The role of green logistics for environmental issues in city transport road ecology: A review

B. Yedilbayev[1], A. Kazmagambetov[2], K. Kazbekova[3], S. Akhmetkaliyeva[3], M.Majewski[4], R.Malybayev[5], L.Alimzhanova[1] and B. Aidarkulov[6]

[1]al-Farabi Kazakh National University, al-Farabi ave, Almaty, Kazakhstan
[2]Kyrgyz-Kazakh University, Bishkek, Kyrgyzstan
[3]Department of business technologies, al-Farabi Kazakh National University, al-Farabi ave, Kazakhstan
[4]Institute of Biology and Earth Sciences, Pomeranian University in Słupsk, Poland
[5]International University of Information Technologies, Almaty, Kazakhstan
[6]JV Kazgermunai LLP, Kyzylorda, Kazakhstan

Abstract. The city from the ecological point of view represents the difficult habitat of the human including natural and anthropogenous subsystems. The first is made by the atmosphere, a lithosphere, the hydrosphere, and the biosphere, and the following subsystems enter into the second: production, town planning, and infrastructure. The degree of environmental friendliness of the city depends on a ratio of natural and anthropogenous subsystems.
Currently, many ways and methods are being used to use green logistics to solve environmental issues. There are factors that can help with this: fuel, infrastructure, the aerodynamics of cars, and technology.
In this literature review, green logistics in city transport road ecology is summarized as one of the main types of sources for solving environmental issues.
Investigating the city ecology by factual consideration includes town-planning ecology. The difference between town-planning ecology the engineering is that a subject of discipline is not the separate enterprise, but territorial complexes and systems of the occupied places. Thus, territorial and town-planning environmental management is studied. From these positions, the town-planning ecology is the key to the planning-technical subject. Methods of achievement of ecologically optimum compromise between anthropogenous systems of different levels and environments are investigated in it.

Keywords: anthropogenous, air, ecology, green, logistics, pollution, transport.

1. Introduction

Transport and operational conditions include the road – a relief, width of the carriageway, type and paving condition, factor of coupling and flatness of a covering, a condition of roadsides, existence, and quality of elements of the engineering equipment; the transport – a sort of transported cargo, intensity, stream density, a high-speed mode of movement; the weather and climatic – visibility, precipitation, temperature, pressure, and humidity of air; culture of operation – level of the organization of works andmanagement, qualification and discipline of drivers, material base, quality of operational materials.

Road conditions are usually divided into constants and variables. The paving structure, the route plan, a longitudinal and cross-section profile, width of the carriageway, suppression of roads refer to the first, and to variable road conditions–degree of flatness of paving, factor of coupling of wheels from darling visibility of the road, etc.

The city from the ecological point of view represents the difficult habitat of the person includingnatural and anthropogenous subsystems. The first is made by the atmosphere, a lithosphere, the hydrosphere, and the biosphere, and the following subsystems enter into the second: production, town planning, and infrastructure.

Processes realized in a city are not without an impact on the environment. Especially transportation and production systems influence the elements of the ecosystem negatively, which is why the search for solutions to environmental problems in city management is virtually as important as the realization of economic goals. But as the two objectives are often divergent, it is not an easy task to achieve both. The benefits of pro-environmental activities can be non-measurable, which makes it hardto express them through an outlay-benefit analysis. Air pollution is one of the environmental problems of cities. It is an especially burdensome factor because it means harm to people's health as well as deterioration of living conditions.

Quality of air is one of the Local Agendas 21 indexes which determined the sustainability of a city at a local level [1]. Air purification and carbon sequestration are regarded as ecosystem services in the context of cities [2]. These services are defined as benefits provided by nature [3]. But for the environment, it is only possible to provide services when it is protected. Protection of intrinsic qualities of natural ecosystems is a social need and is understood as an enhancement, retention, or reinforcement of the state of ecosystems in terms of internal goals through appropriate resources, infrastructure, and institutions [4]. In order to be able to provide services, ecosystems require proper maintenance and revitalization, which motivates cities to undertake pro-environmental initiatives[5].

