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URBAN FORESTRY AS A FUNCTION OF GREEN LOGISTICS

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ABSTRACT

Transportation system has its important role of continuously connecting separated elements of supply chain providing the flow of goods as its objective. By reaching its purpose, transportation system has numerous negative effects including those in urban areas that are researched by decades now, and are creating significant part of the total impact. In urban areas, environmental impacts manifest especially in lower air quality, which is significantly influenced by city logistics. One can lower the negative impact of city logistics by greening it, using concepts of green logistics. One of the activities that reduces air pollution from transport and improve air quality is urban forestry that is based on forestation of urban areas.

**Key words:** logistics, city logistics, green logistics, urban forestry

1. INTRODUCTION

As urban areas across the world are growing, the need for mobility and transportation of goods is increasing. To satisfy the final consumers need for right product at the right time, logistics system with its all elements is evolving and expanding. The negative impact of logistics on the environment is continuously rising, especially in urban areas, and this issue should be solved from the long-term aspect of sustainable development. Sustainable development can be partly achieved by implementation of green logistics activities and strategies. Designing a green logistics cannot be specified on one of the points in supply

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chains. To achieve improvements, green logistics must be a collection of organised and integrated activities in the supply chain, focused on creation of sustainable and upgradable green network.

Negative logistics impacts are especially manifesting in urban areas through traffic congestions and environment pollution. Very often, green logistics and distribution logistics are in paradox, where distribution logistics has different approaches that are provided to deliver goods on time and in any form, green logistics strategy is to deliver as soon as possible but concerning environmental impact. To effectively solve many of logistics and transport problems in urban areas, city logistics is implemented. One of main elements of city logistics is freight transport in urban areas.

When analysing environmental effects of transport sector, it can be concluded that the transport sector in EU has the second biggest greenhouse gas emissions. More than two thirds of transport-related greenhouse gas emissions are from road transport. In these two thirds, significant part relates to the emissions in urban area caused by urban transport<sup>1</sup>.

Based on the fact that urban areas around the world are expanding one of the biggest challenges facing city logistics is a creation of long-term sustainable urban areas created by integration of all activities related to the city and green logistics.

Implementing the concept of urban forestry, the negative impacts of city logistics, especially air pollution caused by freight transport, can be reduced resulting in less pollution, better air quality and other social, economic and ecological benefits.

## 2. GREEN LOGISTICS STRATEGIES

The negative impact of logistics activities on the environment has resulted in the need for sustainable development. According to the most accepted definition made by Brundtland Commission, Sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”<sup>2</sup>.

Sustainable development can be achieved by implementation of green logistics activities and strategies. Green logistics consists of all activities related to the eco-efficient management of the forward and reverse flows of products and information between the point of origin and the point of consumption whose purpose is to meet or exceed customer demand<sup>3</sup>.

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<sup>1</sup> [http://ec.europa.eu/clima/policies/transport/index\\_en.htm](http://ec.europa.eu/clima/policies/transport/index_en.htm) (07.02.2013.)

<sup>2</sup> [http://www.unece.org/oes/nutshell/2004-2005/focus\\_sustainable\\_development.html](http://www.unece.org/oes/nutshell/2004-2005/focus_sustainable_development.html) (07.02.2013.)

<sup>3</sup> Thiell, M., Soto Zuluaga, J. P., Madiedo Montañez, J. P., Bart van Hoof: Green Logistics: Global Practices and their Implementation in Emerging Markets, 2011.

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Designing a green logistics cannot be specified on one of the points in supply chains. To achieve improvements green logistics must be a collection of organised and integrated activities (as shown in figure 1.) focused on creation of sustainable and upgradable green network.

In this sense, green logistics must encompass all activities related to the green production, green transport, waste reduction, energy, space and resource savings, planning a green supply chain management and having a green consumer<sup>4</sup>.



Figure 1. Collection of some supply chain activities that need to be strategically planned

*Source: Bajor, I., Božić, D., Rožić, T.: Influence of green logistics strategies on reducing supply chain management costs in Croatia, ICTS 2011.*

### 3. IMPACT OF CITY LOGISTICS ON URBAN POLLUTION

According to the European Environment Agency, around 75 % of population of the EU is living in urban areas. Furthermore, economy and industrial production are also concentrated in urban areas, which leads to a high level of urban transport<sup>5</sup>.

To effectively solve many of logistics and transport problems in urban areas, process of city logistics are implemented. City logistics can be defined as the process of optimising the logistics and transportation activities of companies in urban areas while considering the traffic environment, the traffic congestion and energy consumption within the framework of a

<sup>4</sup> Bajor, I., Božić, D., Rožić, T.: Influence of green logistics strategies on reducing supply chain management costs in Croatia, ICTS 2011.

