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STUDENT FORUM

System-thinking approach to the applied interaction between transport and economy

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Abstract
This paper discusses the correlation balance of transport as a dynamic system and the economic growth of specific regions and countries expressed in gross domestic product (GDP). The contemporary transformation processes of the input resources to the desired outcomes need new intelligent approaches based on new information system techniques. These research determinations are specifically focused on achieving the objective of providing with the analyses concerned with giving a more estimated answer to some of the complex questions related to the economic dynamics, new information technologies, sustainable development, and transport. The assumption is that transport can be considered as one of the most influential and vibrant systems of the economy. Taking into consideration that transport system is a dynamic system which is continually changing in time and space, to maintain functioning and competing level, it should be enabled and followed by the high communication and operation technology. From this assumption, a research an interesting question has arisen: do transport contribution to the GDP increases, of the same is decreasing over time? To answer this answer, a research encompassed the mix research methodology combined with qualitative and quantitative research features. The qualitative research conclusions represent the identified and defined factors which determine the relationship between transport and the economy. The quantitative research is oriented in generating information and knowledge based on statistical data which provide with the evidence about the more realistic relationship between transport and the economy. The main goal of this research paper is to provide decision makers, planners, and academic spectrum with a demanding clarification of the applied relationship between the transport system and the economic development of a country or a region in terms of economic growth expressed in GDP, and to make them aware with regard to the implementation of new technology, new information systems, and smart or intelligence approaches within the field.

Keywords Transport · Knowledge economy · Information systems · GDP · Growth

1 Introduction

In the frame of transport planning at the policy level, many issues are debatable at various academic and strategic levels. In this area, many questions remain opened requiring new and challenging research efforts.

One of the main concerns in this area is the demand for clarification of the relationship between transport system and the economy. Based on this setting, this research is initially concerned with providing with the essential information and with definitions related to the study topic. Consequently, the research points the focus to investigate whether the location, the position, and the size of economic activity locations influence the transport system dynamics, or transport system development determines the economic activity location, space, and technological solutions. If one or another, whether these influences can be identified and expressed in variables usable in building the information and communication database. Consistently, this research adopts the GDP as a data to explain the relationship between transport and the economy in seven world leading economies: USA, EU-27, Canada, New Zeeland, Russia, China, and Japan. The final part of the literature research the research focuses intently on the impact of transport infrastructure investments on the economy of regions and countries. In this section, this research adopts the factors influencing the relationship between transport and economy, and the dynamic system

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where transport system as a component is suited. The case study of Kosova as an underdeveloped country functions as an opportunity to utilise the knowledge gained through research. Kosovo as a country has many problems regarding policy development and implementation. In this regard, the results of this research propose a framework which is supposed to serve policy makers as a roadmap to decision making for transport infrastructure investments. The proposed framework can be further utilised in building adequate dataset which can support information system technology analysis related to GDP vibrations and the influence of transport system on the GDP dynamics. This could help making smarter decisions in transport infrastructure investments in the regions situated in the transition.

There are many definitions generated from different studies about the relationship between transport and economy. Adapted in economic terms, transport provides the society with benefits; however, transport has also costs which are often complex and cannot be easily quantified. Nonetheless, the transport costs at the operational level are not in the scope of this research, and the consideration is that the benefits are likely to be directly dependent on the cost of investment and the degree of utilisation of transport system. In this regard, this research provides with the analyses of some conventional transport investment projects appraisals in terms of the costs and benefits with the aim to find a more advanced answer to the recent clarification of the transport relationship with the economy. Nonetheless, the transport infrastructure investment appraisals encompass many factors influencing benefits and costs, and this endeavour does not provide with the abundant flexibility when it comes to implementation across the different zones of the dynamic system (different economies). Accordingly, this research starts with the development of a set of questions regarding the applied relationship between transport and the economy. In this logic, the remarkable set of questions raised which are as follows:

Do transport infrastructure improvements lead to increased economic activity of a specific region or country? Do transport contribution to the economy increases over time? Are economic impacts included correctly in the processes for appraising benefits and costs of transport infrastructure projects? Is transport system capacity properly utilised? Which recommendations may be applicable to the countries in transition concerning transport infrastructure investment?

By addressing the above questions, this research provided with interesting answers concerned with the need for developing a guide model framework dedicated to policy makers and planners engaged in the transport area. Finally, this model is supposed to get in use to explore, to explain, and to include other tangible and intangible measures that influence directly or indirectly the performance of the transport system and its contribution to the economic growth of a country or a region.

1.1 The purpose of the research

The first partial contribution of this research is the provision of a statistical view of transport significance to GDP of main world economies. Consequently, the second limited contribution of this research is the proposed outline intended to for use as a policy roadmap for explanations related to transport expectations viewed in the context of the system where the transport system belongs. In this case, the identification of two variables took place: the state of the economy of a studied region expressed in gross domestic product (GDP) and the impact of transport infrastructure investments in the economy of those regions. The recommended model is an adoption of a theoretical framework and the actual practices without geographical constraints. The research is limited to the availability of data, and it includes data and provides information for the developments from the year 2000 up to the year 2016.

The rationale of this contribution communicates the need of making right public policy, though it would be useful to know the accurate value of every single project invested in transport infrastructure. It would be useful to properly identify and to define the needs for transport infrastructure projects first, to define the missing components strategically, and to make decisions for the development of transport investment programs.

The final contribution of this research focuses on providing the decision makers with a realistic, effective, and efficient decision support approach to comprehend the real relationship of transport with economic growth.

2 Interaction between transport and economy

Historically viewed, many studies were concerned with the relationship between transport and the economy. Most of those studies were oriented towards involvement to make transport more productive, eventually to use transport system more effectively to increase the overall productivity through increased mobility and accessibility. The latest stages of transport policy planning developments were oriented towards transport efficiency and effectiveness, including here the social and the environmental issues. Nevertheless, it remains still questionable the real contribution of transport system activities on the economic growth of countries and regions.

