УДК 656.2 – 027.1(477)

O. I. KHARCHENKO[1*]

[1*]Department «Management by operating work», Dnipropetrovsk National University of Railway Transport named after Academician V. Lazaryan, Lazaryan St., 2, Dnipropetrovsk, Ukraine, 49010, e-mail kharchenko-o@mail.ru, ORCID 000-0003-2068-0640

FORMATION OF INDEXES SYSTEM OF THE SUSTAINABLE DEVELOPMENT OF RAILWAY TRANSPORT DIVISIONS

Purpose. The analysis of the national and foreign literature shows that the approach to the problem of sustainable development at present time has the coupled problem. On the one hand, the problem for today is relevant and it is the center of scientists' attention. On the other hand, in existing research remains underdeveloped methodological and theoretical framework for the sustainable development of enterprises. The aim of the given work is to develop a system of indicators for sustainable development of railway transport divisions for further construction of mathematical models of functioning railway transport divisions from the standpoint of sustainable development. **Methods**. For achievement of this goal the concept of a sustainable development of the transport sector reveals. This refers to the development that can provide on balanced perspective solving problem of socio-economic development, reduce environmental impact and provide with the current and subsequent needs of different sectors of human activity. As the index characterizing development of railway transport divisions in the direction of resource-saving, it is offered to use integral criterion of efficiency; the ecological component of a sustainable development of railway transport divisions is offered to be evaluated based on the indexes reflecting brought to the money equivalent change of bursts of the contaminating substances in the atmosphere and noise environmental pollution; the social component of process of functioning railway transport divisions can be evaluated directly by the amount of monetary assignments on measures for salary increase of workers in divisions, and also on social programs (expenditures on health care, sanitarian resort expenditures, etc.) and programs for training of workers in divisions, and also were considered an index of development in the direction of service quality improvement. **Results.** As a result of the formation of the system of indicators for sustainable development of railway transport divisions were received the integral index, which reflects the basic principle of sustainable development. **Academic novelty.** The new development approach of the indexes system characterizing a sustainable development of railway transport divisions unlike the existing quantitative indices is offered (in particular on railway transport); don't allow to estimate efficiency of actions and to provide the sustainable development. The indexes received in this operation allow carrying out an assessment to functioning of railway transport divisions from a line item of a sustainable development, namely: to implementation of resource-saving technologies, lowering of influence of technogenic system on environment, support of a social component of development, customer service improvement of quality. **Practical importance.** The structural reform of railway transport of Ukraine, which is held at present time, requires in the shortest time solving problems of industry improvement. The integrated index of sustainable development, proposed in the given work, allows evaluating the efficiency of the railway transport divisions from the standpoint of sustainable development.

Keywords: sustainability; railway transport; transport system; railway transport divisions; economic performance; environmental performance; social indicators.

Introduction

The sustainable development of the basic sectors of the economy – transport systems is one of the points of the implementation of the Strategy of sustainable development of Ukraine. Especially this actual problem for railway transport, as the railway transport plays a crucial role in a single transport system of the country, greatly affecting the economic relations between producer and consumer products, regions and economic areas of Ukraine, with foreign states.

However, in recent years in the industry have seen the development of a number of problems, such as increased wear of technical equipment,

ISSN 2309-821X (Print), ISSN 2310-2438 (Online

Proceedings of the Dnipropetrovsk National University of Railway
Transport named after Academician V. Lazaryan «The Problems of the Transport Economics», 2014. is. 7

deterioration of structures not provided adequate traffic safety, increase the negative impact on the environment and human health. It gets in the way of creating conditions for improving relationships both national and on the international level, providing quality transport service entities and population of the export potential of the industry, improving the image of Ukraine as a transit country [8]. In this regard, increasing the need to find ways aimed at sustainable development of railway transport, and the development of the indicators system of functioning railway transport divisions from the standpoint of sustainable development. The choice of indicators for sustainable development has been widely discussed in the world, the problem involved in Department of Political Coordination and Sustainable Development United Nations, this issue is discussed at international conferences and seminars.