Some companies have begun to implement proactive environmental protection measures, such as reporting environmental information that goes beyond the basic commitments to achieve higherenvironmental goals [6]. However, the environmental behavior of Chinese companies has not only been affected by the government, it has also been influenced by others stakeholders such as investors, surrounding residents, industry associations, and employees [7]. Therefore, other methods should be used, such as economic incentives for business-led voluntary initiatives and environmental information disclosure strategies, to enhance the interaction between companies and investors for higher environmental goals [8]. There have been many studies related to external factors for adopting green logistics. Governmental regulations are considered to be the dominant forces. A fleet's environmental strategy is always influenced by environmental regulations, such as emissions standards [9]. Government legislation and enforcement actions are considered as having the most important impact ona truck fleet's environmental decision-making [8]. In addition to external controls from laws and regulations, market participants and the community environment of a truck fleet are becoming important environmental issues [10]. Cooperation with suppliers, consumers, and manufacturers can provide more effective ways to solve environmental challenges [11].

By exploring all these definitions and classifications of logistics centers, it was observed that an environmental emphasis is missing when conceptualizing these clusters. Logistics centers are established in order to contribute to environmental protection. Transportation holding the first row, the energy consumption, packaging, purchasing, and reverse logistics activities all incur separate negative effects on the environment. Only transportation itself accounted for 13% of all GHG emissions in the world and 24% of CO2 emissions in 2006. European policymakers aim to reduce CO2 emission by 60% as of 2050 when compared to its levels in 1990 and reduce the transport industry's dependence on the oil industry by the introduction of decarbonized transport.

Logistics centers are aiming to eliminate these adverse effects as they are intermodal terminals where the cargo carried by road transport is transshipped to railways

Where CO2 emission levels are much lower. They have a special role in the development of green corridors corridors on transportation networks. They also provide logistics areas out of the city centers and thus eliminate heavy congestion of freight transport in urban areas.

Because logistics centers claim to be a solution for the negative impacts of different logistics activities on the environment, the establishment of the link between green organizational buying and logistics centers is required to promote the service purchasing from these centers on an environmentallyfriendly basis [12].

As B.Yedilbayev mentioned that the use of models and methods of computer simulation helps us to find a strategy for optimizing the transport network and to get the correct methods for traffic control. Vehicular traffic in the modern metropolis has a very complex structure. Therefore, the many usual models which ignore the influence of traffic lights on vehicles flow cannot describe adequately the dynamics of traffic density on the streets, and they cannot make a proper evaluation of the air pollution by exhaust gases, as the pollution and the number of emissions depend on the work regime ofthe engine [13].

Now we submit the model of vehicular traffic based on the analogy with the sedimentation

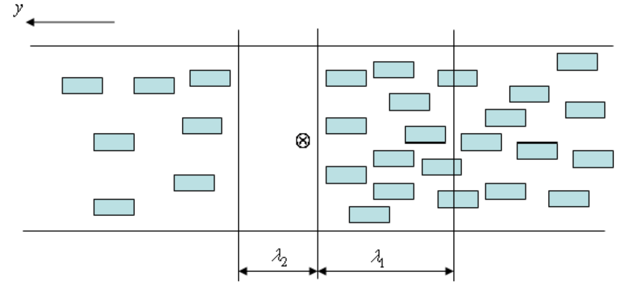

Fig. 1. Scheme of traffic flow

Let $V(\rho)$ be the transport rate, depending on the density of vehicles on a road.

The three characteristic densities can be defined. They are: the optimal density ρ_{opt} under which the maximum allowable speed in urban traffic can be realized, the density of vehicles in traffic in the area nearby traffic lights ρ_{st}, when the red light is on, and the density in a jam ρ_j at which the motion will be stopped.