2.1 The structure of the literature review

The definite correlation between transport and economic development is challenging issue which is not easy to be theoretically established. This issue was the topic of many debates for many years, beginning with the significant increase of demand for transport in the early 60s (Goodwin et al. 2004). In more or fewer environments, transport contribution to GDP is different and not an all comprehensive nor an accurate indicator to measure the degree of interaction and dependence (Norwood et al. 2002). On the other hand, investments in transport system appear to be a facilitator for economic growth in many regions, while in some other regions, economic growth drove pressures on existing transport infrastructures and required additional investments (Jean-Paul Rodrigue 2013). Theories of economic development support the increase of physical capital by investing in infrastructure dynamics (Benitez et al. 2012).

When concerned transport contribution to GDP, there is sufficient evidence showing for around 7% of GDP is the contribution of transport and for around 5% of employment in the EU is attribution of transport activities (EC 2015). In 2006, total annual employment in the USA was about 143.4 million people, where transport sector contributed for 9.12 million jobs (US DOT 2011). In Japan, in 2006 were 63.82 million people employed, and in transport sector were 3.06 million people employed contributing by about 5% of the total employment in Japan (Ministry of Internal Affairs and Communication 2011).

Considering some aspects like the environment and land use, transport is also a negative effect producer involving the cost to the society. Based on the theoretical statistical findings of this research, the verification of the following hypothesis takes place: the economic growth and development influences the transport system size, while physical characteristics of transport influence the location and dynamics of economic activities. To support this assumption, the exploitation of the following arguments finds place:

Current trends underline that economic development shows less direct dependency on relations with the resources and more dependency on relations across space.

Though resources remain the basis of economic activities, the setting up of the economy become more linked with higher levels of material, information, and cash flows of all categories. Parallel with this, resources, capital, and even labour have shown increased levels of mobility (Jean-Paul Rodrigue 2013).

Consistently with the above-described finding, the conclusion is that transport system qualifies itself also as one of the most important systems contributing to the economic development in developing countries. The question is what developing countries should expect from transport to do in the favour of the economic development?

Some of the authors argue that low-cost and faster transport has significantly facilitated the low density and extensive settlements of Metropolitan peripheries (Greene 1997). Transport can connect potential economic areas, but is unlikely to be able to create large market potential in areas that do not have the underlying conditions that allow for economic development (ITF 2011).

Total transport GDP related to final demand (this concept includes the expenditures by end users of goods and services for transport purposes). It includes the transport component of the four components of GDP: personal consumption expenditures, government expenditures and investment, business investment, and net exports. In essence, transport final demand measures the size of transport function in relation with GDP. Is transport system contribution to GDP decreasing or increasing in recent times. The difference occurred because of the rapid decreasing of Russian GDP between the years 2014–2015 and the value of Russian monetary currency against US Dollar. The statistics from Table 1 related to transport contribution

Table 1 Transport contribution to the economy expressed in GDP

Countries	Real GDP growth			Projected GDP growth in %		Transport contribution to Real GDP in %		
	2006	2015	Δ15/06	2017	Δ17/15	2006	2015	Δ15/06
EU-27	3.2	1.6	−1.6	1.9	0.3	7	5.9	−1.1
USA	2.7	1.9	−0.8	2.2	0.3	9.8	6.8	−3
Japan	2.0	0.6	−1.4	0.5	−0.1	5.83	4.9	−1.07
China	12.6	4.7	−7.9	4.9	0.2	3.6	1.6	−2
New Zeeland	4.47	1.7	−0.05		−1.31	1.14	1.1	0.03
Canada	1.4	−0.5	0.9	2.2	1.7	4.2	3.8	−0.4
Russia	8.2	−3.7	−11.9	1.4	−2.3	2.83	1.2	−1.63

Sources: IMF 2013, EC 2011, US DOT (2011), OECD (2014), Ministry of Transport (2015), World Bank (2016), Statistics New Zealand (2016), Statistics Canada (2015), Trading Economics (2016a), Limani, (2016); Trading Economics (2016b, c, d, e)

to the economy in 2006, respectively, in 2015 show the ratio of changes in GDP and transport contribution in this respect.

Despite the positive contribution of transport to GDP, transport activities impact the society on different aspects. The transport system relates strongly to the economy, and the view of the modern economy considers it as a large undertaking. Some physical characteristics of transport have the qualities to critically influence the position of the location of economic activities.

Table 1 shows the relationship between transport and the economy expressed in GDP growth and transport contribution to the GDP. In 2003, transportation-related goods and services contributed about 11%, to US GDP (OECD 2006). In 2006, this contribution has decreased to 9.8% (US DOT 2011), and in 2015, the contribution of transport to the total GDP was 6.8% (World Bank 2016). Taking into account the statistical development, the conclusion is that the share of transport to GDP has decreased from 2006 to 2015 for about 30%, (from 9.8 to 6.8%). Analogous representation is obtainable also in EU, and in other developed and emerging economies, as shown in Table 1.

All transport users and transport providers (e.g., individuals, enterprises, institutions, governments, etc.) constantly need to contract the transfer of goods, people, information, and capital. The rationale behind this lies on that supplies, distribution systems, pricing policy development, wages, locations, management issues, as well as on constantly changing of energy costs (Jean-Paul Rodrigue 2013).

The transport system in developed economies significantly is a very important factor for economic development. This assumption can be argued by taking into consideration facts displayed in Fig. 1 and the related explanations, and the facts showing that transport is an undisputed part of every good and service in developed and in the developing economies.

Taking into account the above findings, the research investigates whether is clear or not what are the main concerns related to transport investment dedicated into consideration in the decision-making process in developing countries.

To answer this question the focus of this research directs in delivering two main products:

1. identification of comprehensive framework of factors affecting economy;
2. utilisation of best practices (theoretical and practical) related to transport investments policies.

