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EVALUATION OF URBAN FREIGHT TRANSPORT MANAGEMENT MEASURES

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ABSTRACT. Background: Problems with urban freight traffic in downtown areas emerge in parallel with the growth of motorization and changes in consumption patterns. Supply chains become more and more dependent on small and frequent deliveries. It is a problem common for most modern cities and one that requires tailor-made solutions which meet local requirements and can be extended, if necessary.
Methods: An extensive literature review was conducted to obtain a comprehensive overview of existing urban freight related problems and possible solutions. The specificity of the problem required a broad approach including an analysis of many case studies from European cities and gathering the theoretical background. On this basis a general set of freight related measures was selected for evaluation. Because of the complexity of both the problem and its solutions an adequate method of evaluation was needed. The method had to be flexible and offer an understandable and manageable structure. The analytic network process (ANP) was selected for this task. It is a multi-criteria decision making method used in complex decisions, which can measure tangible and intangible factors. The author's aim was to build a sufficiently detailed model that ensures reliable results and accomplishes the goals of the main actors and of sustainable city transport policy.
Results and Conclusions: The analysis showed that given the current state of development of urban freight traffic in Gdansk, the situation can be rationalised with regulatory measures. Only well balanced and carefully implemented measures have the potential to rationalize urban freight transport without disturbing the city's economic growth. They have to be prepared in advance on the basis of a continuous analysis of the urban transport system. It is important to involve all actors in the development of more advanced measures in a bottom-up planning process. Otherwise, the risk is that overly complicated solutions without a practical justification will produce counterproductive results.

Key words: urban freight traffic, urban logistics, city transport policy, multicriteria decision making, analytic network process.

INTRODUCTION

Urban freight policy is, or should be, an integral part of urban transport and economic development policy. There are several reasons why public policies in specific fields are needed. They are made when problems arise, challenges occur, objectives have to be set and verified or guidelines are needed. In most cases it is a combination of these factors [Visser, Binsbergen, Nemoto 1999]. Typically, a well-designed urban freight policy makes a rational use of available tools and measures. Freight traffic is a basic requirement for every economic activity within the city. Any changes to how it operates require careful thinking not to disrupt local business but still provide the intended long-term modifications in delivery patterns and traffic conditions.

The aim of this paper is to evaluate the feasibility of diversified measures regarding urban freight transport rationalization. While this is a theoretical paper, the models are firmly based on a critical evaluation of existing examples confronted with local conditions. Gdansk city centre was selected as the implementation area for the analysis. It has a high concentration of businesses, retail shops, services and administrative functions. This was to ensure the practical relevance of the decision factors

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included in the model. Despite that, a certain level of generalization is still possible, because many cities share the same problems and will soon have to decide which measures to adopt. Conducted with the SuperDecisions ANP application, the simulation is intended to prioritise measures rather than select the best option and exclude all the others. The main question is not to find the best solution, but to verify which measure is the most feasible under specific circumstances and limitations. The prioritization helps to understand the distance between the best and the next alternative and gives an overview of future possibilities.

GOALS OF URBAN FREIGHT POLICY

Urban freight transport policy has three main elements: transport chains, different actors and the city's business activity, and how it interrelates with other policy fields such as infrastructure, land use planning, economic development, accessibility and environmental problems [Brown, Piotrowska, Woodburn and Allen 2007]. Moreover, urban freight is part of freight transport in general, and its logistic chains and interconnections expand over a larger area than a single city. Therefore, it is difficult to design an effective urban freight policy without affecting the interurban part of goods flow. [Stratec 2005]. Account must be taken of the general situation on the freight operators market, its development, saturation and competitiveness. All this will determine the feasibility of solutions based on voluntary cooperation. An urban logistic system should be considered with three main pillars in mind [Tanguchi, Thomson, Yamada, 2004]:

- mobility,
- sustainability,
- liveability.

Mobility is considered as a basic requirement for transporting goods within the city as well as into and from urban areas. In terms of connectivity, reliability and safety it requires a well planned transport infrastructure. Reducing traffic congestion and providing a reasonable road capacity, especially through capacity optimization methods, is an important goal for urban traffic management. Sustainability is well recognized because people show a growing concern for environmental issues including air pollution, noise, vibration and visual intrusion. Large freight vehicles or multiple uncoordinated deliveries by smaller trucks are often the source of negative effects. Reducing the negative impacts of transport activity is an important goal of a freight transport policy. Liveability is a complex issue related to the role of the city as a social and economic phenomenon. Residents want to benefit from the proximity and abundance of different services, shopping and delivery possibilities. They are also concerned about general living conditions, traffic safety and real property value, which may be hampered by commercial vehicles operations. The above mentioned pillars provide a strategic basis for planning urban freight transport systems in the form of guiding principles. They may be supported by some specific goals [Tanguchi, et. al, 2004]:

- market competitiveness,
- efficiency of all involved actors,
- environmental awareness,
- congestion alleviation,
- security,
- safety,
- energy conservation.