Green Transport of goods has four transport lines including the transport from manufacturers to retailers, the transport from manufacturers to retailers through third-party logistics, the transport from retailers to the final consumer, and the transport from retailers to consumers through third-party logistics. Manufacturers and retailers and third-party logistics usually reach an agreement to jointly coordinate the logistics process to complete the transport. Current retail distribution models include distribution of suppliers, self-distribution, third-party distribution, and joint distribution. This paper argues that retail enterprises choose the delivery mode according to the different and reasonable modes of operation. Specific measures are as follows. Establishing an electronic information system. The situation of the logistics system can be controlled through the information system of logistics. The delivery system of retailers should include location, time, personnel, cargo type, storage information, installation information, etc. The information system can be applied to the information collection, information classification, information processing, and distribution arrangement of goods [14].

Using green vehicles. The promotion of using green vehicles depends on both business and government support because the cost of green vehicles is higher than ordinary freight cars. The government needs to establish standards for logistics vehicles and control the use of pollution vehicles and give subsidies for green vehicles and establish relevant incentive mechanisms. Choosing a reasonable delivery mode. The reasonable model should be used to the specific circumstances in order
to increase the use of intensive resources and reduce duplication of vehicle transportation and emissions. The above three ways of green transport could be used by manufacturers and third-party logistics [15].

Existing evidence often adopts one of the following four methodologies to estimate the effect of air pollution on health: 1) time-series studies; 2) cross-sectional and cohort-based studies; 3) panel or fixed effects studies; and 4) quasi-experimental studies [16].

There are many activities that generate air pollution in the ports[17]:

- loading and unloading of petroleum products produce organic compound emissions,
- car traffic produces combustion products and evaporative volatile organic compound emissions,
- heavy vehicle traffic and railway traffic contribute to combustion product emissions [18].

Urban freight transportation and goods distribution is a significant issue in the economic, commercial, social, and environmental operation of cities. This area of transportation activity is growing faster than other areas of land transportation. However, efficient and effective urban distribution systems are required in logistics in view of increasing levels of traffic congestion, negative impacts on the environment, crashes and higher energy consumption caused by freight vehicle traffic in urban areas. These are complicated and difficult problems that should be solved for the sustainable development of cities by balancing smart economic growth with a cleaner, quieter and safer environment in urban areas[19].

Environmental Drones (E-drones), as defined by the authors, are programmed autonomous drones used for pollution monitoring, detection, and abatement at altitudes above ground level in a specific geographic region. E-drones produce Air Quality Health Index (AQHI) maps of covered regions for environmental data monitoring and long-term analysis. E-drones are the first aerial systems (especially drone-wise) designed to conduct aerial pollution abatement following successful pollution detection [20].

The term "green logistics" is defined as a set of supply chain management practices and strategies that reduce the ecological and energy footprints of the distribution of goods, which focuses on material handling, and waste [21].

Reverse logistics management, packaging, and transport. Lee & Klassen (2008) define green logistics as green supply chain management by a company (organization), which takes into account environmental issues and integrates them with supply chain management to change the environmental performance of suppliers and customers [22].

Green logistics is a multi-level concept that includes both "green" logistic activity, as well as social activities in aid of green logistic management, standardization, and control [23]. In spite of the fact that green logistics and ecologists are often regarded as identical notions, it seems, however, that the notion of green logistics is slightly broader than that of ecologists, and much broader compared to reverse logistics. All three concepts are closely interrelated and used in the circular economy. Relationships between reverse logistics and ecologists and green logistics are illustrated in Figure 2.

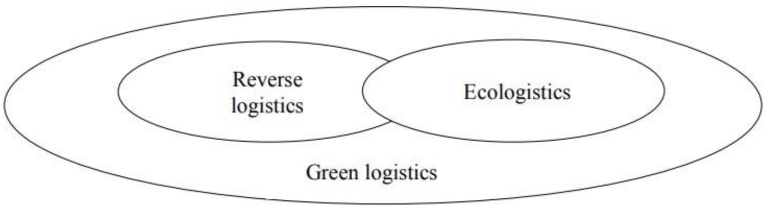

Fig. 2. Relationships between recovery logistics, ecologists and green logistics Source: the authors'compilation based on the study by Seroka-Stolka, O. [24].