2.2 Relationship between transport investments and economic development of a country: case study of United Kingdom

The utilisation of various techniques could explain the relationship between transport and the economy. While Economic

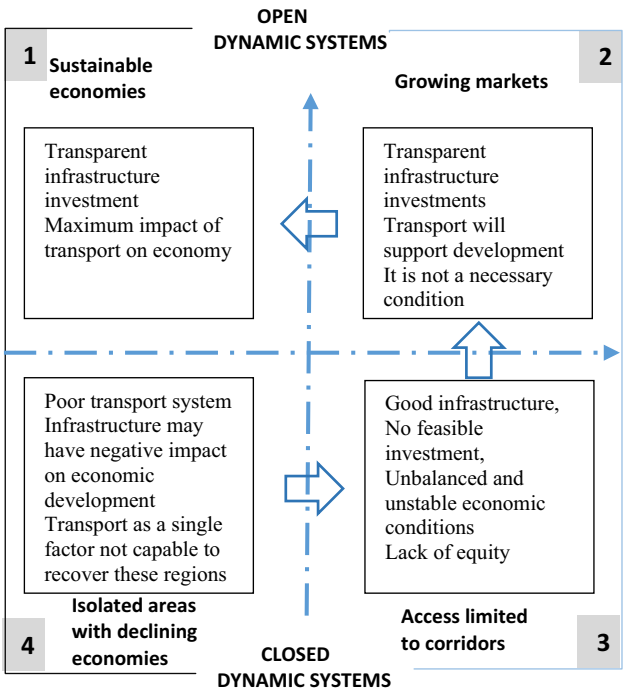

Fig. 1 Transport infrastructure impact on regional economy. Source: Adapted from Banister and Berechman (2000) and Limani (2016)

Impact Analysis is an application which addresses how a project or policy affects the quantity and category of economic activity in a specified region or a country; economic evaluation of transport projects is a set of techniques and procedures used to determine the value of a strategy, program, portfolio, or a single project. It involves the quantification of economic impacts of transport projects, or the determination of net benefits or net value of a transport investment project, and the diffusion of these impacts.

Investments in transport projects like road or rail construction produce benefits during the construction period and over the years into the future. Usually, the number of future years is subject to Cost–Benefit Analysis, which varies from country to country, e.g., in the UK, a transport project appraisal period was 30 years, and for new projects, it has been suggested to be extended to 60 years (Department for Transport 2011).

Discounting is a technique used from the DFT in the UK to compare costs and benefits that occur in different time periods. The axiom: 'better now that later preference of goods and services is the basic principle of this technique' (DFT 2011).

This technique uses the following formula:

$$\mathrm{PV} = S/(1+r)^n \quad (1)$$

where PV = the present value, S = the sum, r = the discount rate, n = year in which the sum is received, and $n = 0$ is the present value year.

The present value of benefits (PVB) in year *0* of a stream of benefits (B*i*) for years *i* where *i* range from *0* to *n* expressed by formula (2) includes basic components:

$$\mathrm{PVB} = B0 + B1/(1+r) + \cdots + Bn/(1+r)^n. \quad (2)$$

The calculation of the present value of costs (PVC) uses similar formula.

The net present value (NPV) of a scheme is

$$\mathrm{NPV} = \mathrm{PVB} - \mathrm{PVC}. \quad (3)$$

The base year for discounting and price base year, representing the discounting base year, all costs and benefits may be determined based on specifics of a particular government. All prices should be synchronised with inflation rates and other changes. In the UK, this the prices base year was the year 2002.

2.3 Some critiques of UK transport project appraisal

The International Transport Forum (ITF) in 2010 has raised some of critiques concerned with the UK policy on transport investments appraisal. Some of those critiques are as follows:

- The appraisal is inadequately aligned with policy or inconsistent with the policy.
- Policy analysis weak relative to project appraisal.
- An appraisal is not very agile—the new problems are reliable, resilience, sustainability, and security. Conventional modelling and appraisal does not handle this well.
- Inadequate appraisal treatment of induced behaviours, land use change, employment, and economic activity impacts (ITF 2010).

Another explanation of the real discount rate takes into account rudiments of inflation and nominal interest rate expressed by the derived formula:

$$r^* = \frac{i-f}{1+f} \quad (4)$$

where r^*—real discount rate; f—inflation rate; and i—nominal interest rate (Jawad and Ozbay 2006).

It is a quite complicated task the choice of the right discount rate. Consequently, many countries of the world face difficulties of deciding about the proper discount rate for their project appraisals.

In conclusion, concerned the described methods for project appraisal, the new question raised over what to take into consideration among others in the case of choosing the right discount rate.

The discount rate should be specified previously to the calculation in the ex-ante evaluation of long-term transport infrastructure project (Jawad and Ozbay 2006; DFT 2011). The proposition is to specify the discount rate of transport projects based on the dynamic systems, as displayed in Fig. 1. Obviously, the factor of uncertainty and risk plays a great role by increasing in power from the first quadrant to the fourth quadrant, as displayed in Fig. 1 (Limani 2016; Bock and Trück 2011). Accordingly, when the NPV of a transport investment project has a positive value, it means that it delivers more benefits than costs as expressed by Eq. 3 (Mackie and Worsley 2013).

The approaches to the appraisal of many countries around the world are similar to those of other countries considered in this research. By this means, the overall conclusion relating to project appraisal topic confirms that the project appraisal models still represent a weak link to policy and strategy, and there is no alternative which can be applied to address requirements that may arise as a result of unforeseen events like economic emergencies (Mackie and Worsley 2013:; Limani 2016). In addition, issues such as reliability, flexibility, and security create contests for transport project appraisals performed by the current method. The example of transport project appraisal has many deficiencies, therefore, in the case of using the same appraisal in developing countries, may deliver uncontrolled results (Limani 2016). Nonetheless, many policies developed to manage the raised issues concerned with the transport project appraisals.

