Nomeda Dobrovolskienė
Dr., Vilnius Gediminas Technical University (Vilnius Tech), Vilnius, Lithuania
ORCID ID: 0000-0002-1606-9980
e-mail: nomeda.dobrovolskiene@vilniustech.lt

Manuela Tvaronavičienė
Prof. Dr., Vilnius Gediminas Technical University (Vilnius Tech), Vilnius, Lithuania
Prof. Dr., General Jonas Zemaitis Military Academy of Lithuania, Vilnius, Lithuania
ORCID ID: orcid.org/0000-0002-9667-3730
e-mail: manuela.tvaronaviciene@vilniustech.lt

Kamilė Jurėnaitė
Vilnius Gediminas Technical University, Vilnius, Lithuania
e-mail: kamile.jurenaite@stud.vgtu.lt

Corresponding author: manuela.tvaronaviciene@vilniustech.lt

SELECTION OF A TRANSPORT INVESTMENT PROJECT BASED ON SUSTAINABILITY INDEX, RETURN ON INVESTMENT AND RISK

Abstract. *Nowadays sustainability, sustainable development and clean environment became important and relevant topic across the world. Sustainability issues have gained particular attention in a transport sector. This sector creates a significant impact on environment, social relationships and economic development. Thus, the sustainability integration in investment projects of a transport sector is inevitable in order to make a positive environmental impact.*

This paper presents the development of sustainability index for a transport investment project and selection of a transport investment project taking return on investment, risk and sustainability into considerations. Therefore, the novelty of this work lies in constructing a transport sustainability index (TSI) relying on an additional sustainability aspect, i.e., technological dimension. The technological inclusion is particularly important today as it allows for developing new technologies, which, in turn, are able to reduce the impact on climate change, replace natural gas by renewable energy sources, enhancing resource efficiency, bringing a competitive advantage in the market and improving living standards.

The index was compiled and the selection of a project was done by applying multi-criteria decision-making methods (MCDM), such as an expert survey, assessment of the compatibility and reliability of group opinions, subjective weighting, the reference value method, simple additive weighting (SAW) and technique for order preference by similarity to an ideal solution (TOPSIS). The results of this study revealed that 14 sustainability criteria (5 environmental, 3 economic, 3 social and 3 technological) weighted by experts formed the basis of a transport project sustainability index. The developed sustainability index could be useful in assessing and comparing projects of a transport sector. Moreover, a transport sustainability index may be useful in making decisions regarding project selection. When addressing the issue of a project selection, *the decision-maker could take into account not only the project's return and risk, but also its sustainability. In addition, this research revealed that there is a statistically significant, strong linear correlation between sustainability and project return.*

Keywords: *a transport investment project, project selection, sustainability, technological dimension, multi-criteria decision-making.*

JEL Classification: C30; C83; G11; L91; Q01; Q53; Q55.

Introduction

Nowadays sustainability is considered one of the most important topics of the decade. Global warming, climate change, social inequality, economic development is critically important while tackling global issues (Dobrovolskiene et al. 2017; Chehabeddine & Tvaronavičienė, 2020; Dobrovolskiene et al. 2021). One of the most fundamental sectors to the economy is transport (Zhang and Graham 2020, Lin 2020, Adeniran and Obembe 2020; Kędzior-Laskowska, M. 2020). It is defined as vital to the economic development, through other industries' reliability and can be linked with every aspect of human activity. However, most importantly, it is considered to be one of the biggest contributors to the pollution as sector's negative externalities affects the community and other participants of the ecosystem (Ajanovic and Haas 2018; Tian et al. 2018; Tvaronavičienė 2018; Georgatzi et al. 2020; Wang 2020; Ye et al. 2021; Comporek et al. 2021). These aspects were and are a growing concern. Most significant 2015 United Nations sustainability goals and Paris Agreement focus and highlights on the inevitable need of a change. Paris Agreement between countries are determined to implement changes in emissions exposure and pollutions and sustainable development, concluding "every sector of society and economy, including clean transport, <…> needs to review their strategies, policies, investments" (PPMC). Understanding transportation importance and significance contributions to economy, social development and pollution, studies have emerged focusing and analysing investments in transport sector, taken into consideration environmental aspect, but also acknowledging other parts of sustainability: social, economic and technological aspects (Badassa et al. 2020, Dobrovolskiene et al. 2021).

Sustainability assessment and acknowledgment in project management is comparatively a new topic, thus emerge of studies that emphasizes the importance and relevance to further explore sustainability consideration in transport investment project and their selection. Therefore, this research focuses on transport investment project selection, taking into account not only return on investment and risk, but sustainability as well.

The aim of this paper is to select a transport investment project taking return on investment, risk and sustainability into account.

With this aim in mind, a number of methods were employed, including a scientific literature review, comparison and synthesis. To construct a transport sustainability index and to select a transport investment project, multi-criteria decision making (MCDM) methods were employed, such as an expert survey, assessment of the compatibility and reliability of group opinions, subjective weighting, the reference value method, simple additive weighting (SAW) and technique for order preference by similarity to an ideal solution (TOPSIS).

This paper is structured as follows: Section 2 presents an overview of relevant scientific literature regarding the relationship between sustainability and transport sector.

Section 3 gives an overview of MCDM methods. Section 4 presents the results of a transport sustainability index (TSI) development and a transport investment project selection. Finally, Section 5 summarizes the concluding remarks.

Literature review

Sustainability development and overall its concept have become exceedingly important, although the term is now being described as a fashionable buzzword of recent years. It originates from the earliest cultures, humankind had to use vital resources carefully, because of their limited access, so sustainability could have been described as a survival strategy printed, as it happens nowadays (Jenkins and Schröder, 2012). Multidimensional concept of sustainability indicates and highlights three areas of people, planet and profit. The original triple bottom line concept has been the main framework for tackling sustainability question and decision-making. However Wu et al. (2018) argues, that traditional framework of sustainability is insufficient and cannot cover entire understanding and concept of sustainability. Consequently, in order to obtain and cover broader idea of the sustainability, additional aspects should be integrated. With growing population and technological development, we as a society have evolved drastically. Considering these factors original framework of the triple bottom line does take into account technologic aspect and its significance to sustainable development. According to Tseng et al. (2020), the researchers who indicate technology importance to sustainability and discuses their relationship, trade-off were very few, however significant increasing through the recent years and published articles suggest, that issues related to sustainability, could be overcome through development of the technology. Technological development and innovations has been recognized as key to sustainable development (Silvestre and Ţîrcă, 2019). According to Silvestre (2015), sustainable performance cannot be achieved without integrated innovations. Changes and improvements in technology enhance and expend our abilities in every aspect in life, in applied business processes and infrastructure, while taking into consideration sustainable development.

Technological dimension integration to sustainability is recognized by its impact to the additional key elements: social, economic and environmental aspects (Dobrovolskiene et al. 2021). Firstly, technological impact is significant to social aspect. Technology and innovations have shaped the society and greatly impacted the quality of life (Tasleem et al. 2019; Nassar & Tvaronavičienė 2021). Yet considering technological impact to social impact in across the industries, it manifests in better quality products and services to customers, better advantages for the health, safety of workers (Saunila et al. 2019). In other words, as technology is part of everyday life, its integration in infrastructures and projects results in positive outcome for the society, in terms of high quality products and services, with enhances overall quality of life.

Consequently, technological aspect significantly affects the economic element of sustainability development. Technology integration in business and infrastructures can benefit by cost reductions, implementing resource-saving technologies, increase overall productivity and efficiency while optimizing processes and entire life-cycle of products or services (Saunila et al. 2019). According to Drejeris and Oželienė (2019), technological dimension is crucially important to sustainability and the application of green technologies in sustainable business activities confirms greater competitive advantages in processes and economic performances, than traditional business. Therefore, technological impact to economic aspect is significant and important in the context of sustainability due to its impacts on economic performance.

