THE IMPACT OF URBAN FREIGHT TRANSPORT
- A DEFINITION OF SUSTAINABILITY
FROM AN ACTORS’S PERSPECTIVE

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ABSTRACT

Urban freight transport has a vital function for society but it is also a major problem for cities to reach sustainability. However, city planning has a strong focus on passenger transport. Freight transport is a business-to-business industry and actions of city administrations to address the impacts are limited to urban and traffic planning. The impacts which become visible at the traffic level are only the final element of a causal chain. Consequently, approaches to achieve sustainable urban freight transport (SUFT) have to go beyond strategic city planning by including all actors involved in the causal chain.

The purpose of this paper is twofold: Firstly, to present a definition of SUFT based on existing theories, and secondly to develop an indicator set that describes SUFT. The definition of SUFT makes a categorisation of actions possible which enables the actors to select effective strategies towards SUFT. The indicator set consists of two levels: 1. impact indicators which describe how urban freight transport violates the principles of sustainability; and 2. performance indicators which describe different categories determining the characteristics and performance of the urban transport system.

A literature study is conducted to analyse the characteristics determining the performance of the actors in the urban freight transport chain. Knowing the current state and improvement potentials of the urban freight transport system are prerequisites for defining successful strategies and implementing effective actions.

Experiences from the ongoing BUSTRIP project, aiming at developing a common guideline for Europe to perform Sustainable Urban Transport Plans, are used to validate the possible strategies.

Key Words: freight transport, impacts, indicators, sustainability, urban transport
1. INTRODUCTION

One of the major problems for cities to reach sustainability is the urban freight transport. However, freight is a business to business industry and the cities effort to address the impacts is often limited to urban and traffic planning. City planning is instead focused on passenger transport. Consequently, approaches to achieve sustainable urban freight transport have to go beyond strategic city planning. Since the impacts, which become visible at the traffic level, are only the final element of the causal chain – all actors involved in this chain should be included in the planning process and implementations of actions.

Studies of this phenomenon have been conducted and in the work with the peer reviews of cities preparing a ‘sustainable urban transport plan’ in the BUSTRIP project1, one of the main findings is that freight issues are not prioritised but have the most negative impacts of the sustainability of cities (Creedy, 2006). Freight is of low interest for cities, there is a lack of knowledge and no clear responsibility for the issue in the cities that are involved in the project. This tends to lead to that freight is seldom involved in discussions. Since goods movements represent between 20 and 30% of the vehicle kilometres in urban areas (Dablanc, 2007a) it has to be addressed if cities are to reach sustainability. Many pilot actions and other small scale projects have been conducted in cities, but the general trend seems to be that nothing happens when the project ends (Zunder and Ibáñez, 2004, Lindholm and Blinge, 2006 and Lindholm and Thalenius, 2006).

This article approaches this problem with the main objective to help decision makers in cities and the involved commercial actors to deal with urban freight transport. It needs to be included in the general transport plans and there is a need for better knowledge. Admittedly, sustainability is a concept with many subjective interpretations, but there is a definite need for a comprehensive definition of ‘sustainable urban freight transport’ as well as a set of indicators to monitor and evaluate urban freight transport. This must be easy to use for the involved actors and at the same time consider the complexities of urban transport.

The scope of the article is to review definitions of sustainability, freight transport and other relevant conceptions and consolidate them into a definition of sustainable urban freight transport. In order to make the definition more accessible for policy makers as well as other stakeholder, a matrix with a suitable set of indicators is presented.

A literature study is conducted to analyse the characteristics determining the performance of the actors in the urban freight transport chain. Knowing the current state and improvement potentials of the urban freight transport system are prerequisites for defining successful strategies and implementing efficient actions. Experiences from the BUSTRIP project are used to validate the possible strategies.

The article is composed of two sections. Firstly there is a section about the main findings of the literature study made in the area of sustainable urban freight. Definitions and previous work in the areas of sustainability, sustainable urban transport, urban freight transport and sustainable urban freight transport are studied and discussed here. Based on this, the section concludes with the development of a definition of ‘sustainable urban freight transport’. In the second section, an indicator set is developed with help of a matrix that connects actors and impacts. The article ends up with implications and conclusions.

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1 www.bustrip.se
2. DEVELOPMENT OF A DEFINITION OF SUSTAINABLE URBAN FREIGHT TRANSPORT

A literature study has been conducted to study different kinds of definitions of sustainability, urban transport, freight transport as well as previous discussions of the subject. There are several definitions accepted in the area, but we have not found a generally adopted definition of sustainable urban freight transport.

