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## Assessing Sustainability of Railway Modernization Projects; A Case Study from Romania

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### Abstract

Projects are important ‘instruments of change’ in realizing a more sustainable society. Sustainability in project management aims to integrate the concepts of sustainability into project management. In order to facilitate the consideration of sustainability aspects of projects, the SPM3 model provides a ‘snapshot’ on how the different variables of sustainability are considered in the management of a specific project.

This paper reports a case study into the consideration of sustainability in the project Modernization of KM614-Curtici Romanian Railway Network. The assessment showed that the project is primarily economically driven, but that environmental aspects are also proactively considered. The project focusses less on the social aspects.

The assessment also showed that the sustainability aspects of the project are mostly considered in relation to the project’s deliverable. Less attention is given to the sustainability of the process. Regarding the level of consideration of sustainability, the participants of the study first of all indicate that a more proactive consideration of sustainability aspects is desired.

The participants also agreed that the assessment of the project with the SPM3 model provided a holistic analysis of the sustainability of the project that formed an essential step in the further development and improvement of the project.

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## 1. Introduction

Transport is in nature an unsustainable activity<sup>1</sup>. Firstly because the infrastructure for transport operations, such as roads and railways, use non-renewable resources. And secondly because the transport process is responsible for great pollution, damages irreplaceable resources and also leads to long-term environmental change. It is believed that sustainability in transport is far from being achieved, especially in developing countries<sup>10</sup>.

Transport plays a critical role in our complex network economy, in which spatial interactions are an essential and dominant feature<sup>11</sup>. Transport has, since the beginning of human history, been an engine of growth and without transport there would have been no trade and no cities<sup>8</sup>. Given this necessity of transport, the sustainability of different transport modes is frequently studied. However, assessing the sustainability aspects of the different modes is not straightforward<sup>8,5</sup>. Indicators that are proposed include energy use, water use, land use, waste, quality of life, noise and safety. Several studies (for example Federici et al.<sup>5</sup>) focus on comparing the sustainability of rail and road transport, as their functionalities are up to a certain level interchangeable in the transport of persons and freight. Gercek and Tekin<sup>7</sup> pointed out that rail transport systems have better characteristics on energy consumption and pollution emissions, compared to road transport and, although the comparison is not as straightforward as it may seem, it is the common perception is that rail transport is more sustainable than road transport<sup>8</sup>.

In Europe, the European Commission has been very active in proposing restructuring the European rail transport market and in order to strengthen the position of railways vis-à-vis other transport modes<sup>4</sup>. The Commission's efforts have concentrated on three major areas which are all crucial for developing a strong and competitive rail transport industry: (1) opening the rail transport market to competition, (2) improving the interoperability and safety of national networks and (3) developing rail transport infrastructure. Within this context, several agreements have been made in order to improve and modernize the European rail transport infrastructure. In order to fulfill the requirements from these agreements, one of the projects developed by the Romanian Railway Company is the "Modernization of KM614-Curtici Romanian Railway Network" project, in which a section of 41,185 km of railway network is modernized and electrified. The project is funded from the ECF (European Cohesion Funds) and from Romanian budget funds. Given the sustainability agenda of the European Commission and the communicated sustainable development strategy of Romanian Railway Company, the sustainability of this project is a relevant topic of study. This paper therefore reports a sustainability assessment of the Modernization of KM614-Curtici Romanian Railway Network project, as a case study in sustainable project management of rail transport modernization projects. The research question for this study is formulated as *How are different dimensions of sustainability taken into account in the management of the Modernization of KM614-Curtici Romanian Railway Network project?*

The remainder of this paper is structured as follows. The following paragraph provides a brief discussion on the relation between sustainability and project management, and the instruments that assess the consideration of sustainability in projects and project management. Paragraph 3 describes the research approach the study deployed and the case project. Paragraph 4, findings, presents the outcome of the sustainability assessment of the case project, whereas Paragraph 5 presents the conclusion of our study and the benefits the assessment provided to the project team.