The traditional analysis of maritime transport logistics problems has been in terms of cost-benefit, economic, or other optimization criteria from the point of view of the logistics provider, carrier, shipper, or other end-user. Such traditional analysis by and large either ignores environmental issues or considers them of secondary importance. Green maritime logistics tries to bring the environmental dimension into the problem, by analyzing various trade-offs and exploring 'win-win' solutions. In doing so, criteria forthe benefit of the private end user may give their place to criteria that are more relevant from a societal point of view.

There can be many definitions of the word 'green', and a definition can be critical as regards thesubsequent approach and measures to achieve whatever goal is set. For instance, if by green we mean minimizing emissions from maritime transport, and we subsequently strive to apply a series of technological measures that would achieve that goal, a conceivable outcome might be that shipping maybecome unprofitable and various undesirable side-effects may occur, including cargo shifts to other modes, reduction of trade, route shutdown, relocation or even shutdown of production, and possibly others. It is clear that one can always minimize emissions from A to B if trade from A to B is minimized.In the extreme case that trade from A to B ceases to exist because no operator would make a profit engaging in that trade, emissions would drive down to zero. But that's not a desirable outcome [25].

Groundwater is usually the most important water resource, especially in arid regions, and thus the protection of groundwater sources is vital worldwide. Due to the complicated hydrogeological conditions and fate and transport processes of contaminants along the pathway, the groundwater pollution risk assessment method for 'source protection has not been well developed. In addition, the joint risk control of soil and groundwater pollution remains a great challenge [26].

The aim of sustainable logistics is, therefore, to strive for optimization of the relationship between society, economy, and the natural environment, so that they are balanced. It is therefore important to ensure sustainable economic growth, but with the use of renewable energy sources in an environmentally friendly way, taking into account the management of natural resources (especially water and energy) insuch a way as to achieve the optimum in integrating the requirements of legal and executive security. This striving is reflected in the idea of "co-opetition", because on the one hand companies compete, andon the other, they cooperate in creating a green supply chain using green technologies (and adjust their activities to legal regulations). This strengthens their powers, especially the so-called "green experience". The point is to provide a product with as small losses, i.e. with operational efficiency. Thus, the "green supply chain" should be understood primarily as an integrated environmental thinking sequential and comprehensive oriented supply chain management, including in particular: product design, material sourcing, manufacturing process, delivery of the final product to customers, and product management at the end of its useful life. Thus, the area of "green supply chain" is included in reactive monitoring of environmental management programs to increase the use of proactive practices implementing various "Rs", for example: Reduce, Re-use, Rework, Refurbish, Reclaim, Recycle, Remanufacture, Reverse logistics, etc.

Table 1. Sustainable development indicators and leading indicators [27]

Sustainable development indicators (thematic area)	Leading indicators
Socio-economic development	GDP growth per capita
Climate Change	Greenhouse Gas Emissions Consumption of energy from renewable sources
Sustainable Transport	Energy consumption in the transport sector in relation to GDP
Sustainable consumption and production	Efficiency of resources
Natural Resources	Occurrence of birds common Protection of fish stocks
Public Health	The average life expectancy in good health
Social inclusion	Risk of poverty
Demographic changes	Employment rate of older people
Global partnership	Official Development Assistance
Good governance	(no leading indicator)

However, so-called "green indicators", especially those that support the rationalization of activities, such as CO2 reduction, point to the need to achieve the required balance between the level of emission reductions and cost savings. This relationship is shown in Figure 2.