2.1. What is sustainability?

The term ‘sustainable development’ first gained major prominence in the report ‘Our Common Future’ published by the World Commission on Environment and Development which is also commonly known as the Brundtland Report. Its definition of sustainable development is still widely used today (Brundtland, 1987, p. 54):

*Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs. [...]

This definition highlights three fundamental components to sustainable development: 1) economic growth and 2) social equity for meeting the needs of today’s generation, and 3) environmental protection for the ability to meet today’s and future generation’s needs. It also disproves the widely spread perception that some impacts in environment and society are trade-offs for economic prosperity.

The EU’s strategy for sustainable development is based on the principle that the economic, social and environmental effects of all policies should be examined in a co-ordinated way and taken into account in decision making (European Commission, 2001). It completes the EU’s commitment to economic and social renewal by adding an environmental dimension to the Lisbon Strategy (“to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion”). This recognises that in the long term, economic growth, social cohesion and environmental protection must go hand in hand (Wolff, 2004).

Brundtland (1987) and Wolff (2004) give the general concept for sustainable development (economic growth, social equity and environmental protection). These dimensions need to be further specified to identify the causes for non-sustainability.

In Black et al. (2002, as cited from May et al., unpublished 2001, pp. 12-13) there is a list of sub-objectives of sustainability which specify the economic and social dimension:

- economic efficiency;
- livable streets and neighborhoods;
- equity and social inclusion;
- safety and
- contribution to economic growth.

The Natural Step, which is an international NGO that helps organizations move strategically toward sustainability, describes the prevailing conditions that will apply in a sustainable society by four basic principles. These are referred to as the four system conditions (Holmberg and Robert, 2000).
The four system conditions cover the three dimensions of sustainable development. The general dimension ‘Environmental protection’ is further specified by system conditions 1, 2 and 3 which describe the causes for environmental non-sustainability. These are 1) increasing concentrations in the atmosphere of substances extracted from the earth’s crust, 2) of substances produced by society and 3) the physical degradation of nature. System condition four covers the social and economic dimension by requiring that human needs are met worldwide. Figure 2.1 shows the general concept and the related principles of a sustainable development.

<table>
<thead>
<tr>
<th>Key concepts of sustainable development</th>
<th>Principles of sustainable development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting needs of present generation</td>
<td>Social equity</td>
</tr>
<tr>
<td></td>
<td>• Equity and social inclusion</td>
</tr>
<tr>
<td></td>
<td>• Livable streets and neighbourhoods</td>
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<td></td>
<td>• Safety</td>
</tr>
<tr>
<td>Ability of future generations to meet</td>
<td>Economic growth</td>
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<tr>
<td>their needs</td>
<td>• Economic efficiency</td>
</tr>
<tr>
<td></td>
<td>Environmental protection</td>
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<td></td>
<td>• No systematic increases in</td>
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<td></td>
<td>concentrations of substances</td>
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<td>from the earth’s crust</td>
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<td>• No systematic increases in</td>
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<td>concentrations of substances</td>
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<td>produced by society</td>
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<tr>
<td></td>
<td>• No systematic physical</td>
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<tr>
<td></td>
<td>degradation of nature</td>
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</tbody>
</table>

Figure 2.1 Concept and principles of sustainable development.

2.2. What is sustainable transport?

Transport systems in a sustainable society need to fulfil the principles defined above. A sustainable transport system contributes to economic growth and social equity without systematically increasing concentrations of substances in the atmosphere and degrading nature.

In April 2001, the EU Council adopted the following definition of a sustainable transport system (European Commission, 2004):

- Allows the basic access and development of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations;
- Is affordable, operates fairly and efficiently, offers choice of transport mode, and supports a competitive economy as well as balanced regional development;
- Limits emissions and waste within the planet’s ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes while minimising the impact on the use of land and the generation of noise.
The above definition is not entirely in line with the principles of sustainability. The use of non-renewable resources should not be allowed in a definition about sustainability at all. Since the definition is described as that this is a sustainable transport system, there should not be an aim that includes non-sustainability. For the same reason, there should not be a ‘choice of transport mode’. The best mode should be used, not the next best mode.