Each goal is connected with one or more actors or stakeholders directly or indirectly involved or influenced by urban goods transport. This illustrates its complexity with multiple goals that may be conflicting. To add to the actor level complexity and number of goals, there is also a number of

different principal urban logistic chains where a common characteristics can be identified [Dablanc 2011]:

- independent retailers and local convenience stores - the sector may account for 30 - 40 percent of all daily deliveries in a city, depending on its structure, size and market profile; local stores are supplied three to ten times a week, when 7 - 8 may be the average [Bertens 2011],
- chain retailing and commercial centers - large retailing brands with subsidiaries expand on the urban market at the expense of independent local stores; this changes the delivery pattern, from numerous small shipments to less frequent deliveries with a larger number of consolidated deliveries and better load factor of vehicles,
- parcel and express services (less than a truck load) are one of the fastest growing group among urban transport operators; they utilize vans or small to medium sized trucks and the deliveries depart from cross-docking terminals located in the inner suburbs and preferably close to ring roads; deliveries are well consolidated within specified delivery areas,
- building sites are a strategic segment in urban freight management because of significant tonnage they generate; building site supply is inefficient because of the number of building contractors on each site, multiple suppliers and poorly planned delivery schedules; deliveries are usually carried by larger trucks than in other examples, causing several problems with congestion, damage to the roads, noise and traffic safety.

OVERVIEW OF THE CURRENT FREIGHT TRAFFIC STRUCTURE IN GDANSK AND TRAFFIC MANAGEMENT MEASURES WITHIN THE DOWNTOWN AREA

Providing a comprehensive picture of urban freight traffic requires data from two sources. First, urban traffic surveys covering the structure of all vehicle flows, number of trips, source and destination patterns, etc. The second source should be a detailed delivery profile survey, examining the number of daily deliveries to different types of businesses, types of cargo and delivery vehicles within a precisely specified area, for example a business district or city center. The combination of two sources gives practical knowledge about urban freight development [Kaszubowski 2011]. The latter survey method is rarely used due to its cost, complexity and a high level of voluntary participation required from both the businesses and delivery companies. In Gdańsk the most recent traffic survey was conducted in 2009. Its results regarding freight vehicles are as follows [KBR 2009]:

- 80 000 trips were made by all types of freight vehicles,
- 80% of freight vehicles were up to 3.5t,
- total share of freight traffic within the city limits was 10%,
- average number of trips per vehicle was 2.15,
- most of the trips (55 000) were made within city borders,
- 60% of trips were made by empty vehicles, while 75% of the rest were loaded up to 30% of capacity,
- average declared travel time for all trips was 45 minutes, and 25 minutes within the city limits,
- average number of trips of empty vehicles was 1.2, for vehicles with foodstuffs 0.22, construction materials 0.19 and other goods 0.32.

When compared with a 1990 general traffic survey [KBR 1990] the results show a significant increase in urban freight traffic. In 1990 40 500 freight vehicles were counted with an average of 2.23 trips per vehicle. The slight decrease in trips per vehicle is outweighed by total trips which doubled. Because urban deliveries are bound to cause problems in areas where transport demand is the highest, downtown Gdańsk was selected as a test site for the proposed measures. The size is about 1.8 sq. km,

with about 12 000 inhabitants and 16 000 jobs in retail, services, etc. Currently, it has a designated limited traffic zone (30km/h) and a pay and display parking zone. There are no specific measures for freight vehicles. Local shopkeepers and business owners can apply to the urban roads authority for a loading bay for their purposes. Permits are granted if there are several potential users in close vicinity. The maximum time of delivery is 30 minutes. When the loading bay is within the parking zone, delivery vehicles still have to pay for parking.

FREIGHT MANAGEMENT MEASURES SELECTED FOR ANP MODELLING

There are a number of different strategies or measures that may be applied in urban freight policy and planning [Visser, et al. 1999]:

- parking and loading strategies: utilization of different types of facilities for parking, loading and unloading, kerb-side, off-street facilities and truck parking facilities, often as part of a wider freight policy [TfL 2009],
- dedicated logistics routes or road network strategies: specific routes may be nominated for truck use; routes may be dedicated to specific classes of vehicles only to prevent entry into restricted areas;
- licensing and regulations: a wide array of measures may be considered, i.e.: allocation of kerb space, loading time restrictions, truck access control, truck route regulations, permits for entering certain areas and vehicle regulations (size, emission, noise standards)
- pricing strategies: road pricing or access/parking charges allow the market and cost calculations to solve traffic congestion,
- city terminals or urban freight consolidation centers: transfer and consolidation facilities are located outside urban areas which helps to optimise truck movement; sometimes additional inner-city transfer points are created,
- voluntary cooperation of transport and logistics operators for coordinated deliveries or terminal operations,
- location and zoning: incentives to concentrate facilities generating transport near freight infrastructure and facilities,
- ITS technology used for city logistics, both as a solution for vehicles and infrastructure-related systems [Kaszubowski, Oskarbski 2011].