<sup>5</sup> <http://www.eea.europa.eu/themes/urban> (08.02.2013.)

market economy<sup>6</sup>. The frame for city logistics is given by local and regional economy, the transport infrastructure, the surrounding environment, legal and regulatory conditions.

One of main elements of city logistics is freight transport in urban areas. Generally, there are four key stakeholders involved in urban freight transport (as shown in Figure 2.). Each of the key stakeholders in urban freight transport has their own specific objectives and tends to behave in a different manner and the main task of city logistics models is to recognise these factors<sup>7</sup>.

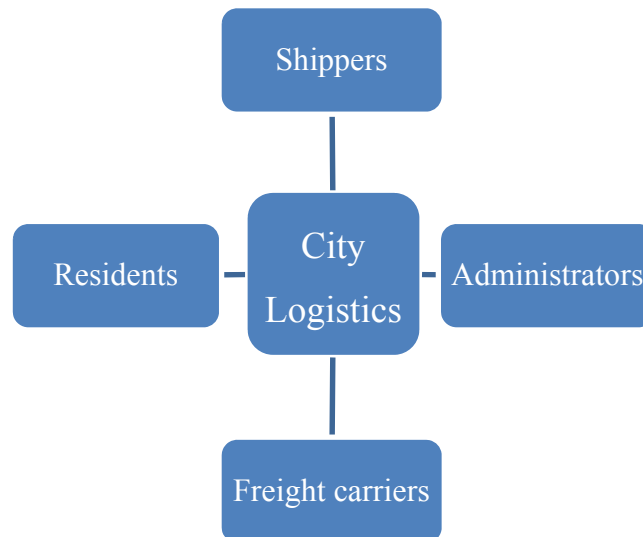


Figure 2. Key stakeholders in City logistics

*Source: Prepared and adopted by authors*

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As population in Europe's urban areas is growing, it results in increase for mobility and transportation of goods (as shown in figure 3.). Increase of transport in urban areas has as a result increase in road congestion, air pollution and increase of noise. In EU, urban transport is responsible for about 23 % of total CO<sub>2</sub> emissions from transport and up to 70 % of other pollutants<sup>8</sup>. In general the share of emissions from freight transport compared to the total

<sup>6</sup> Taniguchi, E., Thompson, R. G., Yamada, T., Ron van Duin: City logistics: Network modelling and intelligent transport systems, Pergamon, 2001.

<sup>7</sup> Taniguchi, E., Thompson, R. G., Yamada, T., Ron van Duin: City logistics: Network modelling and intelligent transport systems, Pergamon, 2001.

<sup>8</sup> [http://ec.europa.eu/transport/themes/urban/urban\\_mobility/](http://ec.europa.eu/transport/themes/urban/urban_mobility/) (09.02.2013.)

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traffic is about 20 to 30% depending on the local situation<sup>9</sup>. Although, different measures are taken regarding the vehicle technologies, distribution optimization and regulations and legislation, emissions in cities are not reducing in satisfactory rate.

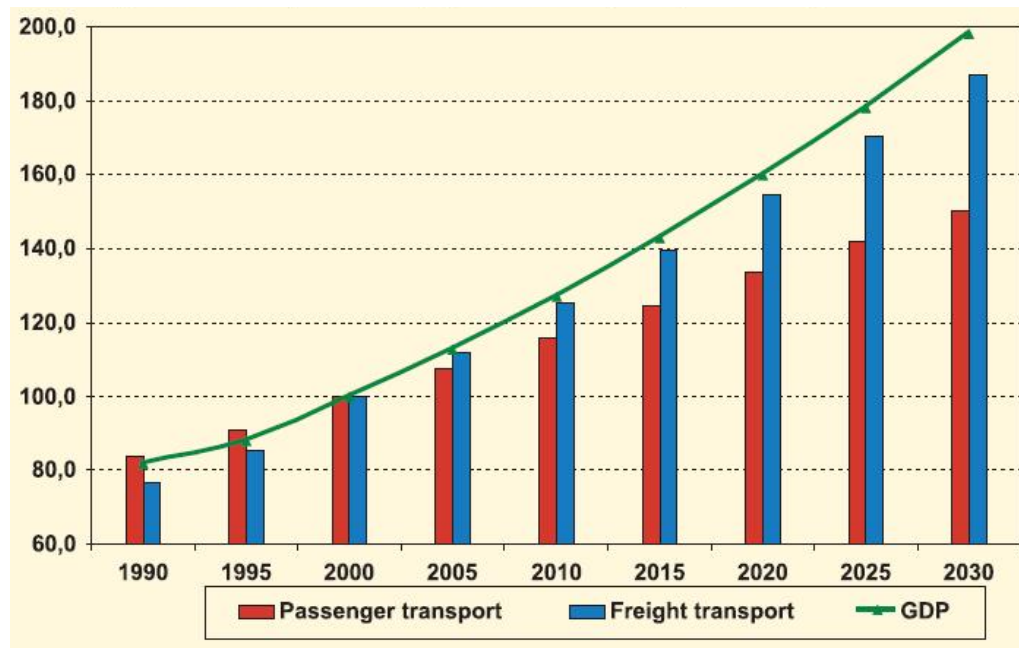


Figure 3. Transport activity growth in EU (index 2000=100)