2.3. What is sustainable urban transport?

The European Commission set up an expert working group on sustainable urban transport plans (Wolfram, 2004) in the context of preparation of a thematic strategy on the urban environment (European Commission, 2004). The group consisted of twenty highly qualified stakeholders, involved in urban transport planning at different levels from twelve EU countries. Based on the definition above for sustainable transport systems, the expert working group defined a set of specific objectives for transport systems in urban areas. A sustainable urban transport system has the following specific objectives:

- Ensuring the accessibility offered by the transport system to all categories of inhabitants, commuters, visitors and businesses, in line with the objectives below;
- Reducing the negative impact of the transport system on the health, safety and security of the citizens, in particular the most vulnerable ones;
- Reducing air pollution and noise emissions, greenhouse gas emissions and energy consumption (including contributing to meeting legislative requirements on air quality and environmental noise e.g. EU directive 2002/49/EC);
- Improving the efficiency and cost-effectiveness of the transportation of persons and goods, taking into account the external costs;
- Contributing to the enhancement of the attractiveness and quality of the urban environment.

The above definition is a good definition for sustainable transport systems. But, health, safety and security in point two is an effect of the impacts in point three and should not be put as two different objectives in a definition. Additionally there is no need to explicitly mention the legislative requirements. Laws and regulations shall obviously always be followed. Furthermore, the goal of minimising the use of land is not included in the above definition.

As discussed here, the above definitions are not totally in line with the general principles of a sustainable development as defined in Figure 2.1. Figure 2.2 provides a definition of sustainable urban transport based on the principles of a sustainable development.
2.4. What is urban freight transport?

According to the OECD (2003), freight transport is a fundamental component of urban life. Every day, citizens consume and use goods – food, clothes, furniture, books, cars, computers – produced by people throughout the world. Urban goods transport enables citizens to have access to these products wherever and whenever they require.

Thus, urban freight transport plays an essential role in meeting the needs of citizens, but at the same time contributes significantly to the non-sustainable effects on the environment, economy and society. The OECD (2003, p. 19) defines urban goods transport as:

*The delivery of consumer goods (not only by retail, but also by other sectors such as manufacturing) in city and suburban areas, including the reverse flow of used goods in terms of clean waste.*

It is recognized that this definition excludes considerable goods traffic flows in urban areas – such as goods transported through urban areas (through traffic), building and demolition traffic, the provision of industry with raw materials and semi-manufactured articles, and the provision of wholesale trade – that are specifically excluded by the OECD.

However, the delivery of consumer goods within urban areas is only part of the whole logistics chain. The majority of products shipped into urban areas are produced outside these areas. These products consist of many different components which are assembled from different areas around the world and shipped from various locations to customers in urban areas. There are also plenty of goods produced within urban areas which shall be transported inside the area or out from the area. Waste, bulk transport and service transport, i.e. transport activities in close relation to the provision of a service such as maintenance of products, are other goods flows that exist in the area. Figure 2.3 shows an example of a distribution pattern integrating the long haul part of a transport chain with the urban ditto.
Dablanc (2007b) defines urban freight transport from an actor’s perspective:

Urban freight is defined as “the transport of goods carried out by or for professionals in an urban environment”. This definition does not include shopping trips made by households with their automobiles, but it does include home deliveries made for them by professional delivery operators (or by employees of shops where clients have gone shopping but have not carried their own bags). This definition also includes freight traffic which crosses the urban territory without bringing goods into the city (freight in transit). It also includes van traffic, which accounts for about half of the deliveries made in a city.

The above definition is very general, which is good in many situations. But, there could be some misunderstandings or wrong usage of a definition like this. One example is that shopping trips made by households should not be included in a definition of freight transport, but it is possible to lead more and more transport to private trips and by that decrease the urban freight transport problems radically. A definition of consumer goods supply chains includes, see also Figure 2.4:

- provision of industry with raw materials and semi-manufactured articles;
- provision of the wholesale-trade with consumer goods;
- provision of the shops with consumer goods;
- inbound and outbound consumer goods produced in the area;
- home deliveries made by professional delivery operators and
- through traffic of goods.

For the benefit of better comparability it excludes these specific flows:

- shopping trips made by households;
- building (including services) and demolition traffic and
- waste (reverse logistics).
The urban goods transport that are included and excluded from the list above contains most of the possible heavy duty vehicle and light duty vehicle transport in an urban area. All the included types of transport are somewhat homogenous, which means that it is possible to make them more efficient by for example consolidate goods into more fully loaded vehicles. The excluded transport are heterogeneous in a way that makes them difficult to consolidate with other types of goods. With many different types of transport in an area it is hard to create clear logistical regulations that considers all. Regulations of vehicle weight, emission standard, time zones etc. is easy to implement as a general rule for certain types, but there will always be exceptions.