Still, unfortunately, there is a weak balance between political and technical factor concerning political vision and mission in one side, and sense of creating models and planning tools on another side. Therefore, the need for additional research in this regard may be streamlined. To challenge the raising issues concerned with the transport and the economy, the development of more specific models is required.

Some authors suggested that transport capital projects can be justified only if they generate sufficient transport benefits (Banister and Berechman 2001; Berechman et al. 2006; Limani 2016). Otherwise, the attempts for rationalisation of implementation of projects based on supposed and unverified economic development benefits basically are mistaken and they may create settings for the implementation of insufficient transport projects (Kernohan and Rognlien 2011).

Figure 1 displays the possible relationships between transport and economic development at regional level. The weakest situation is been presented by the fourth quadrant of the dynamic system representing possible zones which are isolated with declining economies. These zone positions in the closed dynamic system among others weaknesses are characterised with weak accessibility. Fragile transport system may have contributed the economy weakening of the region; however, even with increased infrastructure investment, only the transport system will not economically recover these regions. The above suggestions have been utilised for the creation of the framework

for building recommendations, particularly for developing countries. For transport investments, two main decision criteria need the clear definition.

The primary transport benefits represent the primary decision criteria for transport investments representing the social rate of return.

Economic development effects are secondary decision criteria and they cannot replace transport output evaluation (primary transport benefits). In this condition, the main missing component is accessibility context.

The supplement criteria are capacity management. Building additional capacity without effectively and intensively utilisation of existing capacity represents poor management. This negative singularity occurs unsustainable economics, though transport investments incrementally move out beginning with the implementation of individual projects in the beginning phase, by continuing the implementation of portfolios and programs at second, respectively, the third phase.

Therefore, the policy level is the first level responsible to reflect on the long-term relationship between the transport projects primary accessibility benefits and economic development, while plan and project levels are levels responsible to discover the components of that relationship. By performing both macroeconomics and microeconomic analyses by consequent or parallel approaches, such relationship can be consistently defined (Banister and Berechman 2000; Limani 2016).

While transport investments policy and programs are mostly determined from economic return estimation, transport projects are dependent on certain necessary market conditions. In the case of developing countries, it would be important to identify and to validate the main factors that determine the right conditions. The factors need to interconnect to the specifics of the markets by clearly identifying the presence of such market conditions. In the absence of analyses of market conditions, transport investments possibly will generate improved accessibility and provisional mobility. However, when market conditions emerge or when they previously existed, transport policy should react upon creation of new programs. Such measures should be suitable and robust and they should deliver transport project investments which possibly will promote local and regional economic development and potentially will contribute to the improvement of the social aspects and the environment. The above assumptions turned into thoughtful components in building the structure of transport investment policy in developing countries (Banister and Berechman 2001; Limani and Beqaj 2013).

In theory, there are four correlations between transport and economic growth, which indicate on the cause and effect scheme. In one hand, changes in transport activities are the cause of economic growth, at another hand changes in economic growth are the cause of changes in transport activities. The following correlations illustrate the assumption:

1. Changes in transport activity impact economic growth of countries and regions.
2. Changes in economic growth impact transport activity.
3. The changes in transport activity and changes in economic growth impact each other.
4. There is less or no correlation between transport activity change and economic growth (Ecola and Wachs 2012).

From the analyses, the synthesis of the data displayed in Tables 1 and 3 displays the subsequent and interesting outcomes.

The information displayed in Table 3 shows two important originalities: (1) in 2006, the average of GDP growth of seven studied countries was 4.94%, while the transport contribution to the GDP of the same countries in average was 4.91% for the same analysed period. This proportion shows an interesting equilibrium and parallelism between GDP growth and transport contribution to the GDP.

(2) In 2015, the growth of GDP decreased about 81.8% compared with the GDP growth of the same countries recorded in 2006. The decrease in GDP growth from 2006 to 2015, as shown in Table 3, for the average of selected countries expressed in percentage has not influenced at the same rate the decrease of transport contribution to the GDP. The decrease of transport contribution to GDP average of studied countries expressed in percentage is about 26.5%, as shown in Table 3.

The conclusion is transport contribution to GDP decreased with the decrease of GDP of studied countries; however, it is quite complex to conclude in this case whether the transport contribution to the GDP in general is declining.

3 The methodology

The inconsequential hypothesis of this research identifies transport system to be one of the most complex systems humanity has ever developed. However, there is still a lack of clear definition and clarification of the contribution of transport system to economic development of countries and regions. Historically observed, the transport system advanced by undergoing different stages. The consequential hypothesis is that all those stages where linked with the shifts in the economy. To find the grounds for supporting the consequential hypothesis, this research effort argues the real relationship between transport and the economy expressed in statistical terms by studying the GDP as a general variable. Furthermore, the effort of this research extends in the direction of providing an approach to the correlation between transport and the economy.

The primary significance of this research is the execution of the simultaneous analysis of the transport system performance and economic growth of leading world economies. Sequentially, the research provides the measurement of transport involvement to real GDP of main economies. Since there is the lack of data relating to employment portion of transport in some countries, the study has been limited to real GDP with reference to the countries that provide sufficient data.

The main statistical findings show transport industry in the Europe contributing significantly to the GDP. When assessing the transport system performance, the research is limited to the statistical data concerned with the transport contribution to the GDP of the various countries. Final goal of this research effort is the development and adoption of an approach for developing an appropriate framework aimed to serve the decision makers in developing countries in developing proper transport investment policies. The approach limits in providing policy makers and project appraisal responsible authorities of developing countries with the thoughtful ground instructions and recommendations concerned with the correlation between transport and the economic development. Depending on the specifics of each county or region, further research should offer the prioritisation of instructions.