Table 1. Complexity of urban freight transport policy measures
Tabela 1. Stopień złożoności narzędzi zarządzania transportem ładunków w miastach

Basic regulatory measures	**Intermediate** market-driven initiatives, public sector facilitates and sometimes subsidies the initiatives	**Advanced** full public involvement, alternations to the supply chain supported by additional measures, constant financing, additional regulatory measures required
parking and loading strategies dedicated logistic routes licensing and regulations pricing strategies	freight operators voluntrary cooperation	urban consolidation centre (UCC) based on the public – private partnership
Supporting measures		
ITS road traffic management systems, zoning strategies,		

The policy measures described above should be structured according to their level of complexity (Table 1). They may be discussed as standalone solutions or, preferably, as part of a wider strategy addressing problems identified within the city's transport system. It is also important to note the distinction between measures which concern freight vehicle traffic and those altering the supply chain

performance. Some of them are regulatory in nature while others involve the cooperation of different actors [Marcucci, Danielis, 2008]. Finally, there are measures playing a supporting role. There are spatial strategies designed to concentrate freight-related activities or road traffic management systems (ITS).

Four measures were selected for the evaluation of the most feasible urban freight transport management solution in the Gdańsk city center:

1. continuation of the current traffic policy,
2. regulatory scenario: mix of access restrictions, weight restrictions and loading time restrictions,
3. voluntary cooperation of freight operators,
4. urban consolidation centre (UCC).

The Tristar ITS road management system was selected as the possible supporting measure due to its advanced implementation stage. All of the proposed measures have been discussed and described in many publications and analyses. However, some of the solutions, i.e. voluntary cooperation and urban consolidation centers vary in terms of how they are implemented. It must be clarified at this point which concrete option is being considered to avoid confusion and unclear conclusions derived from the ANP model.

Regulatory measures are the most common actions to solve basic problems of freight traffic in urban areas. Access restrictions according to weight, time windows and loading zones followed by parking restrictions represent the typical set of regulations [Duin, Muňuzuri, 2006 s. 343]. Such measures are often introduced "automatically" - without previous analysis or without the knowledge of the area's delivery structure. But if well planned and managed, the measures can offer practical tools for urban traffic management and create a basis for further developments. This can be observed for example in London, where the Traffic for London authority (TfL) introduced several additional measures to unlock the potential of existing regulations within the London Freight Plan [Tf, 2007].

Voluntary cooperation of freight operators may be considered as a method of improving the effectiveness of logistic operations. It was introduced in Kassel in 1994 as an initiative of private companies. Several other cities followed suit (i.e. Freiburg, Essen) with their own alterations of the scheme. The idea in Kassel was to consolidate goods and have a single neutral carrier make the deliveries. The intended traffic reduction and vehicle utilization rates were achieved leading to a 60% reduction in inner city mileage and a 100% increase in vehicle saturation by volume [Kohler, 2003, 321-333]. However, the project collapsed due to high costs of transshipment operations and fleet maintenance. Keywords for this alternative are: private initiative and kick-off financing, and public involvement (direct subsidy) if possible.

The urban consolidation center is described as a logistics facility that is situated in close proximity to the city center (in most cases) or to a specific site (e.g. shopping center), from which consolidated deliveries are carried within the area [Browne, 2005]. To provide a clear distinction from the voluntary cooperation model (initiated by the private sector) it was assumed that UCC in this case will be a public initiative as part of an active urban freight policy. It requires stable financing from the public sector and a clear long term policy orientation. There are examples [Duin 2010] of consolidation centers initiated in this way (Leiden - Netherlands, Malaga - Spain) indicating the critical factors to be considered, besides the necessary financial involvement. There may be opposition both from retailers and freight operators claiming that the municipality is aiming to create a monopoly in the urban freight market. Moreover, when other measures provide an acceptable level of delivery service for retailers, a UCC is likely to be considered a nuisance. The keywords for this measure are: direct public involvement, public-private partnership, dedicated facility and regulatory measures.

DESCRIPTION OF THE ANALYTIC NETWORK PROCESS METHOD (ANP)

The analytic network process (ANP) is a multicriteria theory of measurement used to derive relative priority scales of absolute numbers from individual judgments or from actual measurements normalized to a relative form [Saaty 2009]. It may be applied as a decision making framework for political, social and economic problems. It includes all the factors and criteria, tangible and intangible, which are important to understand the problem. Judgments represent the relative influence of one of two elements over the other in a pairwise comparison process on a third element in a system, with respect to an underlying control criterion. In the ANP dominance or influence are central concepts. A decision maker or a group of decision makers use the fundamental scale of absolute numbers (1 - 9) to make a comparison [Saaty 2006] as shown in Table 2.