Source: <https://ilmasto-opas.fi/en/ilmastonmuutos/hillinta/-/artikkeli/cd3c06f0-ddc2-4984-840f-c35a98daf01e/liikkuminen-ja-yhdyskuntarakenne.html> (09.02.2013.)

One of the biggest challenges facing city logistics is a creation of long-term sustainable urban areas with the least possible negative environmental impact. This long-term sustainable urban areas must be created by integration of all activities related to the city and green logistics.

#### 4. URBAN FORESTRY AS AN ELEMENT OF CITY LOGISTICS

Urban forestry was conceptualized in the late 1960s in North America, and grew out of what was initially termed environmental forestry. In general, urban forestry can be defined as a management of tree populations in urban settings, for the purpose of improving the urban environment.

More precisely, urban forestry can be defined as a planned and programmatic approach to the development and maintenance of the urban forest, including all elements of green infrastructure within the community, in an effort to optimize the resulting benefits in social,

<sup>9</sup> [http://www.bestufs.net/download/BESTUFS\\_II/key\\_issuesII/BESTUF\\_Quantification\\_of\\_effects.pdf](http://www.bestufs.net/download/BESTUFS_II/key_issuesII/BESTUF_Quantification_of_effects.pdf) (09.02.2013.)

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environmental, public health, economic, and aesthetic terms, especially when resulting from a community visioning and goal-setting process<sup>10</sup>.

Today, urban forests are, because of seasonal changes and their size, shape, and colour, the most prominent elements of urban nature. Their benefits are several, from social, climate, architectural, to the economic.

Generally, benefits of urban forestry can be divided into four groups<sup>11</sup>:

- social
- aesthetic and architectural
- climate and ecological
- economic.

One of the generally acknowledged functions of urban forestry, in social sense, is the provision of recreational opportunities. By offering an attractive environment for recreational activities, improving air quality and reducing noise, urban forests may improve public health. Architectural benefits are related to the various landscape variations which are created through different colours, textures, forms and densities of plants. Urban trees can direct vision, break up large spaces, and define space and with that improve and restore constructed townscapes. Aesthetic benefits relate to the different colours, structure, forms and densities of vegetation that people experience and which has an impact on people's mental and emotional state.

Climate and ecological benefits relates to the impacts of urban forestry through temperature and humidity control, air quality, hydrology, biodiversity and energy use in urban areas. One of the relevant problems in urban areas, especially in summer, is overheating. The most effective way in reducing heat in urban areas is by urban forestry. Also, used energy for cooling family houses in summer season can be significantly reduced through strategically shading with trees.

Urban forests is especially important in hydrology as it can reduce surface runoff and thus alleviate the strain from the urban sewage system and dampen peak flows of streams. The

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<sup>10</sup> Schwab, C. J.: Planning the Urban Forest: Ecology, Economy, and Community Development, American Planning Association, 2009.

<sup>11</sup> Tyrvaäinen, L., Pauleit, S., Seeland, K., Vries, S.: Benefits and uses of urban forests and trees, Urban Forests and Trees in Europe A Reference Book, 2004.

hydrological function of urban forestry is increasingly stressed as protection of drinking water resources<sup>12</sup>.

The most important benefit of urban forestry, from transportation and city logistics point of view, is improvement of air quality and absorption of greenhouse gases. Today, air pollution is a major environmental concern of most urban areas across the world.

Freight transport in urban areas emits about 20 to 30 % of pollutants compared to the total traffic, as mention before, with the trend of growth. According to this, improving air quality must be an imperative of environmental policies in urban areas. Urban forestry cleans the air by absorbing carbon dioxide, sulphur dioxide, nitrous oxides and other pollutants.

Many studies have been conducted about urban forestry and their ability to absorb emissions. Urban forests in the USA store 700 million tonnes of carbon with value of 14,300 million dollars. Except carbon, urban forests also remove large amounts of air pollution that consequently improve urban air quality. Pollution removal (O<sub>3</sub>, PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO) varied among cities with total annual air pollution removal by US urban forests estimated at 711,000 metric tons (\$3.8 billion value)<sup>13</sup>.