Technology impacts and significance to environmental issues and their relationship are highly discussed (Chege and Wang, 2020). In terms of digital technologies and Industry 4.0 has affected environmental sustainability, examples could be artificial intelligence, mobile technologies, big data analytics generate improvements for industries, and deployed technologies improve and contribute to environmental sustainability (Balogun et al. 2020, Feroz et al. 2021, Goralski and Tan, 2020). Moreover, technological innovations adaptations and utilizations are emerging renewable energy and transportation and other industries. In order to obtain environmental sustainability industries are now more reliable on technologies (Tasleem et al. 2019). To reduce negative footprint on environment, technologies and innovations must be implemented, such as minimizing waste, increasing efficient resource use, recycling and promoting circular economy (Monni et al., 2017; Söderholm 2020, Mazzoni, 2020; Dobrovolskienė et al. 2021; Marino, & Pariso, 2021).

Hence, a scientific literature review has indicated the importance of implementation technologies and innovation to business and infrastructure activities, highlighting its affects to other key elements to sustainability: social, economic and environmental. Taken into consideration technological aspect significance, it could be concluded, that technological dimension is necessary for sustainable development. Thus, based on Dobrovolskienė et al. (2021) modified sustainability concept (see Fig. 1), the sustainability analysis in this study will include technological dimension.

Figure 1. Modified "triple bottom line" construct.
Source: Dobrovolskienė et al. 2021

Transportation and sustainability relationship is undeniable. The transport sector has tremendous impact to society, economy and environment and sector's sustainable development topic has gain popularity among academics and practitioners (Yunus et al. 2019, Kormishkina et al. 2019, Zhao et al. 2020). The foundation of sustainability in transportation infrastructure is typically understood by previously mentioned triple bottom line, considering of economic, social and environmental dimensions (Alonso et al. 2015, Mahdinia et al. 2018, Miller et al. 2016). In social sustainability context, transportation plays important role. Considering the scientific literature about social sustainability, high focus is on the transport accessibility. It is one of the main indicator's for social sustainability in the context of transport (Sierra et al. 2018). Traffic safety is another very important aspect, which refers to crashes, injuries and accidents (Mahdinia et al., 2018). In sustainable context, transport must improve and enhance safety in order to prevent and minimize risk of crashes and injuries. Consequently, social aspects also include transport system effect on health, through enhancing health life-style (increasing bicycle modes) and minimizing exposure to pollution, through air quality and minimizing related illness (Al-Kaabi et al. 2020). Transport in economic sustainability is most considered with economic development and efficiency. As discussed earlier, transport is significantly important to economy and its development. Consequently, indicator of economic efficiency is important to include, as it is important in the context of regional and national economic development (Badassa et al., 2020). The next essential dimension in transportation is environmental, which is considered and highlighted significantly. Transport and its infrastructure is one of the biggest contributor's to environmental problems. Widely used environmental sustainability indicators in transport include GHG emissions (CO2), air pollutants (CO, NOx, etc.), energy consumption, noise and water pollution, waste management, land consumption, renewable and alternative fuel consumption (Al-Kaabi et al. 2020, Guimarães et al. 2018, Mansourianfar and Haghshenas 2018, Sdoukopoulos et al. 2019). Moreover, transport environmental sustainability includes ecological damage and impact to natural habitats (Bueno Cadena and Vassallo Magro 2015, Tian et al. 2020). Lastly, considering technological aspect it is not a new concept in the sustainable transport. Various researchers highlighted or included technological aspect in sustainable transport (Amiril et al. 2014, Dobranskyte-Niskota et al. 2009, Mitropoulos and Prevedouros 2013, Miller et al. 2016, Mitropoulos and Prevedouros 2016a, Ogryzek et al. 2020; Tian et al. 2020, Zito and Salvo 2011). According to the scientific literature review (Al-Kaabi et al. 2020, Amiril et al. 2014, Balasubramaniam et al. 2017, Basbas and Politis 2008, de Almeida Guimarães and Leal Junior 2017, Dobranskyte-Niskota et al. 2009, Haghshenas et al. 2015, Haghshenas and Vaziri 2012, Hosseininasab at al. 2018, Iniestra and Gutiérrez 2009, Jeon et al. 2013, Joumard and Nicolas 2010, Li et al. 2017, Litman 2008, Litman 2011, Locatelli et al. 2017, Lopez-Carreiro and Monzon 2018, Mahdinia et al. 2018, Mahmoudi et al. 2019, Mansourianfar and Haghshenas 2018, Miller et al. 2016, Mitropoulos and Prevedouros 2013, Mitropoulos and Prevedouros 2016b, Nanaki et al. 2017, Ogryzek et al. 2020, Puodziukas et al. 2016, Sdoukopoulos et al. 2019, Tafidis et al. 2017, Thompson et al. 2013, Tian et al. 2020, Winata and Rarasati 2018, Yang et al. 2016, Zheng et al. 2013; Mazzanti et al. 2020) 10 environmental, 7 social, 9 economic and 5 technological criteria are selected (see Table 1).

Table 1. Sustainability criteria in transport sector

Sustainability dimension	Criteria
Environmental	Greenhouse gas (GHG) emissions - (CO_2)
	Air pollutant emissions – (CO, NOx)
	Gross energy consumption
	Use of renewable energy
	Use of alternative fuels
	Land consumption
	Noise pollution
	Water pollution
	Waste management
	Ecological damage (Impact on natural habitats)
Social	Project accessibility to the public
	Impact on human health
	Transport traffic safety
	Safety and wellbeing of workers
	Improvement of the life quality
	Training of workers
	Increasing employment of the population (creation of new jobs places)
Economic	Life-cycle costs
	Project service affordability for the public
	Promotion of economic efficiency (Economic benefit and importance of the region)
Economic	Created transport mobility (reducing traffic congestion, improving traffic flows)
	Quality control
	Public expenditure and investments to the project
	Reduction of direct costs
	Reduction of non-direct costs
	Project duration
Technological	Innovative technologies employed
	Technical maintenance frequency
	Technical capacity and reliability
	Overall project quality
	Technical risk throughout the project life-cycle

Source: developed by the authors

On the basis of these selected criteria, a transport sustainability index will be developed. The index will be then integrated into the transport investment project selection.

Materials and methods

In this part, MCDM for a transport sustainability index development and a transport investment project selection are described. MCDM methods have been acknowledged by various researchers (Shvetsova et al. 2018, Dobrovolskienė et al. 2021) and can be find in the analysis of sustainability and its assessment. Thus, researchers have indicated MCDM methods effectiveness over other provided tools, as it incorporates various aspects while others fail to do so (Myllyviita et al. 2017, Windsor et al. 2018, Dobrovolskienė et al. 2021).

Simple additive weighting (SAW) method is considered as one of the most popular MCDM method's, which lies under multi-attitude decision-making (MADM) group (Setyawan et al. 2017). It is widely used in decision-making, as provided alternatives are evaluated according to the criteria, which are weighted depending on their significance and importance (Sorooshian and Parsia 2019). While using this method, importance and significance weights are assign to each of the criteria or attribute, thus the score is obtained by the summation of multiplication of assign weights and obtain criteria results (Yuda 2020). The alternative with the higher score is recommended and suggested as the best option (Ibrahim and Surya, 2019).

Other broadly used MCDM method is Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS). Method is also belongs to MADM group (Garuda et al. 2017). TOPSIS is used to solve decision-making problems with identified options. Method's goal is to rank given alternatives, which simultaneously has shortest distance from the positive ideal solution and the longest distance from negative ideal solution and finally propose the optimal solution or alternative (Chen, 2019). Significance weights are assigned to criteria and through decision normalization matrix negative and positive solutions are identified. Thus, following calculated distances coefficient of each option indicate and rank the alternatives, proposing the best option.

