URBAN TRANSPORT OPTIMIZATION – A SMART MOBILITY APPROACH

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Abstract:
Each person who travels in a city wants to arrive to the destination as quickly as possible. Nevertheless, in the same time, from an urban transportation company's perspective, it is also very important to assure that the access to public transport services is available for as many people as possible, according to their needs. In this paper, we try to present a model of public urban transport optimization in order to satisfy better the passengers' needs.

Key words: urban transport, smart mobility, sustainable development, passenger traffic, traffic variations

1. Introduction

Firstly, the transport companies and the citizens sought solutions to satisfy their transport needs without taking into account some urban aspects of their urban life (Hillman, Henderson and Whalley 1973, 1976), such as increasing the flow of vehicles, the parking congestion or the ever-increasing pollution. For example, there are some studies, which prove that the development of a region or of a country implies a higher degree of pollution (GHG emissions) due to the transport congestion, too (Popescu and Șipoș, 2014). Nowadays, smart mobility supposes the consideration of both transport infrastructure and people. Therefore, the urban transport approach shifts from vehicular perspective to people mobility, and from traffic congestion (avoiding traffic congestion) to people accessibility to the desired places from the city. More so, it is proved that more than 25% of the CO_2 emissions out of the total energy use is due to the transport sector (Woodcock, J. et al, 2009).

This paper aims to present a proper model of urban transport optimization. We will start by presenting the objectives of the public urban transport, and then we will point out the main steps to determine the volume and intensity of passenger traffic. The main part of the paper presents the manner in which a preferential equilibrium model can optimize the urban transport.

The conception regarding the selection and introduction of transport means in a city has to take into account:

- The satisfaction of the city's development demands: high transport capacity, manageability, silence preservation, elasticity to the traffic variations, occupying a surface as small as possible out of the city's surface, the reduction of pollution;
- The ensuring of social and economic development: investments, costs reduction, economic return, reduction of energy consumption. In order to determine people to use public transport, authorities should increase the quality and the efficiency of transport services, and make individual road users pay higher costs if using their own cars instead of public

transport services (Mayeres et al., 1996).

2. Model regarding the optimization of public urban transport

The organization of the urban public transportation targets: the street network; the determination of the volume and intensity of passenger traffic; the determination of transport means ensuring the movement requirements; the organization of urban transport companies; the organization of urban transport process.

2.1. Determination of the volume and intensity of passenger traffic

Transport demand, expressed by the number of passenger who should be transported and who require urban public transport services, in a determined period of time, derived from the configuration of the street network of the city and also, from the characteristics of the in-the-city movements (for professional, personal or recreation movements purposes).

Every industrial area, every neighborhood, every big company, every social and cultural establishment represents a polarizing center for travelers, who determine the passenger transport demands. For example, the fast fashion industry influences consumers' behaviors to continuously seek for new products (Popescu, 2015), which appear more frequently than the before two main season, fact which determines a regular flow of people to specific parts of the city, where shopping centers find themselves.

In the context of complex cities, it is vital for the public transport companies to know permanently the transport demand, its maximum and minimum limits, phased on time intervals at route level and transport network level. Transport companies have to correlate the offered transport capacity with the required capacity, and have to determine the transport demand. An efficient public transport encourages people to use it instead of their own cars, fact which decreases pollution (GHG emissions), contributing to the implementing of green logistics policies (Popescu and Șipoș, 2015).

Figure 1 represents a logical scheme for the connections between the transport issues, which appear when trying to correlate transport demand with the offered capacity.

In each area there is a certain traffic value that constitutes the traffic volume and that represents the total transported (or for transport) passengers. In another paper, we used the term of *passenger traffic* for the frequency of transport operations at the level of a certain time interval.

Given a polarizing point of the route, the traffic volume includes proper traffic volume and transit traffic volume.

In order to calculate the traffic volume from a particular route sector, we consider the traffic volume from both directions.