Table 2. ANP fundamental scale of comparisons
Tabela 2. Fundamentalna skala porównań w metodzie ANP

Intensity of importance	Definition	Explanation
1	equal importance	two activities contribute equally to the objective
2	weak importance	
3	moderate importance	experience and judgments slightly favor one activity over another
4	moderate plus	
5	strong importance	experience and judgments strongly favor one activity over another
6	strong plus	
7	very strong or demonstrated importance	an activity is favored very strongly over another, its dominance is demonstrated by practical examples
8	very, very strong	
9	extreme importance	the evidence favoring one activity over another is of the highest possibile level

In order that all influences would be meaningful to synthesize it is essential to take the same criterion to all the comparisons. Such a criterion is called a control criterion. It is an important way for focusing thinking to answer the question of dominance among selected factors. Control criteria are utilized to cover both favourable and unfavorable concerns which must be considered to achieve rationality of decision. They are grouped into benefits, opportunities, costs and risks [Saaty, Vargas 2006]. Benefits are favourable sure concerns and unfavorable ones are costs. The uncertain concerns of a decision which are positive are the opportunities connected with the decision. The last group, risk, covers all the negative factors the decision can entail. These four groups of concerns are referred to as the BOCR merits. ANP models generally have three layers, also presented in Figure 1:

Top layer - a single network that includes benefits, opportunities, costs and risk nodes (BOCR nodes) and the strategic criteria used to evaluate their importance for the decision. Strategic criteria are the optional element of the model. If they are not included, BOCR control networks are rated with respect to their influence on the decision; this approach is used in the presented paper.

Control criteria network - each of the BOCR with a subnet containing its control criteria.

Decision networks - the alternatives to the decision appear in a cluster in each decision subnet, with all connections between control criteria.

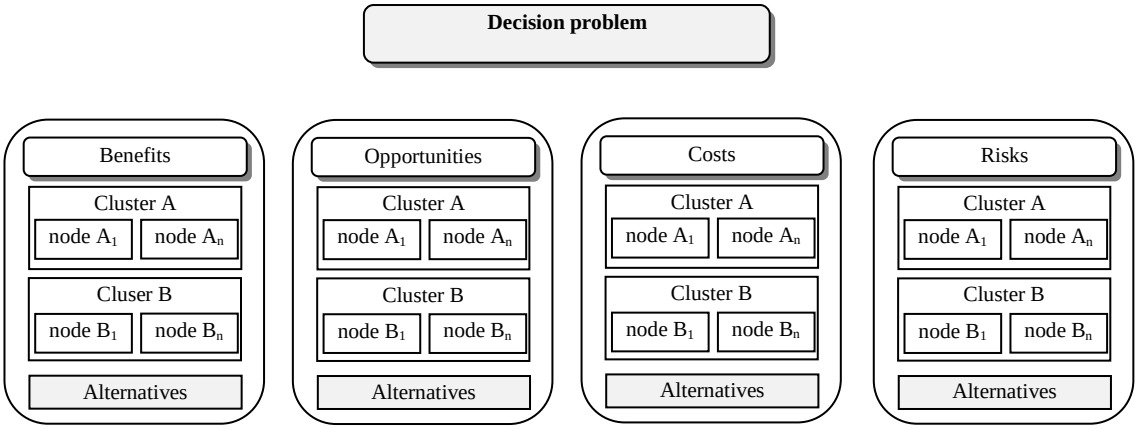

Fig. 1. General framework of the ANP method model
Rys. 1. Bazowa struktura modelu w metodzie ANP

There are several decision situations to which the analytic network process method can be applied [Forman, Gass 2001]:

- choice: the selection of one alternative from a given set of alternatives, usually where there are multiple decision criteria involved,
- ranking: putting a set of alternatives from the most to the least desirable,
- prioritization: determining the relative merit of a set of alternatives, as opposed to selecting a single one or merely ranking them,
- resource allocation: apportioning resources among a set of alternatives,
- benchmarking: comparing the processes in one's own organization with those of other best-of-breed organizations,
- quality management: dealing with the multidimensional aspects of quality and quality improvement.

In this paper the prioritization approach was selected as the most feasible. When prioritizing alternatives, the order, intervals, and ratios of the resulting priorities are of interest, in addition to knowing which alternative has the highest priority. This is important because in the presented model all alternatives may be rational under favourable conditions and they have the potential to supplement each other when properly executed.

ANP MODEL AND RESULTS

The criteria used to evaluate selected alternatives are derived from the main goals of urban freight traffic policy. They are directed at providing consistency between all involved stakeholders' objectives. At the same time criteria must reflect general long-term policy objectives. Criteria were clustered within each BOCR (benefits, opportunities, costs and risks) control network. Clustering similar criteria is a practical method to make the analysis manageable. It also gives an opportunity to check whether the first assumptions were appropriate by confronting different clusters. The number of decision criteria is intentionally limited not to blur the whole picture by implementing a large number of irrelevant factors.