Simple Additive Method (SAW) will be used for further research estimating transport project sustainability due its simplicity and easy applications.

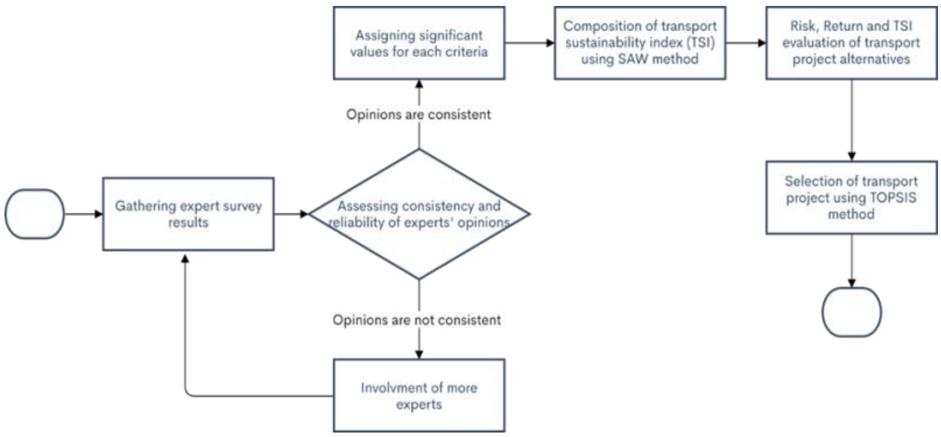

Figure 1. Process of TSI composition and integration to transport project selection

Source: compiled by author.

In order to obtain sustainability index for a sustainable transport project, expert survey is considered to be one of the most important step. Expert survey provides information crucial to the research, when there is uncertainty and possible disagreement (Garrido Azevedo and Barros, 2017). As weight determination is based on expert opinions, the process is subjective (Dobrovolskienė et al. 2019, Odu 2019). The results of expert survey indicate which of the criteria is considered the most important and critical to expert.

While evaluating the results of an expert survey, the fact that expert opinion varies must be taken into consideration. To estimate the consistency and compatibility degree of the results, Kendall's concordance correlation coefficient is obtained (Duleba and Moslem, 2018).

$$W = \frac{12S}{m^2(n^3-n)} \quad (1)$$

where:

W – Kendall's concordance correlation coefficient;
S – The sum of the deviation of ranks from the mean;
m – The number of experts;
n – The number of criteria.

Interpretation of the Kendall's concordance correlation is understood as follow: the coefficient W is 0 - there is no agreement, 0.10 – there is a weak agreement, 0.30 – there is a moderate agreement, 0.60 – there is a strong agreement and when W is equal to 1 – there is a perfect agreement among the results (Duleba and Moslem, 2018).

Following step of the research is to evaluate the reliability of the expert opinions. According to Dobrovolskienė et al. (2021), the reliability of the opinions can be evaluated using Pearson criteria.

$$\chi^2 = m(n-1)W \quad (2)$$

For this analysis, using Chi - distribution table and selected $\propto$ (significance level – in literature most often used 0.05 or 0.01) and degree of freedom ($\upsilon = n - 1$) critical value is obtained (X^2_{cr}). If computed value of χ^2 is higher than X^2_{cr}, it can be concluded, that expert's opinions are reliable (Podvezko 2008).

The received information about criteria should be determined by its significance. The most important criteria should have the highest weight (ω_i) and the sum of all criteria weights must be equal to one (Dobrovolskienė et al. 2019).

$$\sum_{i=1}^{m} \omega_i = 1 \quad (3)$$

As used criteria are assigned their significance value, they should be normalized, because different criteria are expressed in various measures. In order to normalize the criteria, the first step is to identify which criteria are beneficial to sustainability (maximizing) and which ones are negatively impacting sustainability (minimizing).

There are methods (e.g., SAW) able to deal only with maximized indicators; therefore, minimized indicators have to be transformed (i.e., normalized) into maximized ones according to Formula (4) (Dobrovolskienė et al. 2021):

$$\widetilde{r_{ij}} = \frac{\min_j r_{ij}}{r_{ij}} \quad (4)$$

where: r_{ij} is the value of *i*th indicator for *j*th alternative; and min r_{ij} is the smallest value of *i*th indicator. After normalization of variables, the smallest value obtains the largest value equal to one. Similarly, the values of maximized indicators can be transformed so that the largest value of an indicator acquires the largest value equal to one:

$$\widetilde{r_{ij}} = \frac{r_{ij}}{\max_j r_{ij}} \quad (5)$$

After the normalization of minimizing and maximizing criteria, the final step is the summation of multiplication of weights and normalized variables to obtain sustainability index, by the following formula (Dobrovolskienė, 2021).

$$S_j = \sum_{i=1}^{m} \omega_i n_{ij} \quad (6)$$

where:

S_j – obtained sustainability index;

ω_i – weight of *i* variable;

n_{ij} – normalizes value of *j* alternative *i* variable.

Obtained sustainability index (*Sj*) value can be between 0 and 1. The decision of choosing the best alternative regarding the most sustainable project will be determined by the highest value of the index.

Project selection, as one of the most essential part of project portfolio management, is considered as a process of evaluating and choosing the best project alternative. Thus, for this reason, TOPSIS method is chosen.

The first step of this method is normalization of the criteria by applying the following Formula (7) (Walczak and Rutkowska, 2017):

$$(r_{ij})_{n\times m} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}}, i = 1,2,\dots,n, j = 1,2,\dots,m \quad (7)$$

where:

x_{ij} - value of *j* alternative *i* criteria;

m – number of criteria;

n – number of alternatives.

The second step is to multiply normalized value with identified evaluation criteria weights, according to the Formula (8) (Walczak and Rutkowska, 2017):

$$(t_{ij})_{n\times m} = (w_{ij}r_{ij})_{n\times m}, i = 1,2,\ldots,n, j = 1,2,\ldots,m$$
(8)

where:

w – weight of j alternative i criteria.

The following step of the process involves determination of the positive ideal solution (PIS) and the negative ideal solution (NIS) (Walczak and Rutkowska 2017).

$$PIS_i = \{(\mathrm{Max}\,(t_{ij}|i = 1,2,\ldots,n) j \in J_+), (\mathrm{Min}(\,t_{ij}|i = 1,2,\ldots,n)\ j \in J_-)\} \quad (9)$$

$$NIS_i = \{(\mathrm{Min}\,(t_{ij}|i = 1,2,\ldots,n) j \in J_+), (\mathrm{Max}(\,t_{ij}|i = 1,2,\ldots,n)\ j \in J_-)\} \quad (10)$$

where:

J_+ – benefit criteria (more is better);

J_- – negative criteria (less is better).

Furthermore, TOPSIS method requires to identify the distance for each alternative to Positive Ideal Solution (D_{iPIS}) and Negative Ideal Solution (D_{iNIS}) (Walczak and Rutkowska, 2017).

$$D_{iPIS} = \sqrt{\sum_{j=1}^{n}(t_{ij} - PIS_{iJ})^2}, i = 1,2,\ldots,n$$
(11)

$$D_{iNIS} = \sqrt{\sum_{j=1}^{n}(t_{ij} - NIS_{iJ})^2}, i = 1,2,\ldots,n$$
(12)

The final step of the TOPSIS procedure is finding the performance score (S_i), i.e., the relative closeness to the ideal solution according to the following Formula (13) (Walczak and Rutkowska 2017)

$$S_i = \frac{D_{iNIS}}{D_{iNIS} + D_{iPIS}}$$
(13)

Performance score (S_i) falls between 0 and 1. The higher the score, the better alternative option. Lastly, project selection using TOPSIS method requires to rank the alternative according to (S_i) (Walczak and Rutkowska 2017). The alternative with the highest rank and performance score is selected as the most optimal solution.