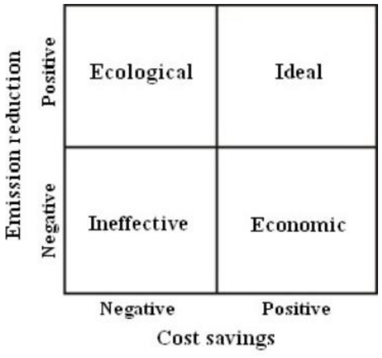

Fig. 3. Categorization of measures according to their monetary and ecological impact [28].

Many van operators have investigated the cost-effectiveness of using alternative fuels (especially liquefied petroleum gas and compressed natural gas) by undertaking local trials. For many, the use of such alternative fuels is not cost-effective due to the cost of the additional equipment required, the limited refueling infrastructure, the loss of loading space, and the lower fuel efficiency compared to diesel.

Many manufacturers are currently developing a range of diesel hybrids that, when available, will produce fuel efficiencies in the high 60 – 70 miles per gallon. Although these vans are likely to initially incur extra purchase costs, the development of such hybrids is seen by many as the next step in fuel efficiency, before ultimately moving towards fully electric vans.

There are several characteristics of vans and van use that lend themselves to adopting electric power. For example, the relatively low average trip per day distance and much of the activity that takes place in urban areas make access to refueling points simpler. For vans, as opposed to HGVs (Heavy Goods Vehicles) the weight carrying capacity is not necessarily a critical feature - for example in the case of service trips then weight carrying may not be a very important feature of the vehicle. Since van traffic is mainly urban, the benefit of electrifying vans is not only on CO2 it is also on local pollution [29].

Green logistics is a multifaceted discipline, which comprises economic, environmental, and social elements. It focuses on actions to minimize harmful effects on the environment and introduces the tools and behaviors that contribute to improving society and its economic level [30].

Environmental goals mainly succeed in using environmental management that targets to balance between utilizing natural resources and human requirements in accordance with the possibilities of the environment [31]. The environmental integrity principle ensures that human activities do not erode the earth's land, air, and water resources. Human activities can have a significant negative impact on the natural environment such as ozone depletion, accumulation of greenhouse gases, and waste generating [32]. Environmental benefits include the reduction of waste, fossil fuel consumption, and air and water emissions as well as raised energy usage efficiency.

Generally, transportation is the major activity of most logistics services [33]. As far as more countries continue to industrialize rapidly, the associated carbon emissions are greatly increased. Thus, there is a growing need for climate-friendly solutions, especially in the area of logisticstransport. Nowadays, significant reduction of carbon emissions, as well as costs during transport, are achievable by optimizing the design of a logistic network, using the right modes of transportation, and managing efficiently the load capacities and routes.

C. Ramus points out three types of environmental initiatives: those that decrease the environmental impact of the company, those that solve environmental problems of the company, and those that develop more eco-efficient services. Some environmental initiatives tend to be implemented at the corporative and organizational level, thereby affecting the whole company, and primarily focusing on strategic planning and organizational structure. Others have a more functional character, the operations and production function playing an essential role in environmental issues. Several papers have highlighted the key importance of this function in environmental management, thus revealing that many green initiatives need to be implemented in the domains of the operations functionand require the involvement of the operations managers. In response to that, the adoption of green initiatives is a great challenge for logistics companies that strive to develop and implement more green service offerings for their customers [34].

The three pillars of Sustainable Development can be applied to green logistics (see Figure 2). As mentioned in the definitions of green logistics before, in the past, companies coordinated their logistics activities comprising freight transport, warehousing, packaging, materials handling, and data collection and management to meet customer requirements at minimum cost which just refers to the monetary terms [35]. Now, the environment has become a concern. It is treated as a factor of the cost. Some companies have already taken external costs of logistics associated especially with environmental issues such as climate change, pollution, and noise into account. Green logistics is therefore defined as efforts to examine ways of reducing these externalities and achieving a more sustainable balance between environmental, economic and social objectives, (see Figure 2). All efforts in the "green" logistics area are therefore focused on contributing towards, and ensuring, sustainability [36].