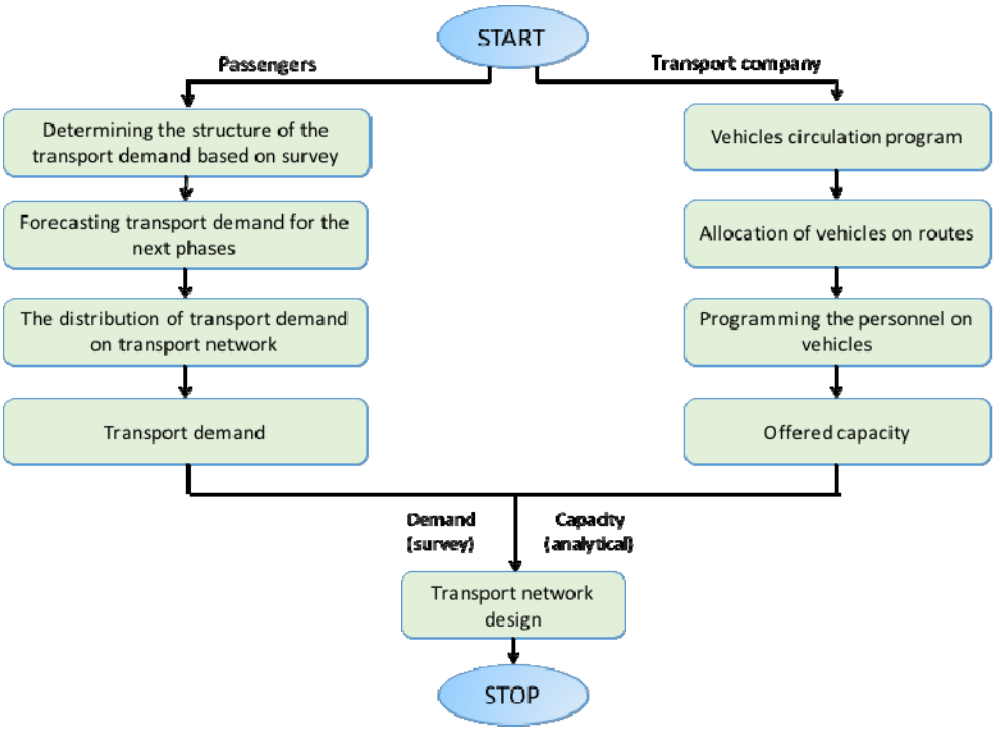

Figure 1. The logical scheme or the connections between urban transport problems

Source: own conception

Passenger movement occurs between two transport points or polarizing centers. This movement represents the traffic current, formed by the traffic volume transported by time unit, on a single direction of a route.

On a route, there is a variation of traffic volume and traffic currents, appropriate to each section. The amount of traffic values from the sectors of a particular route gives the total value of the traffic volume and the route traffic currents.

The information regarding passengers traffic allow the determination of the necessary transport capacity and offer the possibility to draw circulation graphics; at transport network level, this information allows the determination of the vehicle fleet, the number of stations, vehicles and personnel. Sometimes, collecting detailed information regarding the transport demand is quite hard due to the large number of city's inhabitants[1].

The forecasting of the volume and intensity of passengers traffic represents an important element for knowing the future evolution of the elements of urban transport system. In order to solve these kind of issues we can use forecasting mathematical models, which can be implemented throughout the use of different software programs. The models we propose are

[1] According to Japan International Cooperation Agency (2011), in China, for example, there are 72 cities with a population over 1 million inhabitants.

models based on extrapolation, weight type models and operational models.

Models based on extrapolation

The first step of the model supposes that we determined the total outgoing and incoming passenger number for an area *I* for the current period T_i and estimated period T_i'. We can determine the traffic n'_{ji} for different areas and *j* for the estimated period, according to the traffic from the current period n_{ji} and growth factors:

$$F_i = \frac{T_i'}{T_i} \text{ and } F = \frac{\sum_i T_i'}{\sum_i T_i}$$

The traffic n'_{ji} is:

$$n_{ij} = f\left(n_{ij}, F_i \times F_j \times F\right),$$

realizing iterative corrections until respecting the conditions at limit:

$$T_i' = \sum_j n_{ij}$$

The extrapolation could be realized using multiple factors:

- uniform factor:

$$n_{ij}' = n_{ij} \times F$$

- average factor:

$$n_{ij}' = n_{ij} \times \frac{F_i + F_j}{2}$$

- detroit factor:

$$n_{ij}' = n_{ij} \times \frac{F_i \times F_j}{F}$$

Weight type models

The most used model from that category is the model of preferential equilibrium. The practical studies realized using that model allow the passenger traffic forecasting on the long run with a rather good accuracy.