Financial decision-making in regards to financial products (in this case investment projects) is highly influenced by the expected returns and associated risks (Bauer and Menrad, 2020). It is widely understood, that the higher expected return of the investment project corresponds to the higher expected risk, that investor will hold. Thus, investors bearing the higher risk expect the same level of return.

Return on investment project can be understood as profit expected from the investment in the project, future cash flows of the investment in the projects generated in regards to innate investment cost. In other words, this indicator shows produced gain from the amount investment or used capital (Zamfir et al. 2016). According to Dobrovolskienė and Tamošiūnienė (2016), to calculate the expected return the arithmetich mean is used and to estimate the average return on the investment project the following formula is used:

$$R_i = \frac{1}{n}\sum_{i=1}^{n} \frac{G - I}{I} \tag{14}$$

where:

R_i – the average project's *i* return;

n – the number of scenarios;

G – the investment income;

I – the cost of investment.

Risk can be explain as the exposure to the potential losses and is one of the most important factors for decision-making and expected project returns. According to Dobrovolskienė and Tamošiūnienė (2016), investment project risk is evaluated by computing variances or standard deviations of the past returns. However, as in this case, past returns are unknown, the average of three scenarios will be applied. Variance measurement in investment is the parameter used to evaluate volatility of relegalized return from the expected return, capturing the uncertainty of returns (Hundal et al. 2019). Thus, the variance will be computed according to (Dobrovolskienė and Tamošiūnienė 2016):

$$V_i = \frac{1}{n}\sum_{i=1}^{n} (R_{ij} - R_i)^2 \tag{15}$$

where:

V_i – the average dispersion of project's *i* return;

n – the number of scenarios;

R_{ij} – the project's *i* scenario *j* return;

R_i – the average project's *i* return.

Standard deviation is one the most known risk measurement, helping to evaluate deviation between returns from the average (Jurevičienė and Bapkauskaitė, 2014). In other words, this dispersion measure indicate the variability of the returns or data relative to the average return (Andrade, 2020). Standard deviation is calculated by squared root of variance:

$$SD_i = \sqrt{V_i} = \sqrt{\frac{\sum_{i=1}^{n}(R_{ij} - R_i)^2}{N}} \quad (16)$$

According to Zeisberger (2021) the higher results of standard deviation indicate a higher variability of the returns, which indicate a higher risk of the investment.

Results

In this study, two stage expert survey was conducted. In the first stage of the survey, experts had to provide information about their academic degree, experience in evaluating sustainable transport projects and indicate representative city, country. Following, experts were asked to rate each of sustainability criteria of each dimension (environmental, social, economic and technological) separately from 1 to 5, where 1 – the least significant criteria and 5 – the most significant criteria.

Composed survey form was sent to 18 sustainable transport experts, with reference to their work experience and knowledge about sustainable transport project management. However, answers were received from 8 experts, from which three had PhD degree with experience of 5 to 10 years, one Associate Professor (Docent) with 4 year experience, two experts with Masters' degree with 8 to 13 years of experience and two assistant professors with 2 to 3 years experience with sustainable transport projects. Further, the results received indicate around 44% rate of responsiveness. The rate compared to other studies is expectable and considerably high (Dobrovolskienė et al., 2019). According to Dobrovolskienė et al. (2016), the smaller group of expert panellists represent and indicate the same accurate results as the larger group of experts. In this case, it was decided, that sustainability evaluation of transport projects will be conducted using 8 experts opinions.

After filled surveys were received with indicated significance values of criteria, average of each criterion was estimated. The least significant criteria in this study include increasement of employment (creating new job places), land consumption for the transport project, project life-cycle costs and public expenditure and investment for the project. The critical significance mean of 3.5 was chosen, as too much criteria increase the difficulty of evaluating the impact of criteria to the final result (Dobrovolskienė et al., 2019). Further, the most significant criteria were chosen with the mean higher than 3.5, result in final 14 criteria (5 environmental, 3 social, 3 economic and 3 technological).

As 14 most significant criteria were selected, the second stage of expert survey was executed. In this stage, the list of most significant criteria was sent to the same 8 experts. They were asked to assign values for all criteria, where 14 points indicated the most important criteria and 1 point indicated the least significant criteria for sustainability evaluation. The results were received from all 8 experts and the sum of the assigned values for each criterion was calculated. The scores of each criterion are presented in the Table 2.

Table 2. Result from the second phase of expert survey

Dimension	Criteria	Unit of measurement	Total points
Environmental	Greenhouse gas (GHG) emissions -(CO2)	CO2 (t)/net income	109
Technological	Innovative technologies employed	Number of experience employees that are able to design, build, use the technology/Total number of employees	90
Environmental	Air pollutant emissions – (CO, NOx)	CO (t)/net income; NOx(t)/ net income.	87
Technological	Overall project quality	Objectives were reached: YES (1) or NO (0).	84
Economic	Reduction of direct costs	Direct costs/ all costs	75
Environmental	Noise pollution	Cost of sound minimizing materials and technologies implemented/total cost of materials	64
Social	Transport infrastructure and traffic safety	Fatalities and injuries of traffic accident /total deaths and injuries	60
Social	Safety and wellbeing of workers	Number of employees injuries/total number of employees	55
Environmental	Use of renewable energy	Renewable energy/all energy	52
Social	Training of workers	Yearly training hours/total number of employees	39
Technological	Technical risks throughout the project life-cycle	Costs of changed technology, materials and additional training of workers/total costs	36
Economic	Promotion of economic efficiency (Economic benefit and importance of the region)	Project costs/all costs	32
Environmental	Use of alternative fuels	Alternative fuel/all fuel	31
Economic	Quality control	Number of quality control violations. (2 is acceptable).	26

Source: developed by the authors

Results indicate that the most significant criterion in this study is green-house gas emissions (CO_2), innovative technology implementation, air pollutants and overall project quality. Thus, project quality control, according to experts, was the least significant criteria for sustainable transport project evaluation.

Considering that experts opinions varies and are not united regarding some indicators, the degree of consistency and reliability were evaluated. Using Kendall's concordance correlation coefficient ((1) formula) the degree of consistency was obtained with the value of 0.60, which conclude, that expert opinions are strongly united. Further, to estimate the degree of reliability, Pearson's correlation was calculated ((2) formula). The estimated value of χ^2 is higher than χ^2_{cr} (62.386>22.362) at a significance level α = 0.05. Thus, the results of Kendall's and Pearson's coefficients indicate, that experts opinions are consistent and reliable. Therefore, 14 selected transport sustainability criteria can be used for further sustainability evaluation research.

After receiving final answers from the experts and their evaluation, the significance weight was obtained by applying (3) formula. Consequently, each criterion is devided into maximazing (positively impact transport sustainability) and minimazing (negatively impact transport sustainability) regarding their affect on trasport sustainability (see Table 3).