2.5. What is sustainable urban freight transport?

Based on statistics, freight transport has an important role in urban transport issues. Goods movement represent between 20 and 30% of vehicle kilometres and between 16 and 50% of the emissions of air pollutants, depending on the pollutant considered, by transport activities in a city (Dablanc, 2007a). Private cars outnumber the light duty vehicles and heavy duty vehicles according to several studies made in different cities (Schoemaker et al., 2006).

Sustainable development measurements mainly focus passenger transport. Freight transport is considered to be a private industry on both the supplier and user sides and it is driven by economic parameters. According to Crainic et al. (2004), public authorities do not feel concerned by the operations of private firms. Consequently, they state that freight transport issues at city level are still not well understood, not quantified and there is no methodology specifically aimed at the analysis and planning of freight movements. New organizational models for the management of freight movements within the city limits are therefore called for, where city authorities play a more pro-active role, similar to the one they fulfil relative to public transport. Since freight transport, as mentioned, is mainly business-to-business, models cannot be worked out without a public-private understanding and cooperation.
The large majority of cities have not yet found adequate solutions to help optimise the urban movements of goods. It actually seems that all players are expecting initiatives to come from the other side. On the one hand, city governments expect businesses to set up new logistics services fit to the emerging needs of the customers and retailers. On the other hand, logistics providers wait for municipalities to initiate (and subsidize) new services before starting a business, which could prove poorly profitable and highly risky (Dablanc, 2007a). A combination of company initiatives and government policies will be necessary in developing a sustainable urban freight system (Anderson et al., 2005).

Most of the resources on city level are focused on public transport and cars. Zunder and Ibáñez (2004) describe the results of a questionnaire sent out to cities in the BESTUFS project, where 25% of the cities had no-one in charge of freight issues, and another 44% had less than a half full-time employee working on the subject. Half of the cities answering had no freight policy or planning at all. It is assumed that the actual number, since the sample that answered the questionnaire was self-selecting, with no plan or policy for freight issues are far greater.

The meaning of and the effort to develop ‘sustainable transport’ is also discussed by Goldman and Gorham (2006). They state that projects and discussions in this area tend to fall into two categories: those that envision sustainable transport as a pathway, and those that envision it as an end-state. The differences between those two categories are that:

- The pathway policy avoids defining particular outcomes and instead tries to suggest policies that drive the society along a more sustainable pathway, relying on indicators that will improve. Advantages of pathway policies is that they could be more easily understood by politicians and the general public, since it is often smaller steps and initiatives that are discussed. Disadvantages are that they often fail to come to grips with larger systems and side-effects of decisions.

- The end-state vision category makes efforts to come up with a definition of how a sustainable system might look like. They also rely on indicators, but opposed to the pathway category, they are used in service for the vision instead of as a replacement for it. Problems with end-state visions are that they could be so complex that it is difficult to work with them and that no guidance on how to attain the vision is provided.

The problem with both the adopted definition from the European Commission and the Goldman and Gorham discussion are that they fail to show the actors involved the causes for the consequences of unsustainable urban transport and they fail to show the role of the actors’ performance in the causal chain - linking the actors’ performance with the impacts.

2.6. A definition of sustainable urban freight transport

Based on the definitions of sustainable transport, sustainable urban transport and urban freight transport discussed in the previous sections, we have composed a definition of Sustainable Urban Freight Transport (SUFT).

A SUFT system fulfils all the following objectives:

- to ensure the accessibility offered by the transport system to all categories of freight transport;
- to reduce the air pollution, greenhouse gas emissions, waste and noise to levels without negative impacts on health of the citizens or nature;
- to improve the resource- and energy efficiency and cost-effectiveness of the transportation of goods, taking into account the external costs and
• to contribute to the enhancement of the attractiveness and quality of the urban environment, by avoiding accidents, minimizing the use of land and without compromising the mobility of citizens.

This definition contains all parts of the requirements for a sustainable development (see Figure 2.2). The definition is a pathway approach combined with an end-state vision approach which gives the objectives of what a totally sustainable system would look like and a hint on the trajectory to fulfilment. The definition should be used as an objective and to be able to work towards this objective some kind of tool is needed. An indicator set for different actors could be used to monitor and measure the effects of actions taken towards this objective. There are many easily understandable and applicable indicator sets for actors involved in urban transport, but they fail to reduce the complexities and grapple with the contradictions of sustainable transport.