The most common methodology of sustainable development indicators is integrated development of the UN Commission on which all indicators were divided into 4 groups: social, economic, environmental and organizational [1,7,11]. But a large number of parameters (134 indicators) led many scientists to focus on developing the summary of indicators, in other words to make short lists that has reduced the number of indicators by more than 2 times [13].

The analysis of the national and foreign literature shows that the approach to the problem of sustainable development at present time has the coupled problem. On the one hand, the problem for today is relevant and it is the center of scientists' attention. On the other hand, in existing research remains underdeveloped methodological and theoretical framework for the sustainable development of enterprises.

Purpose

The aim of the given work is to develop a system of indicators for sustainable development of railway transport divisions for further construction of mathematical models of functioning railway transport divisions of from the standpoint of sustainable development.

Method

Under the sustainable development of the transport sector understand such development, which could provide a balanced perspective on problem solving socio-economic development, reduce environmental impact and to ensure the current and subsequent needs of different sectors of human activity. The results of theoretical studies that presented in [12] suggest that indicators of sustainable development of railway transport divisions should reflect measures for the development and implementation of energy-saving technologies as well as to characterize the environmental and social components of functioning railway transport divisions.

Because the units of railway divisions transport are serving logistics systems, then indicators to assess their effectiveness is also advisable to include criteria that allow characterizing the quality of service customers (companies, cargo owners).

According to the Development Strategy of Railway Transport 2020, the task of implementing resource-saving technology has become one of the main strategic objectives. The problem of resource-saving at the enterprises and facilities of railway transport is decided on all stages of material production – at the designing, the production and operation [9].

The special attention is paid to the conservation and wise use of energy resources as well as money spent on fuel and energy resources, substantial costs on the railway transport. In terms of increasing the investment attractiveness of particular importance to the issues of quality assessment in enterprises implementing energy-saving vehicle technologies that funds are released to send to the modernization of the transport machinery.

As the index which is characterizing the development of railway transport divisions in the direction of resource-saving E_{pec} it is offered to use integral criterion of efficiency, which reflects the amount given at the cost of the i- type resources:

$$E_{\text{pec}} = \sum_i \Delta R_i \cdot c_{R_i},\qquad (1)$$

where ΔR_i – abbreviations (gain) of a resource i- type owing to implementation of actions for improvement of technological processes of service of clients by forces of railway transport divisions;

c_{Ri} – cost of resource using i- type in the operation of railway transport divisions.

The sustainable development of railway transport must occur in compliance with environmental requirements. Railway transport in Ukraine is the leading sector in the road transport sector of the country, which provides 82% of freight and nearly 50% of passenger traffic carried by all modes of transport [2]. Such volumes of works related to large emissions of pollutants into the biosphere. In spite of the fact that the railway transport is the ecologically safest of all other means of transport, for Ukraine the problem of pollution of atmospheric air by rail is actual because density of a railway system and a freight density exceeds many other countries of the Central Europe.

When using the main locomotive in the atmosphere out the exhaust gases, which, besides water vapor contains more than 200 chemical combinations and elements. One way to minimize emissions of air pollutants during transport is to change the number of locomotives that run on diesel fuel due to the electrification of the transport network.

In addition, a process of polluting factors cargo is noise. Noise from the rolling stock of the railway lines that pass near to residential development exceeds all permissible limits. Changing the noise pollution from the work of railway rolling stock is achieved by technical improvements in running gear rolling stock.

Environmental component of sustainable development $E_{\mathrm{ек}}$ of railway transport divisions is proposed to be evaluated on the basis of indicators reflecting reduced to monetary equivalent change in emissions of air pollutants and noise pollution:

$$E_{\mathrm{ек}} = \Delta M_{\mathrm{атм}} \cdot c_{\mathrm{ек}} + \Delta D_{\mathrm{шум}} \cdot c_{\mathrm{шум}}, \qquad (2)$$

where $\Delta M_{\mathrm{атм}}$ – changes in emissions of air pollutants, um. t;

$c_{\mathrm{ек}}$ – the equivalent of damages suffered as a result of which the emission of 1 ton of oxide carbon into the atmosphere, UAH / um. t.;

$\Delta D_{\mathrm{шум}}$ – change in noise pollution dBA;

$c_{\mathrm{шум}}$ – cash equivalent losses which caused as a result of noise pollution, UAH/dBA.