2.2. The optimization of urban transport using preferential equilibrium model

The city has to be divided into homogenous areas taking into account geographical, social and economic or physical characteristics. For each area, we have to obtain the following information:

- a_i, a_j – the age of the working people, who live in area *i*, respective area *j*;
- e_i, e_j – people working in area *i*, respective area *j*;
- n_{ij} – actual traffic between area *i* and area *j*.

Those data verify the following relations:

$$\sum_{i=1}^{m}\sum_{j=1}^{m} n_{ij} = N,$$

and

$$\sum_{i=1}^{m} a_i - \sum_{j=1}^{m} e_j - N,$$

where *N* represents the total number of passengers from the city and *m* represents the number of areas the city was divided in.

We have to respect the following conditions at limit, because we have the characteristics of a closed system:

$$\sum_{j=1}^{m} n_{ij} = a_i$$

And

$$\sum_{i=1}^{m} n_{ij} = e_j$$

For a future period, we estimate the following:

- $a_i^{'}$ – the age of the working people from areas *i*;
- $e_j^{'}$ – number of jobs from the *j* areas.

Taking into account the actual values of the traffic n_{ij} between all city's areas, we build a matrix N_{ij} as following:

$$\begin{matrix} n_{11} & n_{12} & \dots & n_{1j} & \dots & n_{1m} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ n_{i1} & n_{i2} & \dots & n_{ij} & \dots & n_{im} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ n_{m1} & n_{m2} & \dots & n_{mj} & \dots & n_{mm} \end{matrix}$$

respecting the condition: $a_i = e_j$

The next step is computation of vertical coefficients:

$$KV_j = \frac{e_j^{'}}{e_j}$$

Then we build the vertically corrected matrix, computing each element as following:

$$n_{ij}^{(1-1)} = n_{ij} \times KV_j$$

We have to compute the sums:

$$a_i^1 = \sum_{j=1}^{m} n_{ij}^{(1-1)}$$

The next step consists in a computation of the horizontal coefficients:

$$KO_i = \frac{a_i^{'}}{a_i^1}$$

Then we build the horizontally corrected matrix, computing each element as following:

$$n_{ij}^{(1-2)} = n_{ij}^{(1-1)} \times KO_i$$

and we obtain the sums:

$$e_j^1 = \sum_{i=1}^{m} n_{ij}^{(1-2)}$$

The process repeats itself until obtaining the convergence of horizontal and vertical coefficients. Practically, the fulfillment of the following conditions is sufficient:

$$0{,}95 \le KV \le 1{,}05$$
$$0{,}95 \le KO \le 1{,}05$$

The elements of the final matrix, which respect the convergence conditions after computing horizontal and vertical coefficients, represent the forecasted traffic between the city's areas for a future period.

3. Conclusions

In order to be attractive, the urban transport has to be effective, to meet the passengers' needs better and better. In the same time, urban transport has to be sustainable: to ensure the possibility of cost reduction, of energy consumption, and pollution.

An improved value of the urban transport infrastructure and the fulfillment of people's needs on the short and the long run represents a desideratum for actual cities' authorities.

Understanding and quantifying urban people's transport needs and forecasting it represents the key element of an effective urban mobility. In order to realistically plan urban transport and implement it, authorities have to know the structure of the urban transport demand and its distribution along the transport network, according to people's accommodation places and

their main regular destinations (depending on their jobs, social, economic and cultural interests etc.) very well.

If offering to a city's inhabitants an effective and efficient urban transport system, people will start to use the public transport more often and their own cars rarely, fact which will determine the reduction of pollution, noise, and traffic congestion. In this manner, the living conditions from the respective city will also improve, becoming more sustainable.

Acknowledgement
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GREENER SMES – INITATIVES FOR COMPETITIVNESS AND EFFICIENCY

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Abstract:
Small and Medium Enterprises (SMEs) play a crucial role in reorienting the European economy towards more sustainable patterns of production and consumption, in the context of economic and environment changes. Taking into consideration the significant contribution to economic activities, SMES are important for green growth and they determine a considerable impact on the environment. At European level there were elaborated environment policies and implemented legislative measures in this field. Under the Europe 2020 Strategy, the Green Action Plan (GAP) support SMEs towards the opportunities offered by the transition to a green economy. Thus, SMEs can turn environmental challenges into business opportunities and increase their competitiveness.