4 Developing the framework

The developed structure of the framework displayed in Table 4 consists the data from Fig. 1 and from the literature review. The dynamic systems analyses and transport indicators as displayed in Table 4 in the first, respectively, in the second column are the extracts from systematic literature research. We developed the third and the fourth columns of the framework matrix which represent needs and approaches. In this regard, some future research could be oriented toward the validation and calibration of variables represented in the Needs dimension, respectively, in the approaches vector.

We developed the third and the fourth columns of the framework matrix which represent Needs and Approaches. In this regard, some future research could be oriented toward the validation and calibration of variables represented in the Needs dimension, respectively, in the approach vector.

Based on the findings from the literature (ITF 2011; Greene 1997; Banister and Berechman 2000; Limani 2016; Ecola and Wachs 2012; Crafts 2009; Banister and Berechman 2001; Sousa et al. 2015), and on the results from the synthesis of data displayed in Tables 1, 2, and 3, and in Figs. 1 and 2, a new and final assumption raised up. Decision makers, to identify and understand the transport system issues, the dynamic systems, open systems and closed systems, the factors and indicators, and needs to make more effective decisions concerned with transport infrastructure investments can modestly use the framework presented in Table 4 in combination with recommendations displayed in Table 5.

In the Table 6 are displayed the topics and related studies which have been utilised insupporting the development of the framework displayed in Table 5.

4.1 Implementing the framework

The proposed framework practising depends on the country position and on the specific policy and project needs. To practice the proposed framework, the policy makers and planners need to go through the subsequent stages:

- Identification and definition of the zone in the dynamic system are displayed in Fig. 1, where the country or the region is situated.
- Identification and definition of factors and indicators displayed in Tables 2 and 4 which are related to defined situation.
- Identification and definition of needs of the region or the country according to the information provided.
- Prioritisation and ranking of the identified needs.
- Carrying out of the economic assessment analyses.
- Decision making (policy level).
- Planning (plan level).
- Executing (project level).

This tool serves as a suggestion to the policy making in developing countries; nonetheless, the responsibility of its implementation remains the part of the internal policy of each country or region who aim to implement this. However, we recommend developing countries situated in the closed dynamic system with declining economies to implement the proposed framework when developing their transport investment policies.

5 The case study of Kosova

The investments in the transport system, mostly on highways and other priority roads in Kosovo, have increased from 0.6 to 12% of the country's GDP. Kosovo spent a great quantity of its capital budget on building a particular highway. Nonetheless, the studies show how other smaller road improvements would have had higher economic rates of return (World Bank 2014). Kosovo as a developing country invested mainly in road transport infrastructure much more than other developed and developing economies. Kosovo differs from other countries in the sense of transport investment projects. Taking into account the facts, Kosovo has

Table 2 Factors (variables) affecting the relationship between transport and the economy

Factors affecting relationship of transport with economy	The economic assessment of the effects of transport factors		Other impact of transport	
	Positive	Negative	Social	Environmental
Infrastructure	Tax revenues Productivity Mobility Accessibility	Deterioration	Level of sufficient access to transport system diversity and basic activities	Land fragmentation Land take
Mobility	Movement of goods and people-increased productivity		Noise Psychological pressure	Air pollution Energy resources depletion
Congestion		Time waste Operational cost increase	Psychological and physical pressure	Air pollution Energy resources depletion
Energy use	Tax revenues Productivity increase		Noise	Air Pollution Energy resources depletion
Safety and Security (accidents)		Costs of crashes	Injuries Psychological consequences	Congestion Noise Air pollution
Equity	Equal share of transport costs		Level of sufficient access to transport system diversity and basic activities	Equal accessibility distribution
Accessibility	Increased mobility Broadening product distribution, service, and labour markets		Access for people with disabilities	

Source: Adapted from Limani and Beqaj 2013

Table 3 Synthesis of data displayed in Table 1

Year	Real GDP growth in % (the average from seven countries displayed in Table 1)	Transport contribution to GDP in %
2006	4.94	4.91
2015	0.9	3.61
Δ15/06	−4.04	−1.3
Δ15/06 (%)	81.8	26.5

changed all through the pre-transition state-controlled economic system to the system of free market economy, and the historical trends over long periods of time cannot be the right tool for determining the transport infrastructure project appraisals.

The investments in the transport system in other various countries differ from 0.7 to 7% of countries GDP measured for the year 2014. Figure 3 displays the statistical data about the percentage of GDP invested in transport infrastructure in a number of observed countries. The set of countries is chosen based on regional criteria including here some of the countries bordering Kosovo, some countries from the near region, and some countries situated in different economic zones compared with the dynamic system, as displayed in Fig. 1. The analyses of the data displayed in Fig. 3 raised question whether Kosovo did right invest a huge share of country's GDP. Having into consideration, the country's GDP decreased by about 12% in the consequent year (World Bank 2017), this decision requires more in-depth assessment for justification. The statistics displayed in Fig. 3 indicates transport infrastructure investment maintenance spending and infrastructure capital value for all other countries, while for Kosovo indicates only investments in transport infrastructure. This detail points to the possibility for occurring higher biases because of the non-inclusion of the maintenance cost of transport infrastructure in Kosovo. There are many other disputes concerned with the economic rationality of infrastructure investments carried out in Kosovo. 'Decisions on transport infrastructure spending should be based on quantitative data and analysis. Improving international comparability of such data should be one of the key goals of the international statistical community' (International Transport Forum 2013).