3. DEVELOPMENT OF AN INDICATOR SET

A key problem for implementing an achievable sustainable strategy is determining the parameters of measurements. Actors involved in urban freight transport need an understandable and applicable set of indicators to define actions and measures, which will result in more sustainable cities and a more sustainable urban freight transport system within that city (Anderson et al., 2005). Existing indicator sets either fail to grapple the complexities and interdependencies in urban transport (pathway policies) or are not applicable by the actors involved (impact indicators of an end-state vision). The definition of SUFT as developed in the previous section combines pathway policies with an end-state vision. An indicator set based on this definition can overcome the limitations of existing indicators sets. This requires considering impact indicators but also the complexities and interdependencies of actors involved in urban transport.

The realisation of transport demand by traffic movements result from decisions by many actors who show strong interdependence. Sjöstedt (1994) presents a simple model that highlights basic interactions and indicates important actors. Many more actors influence transport systems but the number of actors has been kept to a minimum in Figure 3.1 to avoid complexity.
The model is system oriented and it is organised around three basic elements: These are *goods* that demand transport, *vehicles* being used and *infrastructure*. These elements interact in pairs in three different subsystems. The *activity system* comprises all activities that require movements of goods. In the *transport system* the demand for transport services is matched by vehicle operators. In the *traffic system*, finally, actual physical movement of vehicles is realised in physical networks in which traffic units absorb infrastructure capacity (Sjöstedt, 1996).

It is at the traffic system level that vehicles consume energy and produce emissions where most of the negative impacts of freight transport take place. As the model shows the traffic system is though only the final element of the causal chain Activities – Transport – Traffic. Consequently, not only the actors of the traffic level hold the responsibility for the unwanted effects of transport but also the actors involved in the activity and transport systems. Thus, these actors need to be involved in sustainable development strategies.

Anderson *et al.* (2005) state that freight transport is a derived demand, a common conception that however is challenged by Hesse and Rodrigue (2004), who claim that improvements of freight transport capabilities also foster transport demand. In order to consider how freight transport could be made more sustainable it is also necessary to understand the driving forces behind goods flows. A systematic way of analysing the complexities and interdependencies in transport systems is the following equation, which shows the interdependencies of the CO₂ emissions of the transport sector but it can also be applied for all other types of vehicle emissions and energy use.

\[
\text{CO}_2\text{Emissions} = \text{GNP} \times \frac{\text{TransportWork}}{\text{GNP}} \times \frac{\text{TrafficWork}}{\text{TransportWork}} \times \frac{\text{CO}_2\text{Emissions}}{\text{TrafficWork}}
\]

Assuming that GNP is desirable, attempts to decrease emissions and energy use must focus on the other segments of the formula. Using the terms of Sjöstedt’s model, actors need to de-
crease the transport intensity of the activity system (transport work/GNP), decrease the traffic intensity of the transport system (traffic work/transport work) and increase the technical capabilities of the traffic system.

Indicators do not necessarily need to quantify the impacts which are the last element in the causal chain. The causal chain presented in both Sjöstedt’s model and the formula shows that improvements in terms of transport intensity, traffic intensity and technical capabilities will result in more sustainable transport. Consequently, indicators need to be identified which describe the actors’ performance upstream the causal chain. Though they cannot measure the scale of the improvement of sustainability they keep the level of complexity low and provide high usability for the actors involved.

To summarize, applicable indicator sets need to take into consideration that freight transport, at least in the short term, is a derived demand and that the impacts are the final element in a causal chain which is influenced by many actors. A good way of identifying the role of the actors in this causal chain, and by this the actors’ responsibility for the impacts of urban freight transport is the development of a matrix, in which the actors constitute the rows and the causal chain the columns of the matrix. The cells of the matrix represent the indicators. These indicators consist of two levels: impact indicators which describe how urban freight transport violates the principles of sustainability; and performance indicators which describe different categories determining the characteristics and performance of the actors involved in urban freight transport.

As discussed in section 2, urban freight transport includes all transport of a consumer goods supply chain. To develop a workable matrix and define an indicator set, the scope is in this article limited to the distribution of consumer goods into areas of high density of retail activities. Usually this is the central business district of urban areas. Comparable ‘business districts’ can also exist in the city’s suburbs. Therefore, the main attribute for those areas should be a high density of retail activities within an area with intense land use. Figure 3.2 shows the selected part of urban freight transport that is taken into account for the development of an indicator set (compare with Figure 2.4).