Keywords: greener SMEs, environment, competitiveness, efficiency

1. Introduction

Small and medium enterprises (SMEs) are the engine of the European economy and suggestive arguments in this respect are the share in the total number of enterprises (99.8%), contribution to the creation of economic value added (58%) and jobs (two thirds of jobs in the private sector) (EC, 2012). Therefore, the SMEs play a crucial role in shifting the European economy towards more sustainable system of production and consumption. Given the significant contribution to economic activities, SMEs determines a considerable impact on the environment.

In the context of economic and climatic changes, the deficit of energy resources and sustainable development are key challenges for SMEs, which must adopt new business models. Demand for green products and services also generate new business opportunities which can be used only if they have the information and professional knowledge. In addition, environmental legislation is becoming more complex and non-compliance costs are increasingly higher.

EU has a fundamental role in developing environmental legislation and in international environmental negotiations. The first initiatives where taken in the 70's.

The European environment policy was adopted by the European Council in Paris in 1972.

In 1987 the Single European Act introduced a new title *Environment,* which provided the first legal basis for a

common environmental policy that aims at preserving the environment quality, protecting human health and ensuring the rational use of natural resources (Ohliger, 2015).

Subsequently, under the Treaty of Maastricht (1993), the environment became an official EU policy and the Amsterdam Treaty (1999) established the obligation to integrate environmental protection into all EU sectorial policies.

In 2000, it was elaborated the Lisbon Strategy to make the EU economy the most dynamic and competitive knowledge-based economy in the world.

The Small Business Act (SBA) elaborated by the European Commission in June 2008 underlined the new framework for SME development and established that EU Member States should support SMEs to transform environmental challenges into opportunities.

Through the Lisbon Treaty (2009), the climate changes and sustainable development became specific objectives.

In March 2010, the European Commission published its new strategy for smart, sustainable and inclusive growth entitled Europe 2020.

Europe 2020, the new EU strategy for economic growth establish the priority of EU to become a sustainable economy and to set ambitious targets in order to combat climate change and increase of energy efficiency.

Green Action Plan for SMEs adopted in July 2014 provides a clear framework and guidelines for measures and actions to be implemented by European Union, Member States and regions, in order to support the SMEs and to develop the business opportunities offered by the green economy.

2. Barriers on implementing environmental policy for greener SMEs

Green growth is an important factor in decreasing the environment degradation and influencing the climate change. In this way, the green growth can intermediate the reconciliation of the economic growth with environmental sustainability and can offer business opportunities for SMEs.

Depending on their activity sector, companies can offer their green products and services to the green market. They can also make environmental improvements in their operations to reduce costs and comply with regulatory requirements. Companies that intend to involve in greening, however, are often faced with a lack of specialized knowledge, difficulties in access funds and regulatory burdens. (European Parliament, 2015).

Resource efficiency is a major factor in the firm competitiveness, since the European manufacturing companies spend on average 50% of their costs for raw materials and energy and water, compared with 20% for labor costs in total production costs (Europe INNOVA, 2012).

The main indicator to measure the resource efficiency is resource productivity which measures the total amount of materials used by an economy in relation to GDP. (European Parliament, 2015) (figure 1). The highest levels are registered in developed countries (such as Netherlands, Luxemburg, United Kingdom, Spain, Italy) which reached levels of resource productivity indicator above the EU-28 average. The most reduces levels of resource productivity indicator are registered in eastern European countries (Romania, Bulgaria).

The resource efficiency on EU member states depends on structure of their national economies and international trading. In the industrial economies are imported high quantities of raw materials, that are then exported as finished products. In service economies, the GDP is created mostly from services which are not based on raw materials, therefore these economies appear to be more efficient because they consume lower material resources.

There are clear signals regarding orientation of large industrial sectors toward green production processes in order to answer to the imperatives regarding the climate changes. But compared with large enterprises, SMEs face different and sometimes more difficult challenges and they should approach specific issues related to environmental impact and environment legislation compliance.

The SMEs are more vulnerable to the present trends of increasing prices for raw materials and energy, as well as climate changes and they have to get to a higher level of efficiency and capacity to adapt to these changes and to turn them into opportunities.