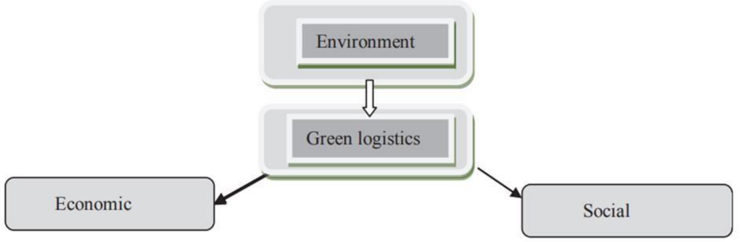

Fig. 4. Green logistics as an element of sustainable development.

Green logistics is the integration of the environmental features into logistics activities and managing in a way that considers the environment in every decision-making process across logistics networks as defined by Pishvaee et al [37]. In many industries, the terms such as green logistics, green supply chain, and reverse logistics are used to refer to the implementation of sustainable proactive environmental protection measures in manufacturing and transportation. Much research has been conducted on green logistics across varied industries as mentioned in [38, 39]. Green logistics research on the automotive industry; which compromises all the facilities, processes, and activities involved in the manufacture of motor vehicles is limited. In this paper, green logistics will be assessed in an automotive assembly line. As mentioned in [40-42] in automotive industry green logistics initiatives focus on minimizing greenhouse gasses (which raise the temperature near the surface of our planet) such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), re-use and recycling of material, waste disposal and optimal utilization of energy.

The focus is on avoiding climate killers like CO2 and their subsequent social costs (e.g. cancer) bya reduction of transport that is generated by today's marketing Instruments [43].

2. Conclusion

As shown in this review article, we proceed then specifically with summarizing, and critically reviewing the information pertaining to the green logistics and city transport road ecology. Most of the summarized literature reported significant green logistics technologies in subsets of the targeted emissions. Most ofthe research was carried out on a field and experimental scale.

However, these complex issues practically in all textbooks and manuals on ecology are considered factually, i.e. separately without interrelation. And questions of interrelation or mutual influence of emissions of motor transport in aggregate with infrastructure SRN (traffic lights, intersections, sidewalks, avenues, etc.) on the environment are not still considered in the world literature. Besides, there are no data on the distribution of exhaust gases (EG) of motor vehicles in the residential area nearhighways at any source. Therefore, even it is difficult for an expert to define the main sources of pollution in an urban air environment [44].

Therefore, in this article, the problem of city transport-road ecology (CTRE) for the first time is considered.

Also, this article describes an analysis of the development of green logistics.

The opinions of various authors on the impact of vehicles on the environment and their solutions for the conservation of biodiversity were also discussed.