Table 3. Weights and types of sustainability criteria

Dimension and criteria	Code	Weight coefficient in a group	Total weight coefficient	Type
Environmental		**0,408**		
Greenhouse gas (GHG) emissions -(CO2)	C1	0,318	0,130	Min
Air pollutant emissions – (CO, NOx)	C2	0,254	0,104	Min
Use of renewable energy	C4	0,152	0,062	Max
Use of alternative fuels	C5	0,090	0,037	Max
Noise pollution	C7	0,187	0,076	Min
Social		**0,183**		
Transport infrastructure and traffic safety	C13	0,390	0,071	Max
Safety and wellbeing of workers	C14	0,357	0,065	Max
Training of workers	C16	0,253	0,046	Max
Economic		**0,158**		
Promotion of economic efficiency (Economic benefit and importance of the region)	C20	0,241	0,038	Max
Project quality control	C22	0,195	0,031	Max
Reduction of direct costs	C24	0,564	0,089	Max
Technological		**0,250**		

Innovative technologies employed	C27	0,429	0,107	Max
Overall project quality	C30	0,400	0,100	Max
Technical risks throughout the project life-cycle	C21	0,171	0,043	Min

Source: compiled by the authors

Furthermore, as each criterion was categorized by type (maximizing and minimizing), the following step is normalization, based on the highest and the lowest values of each three alternative as reference value. Consequently, normalization for SAW method is estimated by applying (4) and (5) formulas based on their positive or negative impact on sustainability. Lastly, sustainability index is obtained by applying SAW method ((6) formula), summing the multiplication of weight and criteria results:

$$TSI = 0.130C_{N1} + 0.104C_{N2} + 0.062C_{N3} + 0.037C_{N4} + 0.076C_{N5} + 0.046C_{N6} + 0.071C_{N7} + 0.065C_{N8} + 0.038C_{N9} + 0.089C_{N10} + 0.031C_{N11} + 0.107C_{N12} + 0.100C_{N13} + 0.043C_{N14}$$

To sum up, the obtained TSI falls between 0 and 1. Value closer to 1 indicates a higher sustainability level.

For further research X transport company was chosen. This company operates for 26 years. The company's business activities include international transportation of goods, warehousing and logistics, repairment and maintenance of the vehicles, etc. Therefore, considering these main activities 3 projects were selected for the analysis.

In order to properly select the transport project, sustainability index (TSI), return on investment and risk were calculated by applying 14, 16 and 17 formulas, respectively. Nevertheless, as there is no available historical data, the return and risk for all three projects were calculated as the averages of optimistic, realistic and pessimistic scenarios. Obtained resuls are presented in Table 4.

Table 4. Computed data of the projects

Project	Sustainability (TSI)	Return on investment (R)	Risk (SD)
P1	0.614	0.257	0.486
P2	0.371	0.624	0.571
P3	0.448	0.527	0.519

Source: compiled by the authors

Investors typically make investment decisions based on return and risk, however with additional criterion, decision makers are able to derive investment resolution while take sustainability into account. Therefore, according to the information in the Table 4, TOPSIS method was applied, given to each criterion (sustainability, return and risk) equal significance weights. Using this method, performance score (S_i) for each transport project alternative was computed according to (13) formula:

$$S_i = \frac{\sqrt{(0.333TSI_i - NIS_{TSI})^2 + (0.333R_i - NIS_R)^2 + 0.333SD_i - NIS_{SD})^2}}{\sqrt{(0.333TSI_i - NIS_{TSI})^2 + (0.333R_i - NIS_R)^2 + (0.333SD_i - NIS_{SD})^2} + \sqrt{(0.333TSI_i - PIS_{TSI})^2 + (0.333R_i - PIS_R)^2 + (0.333SD_i - PIS_{SD})^2}}$$

As performance score for all alternatives is calculated, transport projects were ranked: the higher the score, the higher the rank. Project selection while taken three criteria into account (sustainability, return and risk) are summarized in the table below:

Table 5. Results of the TOPSIS method for the transport project selection

Project	Performance score (S_i)	Rank
P1	0,4147	3
P2	0,5853	2
P3	0,5901	1

Source: compiled by the authors

From the Table 5, it can be seen the performance scores of each three transport project alternatives, while giving each selection criteria (transport sustainability index, return on investment and risk) equal significance weights. Using TOPSIS method, the score identifying simultaneously the shortest distance from the ideal solution and the longest distance from the worst solution is computed and indicate the following rank of the projects: P3, P2 and P1. Therefore, for the decision-makers or investors P3 alternative is selected as the optimal choice. Moreover, it could be noticed, that as the sustainability of the project increases, the return on investment decreases. The correlation coefficient between the sustainability and the return on investment is -0.99, which indicates a strong negative correlation. This could be explained by the higher costs of materials and vehicles, which comply with environmental and sustainability standards, which in the short period of time does not provide higher returns. However, as the transport sector is one of the largest from economic perspective, heavily impacts the environment and greatly affects society, the changes and new technology implementation is unavoidable future. Current regulations and future prospects further indicate the need of sustainability implementation and especially in the transport sector. As the returns in the shorter period of time are smaller, thus in long term investments would ultimately pay-off, in terms of efficiency of the resources, optimization, safety, well-being of employees and impact to environment.

Using TOPSIS method, company has the ability to select the optimal investment project option, taken into consideration return on investment, risk and composed sustainability index – TSI. In this case, all these criteria were given equal significance.

However while implementing this method and index further, the selection weights could be modified regarding the preference of the decision-makers.

Conclusions. The transport sector, as one of the most significant economically, environmentally and socially, was analysed in this research. The transport sector has a positive impact to economic growth and development. However, this sector significantly contributes to environmental issues and pollution. Thus, the relationship between sustainability and transport sector was analized. Therefore, the original concept of sustainability was supplemented by an additional technological dimension, as it is the main tool for transition to a sustainable future.

14 criteria for TSI composition were selected (5 environmental, 3 economic, 3 social and 3 technological). Obtained results indicate that the most significant criterion in this study is green-house gas emissions (CO2), innovative technology implementation, air pollutants and overall project quality. Thus, project quality control, according to experts, was the least significant criterion for sustainable transport project evaluation.

Using TOPSIS method, including three criteria (sustainability, return on investment and risk) and given them equal importance, project alternatives were ranked and the most optimal solution was selected. In this case, company X should consider P3 as the optimal choice, which provide moderate sustainability level with prospective return on investment and risk.

Research revealed that there is a statistically significant, strong linear correlation between sustainability and project return. However as environmental concerns and requirements constantly increases, the higher investments in sustainability are inevitable and in the longer period perspective would pay-off. For further research and analysis of the project selection the weights of criteria could be modified in regards of sustainability importance to the company.

References

Adeniran, A.O. & Obembe, O.E. 2020. The significance of strategic management accounting on the performance of transport businesses in Nigeria. Insights into Regional Development, 2(3), 677-688. https://doi.org/10.9770/IRD.2020.2.3(5)

Ajanovic, A. & Haas, R., 2018. Economic prospects and policy framework for hydrogen as fuel in the transport sector. Energy policy, 123, 280-288.

Al-Kaabi, M. J., Maraqa, M. A., & Hawas, Y. S. 2020. Development of a composite sustainability index for roadway intersection design alternatives in the UAE. Sustainability, 12(20), 1–18. https://doi.org/10.3390/su12208696

Alonso, A., Monzón, A., & Cascajo, R. 2015. Comparative analysis of passenger transport sustainability in European cities. Ecological Indicators, 48, 578–592. https://doi.org/10.1016/j.ecolind.2014.09.022

Amiril, A., Nawawi, A. H., Takim, R., & Latif, S. N. F. A. 2014. Transportation Infrastructure Project Sustainability Factors and Performance. Procedia - Social and Behavioral Sciences, 153, 90–98. https://doi.org/10.1016/j.sbspro.2014.10.044

Andrade, C. 2020. Understanding the Difference Between Standard Deviation and Standard Error of the Mean, and Knowing When to Use Which. Indian Journal of Psychological Medicine, 42(4), 409–410. https://doi.org/10.1177/0253717620933419

Badassa, B. B., Sun, B., & Qiao, L. 2020. Sustainable Transport Infrastructure and Economic Returns : A Bibliometric and Visualization Analysis. 1–24. https://doi.org/10.3390/su12052033

Balasubramaniam, A., Paul, A., Hong, W. H., Seo, H. C., & Kim, J. H. 2017. Comparative analysis of intelligent transportation systems for sustainable environment in Smart Cities. Sustainability, 9(7), 1–12. https://doi.org/10.3390/su9071120