The railway transport is a branch not only enormous economic significance, but also a great social responsibility. Trade union committee of

Railway men and Transport Builders states that the number of workers' rights and interests they represent is about 400 thousand. This suggests the significant role of the social dimension of sustainable development of railway transport divisions'.

The social component of $E_{\mathrm{соц}}$ the functioning railway transport divisions can be estimated directly the sum cash payments for activities to increase salaries of employees of the divisions, as well as social programs (health care costs, health spa expenses, etc.) And the programs to train staff of divisions:

$$E_{\mathrm{соц}} = \Delta C_{\mathrm{зп}} + C_{\mathrm{соц}} + C_{\mathrm{нав}}, \qquad (3)$$

where $\Delta C_{\mathrm{зп}}$ – the funds allocated for increasing salary of workers of railway transport divisions, UAH;

$C_{\mathrm{соц}}$ – contributions to social programs, UAH;

$C_{\mathrm{нав}}$ – contributions to the program on training the staff railway transport divisions, UAH.

Funds are allocated for a social component of development of railway transport divisions from net profit for the previous period.

In the conditions of a difficult economic situation, both on transport, and in the country in general, there is a need of encouragement of additional volumes of transportation on all means of transport, including on railway [5]. Recently, the main purpose of rail transport is the output of each industry sector for quality of service and prices that would withstand competition from other modes of transport. The indicator of the quality of transportation for the user is the speed of delivery of the goods or otherwise according to the date of delivery. Therefore, the development of railway transport divisions towards improving the quality of service offered cargo estimate is based on the characterizing reduce total processing time car traffic volume by improving technology services. This figure is calculated on the based on the total processing time changes in transport hubs cars and trucks posts and the weighted average cost of 1 hour of downtime freight cars.

Index of $E_{\mathrm{як}}$ in the direction of improving the quality of service is measured by the formula:

$$E_{\mathrm{як}} = \Delta T_{\mathrm{ваг}} \cdot c_{\mathrm{ваг}}, \qquad (4)$$

where $\Delta T_{\mathrm{ваг}}$ – the change of the total processing time in transport nods and cars trucks items of

railways, as well as transactions with train stations within the transport network, h;

$c_{\text{ваг}}$ – weighted average cost of yard time of freights, UAH/hour.

The overall indicator of sustainable development $E_{\text{и}}$ can be represented as the arithmetic sum of the above indicators:

$$E_{\text{и}} = E_{\text{рес}} + E_{\text{ек}} + E_{\text{соц}} + E_{\text{як}} \tag{5}$$

Results

As a result of the system formation of indicators for sustainable development of railway transport divisions were received the integral index, which reflects the basic principle of sustainable development. The components of the proposed integral index of sustainable development is a set of constants that define the economic parameters of the division's function, and a set of parameters that characterize the improvement of technology of railway transport division functioning.

Academic novelty and practical importance

In this paper, we propose a new approach to developing a system of indicators that characterize the sustainable development of railway transport divisions. Today the question of developing a system of indicators of sustainable development is important because existing quantitative indicators (especially railways) do not allow evaluating the effectiveness of actions and ensuring sustainable development. The above parameters allow assessing the functioning of railway transport divisions from a position of sustainable development, namely:

- introduction of resource-saving technologies;
- reduce the impact of technological systems to the environment;
- ensuring the social dimension of development;
- improving the quality of customer service.

The structural reform of Railway Transport of Ukraine, which is held at present time requires in the shortest time solving problems of improvement of the industry. The overall indicator of sustainable development proposed in this paper allows evaluating the efficiency of the railway transport divisions from the standpoint of sustainable development.

Conclusions

The result will be further used to develop mathematical model of railway transport divisions from a position of sustainable development.

REFERENCES

1. Bobylev C.N., Indikatory ustoychivogo razvitiya: regionalnoe izmerenie [Indicators of sustainable development: a regional dimension.]. Moscow, Akropol Publ., 2007, 60 p.