## 2. Assessing sustainability in project management

With the growing attention for sustainability, its concepts are also being related to projects as temporary organizations that deliver (any kind of) change to organizations, products, services, business processes, policies or assets<sup>17</sup>. Marcelino-Sádaba et al.<sup>9</sup> observe that "projects are the ideal instrument for change management" and that "the necessary change that we require towards sustainability will be boosted by applying the project management discipline to sustainability."<sup>9</sup> And where early studies concluded that sustainability is rarely considered "in temporary organizations such as projects and programs"<sup>6,1</sup> and the standards for project management "fail to seriously address the sustainability agenda"<sup>2,288</sup>, the later work by Silviu and Tharp<sup>18</sup> concluded that "the relationship between sustainability and project management is ... picking up momentum"<sup>18:xix</sup>.

Assessing sustainability requires a good understanding of what defines sustainability. One of the widely used definitions of sustainable development states that sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"<sup>20</sup>. And although this definition provides a conceptual starting point for the assessment of sustainability, it does not operationalize the concept in more

measurable variables. Crucial for developing more sustainable business practices is the ability to evaluate the sustainability aspects of different policies and projects, as well as to monitor progress<sup>14</sup>.


Many organizations have developed frameworks of indicators for this goal. The International Institute for Sustainable Development (IISD) maintains an online directory of sustainable development indicator (SDI) initiatives. This directory includes more than 600 initiatives at national and international levels by governments, non-governmental organizations (NGOs) and individuals. From this directory it should be concluded that, although many organizations have offered meaningful lists of indicators, consensus on how to measure and assess sustainability has not emerged yet. A recurring structure in many frameworks is the “triple bottom line” concept of harmony between the economic, social and environmental perspectives<sup>15</sup>. However, some frameworks, for example ISO 26000, adopt a completely different structure and also different perspectives<sup>14</sup>.

In order to provide a practical tool for the development and integration of sustainability into project management, Silviu and Schipper<sup>15</sup> developed the Sustainable Project Management maturity model (SPM3) that addresses the consideration of sustainability aspects specifically to project management. Maturity models are suitable instruments to assess the implementation of complex concepts and to raise awareness for potential development<sup>15</sup>. They may also provide guidance for action plans and allow organizations to monitor their progress. As most maturity models, the SPM3 model is designed as a descriptive model, with which organizations can assess their level of integration of sustainability in a specific projects. However, with the description of the different maturity levels and the list of sustainability indicators, the SPM3 model also provides extensive guidelines on how to develop the integration of sustainability in projects. In this aspect, the model also bears the characteristics of a prescriptive model. The prescriptive use of the model is further developed by assessing the integration of the individual sustainability indicators twice. The first time as assessment of the ‘actual’ situation of the project and the second time as assessment of the ‘desired’ situation of the project. The difference between the ‘actual’ and ‘desired’ maturity level logically indicates a required improvement.

A question that arises when assessing the integration of sustainability in a project, is whether the process of realizing the project is assessed or the product/deliverable that the project creates. In other words are we assessing the sustainable *management* of projects or the management of *sustainable projects*? The SPM3 model independently assesses the *process* of delivering and managing the project, including the resources used in the project processes and the way the processes are organized and executed, and the *product/deliverables* that the project realizes, including their effects on various stakeholders and society.

For the scale of maturity levels, the SPM3 model distinguishes between “making a positive contribution” strategy and a “do no harm”. In a four level maturity scale. These four maturity levels are described in Table 1.

Table 1. The maturity levels of the SPM3 model<sup>15</sup>.

Strategy	Maturity level	Description
 ‘do no harm’	Level 1: Compliant	(This aspect of) Sustainability is considered minimalistic and implicit, and (only) with the intention to comply with laws and regulations.
	Level 2: Reactive	(This aspect of) Sustainability is considered explicitly, with the intention to reduce negative impacts of the project.
	Level 3: Proactive	(This aspect of) Sustainability is explicitly considered as one of the areas that the project contributes to.
	Level 4: Purpose	Making a contribution to (this aspect of) sustainability is one of the drivers behind the project and sustainability considerations are included in the justification of the project.
‘positive contribution’		

For the indicators of sustainability, the SPM3 model defines 22 indicators that were derived from the SDI frameworks, studies on sustainability in project management and several documented practices. The SPM3 model adopted the structure of the triple bottom line classes of economic, social and environmental indicators. Table 2 presents the population of the model with the description of variables. With the SPM3 model, the level (compliant, reactive, proactive or purpose) on which the different indicators of sustainability are considered in the project can be assessed.