Derived from the rendering above, Table 1 shows the indicator matrix for the distribution of consumer goods. The rows show the actors (except for the last row, impacts) and the columns

![Figure 3.2 Distribution of consumer goods. CBD: Central Business District, DC: Distribution centre, P: Producer, S: Shop.](image)
show the causal chain of transport – traffic – technology. The indicators in the matrix cells are divided into two categories: impact indicators and performance indicators of the actors. The cells also show categories of measures that determine the indicators. Actors, indicators and measures in the matrix are not complete. The purpose is to show its functionality, so the complexity has been kept on a low level.

Table 1: Indicator matrix for distribution of consumer goods.

<table>
<thead>
<tr>
<th>Transport intensity</th>
<th>Traffic intensity</th>
<th>Technical capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>City administrations/Planning agencies</td>
<td>Land use planning</td>
<td>Infrastructure</td>
</tr>
<tr>
<td>• urban sprawl</td>
<td></td>
<td>• length of traffic network (road, rail, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• number of loading/unloading zones</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• location of loading/unloading zones</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regulations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• congestion charge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• access restrictions</td>
</tr>
<tr>
<td>Consignor/Consignee</td>
<td>Shipment</td>
<td>Mode choice</td>
</tr>
<tr>
<td></td>
<td>• number of shipments</td>
<td>• modal split</td>
</tr>
<tr>
<td></td>
<td>• average size of shipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• frequency of delivery</td>
<td></td>
</tr>
<tr>
<td>Freight forwarder</td>
<td></td>
<td>Terminal location (excl. City consolidation terminals)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• average distance between terminal and city centre</td>
</tr>
<tr>
<td>Transport operator</td>
<td>Route planning</td>
<td>Vehicle choice</td>
</tr>
<tr>
<td></td>
<td>• average distribution distance</td>
<td>• vehicle size</td>
</tr>
<tr>
<td></td>
<td>• number of distribution trips</td>
<td>• load factor</td>
</tr>
<tr>
<td></td>
<td>• total distribution km</td>
<td>• engine technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• fuel type</td>
</tr>
<tr>
<td>Impacts</td>
<td>Accessibility</td>
<td>Air pollution</td>
</tr>
<tr>
<td></td>
<td>Accidents</td>
<td>Greenhouse gas emissions</td>
</tr>
<tr>
<td></td>
<td>Land use</td>
<td>Energy use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noise</td>
</tr>
</tbody>
</table>

The matrix shows that the impacts originate in the traffic and level of the technical capability. It also shows that each segment of the causal chain is influenced by mainly one actor group. The consigner/consignee determines the demand, the freight forwarder the traffic and the transport operator the technical capability. It also becomes visible that the actors are not limited to their “own” column to contribute to a sustainable development. By setting requirements they can influence the actions to the actors downstream the causal chain. City authorities and planning agencies can influence all segments and thus play an important role in designing sustainable development strategies. However, the matrix also shows that they cannot
solve the problem alone. An integrated approach that involves all actors is then necessary. This matrix is considered to facilitate this work since it makes visible all the actors, their responsibilities and possible measures.

There are also limitations of the matrix for being used. Actions towards one sub-goal need to be cross-checked with other sub-goals. Furthermore, the matrix does not provide a time dimension, so it is important to check the long-term effects of measures that provide improvements in the short term, e.g. the construction of a new road-link in order to reduce congestion and improve accessibility. This can undermine endeavours to increase the further use of rail transport.

4. IMPLICATIONS AND CONCLUSION

The definition of SUFT together with the indicator set in the form of a matrix, are believed to be a good start towards the work in handling the problem of freight transport impacts in urban areas. The purpose of the definition is mainly to raise awareness to the need for actions in the urban freight transport area. It is a pathway definition with an end-state vision, which gives clear objectives for what a sustainable transport system should look like. The matrix is a good tool to be able to use the definition in the different actors’ daily work. Implications for city administrations, freight forwarders and other actors of this development are a better understanding for the importance of action in the work towards sustainability.

There are differences between decision making in goods and private/passenger transport in city administrations. Another aspect could be that there are too many decision makers in an administration. The definition of SUFT and the matrix show that one actor alone will not be able to solve the impacts related to freight transport. An integrated approach that involves all actors is then necessary. BUSTRIP is a project that have started the work trying to introduce all kinds of urban transport in the city planning process, but there is a lot of more work that have to be done. Creating knowledge is important, but a useful tool is a good basis for this awareness raising. For further development it would be interesting to test the definition and matrix on a couple of different decision makers in a selection of cities.

5. ACKNOWLEDGEMENTS

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