2. Zahal'na informacija pro Ukrzaliznycju [General information about Ukrzaliznytsia].

3. Available at: http://www.uz.gov.ua/about/general_information

4. Krinichnyy M.N., Printsipy formirovaniya sistemy pokazateley dlya otsenki i anali za effektivnosti deyatelnosti inzhenerno-tekhnicheskikh podrazdeleniy po innovatsionnomu razvitiyu predpriyatiya [Principles of a system formation of indicators to measure and evaluation the effectiveness of the engineering units for the innovative development of enterprise]. Visnyk Donec'koho universytetu ekonomiky ta prava. [Bulletin of Donetsk University of Economics and Law], 2009, issue 2, pp. 80-84.

5. Martsenyuk L. V., Vliyanie zheleznodorozhnogo transporta na razvitie natsionalnoy ekonomiki Ukrainy [The effect of railway transport on development of national economy of Ukraine]. Visnyk Dnipropetrovs'koho nacional'noho universytetu zaliznyčnoho transportu imeni akademika V. Lazarjana [Bulletin of Dnepropetrovsk National University of Railway Transport named after Academician Lazaryan], 2012, issue 42, pp. 274-278.

6. Nahornyj Je. V., Okorokov A. M., Peresta H. I., Doslidžennja rozvytku systemy transportnoho obsluhovuvannja vanta-žovlasnykiv v transportnyx vuzlax. [Research development of transport services in cargo transportation nodes]. Visnyk Dnipropetrovs'koho nacional'noho universytetu zaliznyčnoho transportu imeni akademika V. Lazarjana [Bulletin of

Dnepropetrovsk National University of Railway Transport named after Academician Lazaryan], 2011, issue 38, pp. 58-62.

7. Novikov V. A., Formirovanie sistemy otsenochnykh pokazateley ustoychivogo razvitiya lokomotivnogo khozyaystva Dokt, Diss. [Formation of a system of performance indicators for sustainable development locomotive economy. Doct. Diss.]. Novosibyrsk, 2004, 174 p.

8. Ostrovskiy N. V., Kriterii ustoychivogo razvitiya: munitsipalnye aspekty [Criteria for sustainable development: aspects of municipal]. Available at: http://n-t.ru/tp/ns/kur.htm

9. Prejher D. K., Sobkevyč O. V., Jemel'janova O. Ju., Realizacija potencialu transportnoji infrastruktury Ukrajiny v stratehiji postkryzovoho ekonomičnoho rozvytku [Realization of Ukraine's transport infrastructure in post-crisis economic development strategy]. Kyiv, NICD Publ., 2011, 37 p.

10. Resursosberegayushchie tekhnologii na obektakh zheleznodorozhnogo transporta [Resource-saving technologies in railway transport units]. Available at: http://www.jd-enciklopedia.ru/21-ekologiya/21-3-3-resursosberegayushhie-texnologii-na-obektax-zheleznodorozhnogo-transporta/

11. Skrypčenko N. M., Bosov A. A., Metodyka vyznačennja intehral'nyx ocinok rivnja rozvytku terytorial'nyx odynyc' rajonnoho rivnja [Method for determination of integrated assessments of district level units]. Actual problems of state manegment. Dnipropetrovsk, 2009, issue 1 (37), pp. 167-171.

12. Tarasova N. P., Indeksy i indikatory ustoychivogo razvitiya [Indices and indicators of sustainable development]. Ustoychivoe razvitie: priroda – obshchestvo — chelovek: materialy mezhdunarodnoy konferentsii [Sustainable development: nature - society - people: Proceedings of the International Conference]. Moscow, 2006, pp. 127-144.

13. Kharchenko O.I., Novye napravleniya povysheniya effektivnosti funktsionirovaniya podrazdeleniy zheleznodorozhnogo transporta s pozitsii ustoychivogo razvitiya [New ways to improve the efficiency of rail transport units from the perspective of sustainable development]. Visnyk Dnipropetrovs'koho nacional'noho universytetu zaliznyčnoho transportu imeni akademika V. Lazarjana [Bulletin of Dnepropetrovsk National University of Railway Transport named after Academician Lazaryan], 2014, issue 52.

