation methodology for truck trips*	K. Kawamura S. Hyeon-Shic S. McNeil	*U of Illinois (Chicago)*

Each data collection can now be easily described by a single tool, which can be used to compare it with other surveys.

In order to visualize the parameters represented in the package of 12 examples used, figure 17 demonstrates a view of the classification tool in which they are highlighted, indicating which were used (blue background) and which were not (white background).

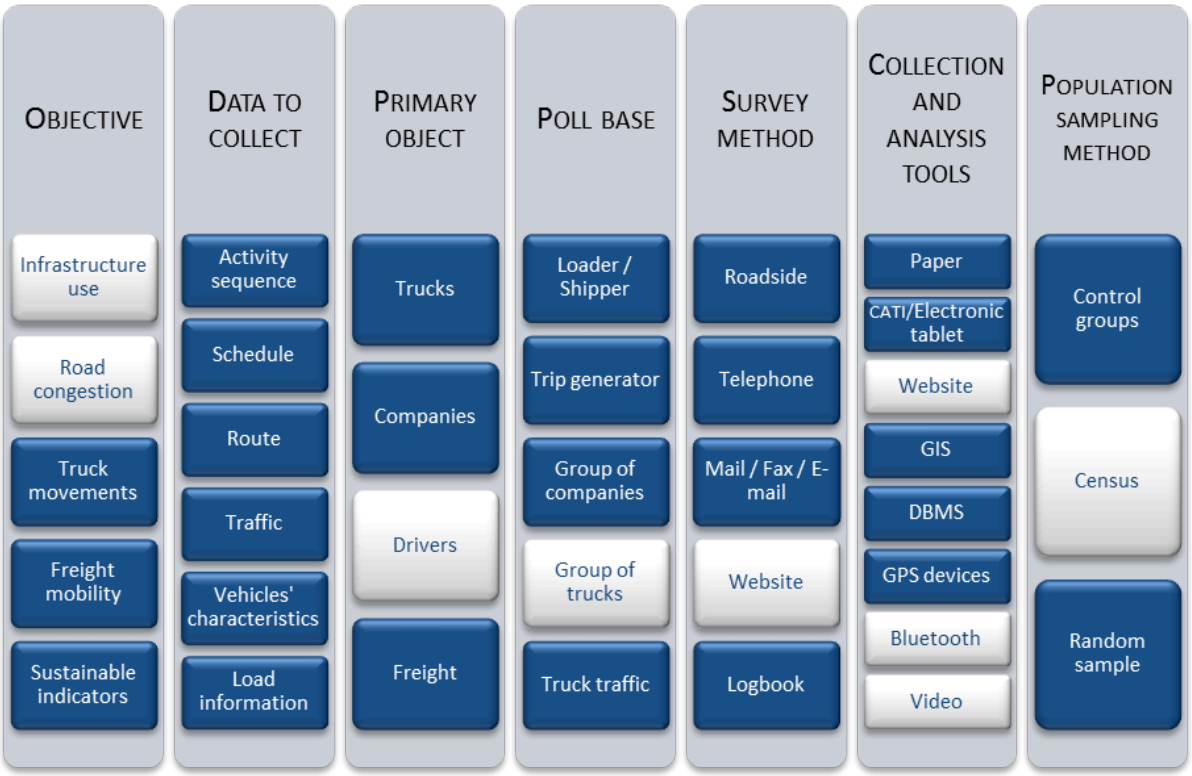

Figure 4 – Classification tool application for all 12 examples

Tables below represent the proportion of examples in which parameters were part of the survey, regrouped for each of the 7 dimensions. These proportions only represent the presence among the examples targeted by this paper. It does not reveal any statistics or verified fact among freight surveys in general. The only purpose here is to show the analysis potential of the classification tool.