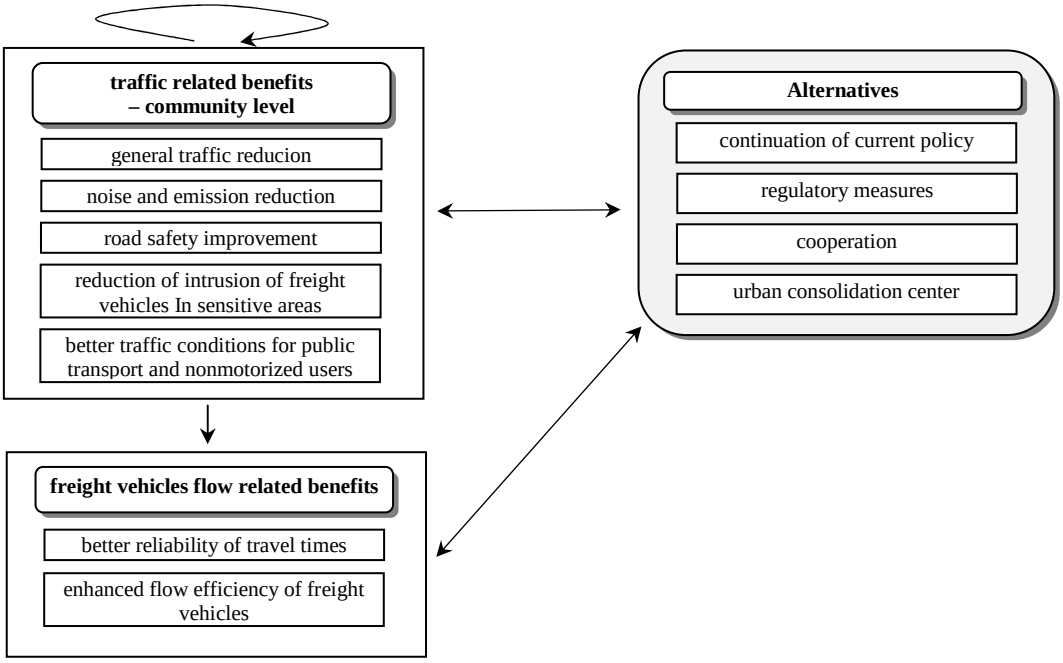

Fig. 2. Benefits subnet
Rys. 2. Sieć korzyści

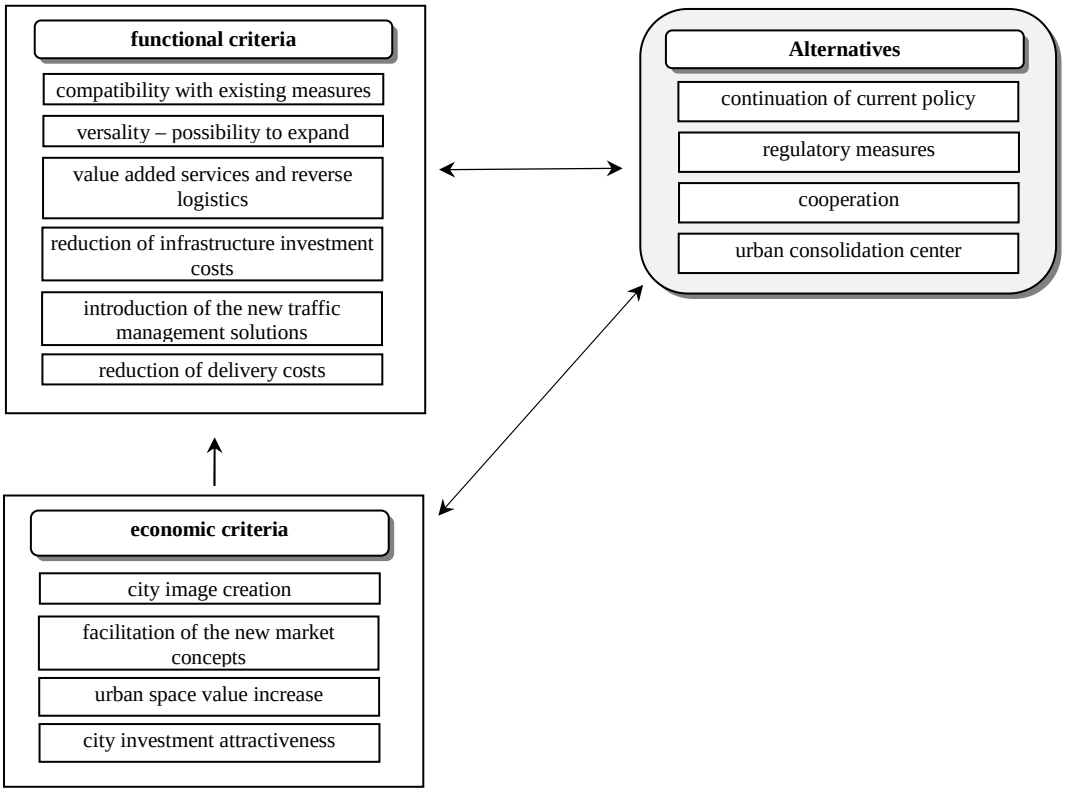

Fig. 3. Opportunities subnet
Rys. 3. Sieć szans

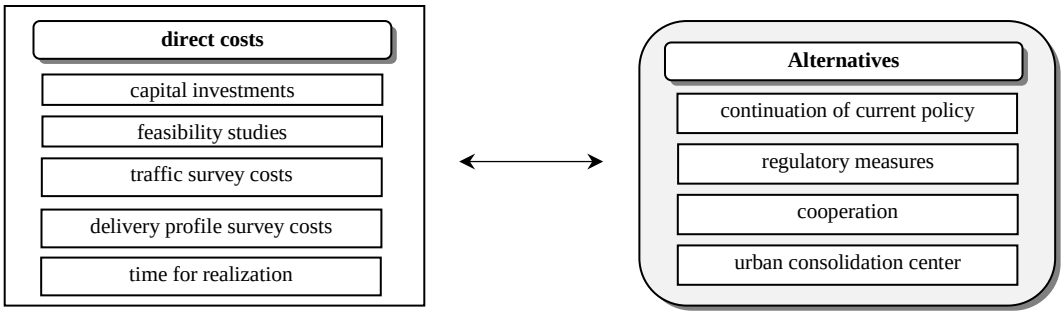

Fig. 4. Costs subnet
Rys. 4. Sieć kosztów

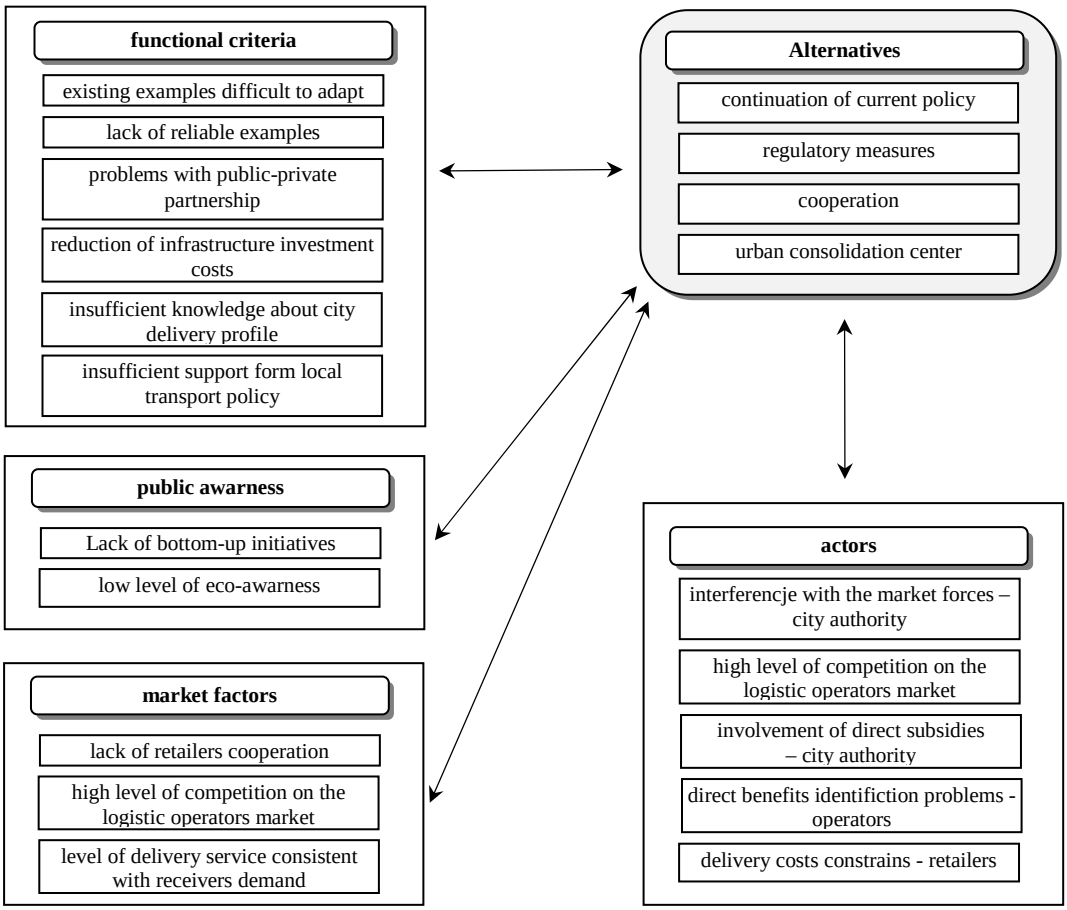

Fig. 5. Risk subnet
Rys. 5. Sieć ryzyka

Due to editorial limitations only the final output of the model will be presented and discussed. According to the structure of the ANP model the top level network was evaluated first. It was achieved by setting the priorities for each of the benefits, costs and opportunities control networks. This provides the necessary balance between all control criteria networks and clusters within them with regards to the nature of the problem analysed. Because the model concerns a policy which influences many areas of the city's economic and social system it has to incorporate a balanced approach. It is reflected directly by accepted priorities:

- benefits 0,15
- opportunities 0,25
- costs 0,20
- risks 0,40

The benefits control network priority is low at 0.15. It is difficult to evaluate the direct benefits for many directly involved actors and indirectly influenced sectors. Accepting the strategic approach, some direct benefits in a longer planning perspective should be considered as opportunities. The main possible positive effects of the measures are within the opportunities control network. They reflect both far-reaching economic benefits and functional opportunities such as the possibility to expand or increase versatility. This control network has the priority of 0.25. However, this is noticeably less than the risks priority set to 0.40. A careful consideration of a wide array of diversified factors must be performed each time. It is difficult to transfer existing good practices because of local differentiation. Experience from many urban freight traffic solutions reveals that measures plausible from the operational perspective are sensitive to unexpected conditions, unique to the implementation area. Thus the priority for risks control network is set at the high value of 0.40.