Balogun, A. L., Marks, D., Sharma, R., Shekhar, H., Balmes, C., Maheng, D., Arshad, A., & Salehi, P. 2020. Assessing the Potentials of Digitalization as a Tool for Climate Change Adaptation and Sustainable Development in Urban Centres. Sustainable Cities and Society, 53, 101888. https://doi.org/10.1016/j.scs.2019.101888

Basbas, S., & Politis, I. 2008. Urban road pricing and sustainable transportation systems: The Thessaloniki central area case. International Journal of Sustainable Development and Planning, 3(1), 1–15. https://doi.org/10.2495/SDP-V3-N1-1-15

Bueno Cadena, P. C., & Vassallo Magro, J. M. 2015. Setting the weights of sustainability criteria for the appraisal of transport projects. Transport, 30(3), 298–306. https://doi.org/10.3846/16484142.2015.1086890

Bauer, A., & Menrad, K. 2020. Beyond risk and return: What motivates environmentally friendly or harmful student fund investments in Germany? Energy Research and Social Science, 67, 101509. https://doi.org/10.1016/j.erss.2020.101509

Chehabeddine, M., & Tvaronavičienė, M. 2020. Securing regional development. Insights into Regional Development, 2(1), 430-442. http://doi.org/10.9770/IRD.2020.2.1(3)

Chege, S. M., & Wang, D. 2020. The influence of technology innovation on SME performance through environmental sustainability practices in Kenya. Technology in Society, 60, 101210. https://doi.org/10.1016/j.techsoc.2019.101210

Chen, P. 2019. Effects of normalization on the entropy-based TOPSIS method. Expert Systems with Applications, 136, 33–41. https://doi.org/10.1016/j.eswa.2019.06.035

de Almeida Guimarães, V., & Leal Junior, I. C. 2017. Performance assessment and evaluation method for passenger transportation: a step toward sustainability. Journal of Cleaner Production, 142, 297–307. https://doi.org/10.1016/j.jclepro.2016.05.071

Dobranskyte-Niskota, A., Perujo, A., Jesinghaus, J., & Jensen, P. 2009. Indicators to Assess Sustainability of Transport Activities Part 2: Measurement and Evaluation of Transport Sustainability Performance in the EU27. In JRCScientific and Technical Research Reports. https://doi.org/10.2788/46618

Dobrovolskienė, N., & Tamošiūnienė, R. 2016. Sustainability-Oriented Financial Resource Allocation in a Project Portfolio through Multi-Criteria Decision-Making. Sustainability, 8, 485. https://doi.org/10.3390/su8050485

Dobrovolskienė, N., Tvaronavičienė, M., & Tamošiūnienė, R. 2017. Tackling projects on sustainability: a Lithuanian case study. Entrepreneurship and Sustainability Issues, 4(4), 477-488. http://doi.org/10.9770/jesi.2017.4.4(6)

Dobrovolskienė, N., Tamošiūnienė, R., Banaitis, A., Ferreira, F. A. F., Banaitienė, N., Taujanskaitė, K., & Meidutė-Kavaliauskienė, I. 2019. Developing a composite sustainability index for real estate projects using multiple criteria decision making. Operational Research, 19(3), 617–635. https://doi.org/10.1007/s12351-017-0365-y

Dobrovolskienė, N., Pozniak, A., & Tvaronavičienė, M. 2021. Assessment of the Sustainability of a Real Estate Project Using Multi-Criteria Decision Making. Sustainability, 13(8), 4352. https://doi.org/10.3390/su13084352

Drejeris, R., & Oželienė, D. 2019. New approach to the technological aspect of corporate sustainable development. Business: Theory and Practice, 20, 363–371. https://doi.org/10.3846/btp.2019.34

Duleba, S., & Moslem, S. 2018. Sustainable urban transport development with stakeholder participation, an AHP-Kendall model: A case study for Mersin. Sustainability (Switzerland), 10(10). https://doi.org/10.3390/su10103647

Feroz, A. K., Zo, H., & Chiravuri, A. 2021. Digital transformation and environmental sustainability: A review and research agenda. Sustainability, 13(3), 1–20. https://doi.org/10.3390/su13031530

Garrido Azevedo, S., & Barros, M. 2017. The Application of the Triple Bottom Line Approach to Sustainability Assessment: the Case Study of the UK Automotive Supply Chain. https://doi.org/10.3926/jiem.1996

Garuda, G., Fadlina, Mesran, Siahaan, A. P. U., & Rahim, R. 2017. Technical Approach of TOPSIS in Decision Making Bit Error Detection and Correction with Hamming Code View project Quality Assurance in Knowledge Data Warehouse View project Garuda Ginting STMIK Budi Darma Medan. https://doi.org/10.23883/IJRTER.2017.3388.WPYUJ

Georgatzi, V.V., Stamboulis, Y. & Vetsikas, A., 2020. Examining the determinants of CO2 emissions caused by the transport sector: Empirical evidence from 12 European countries. Economic Analysis and Policy, 65, 11-20.

Comporek, M., Kowalska, M., & Misztal, A. 2021. The sustainable development of transport enterprises in the context of macroeconomic conditions. The case of Central and Eastern European countries. Entrepreneurship and Sustainability Issues, 8(3), 226-247. http://doi.org/10.9770/jesi.2021.8.3(13)

Goralski, M. A., & Tan, T. K. 2020. Artificial intelligence and sustainable development. International Journal of Management Education, 18(1), 100330. https://doi.org/10.1016/j.ijme.2019.100330

Guimarães, V. de A., Leal Junior, I. C., & da Silva, M. A. V. 2018. Evaluating the sustainability of urban passenger transportation by Monte Carlo simulation. Renewable and Sustainable Energy Reviews, 93(April), 732–752. https://doi.org/10.1016/j.rser.2018.05.015

Haghshenas, H., & Vaziri, M. 2012. Urban sustainable transportation indicators for global comparison. Ecological Indicators, 15(1), 115–121. https://doi.org/10.1016/j.ecolind.2011.09.010

Haghshenas, H., Vaziri, M., & Gholamialam, A. 2015. Evaluation of sustainable policy in urban transportation using system dynamics and world cities data: A case study in Isfahan. Cities, 45, 104–115. https://doi.org/10.1016/j.cities.2014.11.003

Hosseininasab, S. M., Shetab-Boushehri, S. N., Hejazi, S. R., & Karimi, H. 2018. A multi-objective integrated model for selecting, scheduling, and budgeting road construction projects. European Journal of Operational Research, 271(1), 262–277. https://doi.org/10.1016/j.ejor.2018.04.051

Hundal, S., Eskola, A., & Tuan, D. 2019. Risk–return relationship in the Finnish stock market in the light of Capital Asset Pricing Model (CAPM). Journal of Transnational Management, 24(4), 305–322. https://doi.org/10.1080/15475778.2019.1641394

Ibrahim, A., & Surya, R. A. 2019. The Implementation of Simple Additive Weighting (SAW) Method in Decision Support System for the Best School Selection in Jambi. Journal of Physics: Conference Series, 1338(1). https://doi.org/10.1088/1742-6596/1338/1/012054

Iniestra, J. G., & Gutiérrez, J. G. 2009. Multicriteria decisions on interdependent infrastructure transportation projects using an evolutionary-based framework. Applied Soft Computing Journal, 9(2), 512–526. https://doi.org/10.1016/j.asoc.2008.07.006

Jenkins, I., & Schröder, R. 2012. Sustainability in tourism: A multidisciplinary approach. Sustainability in Tourism: A Multidisciplinary Approach, 2, 1–227. https://doi.org/10.1007/978-3-8349-7043-5