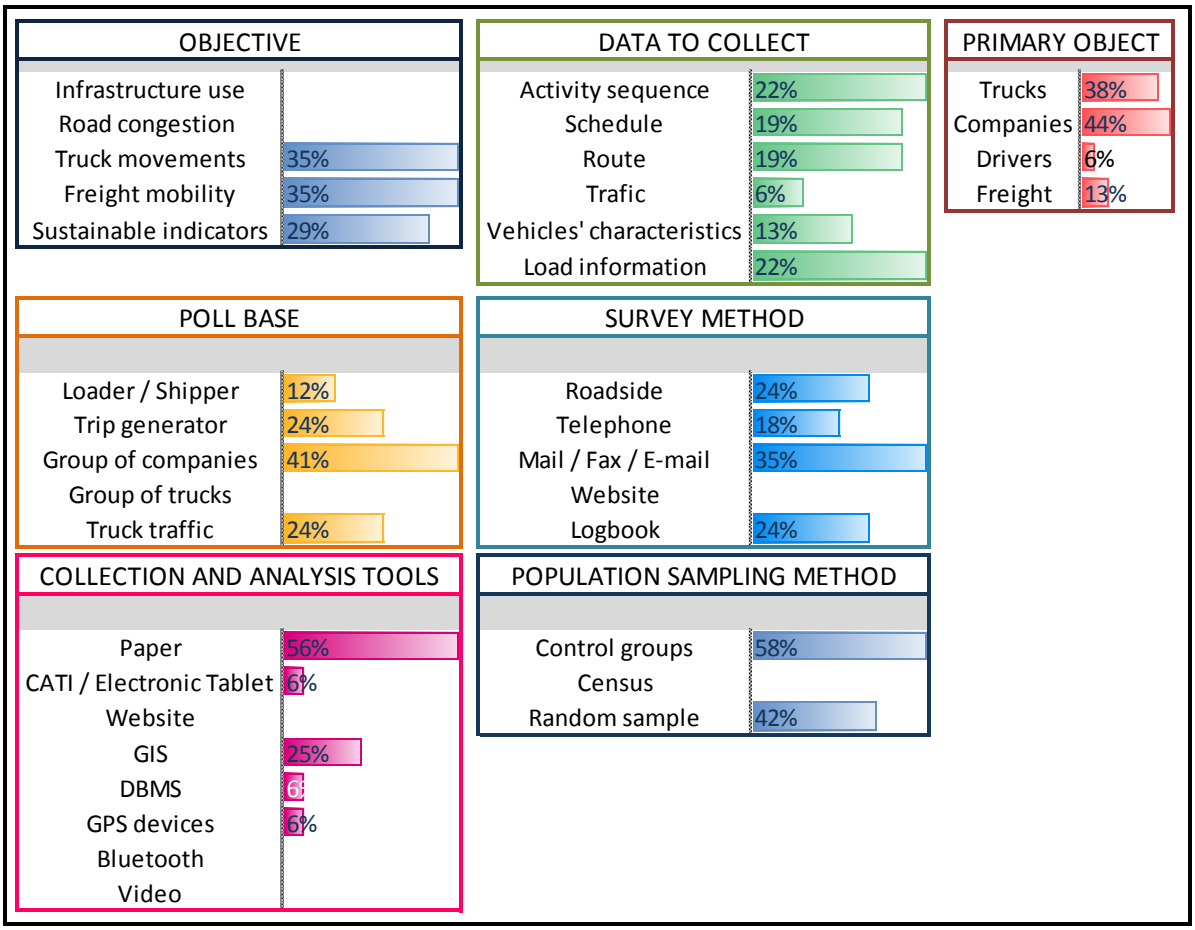

Figure 5 - Proportions of parameters targeted by the data collections regrouped by dimensions

In order to find the most frequent combinations of parameters, we could also analyse the proportions a parameter is affected out of a number of data collections. Here, for every objective there was in the 10 chosen examples, we calculated the percentage of experiments in which each parameter was affected.