14. Indicators of Sustainable Development: Framework and Methodology. New York, United Nations Publ., 1996, p. 428. Available at: http://www.eea.europa.eu/data-and-maps/indicators/land-cover-distribution-and-change/indicators-of-sustainable-development-framework

15. The business for Sustainable Development: Making a difference towards the Earth Summit 2002 and beyond. Ranald, Dr. Patricia Corporate Environmental Strategy Publ., 2002, vol. 9, no. 3, pp. 226-235. Available at: http://www.sciencedirect.com/science/article/pii/S1066793802000714.

16. Gan K., Zheng X., Environmental protection and economic sustainable development in the western nationality areas. International Conference on Electronics, Communications and control, ICECC. 2011, Proceeding 6068077, pp. 4289-4292. Available at: http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6068077&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6068077

О. И. ХАРЧЕНКО[1*]

[1*]Каф. «Управление эксплуатационной работой», Днепропетровский национальный университет железнодорожного транспорта имени академика В. Лазаряна, ул. Лазаряна 2, Днепропетровськ, Украина, 49010, тел. +38 (056) 776 85 95, эл. почта kharchenko-o@mail.ru, ORCID 000-0003-2068-0640

ФОРМИРОВАНИЕ СИСТЕМЫ ПОКАЗАТЕЛЕЙ УСТОЙЧИВОГО РАЗВИТИЯ ПОДРАЗДЕЛЕНИЙ ЖЕЛЕЗНОДОРОЖНОГО ТРАНСПОРТА.

Цель. Проведенный анализ отечественной и зарубежной литературы показывает, что проблема выбора показателей устойчивого развития, с одной стороны, является актуальной и находится в центре внимания ученых, а с другой стороны, в существующих научных исследованиях недостаточно разработана методическая и теоретическая база формирования системы показателей устойчивого развития предприятия. Целью данной работы является разработка системы показателей устойчивого развития подразделений железнодорожного транспорта, для дальнейшего построения математических моделей функционирования подразделений железнодорожного транспорта с позиции устойчивого развития. **Методика.** Для достижения поставленной цели раскрывается понятие устойчивого развития транспортного сектора. Под которым понимается такое развитие, которое способно обеспечить на перспективу сбалансированное решение проблем социально-экономического развития, сокращение негативного влияния на окружающую среду, а также внедрение ресурсосберегающих технологий обеспечивая настоящие и будущие потребности различных отраслей и сфер человеческой деятельности. В качестве показателя, который характеризует развитие подразделений железнодорожного транспорта в направлении ресурсосбережения предлагается использовать интегральный критерий эффективности; экологическую составляющую устойчивого развития подразделений железнодорожного транспорта предлагается оценивать на основании показателей, которые отображают приведенные к денежному эквиваленту изменения выбросов загрязняющих веществ в атмосферу и шумового загрязнения окружающей среды; социальная составляющая процесса функционирования подразделений железнодорожного транспорта оценена непосредственно суммой денежных отчислений на мероприятия по повышению зароботной платы работников подразделений, а также на социальные программы и программы по обучению работников подразделений, а также был учтен показатель развития в направлении повышения качества обслуживания. **Результаты.** В результате формирования системы показателей устойчивого развития подразделений железнодорожного транспорта был получен интегральный показатель, который отражает основной принцип устойчивого развития. **Научная новизна.** Предложен новый подход по разработке системы показателей, которые характеризуют устойчивое развитие подразделений железнодорожного транспорта, в отличии от существующих количественных показателей, которые не позволяют оценить эффективность действий и обеспечить устойчивое развитие. Полученные в данной работе система показателей позволяет давать оценку функционированию подразделений железнодорожного транспорта, а именно: внедрению ресурсосберегающих технологий, снижению влияния техногенной системы на окружающую среду, обеспечению социальной составляющей развития, а также повышению качества обслуживания клиентов. **Практическая значимость.** Структурная реформа железнодорожного транспорта Украины, которая проводится в настоящее время, требует в кратчайшие сроки решение задачи повышения эффективности работы отрасли. Предложенная система показателей, которая характеризует устойчивое развитие подразделений железнодорожного транспорта, позволяет оценивать эффективность функционирования подразделений железнодорожного транспорта с позиции устойчивого развития.