Jeon, C. M., Amekudzi, A. A., & Guensler, R. L. 2013. Sustainability assessment at the transportation planning level: Performance measures and indexes. Transport Policy, 25, 10–21. https://doi.org/10.1016/j.tranpol.2012.10.004

Joumard, R., & Nicolas, J. P. 2010. Transport project assessment methodology within the framework of sustainable development. Ecological Indicators, 10(2), 136–142. https://doi.org/10.1016/j.ecolind.2009.04.002

Jurevičienė, D., & Bapkauskaitė, G. 2014. Kompleksinis investicinių fondų veiklos vertinimas. Business Systems & Economics, 4(1), 64–77. https://doi.org/10.13165/vse-14-4-1-06

Kędzior-Laskowska, M. 2020. Polish road freight transport and process of internationalisation – selected effects for quality and competitiveness, Entrepreneurship and Sustainability Issues, 7(3), 2481-2493. https://doi.org/10.9770/jesi.2020.7.3(68)

Kormishkina, L. A., Kormishkin, E. D., Gorin, V. A., Koloskov, D. A. & Koroleva, L. P. 2019. Environmental investment: the most adequate neo-industrial response to the growth dilemma of the economy. Entrepreneurship and Sustainability Issues, 7(2), 929-948. http://doi.org/10.9770/jesi.2019.7.2(10)

Li, Z., Meng, N., & Yao, X. 2017. Sustainability performance for China's transportation industry under the environmental regulation. Journal of Cleaner Production, 142, 688–696. https://doi.org/10.1016/j.jclepro.2016.09.041

Lin, X., 2020. Multiple pathways of transportation investment to promote economic growth in China: a structural equation modeling perspective. Transportation Letters, 12(7), 471-482.

Litman, T. 2008. Sustainable Transportation Indicators. A Recommended Research Program For Developing Sustainable Transportation Indicators and Data. Transportation, November.

Litman, T. 2011. Developing indicators for comprehensive and sustainable transport planning. Transportation Research Record, 2017, 10–15. https://doi.org/10.3141/2017-02

Locatelli, G., Invernizzi, D. C., & Brookes, N. J. 2017. Project characteristics and performance in Europe: An empirical analysis for large transport infrastructure projects. Transportation Research Part A: Policy and Practice, 98, 108–122. https://doi.org/10.1016/j.tra.2017.01.024

Lopez-Carreiro, I., & Monzon, A. 2018. Evaluating sustainability and innovation of mobility patterns in Spanish cities. Analysis by size and urban typology. Sustainable Cities and Society, 38(January), 684–696. https://doi.org/10.1016/j.scs.2018.01.029

Mahdinia, I., Habibian, M., Hatamzadeh, Y., & Gudmundsson, H. 2018. An indicator-based algorithm to measure transportation sustainability: A case study of the U.S. states. Ecological Indicators, 89 (March 2017), 738–754. https://doi.org/10.1016/j.ecolind.2017.12.019

Mahmoudi, R., Shetab-Boushehri, S. N., Hejazi, S. R., & Emrouznejad, A. 2019. Determining the relative importance of sustainability evaluation criteria of urban transportation network. Sustainable Cities and Society, 47(March), 101493. https://doi.org/10.1016/j.scs.2019.101493

Mansourianfar, M. H., & Haghshenas, H. 2018. Micro-scale sustainability assessment of infrastructure projects on urban transportation systems: Case study of Azadi district, Isfahan, Iran. Cities, 72 (March 2017), 149–159. https://doi.org/10.1016/j.cities.2017.08.012

Marino, A., & Pariso, P. 2021. The transition towards to the circular economy: European SMEs' trajectories. Entrepreneurship and Sustainability Issues, 8(4), 431-445. http://doi.org/10.9770/jesi.2021.8.4(26)

Mazzanti, M., Mazzarano, M., Pronti, A., & Quatrosi, M. 2020. Fiscal policies, public investments and wellbeing: mapping the evolution of the EU. Insights into Regional Development, 2(4), 725-749. http://doi.org/10.9770/IRD.2020.2.4(1)

Mazzoni, F. 2020. Circular economy and eco-innovation in Italian industrial clusters. Best practices from Prato textile cluster. Insights into Regional Development, 2(3), 661-676. https://doi.org/10.9770/IRD.2020.2.3(4)

Miller, P., de Barros, A. G., Kattan, L., & Wirasinghe, S. C. 2016. Public transportation and sustainability: A review. KSCE Journal of Civil Engineering, 20(3), 1076–1083. https://doi.org/10.1007/s12205-016-0705-0

Mitropoulos, L. K., & Prevedouros, P. D. 2013. Assessment of sustainability for transportation vehicles. In Transportation Research Record, 2344, 88–97. https://doi.org/10.3141/2344-10

Mitropoulos, L. K., & Prevedouros, P. D. 2016a. Incorporating sustainability assessment in transportation planning: an urban transportation vehicle-based approach. Transportation Planning and Technology, 39(5), 439–463. https://doi.org/10.1080/03081060.2016.1174363

Mitropoulos, L. K., & Prevedouros, P. D. 2016b. Incorporating sustainability assessment in transportation planning: an urban transportation vehicle-based approach. Transportation Planning and Technology, 39(5), 439–463. https://doi.org/10.1080/03081060.2016.1174363

Monni, S., Palumbo, & Tvaronavičienė, M. 2017. Cluster performance: an attempt to evaluate the Lithuanian case. Entrepreneurship and Sustainability Issues, 5(1), 43-57. http://doi.org/10.9770/jesi.2017.5.1(4)

Myllyviita, T., Antikainen, R., & Leskinen, P. 2017. Sustainability assessment tools-their comprehensiveness and utilisation in company-level sustainability assessments in Finland. International Journal of Sustainable Development &World Ecology. https://doi.org/10.1080/13504509.2016.1204636

Nanaki, E. A., Koroneos, C. J., Roset, J., Susca, T., Christensen, T. H., De Gregorio Hurtado, S., Rybka, A., Kopitovic, J., Heidrich, O., & López-Jiménez, P. A. 2017. Environmental assessment of 9 European public bus transportation systems. Sustainable Cities and Society, 28, 42–52. https://doi.org/10.1016/j.scs.2016.08.025

Nassar, N. Tvaronavičienė, M. 2021. A systematic theoretical review on sustainable management for green competitiveness. Insights into Regional Development, 3(2), 267-281. https://doi.org/10.9770/IRD.2021.3.2(7)

Odu, G. O. 2019. Weighting methods for multi-criteria decision making technique. Journal of Applied Sciences and Environmental Management, 23(8), 1449. https://doi.org/10.4314/jasem.v23i8.7

Ogryzek, M., Adamska-Kmieć, D., & Klimach, A. 2020. Sustainable transport: An efficient transportation network-case study. Sustainability, 12(19), 1–14. https://doi.org/10.3390/su12198274

PPMC. Paris Agreement on Climate Change, a Strong Call to Action for the Transport Sector. Retrieved January 24, 2021. http://www.ppmc-transport.org/paris-agreement-on-climate-change-a-strong-call-to-action-for-the-transport-sector/

Podvezko, V. 2008. Sudėtingų dydžių kompleksinis vertinimas. 9(3), 160–168. https://doi.org/10.3846/1648-0627.2008.9.160-168

Puodziukas, V., Svarpliene, A., & Braga, A. 2016. Measures for Sustainable Development of Road Network. Transportation Research Procedia, 14, 965–972. https://doi.org/10.1016/j.trpro.2016.05.076

Saunila, M., Nasiri, M., Ukko, J., & Rantala, T. 2019. Smart technologies and corporate sustainability: The mediation effect of corporate sustainability strategy. Computers in Industry, 108, 178–185. https://doi.org/10.1016/j.compind.2019.03.003

Sdoukopoulos, A., Pitsiava-Latinopoulou, M., Basbas, S., & Papaioannou, P. 2019. Measuring progress towards transport sustainability through indicators: Analysis and metrics of the main indicator initiatives. Transportation Research Part D: Transport and Environment, 67 (December 2018), 316–333. https://doi.org/10.1016/j.trd.2018.11.020

Setyawan, A., Arini, F. Y., & Akhlis, I. 2017. Comparative Analysis of Simple Additive Weighting Method and Weighted Product Method to New Employee Recruitment Decision Support System (DSS) at PT . Warta Media Nusantara. 4(1), 34–42.