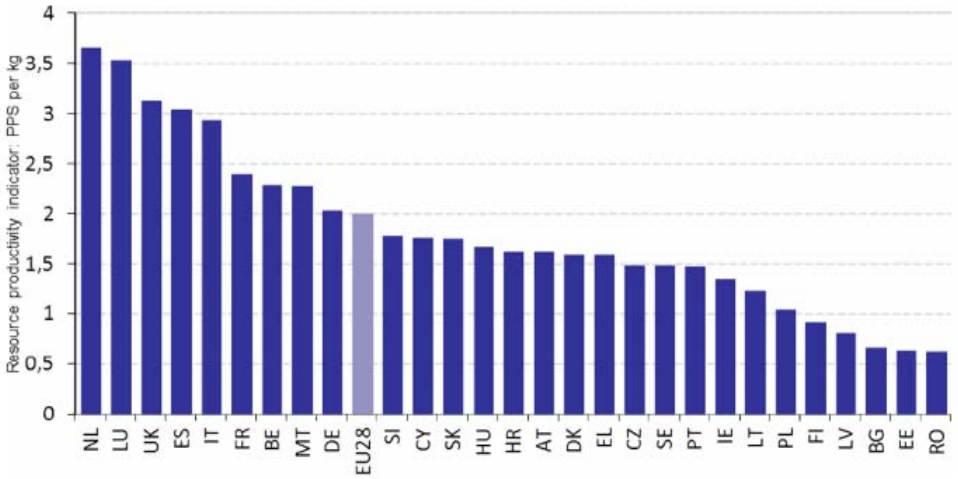

Figure 1. Resource efficiency in EU-28
Source: Eurostat, Resource Efficiency Scoreboard, 2015

But often SMEs are not fully aware of the impact their activities have on the environment. In general, SMEs contribute 64% of environmental impact (EC, 2010b). For an individual company the environmental impact can be reduced but at the sectorial level the overall impact can be high if the number of companies from that sector is wide.

Even the schemes and environmental management tools are rarer among SMEs than among larger firms when they are introduced they can generate considerable changes. But, only about 24% of SMEs are actively engaged in reducing the environment impact and only 0.4% of them use a certified Environmental Management System (EC, 2010b).

In the case of environmental legislation applicable to SMEs, they tend to consider that they comply with legal provisions and, therefore, full

respect of legislation is often an result of external action after a control rather than an ongoing process of verification of legal requirements.

Also, often, SMEs do not have legal and environmental protection knowledge necessary to understand and apply the environmental legislation, thus (EC, 2010b):

- for SMEs it is more difficult to adopt the environmental legislation than for large companies;
- SMEs are more familiar with the national legislation regarding the environment than the EU legislation on this field;
- SMEs do not have enough knowledge concerning specific environmental legislation and this fact that can affect their activities;
- SMEs have to face administrative burdens in the process of monitoring and reporting.

This situation can have multiple and complex effects:

1. Taking into account recent developments in the field of environmental and energy policy, the SMEs can miss the chance to take the economic benefits created by a better environmental management and eco-innovation;
2. In the case the SMEs are unaware of the impact their activities have on the environment, their activities may represent a significant threat to the environment, risking to compromise the community measures for environmental protection;
3. The impact of SMEs on the environment associated with the lack of information and a low degree of legal compliance may be an additional risk factor for the health and safety of workers (exposure to chemicals, air pollution, etc.).

In general, there is a consensus regarding the main obstacles faced by SMEs in complying with environmental legislation and in adopting improvement measures. Thus, the main obstacles to integration of environmental concerns into the core activities of SMEs are:

- lack of information and knowledge on environmental issues, impacts and risks;
- lack of information about the potential benefits of environmental management and life-cycle oriented approach. For medium and large companies and firms with a high impact on the environment the certified environmental management systems can represent more attractive solutions;
- insufficient access to information, tools and training activities in environmental protection field;
- limited knowledge, financial and human resources to address legislation compliance;
- the behavior towards the environment is usually dictated by public regulation or pressure;
- the respect for the environment is not sufficiently rewarded/appreciated by the market.

Moreover, SMEs are not enough supported in their actions to achieve potential cost savings based on a better resource efficiency. This could create productivity gaps between enterprises who make improvements regarding the resource efficiency and those who do not. Moreover, this could affect the competitiveness of European companies as well as the possibilities for many SMEs to place themselves in global value chains.