Taking the above findings and comparing it with the Sectorial Strategy and Multimodal Transport 2015–2025 and the Action Plan for 5 years (Kosova government 2015), the conclusion can be driven that there is a lack of deep and consistent strategic planning concerned with the issues which should be taken into considerations prior to decision making. There are also other deficiencies of the strategy, e.g., the evasion of transparent cost assessment, return on investment

Table 4 Framework matrix for policy making in transport infrastructure investments

System approach	Indicators	Needs	Strategic approaches
Open dynamic systems			
Sustainable economies	Transparent investment High accessibility High mobility Identified and calculated contribution of transport on GDP Other specific indicators	Maximisation of the efficiency and efficacy (cost-effectiveness and agile approach) Minimisation of the environmental impact of transport system Other specific needs	Make transport system more sustainable Continuous improvement Maintain and improve continuously Innovate–introduce improved and new products and services Novate–replace old products and services with new innovated products and services Manage capacities
Fast growing economies Market with strong conditions for growth	Transparent investment Improving accessibility Increased mobility Variable contribution of transport on the GDP Other specific indicators	Maximisation of efficiency and effectiveness Development of modal transport system Other specific needs	Empower public policy and management Utilise capacities Make transport system more sustainable Improve continuously Innovate Novate
Closed dynamic systems			
Developing economies Access limited to corridors	Satisfactory infrastructure Lack of feasible investments Uncertain transparency Lack of equity in infrastructure investments Unstable economic conditions Other specific indicators	Capacity improvement Accessibility Feasibility Transparency Equity Other specific needs	Improve and empower the quality of public policy and management Utilise capacities Distribute information Create and utilise the capacities Gain more knowledge Develop sustainable transport Improve existing infrastructure Support innovation
Developing and underdeveloped economies Isolated areas with declining economies	Poor transport system Lack of infrastructure Lack of transparency Transport not capable to recover these regions Other specific indicators	Resources Capacity development Education and training Accessibility Feasibility Transparency Equity Other specific needs	Identify accurately the economic development capacities and potential regions Improve transport system based on sustainable development principles Develop and empower public policy Classify and distribute the information Gain knowledge and expertise Link economic and strategic activity zones with proper transport infrastructure Plan, create and utilise the capacities Develop policies and plans for sustainable transport Utilise capacities Improve existing infrastructure Develop infrastructure to support innovation Develop and implement strategic plan and adjust transport infrastructure investment with other priority issues

Source: Adopted from: Limani (2016), Crafts (2009), Sousa et al. (2015), Herrendorf et al. (2012), Gurgul and Lach (2012), Chatman and Noland (2011) and Berechman et al. (2006)

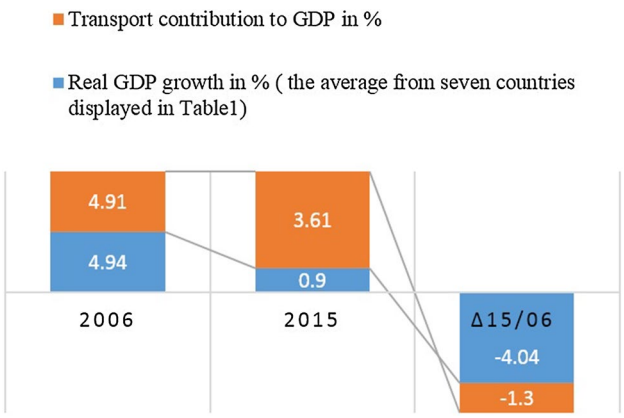

Fig. 2 Average of GDP of studied countries presented in Table 1 and transport contribution to the GDP

calculation, the clear interpretation of interrelation between transport and economic development, rationale of project execution, cost–benefit analyses, etc.

Table 5 displays seven recommendations for developing countries, which need attention in the case when developing the transport policy and planning.

The main missing strategic principles from the Sectorial Strategy and Multimodal Kosova are similar with the recommended objectives, as presented in Table 5. Those objectives amalgamated with the fundamental concepts driven from the literature research conducted in this paper, the final product emerged and represented in Table 5. The judgement of seven fundamental objectives represented in Table 5 occurred utilising the findings from statistical research, the knowledge gained through literature review, and from the state-of-the-art of the studied country.

The rationale for doing such categorization of issues lies on the need for setting up the basis for the development of more functional and executable transport investment policy stated in the objectives and in the propositions of this research.

Specifically for Kosovo, the seven recommended objectives presented in Table 5 could strengthen the attitude of decision makers and planners in developing a more clear vision and strategic objectives for transport strategic planning and policy in the long run. The proposed recommendations need ranking and prioritisation, which process requires additional research using methods such multi-criteria analyses, regression analyses, and alike.

The judgement of the options presented in Table 5 utilised the knowledge and experience gained through qualitative and quantitative researches.

The framework consists elements developed from the literature review, elements from the analysis of the reports, and originally proposed elements. The proposed stages as approaches, results, and synthesis represented in the first column of the framework, as displayed in Table 5, call for utilisation of proper methods and tactics first. The utilisation of proper methods in addressing transport infrastructure investments issues requires justification. Capacity development through communicating best theories and practices could ensure the validation of chosen approaches. Observing statistical developments, the transport contribution to the country's GDP depends on various factors; however, the main factors remain economic growth of a country. The short observation of a various 70 countries around the world, exclusive the countries from G20, the average transport contribution to the GDP of those countries is declined for about 6% in 2017 compared with the previous year. Observing the countries from G20, the same statistical correlation shows the increase of transport contribution to GDP for about 4% in 2017 compared with the previous year (Trading Economics 2017).

The conclusion is the assumption from Fig. 1, assuming that transport impact on the economy is maximum when economic conditions are stable. The same figure assumes that the weak economies are not a subject of economic recovery by transport infrastructure investments only. The latest is validated statistically again taking into consideration most of the world countries struggle with economic growth problems. In the final conclusion, weak economies need to undergo strategic changes to incline from the current position in the direction of more sustainable economic development, as presented in Fig. 1 and in Table 5.

6 Conclusions

As this research addresses important aspects of the transport economics, it considers the transport system as one of the most enablers of the economic growth of countries and regions. Questions concerned with the relationship of transport and economic development of countries and regions affect the whole components of the transport system such as information technology, infrastructure, and management issues. Thereby, a set of conclusions is established, and the conclusions represent most important assumptions of this research:

The first question addressed the relationship between transport infrastructure investments and economic activity of a specific region or country.