After performing pairwise comparisons within each BOCR control network, involving clusters and nodes, the final model was obtained as a set of priorities. The first value is the normalized value (all priorities divided by the priority of the best alternative), while the latter value in brackets is a standard priority:

1. regulatory scenario 1,000000, (0.354384)
2. current traffic policy 0.717577, (0.254298)
3. cooperation scenario 0.667857, (0.236678)
4. urban consolidation center 0.436366, (0.154641)

As stated before, the prioritization approach was accepted to determine the relative merit of a set of alternatives. All alternatives included into the ANP model are supplementary to some extent. Some of them may be considered as a favourable precondition for achieving measures of a higher level of complexity. This is the case in the regulatory scenario and the current traffic management policy. The possibility to implement restrictions (weight, time, etc.) depends on the existing inner city traffic regulations and effective enforcement. Regulatory measures influencing freight vehicles complement regulations already in place in sensitive areas. If properly managed, they allow a seamless introduction and positive feedback from involved actors - retailers, transport companies and the community. This is reflected by the highest ranking of the regulatory scenario among other alternatives. The current traffic policy was regarded as a continuation of different measures, for example speed limits, restricted parking zones etc., and ITS road management systems covering arterial roads and other roads if needed. The relatively high ranking of this measure, scoring 0.71 of the best alternative, confirms the link between them. In practical terms, standard measures may be followed by more detailed regulatory solutions when applicable. The strong dominance of these two alternatives seems rational from the perspective of market development, existing examples and traffic conditions. Because they are traffic-related measures, they may be a step forward towards more complex solutions such as operator cooperation or an urban consolidation center. Cooperation and UCC differ in character because they focus mainly on logistic chain efficiency. While they follow similar objectives, they differ in the implementation methods and level of interference with existing delivery patterns. Both require a well developed cooperation between operators, significant pressure on the quality of deliveries and, in the case of UCC, on direct involvement of city authorities. Especially the UCC concept requires a high level of public involvement. To implement the consolidated deliveries scheme with a UCC as a central point, strict traffic regulations are important as a factor influencing both freight demand and supply. Direct subsidies are required in most cases, not only in the initial phase, but most likely during the whole period of operation. All of these factors make such initiatives very demanding and vulnerable to unexpected circumstances. This limitation is reflected with lower priorities derived from the model for

voluntary cooperation and UCC, 0.66 and 0.43 respectively. In other words, UCC is about 2.5 times less plausible than the regulatory scenario within existing and predicted conditions.

CONCLUSIONS

The evaluation of freight management measures carried out with the analytic network process (ANP) method provided some important findings. If well structured, this method can serve as a useful management tool for decision-makers seeking support with complex problems. The analysis can be performed for different levels of detail regarding the decision criteria or alternatives to be verified. It provides an opportunity to include and rationalize many opinions from experts, stakeholders, businesses and decision-makers. The ANP follows a natural process of comparing alternatives in accordance with the influencing factors. It can guide this process through a flexible structure of the model and achieve understandable results in the form of priorities.

The results achieved with the model and studies of literature reveal a growing importance of dedicated freight-related measures within urban transport policy. Freight traffic produces increasing pressures on urban transport systems and the city itself. As a consequence, the negative side-effects of transport are likely to exceed public acceptance and the capacity of the transport system. A rational evaluation is essential as a prerequisite for a successful introduction of optimal measures. Pursuing idealistic objectives is out of the question. Solutions should be tailor-made to existing problems, but with an option to expand if required. The ANP model showed that regulatory measures are the most feasible measure, as exemplified in the current policy profile and experiences from other cities. The final form of this measure should be developed with a detailed technical analysis covering both economic and traffic flow related aspects because different combinations of the practical tools are possible.

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OCENA WSKAŹNIKÓW ZARZĄDZANIA TRANSPORTEM MIEJSKIM

STRESZCZENIE. **Wstęp**: Problemy funkcjonowania przewozów ładunków w centrach miast stają się coraz wyraźniejsze wraz ze wzrostem poziomu motoryzacji oraz zmianami w strukturze popytu. W rezultacie łańcuchy dostaw stają się coraz bardziej uzależnione od częstych dostaw małych partii zróżnicowanych ładunków. Jest to typowy problem w większości współczesnych miast, którego rozwiązanie wymaga precyzyjnie dopasowanych narzędzi.

Metody: W celu uzyskania kompleksowej charakterystyki problemów związanych z transportem ładunków w miastach oraz ich możliwych rozwiązań dokonano analizy istniejących doświadczeń w tym zakresie. Specyfika poruszanej problematyki wymagała szerokiego podejścia badawczego. Obejmowało ono zarówno analizę szeregu przykładów i doświadczeń z miast europejskich, jak również weryfikację uwarunkowań teoretycznych. Na tej podstawie opracowano zbiór najczęściej występujących metod usprawnienia systemu transportu ładunków, który następnie poddano weryfikacji. W tym celu konieczne było zastosowanie metody analitycznej odzwierciedlającej złożoność badanego problemu. Musiała ona zapewniać elastyczność związaną z koniecznością uwzględnienia wielu zróżnicowanych kryteriów, przy zachowaniu jednocześnie przejrzystej struktury modelu. Do tego celu została wybrana metoda analitycznego procesu sieciowego (ANP - analytic network process). Jest to metoda wielokryterialnego wspomagania procesu decyzyjnego stosowana w złożonych problemach decyzyjnych, umożliwiająca relatywną ocenę zarówno wymiernych jak i niewymiernych czynników. Założeniem autora było stworzenie modelu zachowującego racjonalny poziom szczegółowości odzwierciedlający wszystkie najważniejsze kryteria decyzyjne oraz interesy zaangażowanych podmiotów.