3. EU initiatives and perspectives regarding SMEs environmental policy

The ambitious targets set by the European Council in terms of reducing emissions of greenhouse gases, renewable energy and energy efficiency require a new economic model, able to

transform the environmental concerns into an integrated part of production processes.

The Europe 2020 Strategy underlines the EU's priority to become a sustainable economy and to set ambitious targets to combat climate change and increase the energy efficiency.

The strategy include three mutually reinforcing priorities (EC, 2010a):

- Smart growth that involves a knowledge and innovation economy;
- Sustainable growth that involves a resource efficient, greener and competitive economy;
- Inclusive growth that involves an employment economy based on social and territorial cohesion.

Green Action Plan for SMEs adopted in July 2014 provides a new framework regarding the actions the EU, Member States and regions, intend to support SMEs to get the business opportunities offered by the transition to a green economy.

The green opportunities underlined in the Green Action Plan are directed towards increasing productivity and reducing costs in EU SMEs by actions directed towards resource-efficiency, green entrepreneurship, developing leadership in green processes and technologies.

This new initiative specifically presents a series of actions, new or revised, for SMEs, proposed at European level. The Green Action Plan aims to:

- improve the resource efficiency;
- foster green entrepreneurship;
- exploit the opportunities of the green value chains.

Green Action Plan aims to contribute to the reindustrialisation of Europe (EC, 2014c), by increasing the competitiveness of SMEs and supporting the development of green economic activities in all European regions, given the fact that, there are significant differences in terms of resource efficiency across sectors and Member States.

The Action Plan is based on Eco-innovation Action Plan (EcoAP), which provides guidance and funding for eco-innovation policy in Europe 2020 based on seven actions: environmental policy and regulation, demonstration projects, standards, funding and SME support, international cooperation, skills and knowledge.

The actions in the Green Action Plan and EcoAP are in general complementary and can generate important effects on the environmental field.

Green Action Plan involve a series of objectives that will be implemented at European level in the multiannual financial framework 2014-2020. In fact, the Green Action Plan include the European actions and measures that could integrate and develop the existing green initiatives for supporting SMEs at national and regional level.

The Commission has set a series of goals to be achieved (EC, 2014a) (figure 2):

I. Greening SMEs for more competitiveness and sustainability;

II. Green entrepreneurship for the companies of the future;

III. Opportunities for SMEs in a greener value chain;

IV. Access to the markets for green SMEs.

Greening SMEs for more competitiveness and sustainability involve the following actions ate European level (EC, 2014a):

1. The European SMEs should have access to practical information, advices on increasing their resource efficiency in a cost-effective way, such as: Eurobarometer on 'SMEs, the Enterprise Europe Network (EEN).

2. Develop an efficient transfer mechanisms for green technologies. Thus, the trade of green technologies is of high priority for SME in the green economy and the Enterprise Europe Network members should ensure cooperation between the different sector groups responsible with resource efficiency.

3. Improve the access to finance for resource-related activities and energy efficiency in SMEs through:

- updated information on SME environmental websites of the European Commission;
- using financial intermediaries for improvement of resource efficiency (such as European Investment Bank);
- support SMEs to access energy efficiency investments (such as Private Finance for Energy Efficiency instruments - PF4EE);
- create a network of private and public investors in order to initiate and develop actions for eco-innovation;
- the European Regional Development Fund (ERDF) and the European Maritime and Fisheries Fund (EMFF) intend to support SMEs' competitiveness for the period 2014-2020.

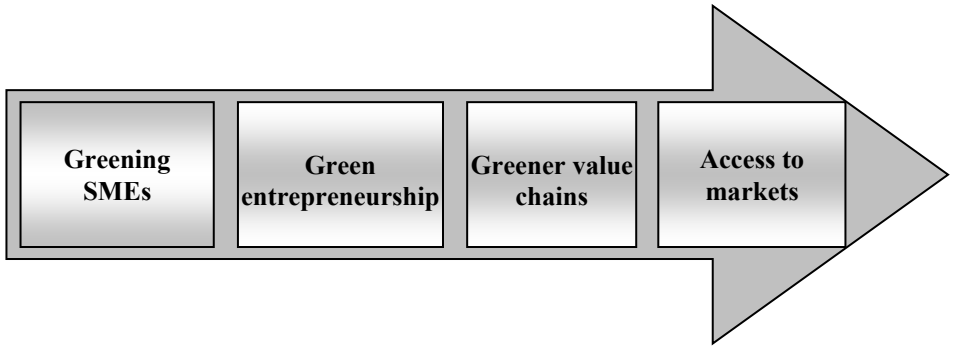

Figure 2. Green Action Plan for SMEs

Green entrepreneurship for the future enterprises include the following actions (EC, 2014a):