In this regard, by analysing Fig. 1, we made four main conclusions:

The first two conclusions relate to the open dynamic system and they are as follows:

Transport investments led to increased economic activity in the developing economies.

Transport infrastructure investment will support economic development in the countries with growing markets;

Table 5 Proposed framework structure for development of transport investment policy in Kosovo

Stages	Validation	Purposes	Goals
Approaches	Theoretical framework historical data statistics	Investment program analyses (project appraisal methods) Utilisation of information systems	Setting innovative concepts/ conclusions
Results	Knowledge gain: state-of-the-art analysis	Identification of best practices and experience gain Building appropriate appraisal method	Development of applied investment agenda
Synthesis	Instructions/recommendations for development of transport investment framework in developing countries (Particularly for Kosovo) Accurate identification of the economic development capacities, the needs, and the potential regions (1) Investment in transport infrastructure should continue to be a priority, but it should be driven by the demand for transport of people, goods and services (it should be oriented in the management of transport infrastructure) Link economic activity zones with proper transport infrastructure (2) Efficiency and effectiveness of public investments in transport infrastructure should be improved Develop and empower public policy (3) Decision making process and accountability should be transparent and in effect Improve transport system based on sustainable development principles (4) Investments in transport system should address similarly the social and environmental issues, not only the economic issue Gain knowledge, develop knowledge bases and user interface systems Manage the information: Gather, process, classify and distribute the information (5) Transport pricing policy should become more advanced, reengineered and empowered by the utilisation of information technology Plan, create and utilise the capacities (6) Transport projects appraisal policy should be strongly linked to strategic plan, it should use the information system, and it should include the component of risk management, The cost and benefit analysis should be carried out more comprehensively by including all related indicators (Department for Transport should develop the indicator data set and information system management by taking into account the specifics of the country) Link economic and strategic activity zones with proper transport infrastructure Develop and implement strategic plan and adjust transport infrastructure investment with other priority issues (7) The other important issues such energy, education, health and security should remain the country's priorities, and there should not be tolerated colossal shortage on investments		

Source: Adapted from Limani (2016) and Limani and Beqaj (2013)

Table 6 Supporting literature of the transport investment policy model approach

Topics	Authors
Theoretical framework	
The relationship between transport and the economy definitions	Norwood et al. 2002; Goodwin et al. 2004; Jean-Paul Rodrigue 2013
Transport infrastructure projects and economic activity	Greene 1997; ITF 2011; Bock and Trück 2011
Historical data statistics	
Transport contribution to GDP	IMF 2013; EC 2011; US DOT 2011; OECD 2014; Ministry of Transport 2015; World Bank 2016; Statistics New Zealand 2016; Statistics Canada 2015; Limani 2016; Trading Economics 2016a, b, c, d, Trading Economics e, 2017
Knowledge gain: state-of the-art analysis	
Economic impact analyses of transport	DFT 2011; ITF 2010; Jawad and Ozbay 2006; Mackie and Worsley 2013; Limani 2016; Banister and Berechman 2001; Berechman 2006; Kernohan and Rognlien 2011; Ecola and Wachs 2012; Crafts 2009; Sousa et al. 2015; Benitez 2012; Bock and Trück 2011
Research contribution	
Setting innovative concepts/conclusions	Table 4: adoption of the framework
Development of applied framework	Table 5: proposed transport investment policy development approach structure

nonetheless, these investments are not considered as necessary conditions.

The next two conclusions relate to the closed dynamic system and they are as follows:

Regardless of the good transport infrastructure, some countries may have that the infrastructure investments are not feasible as the economy of those countries is not stable. Those countries may also show a lack of information transparency, lack of proper information systems, and lack of required knowledge. Altogether, the deficiencies produce other negative effects such as inequity, i.e., lack of equal distribution of investments across the provinces.

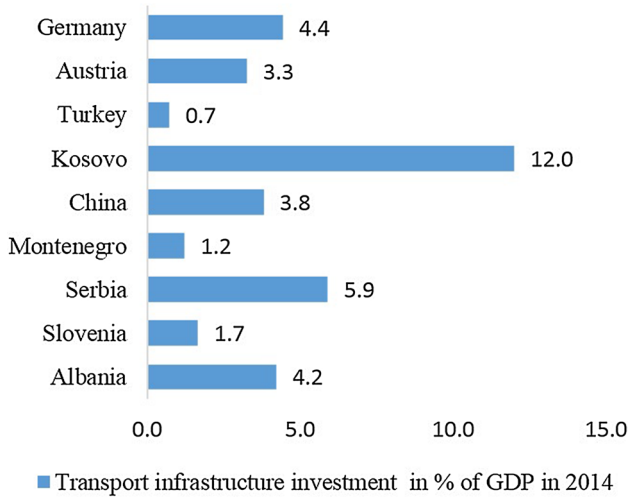

Fig. 3 Transport investment expressed as a GDP share of various countries in 2014. Source: World Bank 2014, 2017; OECD 2017

The final conclusion concerned with the first question is as follows: transport infrastructure investment is not necessarily the main factor for the economic development of a region or a country with a growing market; nonetheless, countries with underdeveloped transport infrastructure may not recover their economies only by investing in transport infrastructure. Those countries may need to develop comprehensively other elements of transport system such smart transport systems based on cutting-edge information technology.

Transport infrastructure should be supported by information technologies such as geographic information system technology, intelligent applications related to safety and security issues, accidents, congestion, calamity forecasting, and response management tools. The artificial intelligence tools are able to provide with very complex data management related to important components of dynamic transport system, such as the geography, speed, time, altitude, land use, etc.

The integration of elements in correlation and in interaction provide with the model base. Model base integrated with strategic objectives and proper information system can provide with knowledge bases. Accordingly, user interface could provide planners and policy makers with a proper intelligent assessment and decision-making model.