Shvetsova, O.A.; Rodionova, E.A.; & Epstein, M. Z. 2018. Evaluation of investment projects under uncertainty: multi-criteria approach using interval data, Entrepreneurship and Sustainability Issues 5(4): 914-928. http://doi.org/10.9770/jesi.2018.5.4(15)

Sierra, L. A., Yepes, V., & Pellicer, E. 2018. A review of multi-criteria assessment of the social sustainability of infrastructures. Journal of Cleaner Production, 187, 496–513. https://doi.org/10.1016/j.jclepro.2018.03.022

Silvestre, B. S. 2015. Sustainable supply chain management in emerging economies: Environmental turbulence, institutional voids and sustainability trajectories. https://doi.org/10.1016/j.ijpe.2015.05.025

Silvestre, B. S., & Ţîrcă, D. M. 2019. Innovations for sustainable development: Moving toward a sustainable future. Journal of Cleaner Production 208, 325–332. Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2018.09.244

Söderholm, P. 2020. The green economy transition: the challenges of technological change for sustainability. Sustainable Earth, 3(1), 6. https://doi.org/10.1186/s42055-020-00029-y

Sorooshian, S., & Parsia, Y. 2019. Modified weighted sum method for decisions with altered sources of information. Mathematics and Statistics, 7(3), 57–60. https://doi.org/10.13189/ms.2019.070301

Tafidis, P., Sdoukopoulos, A., & Pitsiava-Latinopoulou, M. 2017. Sustainable urban mobility indicators: Policy versus practice in the case of Greek cities. Transportation Research Procedia, 24(2016), 304–312. https://doi.org/10.1016/j.trpro.2017.05.122

Tasleem, M., Khan, N., & Nisar, A. 2019. Impact of technology management on corporate sustainability performance the mediating role of TQM. International Journal of Quality & Reliability Management, 36(9), 1574–1599. https://doi.org/10.1108/IJQRM-01-2018-0017

Tian, X., Dai, H., Geng, Y., Wilson, J., Wu, R., Xie, Y. & Hao, H., 2018. Economic impacts from PM2. 5 pollution-related health effects in China's road transport sector: A provincial-level analysis. Environment international, 115, 220-229.

Tian, N., Tang, S., Che, A., & Wu, P. 2020. Measuring regional transport sustainability using super-efficiency SBM-DEA with weighting preference. Journal of Cleaner Production, 242, 118474. https://doi.org/10.1016/j.jclepro.2019.118474

Thompson, U. C., Marsan, J. F., Fournier-Peyresblanques, B., Forgues, C., Ogaa, A., & Jaeger, J. A. G. 2013. Using Compliance Analysis for PPP to bridge the gap between SEA and EIA: Lessons from the Turcot Interchange reconstruction in Montréal, Québec. Environmental Impact Assessment Review, 42, 74–86. https://doi.org/10.1016/j.eiar.2012.10.001

Tseng, M.-L., Chang, C.-H., Lin, C.-W. R., Wu, K.-J., Chen, Q., Xia, L., & Xue, B. 2020. Future trends and guidance for the triple bottom line and sustainability: a data driven bibliometric analysis. Environmental Science and Pollution Research, 27(27), 33543-33567. https://doi.org/10.1007/s11356-020-09284-0

Tvaronavičienė, M. 2018. Towards sustainable and secure development: energy efficiency peculiarities in transport sector. Journal of Security and Sustainability Issues, 7(4), 719-725. https://doi.org/10.9770/jssi.2018.7.4(9)

Walczak, D., & Rutkowska, A. 2017. Project rankings for participatory budget based on the fuzzy TOPSIS method. European Journal of Operational Research, 260(2), 706–714. https://doi.org/10.1016/j.ejor.2016.12.044

Wang, C., Wood, J., Wang, Y., Geng, X. & Long, X., 2020. CO2 emission in transportation sector across 51 countries along the Belt and Road from 2000 to 2014. Journal of Cleaner Production, 266, 122000.

Winata, D. T., & Rarasati, A. D. 2018. Sustainable infrastructure transportation to improve society wellbeing in Karawang. IOP Conference Series: Earth and Environmental Science, 105(1). https://doi.org/10.1088/1755-1315/105/1/012008

Windsor, R., Cinelli, M., & Coles, S. R. 2018. Comparison of tools for the sustainability assessment of nanomaterials. Current Opinion in Green and Sustainable Chemistry, 12, 69–75. https://doi.org/10.1016/j.cogsc.2018.06.010

Wu, K.-J., Zhu, Y., Tseng, M.-L., Lim, M. K., & Xue, B. 2018. Developing a hierarchical structure of the co-benefits of the triple bottom line under uncertainty. Journal of Cleaner Production, 195, 908-918. https://doi.org/10.1016/j.jclepro.2018.05.264

Yang, C. H., Lee, K. C., & Chen, H. C. 2016. Incorporating carbon footprint with activity-based costing constraints into sustainable public transport infrastructure project decisions. Journal of Cleaner Production, 133, 1154–1166. https://doi.org/10.1016/j.jclepro.2016.06.014

Ye, L., Xie, N. & Hu, A., 2021. A novel time-delay multivariate grey model for impact analysis of CO2 emissions from China's transportation sectors. Applied Mathematical Modelling, 91, 493-507.

Yuda Irawan. 2020. Decision Support System For Employee Bonus Determination With Web-Based Simple Additive Weighting (SAW) Method In PT. Mayatama Solusindo. Journal of Applied Engineering and Technological Science (JAETS), 2(1), 7–13. https://doi.org/10.37385/jaets.v2i1.162

Yunus, E., Susilo, D., Riyadi, S., Indrasari, M., & Putranto, T.D. 2019. The effectiveness marketing strategy for ride-sharing transportation: intersecting social media, technology, and innovation. Entrepreneurship and Sustainability Issues, 7(2), 1424-1434. http://doi.org/10.9770/jesi.2019.7.2(44)

Zamfir, M., Manea, M. D., & Ionescu, L. 2016. Return on Investment – Indicator for Measuring the Profitability of Invested Capital. Valahian Journal of Economic Studies, 7(2), 79–86. https://doi.org/10.1515/vjes-2016-0010

Zeisberger, S. 2021. What is Risk? How Investors Perceive Risk in Return Distributions. In SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2811636

Zhang, F. & Graham, D.J., 2020. Air transport and economic growth: a review of the impact mechanism and causal relationships. Transport Reviews, 40(4), 506-528.

Zhao, X., Ke, Y., Zuo, J., Xiong, W., & Wu, P. 2020. Evaluation of sustainable transport research in 2000 e 2019. Journal of Cleaner Production, 256, 120404. https://doi.org/10.1016/j.jclepro.2020.120404

Zheng, J., Garrick, N. W., Atkinson-Palombo, C., McCahill, C., & Marshall, W. 2013. Guidelines on developing performance metrics for evaluating transportation sustainability. Research in Transportation Business and Management, 7, 4–13. https://doi.org/10.1016/j.rtbm.2013.02.001

Zito, P., & Salvo, G. 2011. Toward an urban transport sustainability index: An European comparison. European Transport Research Review, 3(4), 179–195. https://doi.org/10.1007/s12544-011-0059-0