Another study shows that urban forests in different cities in USA contributed to air quality in a great amount removing air pollutions:

- New York City – urban forests removed 1,973 tons of air pollution annually
- Atlanta metro area - urban forests removed 8,618 tons of air pollutants annually
- Philadelphia - urban forests removed 971 tons of air pollution annually
- Los Angeles - urban forests removed about 77,000 tons of carbon per year and about 1,976 tons of air pollution per year.<sup>14</sup>

These studies show that significant amount of air pollutions can be removed with implementation of urban forestry resulting in less pollution, better air quality and other social, economic and ecological benefits.

Total city area of Zagreb is 641 km<sup>2</sup> and around 223 km<sup>2</sup> of total city area, or 35% are forests<sup>15</sup>. Compared with other European cities it can be concluded that Helsinki (Finland)

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<sup>12</sup> Ibidem

<sup>13</sup> Vijai Shanker Singh, V. S., Pandey D. N., Chaudhry, P.: Urban forests and open green spaces: lessons for Jaipur, Rajasthan, India, RSPCB, 2010.

<sup>14</sup> Alliance for Community Trees: Benefits of Trees and Urban Forests: A Research List, 2011.

<sup>15</sup> <http://www.tportal.hr/scitech/tehnolo/181866/Predstavljen-Interaktivni-pregled-suma-Grada-Zagreba.html#.UUHH1TcWadx> (14.02.2013.)

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which total city area is smaller than Zagreb's (around 182 km<sup>2</sup>) has 20%<sup>16</sup> and Zurich (Switzerland) which total city area is larger than Zagreb's (around 1 729 km<sup>2</sup>) has around 60%<sup>17</sup> of area covered in forests.

When analysing forests and green areas it can be concluded that Zagreb has envious position compared to the European cities as Helsinki and Zurich, which present an average 'green city' status. Also, air quality in Zagreb is first category which can be in some part contributed to the urban forests and green areas. Although, percentage of forests and green areas in Zagreb is above European average further forestation is necessary in order to continue the positive trend and enable the city environment to face the future developments and increase of transport activities.

### 5. CONCLUSION

Transport sector in EU has the second biggest greenhouse gas emissions and more than two thirds of transport-related greenhouse gas emissions are from road transport. This problem is especially represented in urban areas where road transport is dominant. Significant amount of emissions comes from freight transport (20 to 30%) which is one of the elements of city logistics.

Based on the fact that urban areas around the world are expanding one of the biggest challenges facing city logistics is a creation of long-term sustainable urban areas with the least possible negative environmental impact. This long-term sustainable urban areas must be created by integration of all activities related to the city and green logistics.

One way to reduce emissions from transport (freight and passenger) is by designing urban forestry in a form of sustainable development. In general, urban forestry can be defined as a management of tree populations in urban settings for the purpose of improving the urban environment. Benefits of urban forestry are several from social, climate, architectural to the economic.

The most important benefit of urban forestry, from transportation and city logistics point of view, is improvement of air quality and absorption of greenhouse gases. Urban forestry cleans the air by absorbing carbon dioxide, sulphur dioxide, nitrous oxides and other pollutants.

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<sup>16</sup> Koskikallio, V.: Urban forests – City of Helsinki, Public Works Department, 2007.

<sup>17</sup> [http://www.stadt-zuerich.ch/content/ted/de/index/gsz/natur-\\_und\\_erlebnisraeume/stadtwald.html](http://www.stadt-zuerich.ch/content/ted/de/index/gsz/natur-_und_erlebnisraeume/stadtwald.html) (14.02.2013.)



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Studies conducted mainly in the USA implicated that significant amount of air pollutions can be removed with implementation of urban forestry resulting in less pollution, better air quality and other social, economic and ecological benefits.

As environmental impact of logistics is significant, concept of green logistics is starting to gain more attention, as a strategic and obligatory option. Designing cities to evolve in sustainable form can provide benefits for many aspects. Collision of different approaches to gain sustainability here is presented as urban forestry that can reduce impact of city logistics. Reducing impact by urban forestry is not solving the issue of environmental pollution, but as one small part of the green logistics strategies, when brought together, can make the difference.

When compared to percentage of green areas in European cities as Helsinki and Zurich, which present an average ‘green city’ status, Zagreb has, in this segment of greening an envious position. Although, Zagreb has satisfying percentage of forests and green areas, Helsinki and Zurich are presenting green concept in broader sense. Green city includes, besides forestation, waste management, green education, sustainable development, etc., where these issues are more representative in mentioned cities.

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