By ignoring the information system implementation, the policy decisions related to the infrastructure investments could produce serious problems towards economic development. An adequate component of information systems is recommended for countries and regions categorized in the closed dynamic systems.

Regarding to existing methods for transport project assessment, we presented the method of cost and benefits as implemented in the case of UK department for transport with some additional elements of other authors. In this case, we can conclude that the average of discount rate in the formula (1) may vary from project to project, and it is supposed to be around 3.5% of the PV of a project; this discount rate should be expressed with a more deterministic approach by showing more flexibility to become adjusted among the four zones of the dynamic system, as presented in Fig. 1. The digital transformation of industries will imply the upgrade of all cost and benefit tools and techniques. In this regard, the authorities responsible for transport investment project assessment should become familiar with the digitalization trends.

Kosovo is positioned in the region with a weak economy and partially in the zone of regions with good infrastructure in a closed dynamic system, as displayed in Fig. 1. This qualification is justified by the facts that Kosovo is a country, where there is a considerable transport infrastructure, but that investments are non-transparent and not feasible at one hand, and at another hand Kosovo, the economic conditions are not balanced and not sustainable.

Lack of transparent investments' cost and benefit analyses, failure of the official institutions to confirm the NPV and NFV of investment projects, is another circumstance justifying the qualification of Kosovo in the closed dynamic system.

The research consequently concludes that transport system planning in countries identified in a closed Transport planning at policy, at plan and at project levels need to get considered as a subset of economic dynamics taking into account other important factors such land use, urban modelling, environment, etc.

Kosovo policy making is mostly focused only on infrastructure constructions. Strategic infrastructure planning and management are not positioned to play a decisive role in determining the equity, i.e., how transport investments should be distributed among the regions and among the communities. The cost and benefit analyses of a transport investment projects carried out throughout the country did not avoid the ignorance of environmental and social impacts of such projects. The benefits of transport investment projects are not focused on the impacts which produce effects across the whole value network, they are mostly concentrated on specific regions, or they are dedicated to a specific community.

According to the literature review and the study of developing economies with the focus on the contribution of transport to the GDP of those countries, trends show transport investments become more multidimensional and complex. In this regard, policy makers and planners need more focus on the impacts of investments in transport which produce effects across the whole transport system, which in turn will impact the whole economy of the country.

Decision makers show insufficient recognition of the importance of economic analyses of transport investments and of a wider range of factors concerned with the complexity of transport infrastructure investment. This development calls for more effective information and knowledge management, more professional education and expertise, AND more utilisation of new technologies, including smart technologies and machine-learning approaches.

The evaluation of cost and benefit analyses models represented in this research characterizes how policy makers and planners are based on primary decision criteria for transport investments. There are two levels of decision criteria: primary decision criteria and secondary decision criteria. Primary decision criteria are proposed to be based on the social rate of return from their primary transport benefits. In the case of Kosovo, we could not find the set of primary decision criteria included in the studied strategic documents.

In conclusion, Table 5 proposes a new approach, where transport output evaluation cannot be replaced by economic development effects' criteria.

The specific conclusion related to the future research on the topic of the relationship of transport and economy communicates the need to address the completion of an equation similar to Eq. (1) including all qualified factors from Table 2, and taking into account the arguments presented in Table 1. Such equation could provide with the more concise value of transport projects over time and may comprise all needed factors and indicators as evaluated in this research and is presented in Tables 2 and 3, respectively. In addition, the consistency between the data represented in Fig. 1 and the data represented in Tables 1, 2, 3, 4, and 5 may contribute effectively to the development of an appropriate and flexible formula capable to offer proper solutions for each region in the dynamic system. The input information to the formula should be validated and purified of potential biases that could risk the accuracy of predictions and analyses.

Artificial intelligence and machine learning can deliver revolutionary exploration and data management and could provide with powerful future scenarios.

6.1 Discussions and future research

A set of suggestions that may lead to adequate transport project investments is presented as follows:

The projects need to be linked with plans and programs, and they need to be a part of the overall network, not as single projects.

The determination of critical success and necessary decision-making processes needs to be aligned at all planning levels.

The transport projects should be always the subject of cost and benefit analyses.

The methods needed to be used for the assessment of transport infrastructure investments may use elements of various existing methods, always by taking into considerations the specifics of the region and the positioning of the region according to the dynamic systems explanation, as given in Fig. 1. The deployment of quantitative methods is suggested to support the theoretical prospects.

In the case of Kosova, the economic development benefits from transport investment are mostly supposed and still unproven. Such sights and perceptions could be basically wrong and they may create an environment for the execution of poorer transport investments projects with a high NPV measured on the base year when projects are accomplished, but with low NFV measured after a period of time when projects product, i.e., infrastructure and transport technology is utilised.

The discount rate of transport infrastructure projects should be determined based on various factors. The leading factor could be the scale of uncertainty which increases in the continuum across the dynamic system.

The transport investment policy should provide with the model base to include all factors displayed in Table 2 to move in the direction of the new technology supportable transport system.

There is a need for professional education of decision makers to positively influence the perception attitude related to transport planning and policy, technology implementation and utilisation, communication and information technology, smart systems and artificial intelligence, and other enablers of industry 4.0.

Transport capital projects can be reasonable only if they generate satisfactory transport benefits. More research efforts should be made in the course of innovative and meaningful technology concepts, capable to assist decision makers and practitioners in more concise appreciation information, and of the relevance and the effects of transport infrastructure investment decisions.

Smart transport is good for jobs and thereby for the economic growth and it is good to expand across the dynamic system from sustainable economies to underdeveloped economies.

One of the possible directions of the future research related to the interaction between transport and economy could contribute in the economic dynamics' field by giving more explanation that is based on mathematical models, simulations, modelling, and machine-learning approaches.

By this means, the well-known physical quantities such speed, distance, and time may be the fundamental variables which could determine the amount and the nature of needed transport infrastructure which correspond to the various zones of the dynamic system.

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