3. References

1. M. L. Marsal-Llacuna, J. Colomer-Llinàs, J. Meléndez-Frigola, the Smart Cities init. Techn. Forec. & Social Change **90,** (2015)
2. D. Rodríguez-Rodríguez, J. H. Kain, D.Haase, F.Baró, A. Kaczorowska, A utop. Persp. from Europ. cities Fut., 70
3. M.Szarejko, J.Ładysz, Akt. asp.polit. społeczno-gospodarczej i prz., **367**, (2014)
4. F.J.Haan, B.C.Ferguson, R.C.Adamowicz, P.Johnstone, R.R.Brown, T.H.F Wong, Techn. Forec.& Social Change, **85,** pp 121 – 132, (2014)
5. A.Mesjasz-Lech, Trans. Res. Proc., **16,** pp 355 – 365, (2016)
6. X.B.Liu, V.Anbumozhi, Journ. of Clean. Prod., **17,** pp 593- 600, (2009)
7. M.Clark, Struc.Change and Econ. Dyn., **16** pp 422-431, (2005)
8. I.Henriques, P. Sadorsky, An empir. app. Journ.Envir.Econ. and Manag., **30 3** pp 381-395, (1996)
9. P.Meegeren, Soc. and Nat. Res., **14** pp 77-86, (2001)
10. W.Chen, D. Soyez, Geogr. Res., **22(5)** pp 601-608, (2003)
11. A.Prakash, M. Potoski, ISO 14001 Amer. Jour. of Pol. Sc., **50(2)** pp 350-364, (2006)
12. C.Altuntas, The Asian Jour. of Ship. and Log., **Vol 29** Number 1 April, pp 059-080, (2013)
13. B.Yedilbayev, A.Brener, A.Shokanova, A. Boltayeva, Trans.and Telec. jour. **vol 22** no 3, pp 301-311, (2021)
14. M.Yanli, L. Qiang, Market Moder. **5,** (2009)
15. C.Xuezhong, Energy Procedia **5** pp 332–336,(2011)
16. C.W.Cheung, Jour. of Envir. Econ. and Manag., (102316) p 101, (2020)
17. C.Trozzi, Barcel.Wess. Inst. of Techn., (2000)
18. E.Twrdy, Transp. Res. Proc., **45** pp 539–546, (2020)
19. E.Sxoinaraki, Trans. Res. Proc., **25** pp 954–964, (2017)
20. G.Rohi, Heliyon 6, **6** e03252, (2020)
21. O.Seroka-Stolka,A . Ociepa-Kubicka,Transp.Res.Proc.,**39,** pp471–479, (2019)
22. L.Su-Yol, D.R.Klassen, Prod. and Oper. Manag. Soc.Jg. **17, H 6,** pp 573-586, (2008)
23. L.Zheng, J.Zhang, Asian Soc.Sc. 6(11) p 116, (2010)
24. O.Seroka-Stolka, Proc.-Soc. and Beh. Sc. **151,** pp 302-309, (2014)
25. N.Harilaos Psaraftis, Trans. Res. Proc. **14,** pp 133 – 142, (2016)
26. H.Huan, Env. Inter., **137**, 105532, (2020)
27. L.Jodkowska, Trendy i wyzwania zrównoważonego rozwoju, Zapol, Szczecin, (2001)
28. M.Jedliński, Proc. – Soc. and Behav. Sc., **151,** pp 102 – 111,(2014)
29. M.Browne, Proc. – Soc. and Behav. Sci., **125,** pp 334 – 344,(2014)
30. V.Mintcheva, Jour. of Clean. Prod., **13,** pp 717-731,(2005)
31. P.Bajdor, Polish jour. of manag. stud, **5,** pp 236-244,(2012)
32. P.Bansal, Strat. Manag. Jour., **26 (3**), pp 197-218, (2005)
33. D.Islam, J.F.Meier, P.T.Aditjandra, T.H.Zunder, G.Pace, Res. in Transp. Econ. **41,** pp 3-16, (2013)

34. C.A.Ramus, Jour. of World Bus., **37(2),** pp 151-164, (2002)
35. J.Nowakowska-Grunt, Advanced Logistic systems, **2(1)** pp 71-74, (2008)
36. I.W.Hans, CSIR Built Environment, (2011)
37. MS.Pishvaee, SA Torabi Razmi J., Comput Ind Eng; 62:624–32, (2012)
38. I.Harris, C.Mumford, M. Naim, Transport. Res. Part E: Logist.Transport. Rev, **66** pp 1–22, (2014)
39. C.Altuntaş, O.Tuna, Asian J Shipp Logist, 29:59–80, (2013)
40. I.Harris, M.Naim, A.Palmer, A.Potter, C.Mumford, Int J Prod Econ;131:313–21, (2011)
41. T.Nemoto, W. Rothengatter, Trans. and Sust., p 375, (2013)
42. I.Harris, PM Naim, C. Mumford, Oper Res:1-6, (2006)
43. R.Savelsberg, The Intern. Fed. of Autom. Cont., (2013)
44. B.Shakirov, A.Brener, B.Edilbaev, Proc. of the Amer. Conf. on app. math, 2010