Ключевые слова: устойчивое развитие; железнодорожный транспорт; транспортная система; подразделения железнодорожного транспорта; экономические показатели; социальные показатели; экологические показатели.

О. І. ХАРЧЕНКО[1*]

[1*]Каф. «Управління експлуатаційною роботою», Дніпропетровський національний університет залізничного транспорту імені академіка В. Лазаряна, вул. Лазаряна 2, Дніпропетровськ, Україна, 49010, тел. +38 (056) 776 85 95, ел. пошта kharchenko-o@mail.ru, ORCID 000-0003-2068-0640

ФОРМУВАННЯ СИСТЕМИ ПОКАЗНИКІВ СТАЛОГО РОЗВИТКУ ПІДРОЗДІЛІВ ЗАЛІЗНИЧНОГО ТРАНСПОРТУ

Мета. Проведений аналіз вітчизняної та зарубіжної літератури показує, що підхід до вивчення проблеми сталого розвитку в даний час носить подвійний характер. З одного боку, дана проблема на сьогоднішній день є актуальною та є центром уваги вчених. З іншого боку, в існуючих наукових дослідженнях залишається недостатньо розробленою методична та теоретична база питань сталого розвитку підприємств. Метою даної роботи є розробка системи показників сталого розвитку підрозділів залізничного транспорту, для подальшої побудови математичних моделей функціонування підрозділів залізничного транспорту з позиції сталого розвитку. **Методика.** Для досягнення поставленої мети розкривається поняття сталого розвитку транспортного сектору. Під яким розуміється такий розвиток, який здатен забезпечити на перспективу збалансоване рішення проблем соціально-економічного розвитку, скорочення негативного впливу на довкілля, а також забезпечити теперішні та наступні потреби різних галузей та сфер людської діяльності. У якості показника, який характеризує розвиток підрозділів залізничного транспорту у напрямку ресурсозбереження, пропонується використовувати інтегральний критерій ефективності; екологічну складову сталого розвитку підрозділів залізничного транспорту пропонується оцінювати на підставі показників, які відображають приведену до грошового еквіваленту зміну викидів забруднюючих речовин в атмосферу та шумове забруднення довкілля; соціальна складова процесу функціонування підрозділів залізничного транспорту може бути оцінена безпосередньо сумою грошових відрахувань на заходи з підвищення заробітної платні працівників підрозділу, а також на соціальні програми (витрати на охорону здоров'я, санітарно курортні витрати та ін.) та програми по навчанню працівників підрозділу, а також було враховано показник розвитку за напрямком підвищення якості обслуговування. **Результати.** В результаті формування системи показників сталого розвитку підрозділів залізничного транспорту було отримано інтегральний показник, який відображає основний принцип сталого розвитку. **Наукова новизна.** Запропоновано новий підхід до розробки системи показників, які характеризують сталий розвиток підрозділів залізничного транспорту, на відміну від існуючих кількісних показників (зокрема на залізничному транспорті), що не дозволяють оцінити ефективність дій та забезпечити сталий розвиток. Отримані в даній роботі показники дозволяють проводити оцінку функціонуванню підрозділів залізничного транспорту з позиції сталого розвитку, а саме: впровадженню ресурсозберігаючих технологій, зниженню впливу техногенної системи на довкілля, забезпеченню соціальної складової розвитку, підвищенню якості обслуговування клієнтів. **Практична значимість.** Структурна реформа залізничного транспорту України, яка проводиться у теперішній час, вимагає у найкоротші терміни вирішення задач з підвищення ефективності роботи галузі. Інтегральний показник сталого розвитку запропонований в даній роботі дозволяє оцінювати ефективність функціонування підрозділів залізничного транспорту з позиції сталого розвитку.

Ключові слова: сталий розвиток; залізничний транспорт; транспортна система; підрозділ залізничного транспорту; економічні показники; екологічні показники; соціальні показники.