DATA TO COLLECT		PRIMARY OBJECT		POLL BASE		SURVEY METHOD		COLLECTION AND ANALYSIS TOOLS		POPULATION SAMPLING METHOD	
Activity sequence	67%	Trucks	50%	Loader / Shipper	0%	Roadside	33%	Paper	100%	Control groups	50%
Schedule	83%	Companies	50%	Trip generator	50%	Telephone	33%	CATI / Electronic Tablet	0%	Census	0%
Route	17%	Drivers	0%	Group of companies	67%	Mail / Fax / E-mail	50%	Website	0%	Random sample	50%
Trafic	33%	Freight	0%	Group of trucks	0%	Website	0%	GIS	33%		
Vehicles' characteristics	33%			Truck traffic	33%	Logbook	17%	DBMS	0%		
Load information	50%							GPS devices	17%		
								Bluetooth	0%		
								Video	0%		

Figure 6 – Proportions of presence for each parameter in experiments with *Truck movements* as an objective

DATA TO COLLECT		PRIMARY OBJECT		POLL BASE		SURVEY METHOD		COLLECTION AND ANALYSIS TOOLS		POPULATION SAMPLING METHOD	
Activity sequence	67%	Trucks	67%	Loader / Shipper	17%	Roadside	50%	Paper	83%	Control groups	33%
Schedule	33%	Companies	33%	Trip generator	17%	Telephone	0%	CATI / Electronic Tablet	17%	Census	0%
Route	50%	Drivers	0%	Group of companies	50%	Mail / Fax / E-mail	50%	Website	0%	Random sample	67%
Trafic	0%	Freight	33%	Group of trucks	0%	Website	0%	GIS	33%		
Vehicles' characteristics	50%			Truck traffic	50%	Logbook	17%	DBMS	17%		
Load information	67%							GPS devices	17%		
								Bluetooth	0%		
								Video	0%		

Figure 7 – Proportions of presence for each parameter in experiments with *Freight mobility* as an objective

DATA TO COLLECT			PRIMARY OBJECT		POLL BASE		SURVEY METHOD		COLLECTION AND ANALYSIS TOOLS		POPULATION SAMPLING METHOD	
Activity sequence	1	20%	Trucks	40%	Loader / Shipper	20%	Roadside	20%	Paper	40%	Control groups	60%
Schedule	3	60%	Companies	60%	Trip generator	40%	Telephone	20%	CATI / Electronic Tablet	0%	Census	0%
Route	2	40%	Drivers	20%	Group of companies	40%	Mail / Fax / E-mail	40%	Website	0%	Random sample	20%
Trafic	2	40%	Freight	0%	Group of trucks	0%	Website	0%	GIS	20%		
Vehicles' characteristics	2	40%			Truck traffic	20%	Logbook	40%	DBMS	0%		
Load information	1	20%							GPS devices	0%		
									Bluetooth	0%		
									Video	0%		

Figure 8 – Proportions of presence for each parameter in experiments with *Sustainable indicators* as an objective

It can now be useful to know which data, object, poll base, method, tool and/or sample was targeted in past survey experiments with same objective.

FINDINGS

The tool produced by grouping survey parameters together allows defining, by a single table, the context of the survey. Comparing and analyzing different surveys can then be made on the same basis. Identifying the main and specific characteristics of a survey can also be made more easily. Since its development, it has been used to compare both surveys described in the literature and new survey experiences developed as part of the research project.

Implications for research and data collection organizers

The purpose of developing such a classification tool resides in the planning of a survey on freight transport. It aims mainly to simplify the identification of successful surveys and successful survey parameters which had the same objectives as the data collection policy and decision makers are planning to conduct. These stakeholders need to conduct surveys efficiently. Therefore, looking upon past experiences allows them to know what parameters have to be part of the survey to collect the right information they need. Identifying these parameters and, therefore defining the survey context is one of the first steps towards conducting a successful survey and we think this tool can be useful during that stage of survey preparation.

CONCLUSION

While the primary objective for developing such a tool for classification of freight transport surveys was to identify the main characteristics of multiple surveys, it was also important to make it in a way that is simple, easy to understand, eye-friendly and user-friendly. We do think the development of the tool is a continuous process over time, but we also believe the tool developed here has reach the purposes listed above and will allow its users to identify their needs and reach their objectives more efficiently. While using that tool, we think it becomes easier to point out more precisely the type of survey that has to be conducted in order to collect data in the most possible efficient way, making the survey experiment a solid basis to achieve transport planning goals and, a little ways down the road, a better mobility for all.

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