Wyniki i Wnioski: Przeprowadzona analiza wykazała, że w obecnej sytuacji optymalnym rozwiązaniem w Gdańsku może być wdrożenie rozwiązań o charakterze regulacyjnym. Odzwierciedla to przekonanie, że jedynie wyważone i przemyślane rozwiązania mogą przyczynić się do usprawnienia systemu transportu ładunków bez narażania na szwank lokalnej gospodarki. Ich wdrożenie powinno być wynikiem regularnie prowadzonych analiz funkcjonowania miejskiego systemu transportowego. Natomiast wdrożenie narzędzi o bardziej złożonym charakterze jest uzależnione od zaangażowania wszystkich zainteresowanych podmiotów w formie planowania oddolnego. W innym przypadku, forsowanie nadmiernie skomplikowanych rozwiązań pozbawionych praktycznego uzasadnienia spowoduje efekty odwrotne do zamierzonych..

Słowa kluczowe: transport ładunków w miastach, logistyka miejska, miejska polityka transportowa, analityczny proces sieciowy ANP.

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KENNZIFFER-BEWERTUNG IM STÄDTISCHEN TRANSPORT-MANAGEMENT

ZUSAMMENFASSUNG. Einleitung: Die Probleme mit der Warentransport-Logistik in den Stadtzentren werden mit der Entwicklung des Verkehrs und der Struktur der Nachfrage immer deutlicher. Im Endeffekt werden die Logistikketten immer stärker abhängig von häufigeren Lieferungen der kleineren Chargen, die aus differenzierten Waren bestehen. Es ist ein typisches Problem für moderne Städte, das nur mit präzise angepassten Instrumenten gelöst werden kann.
Methoden: Zwecks Aufnahme der komplexen Charakteristik der Probleme, die mit der Warenlogistik in den Städten verbunden sind und in Bezug auf die Entwicklung von möglichen Lösungen, wurden die in diesem Bereich schon vorhandenen Erfahrungen analysiert. Der spezifische Charakter der untersuchten Problematik verlangte eine breite Palette von Instrumenten der Forschungsmethodik: sie umfasste sowohl die Analyse von zahlreichen Beispielen und Erfahrungen der europäischen Städte, als auch die Verifizierung der theoretischen Voraussetzungen. Auf diesem Grund ist eine Sammlung der am häufigsten vorkommenden Methoden der Steigerung der Leistungsfähigkeit der Logistikkette entwickelt worden, die dann nachträglich auch verifiziert wurde. Für diesen Zweck war es nötig, ein analytisches Verfahren zu verwenden, das die Komplexität des untersuchten Problems widerspiegeln könnte. Diese Methode musste Flexibilität gewährleisten, die mit der Notwendigkeit der Berücksichtigung von vielen unterschiedlichen Kriterien verbunden war, bei gleichzeitiger Beibehaltung einer transparenten Struktur des Modells. Zu diesem Zweck wurde die Methode des Analytischen Netzwerkprozesses (ANP) in Anspruch genommen. Es ist eine Methode zur Lösung von mehrkriteriellen Entscheidungsproblemen, die bei komplexen Entscheidungsproblemen verwendet wird und die eine relative Bewertung sowohl der messbaren, als auch nicht messbaren Faktoren ermöglicht. Die Voraussetzung des Autors war, ein Modell zu entwickeln, in dem ein rationelles Niveau der Ausführlichkeit beibehalten wird und welches alle wichtigen Entscheidungskriterien und Interessen der betroffenen Akteure widerspiegelt.
Schlussfolgerungen: Die durchgeführte Analyse hat gezeigt, dass in der heutigen Situation die optimale Lösung für Danzig (Gdańsk) wäre, Lösungen vom Regulierungscharakter einzuführen. Es widerspiegelt die Überzeugung, dass nur ausgeglichene und durchdachte Lösungen dazu beitragen können, dass die City-Logistik leistungsfähiger wird, ohne die lokale Wirtschaft zu verletzen. Die Einführung dieser Lösungen sollte das Ergebnis der regelmäßig durchgeführten Analysen des städtischen Transportsystems sein. Was den Einsatz der Instrumente, die einen mehr komplexen Charakter haben, anbetrifft, dann ist er vom Engagement aller interessierten Akteure in die Planung "von unten" abhängig. In anderem Fall wird das Forcieren von übermäßig komplizierten Lösungen, die keine praktische Begründung haben, zu einem ganz anderen Ergebnis führen, als das beabsichtigte.

Codewörter: städtischen Transportsystem, City-Logistik, Methode des Analytischen Netzwerkprozessen ANP

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