- Promote different forms of eco-innovation, such as non technological eco-innovation: the SME Instrument under Horizon 2020; The European Regional Development Fund (ERDF), the European Agricultural Fund for Rural Development (EAFRD) for the period 2014-2020.
- Facilitate business partnering, skills and knowledge for green entrepreneurship: the Communication Green Employment Initiative; LIFE programme for new business models for resource and energy efficiency in SMEs.
- Exploit the role of clusters in developing the eco-innovative SMEs by the Cluster Excellence Programme (COSME 2014-2020).

Facilities for Small and Medium Enterprises in a greener value chain involves the followings actions (EC, 2014a):

- Address systemic collaboration barriers to cross-sectorial and national value chain, business cooperation;
- Facilitate cross-sectorial collaboration in view of promoting the circular economy through the European Cluster Observatory; the LIFE programme; create an expert group on eco-innovation.

Access to the markets for green SMEs involves the following actions (EC, 2014a):

- promote and develop a green internal market in Europe through the organizations on European Standardization;
- support the access to international markets for green entrepreneurs: European Strategic Cluster Partnerships; financial instruments under EU programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises - COSME.

Only an efficient policy and effective actions towards implementation of the main objectives of this Action Plan could ensure a real impact at the European level regarding the eco-benefits of SMEs and an increase of their competitiveness and efficiency.

4. Conclusions

In the present European context the objective of reducing the environmental impact is one of the main challenges for small and medium sized companies (SMEs). Moreover, the pressure on SMEs for developing products and processes with a lower ecological impact will increase in the future years and these could become incentives for their efficiency and competitiveness.

Under the Europe 2020 Strategy, the Green Action Plan (GAP) try to support SMEs to take advantage of opportunities offered by transition to a green economy.

The Green Action Plan emphasizes the role of green growth in ensuring economic recovery within the longer term vision of a efficient use of resources and low-carbon European economy which is now one of the key objectives of the European Union.

The main objectives of the Green Action Plan are the followings:

- raising SMEs' awareness of resource efficiency and the potential of the circular economy for productivity, competitiveness, and business opportunities;
- a better access to information for SMEs regarding EU resource efficiency actions (COSME, Horizon 2020, LIFE programmes, the European Structural and Investment Funds).

Therefore the GAP aims to help business by:

- improving productivity;
- reducing costs;
- supporting green entrepreneurship;
- developing European leadership in green processes and technologies.

Improving the efficiency of resource utilization in SMEs offer great potential for reducing production costs and increase productivity. But many of SMEs in Europe are not aware of this potential.

In addition, improving the efficiency of resource use requires specialized knowledge, which SMEs usually do not have; therefore, they need support and consulting to identify the potential benefits on long-term for innovation processes and organization in order to improve efficiency of resource use.

SMEs face difficulties when seek financing for large initial investments aimed at efficient use of resources. It is therefore important to encourage SMEs to seek consulting regarding appropriate resource efficiency, and secondly, to be offered such consulting in their regions.

SMEs need a favorable business environment in which ideas can be developed, financed and marketed in a simple way. In this context, the "Green Entrepreneurship" should also be encouraged by supporting the potential

entrepreneurs to identify business opportunities generated by the transition to an efficient economy in terms of resource use.

In addition, more efforts are needed to be done to use the green technologies that are developed through research and have succeeded in demonstrating the feasibility, given the fact that many SMEs do not have the resources for this activities.

SMEs have a better chance to enter into global value chains if, instead of acting individually will cooperate with other enterprises. Achieving greater efficiency of resource use in Europe and helping SMEs to successfully integrate into global value chains require international cooperation. Such cooperation is often facilitated by clusters, to gain access to international markets and to engage in cooperative activities and develop long-term strategic partnerships within and across value chains.

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