Table 2: SPM3 indicators of sustainability<sup>15</sup>.

Indicator	Description
<b>Indicators of economic sustainability</b>	
Return on Investment	The creation and distribution of economic value as a basic indication of how the project creates wealth for all stakeholders.
Business Agility	The ability to be flexible or agile in strategies, objectives, requirements, decision making, processes, projects and resources.
Competitive potential	Acquisition or development (through projects) of attribute or combination of attributes that allows the organization to outperform its competitors.
(Business) Continuity	Ensuring that an organization's critical business functions will continue to operate despite incidents or developments. Business continuity includes the ability to change or adapt business functions and the business model.
Motivation and incentives	Motivations and incentives that influence behaviour of individuals in the organization. Personal incentives should be motivational but responsible with respect to stakeholder's interests and the society in general.
Risk reduction	The potential of losing something of (potential) value. Risk assessment should include also long term, social and environmental effects. Risk acceptance strategies should take a prudent approach.
<b>Indicators of environmental sustainability</b>	
Transport	The movement of physical objects from one place to another.
Energy	Use of energy for business resources and processes. Energy use is related to greenhouse gas (GHG) emissions and to scarcity of their origins (e.g oil). The environmental footprint of a project (organization) is shaped in part by its choice of energy sources.
Water	Use of clean water for business resources and processes. Withdrawals from a water system can affect the environment by lowering the water table, reducing the volume of water available for use, or otherwise altering the ability of an ecosystem to perform its functions.
Eco system	The community of living organisms (plants, animals and microbes) in conjunction with the non-living components of their environment (things like air, water and mineral soil), interacting as a system.
Waste and Packaging	Wastes are substances or objects, which are disposed of or are intended/required to be disposed of. Packaging is the enclosing or protecting objects (products) for distribution, storage, sale, and use.
Materials and resources	From an environmental perspective some attributes of materials and resources are important: for example the extent to which materials used for the project are or become toxic during the project, the scarcity of the material, the extent to which fossil (or non-replaceable) materials are used by the project, the reusability of the material after their use, the origin of the material and the incorporated energy of the materials during sourcing or production or use by the project.
Emissions	Emissions of fluids or gasses resulting from an organization's processes or resources on land, on water or in the air.
Spatial planning	Regional/spatial planning gives geographical expression to the economic, social, cultural and ecological policies of society. Several aspects influence this: the use and quality of space, the social relevance and welfare related to the space, reachability, and investment climate to business and inhabitants.
Nuisance	Nuisance describes an activity or condition that is harmful or annoying to others (e.g., loud noises, vibrations, dust, dirt). Nuisance is relevant to project, while during execution nuisance levels of noise, vibrations, dust or dirt commonly rise above aesthetic levels and can be annoying to the community.
<b>Indicators of social sustainability</b>	
Labour practices and decent work	Fair labour practices and decent work is the availability of employment in conditions of freedom, equity, human security and dignity..
Human rights	The extent to which processes have been implemented to safeguard stakeholders' ability to enjoy and exercise their human rights. Among the human rights issues included are non-discrimination, gender equality, freedom of association, collective bargaining, child labour, forced or compulsory labour, and indigenous rights.
Ethical behaviour	Ethical behaviour, consisting of anti-competitive behaviour, anti-trust, and monopoly practices must ensure a level playing field for customers (and supplier) regarding: consumer choice, pricing, and other factors that are essential to efficient markets.
Society, customer and product responsibility	Society, customer and product responsibility concerns with impacts caused by project activities, project results and their effects on customers, society, local communities and other stakeholders.
Participation	Participation is about the proactive involvement of stakeholders, suppliers and customers with respect to the project's development, design, processes, deliverables and effects.
Human capital development	The development of the organization's or individual's intellectual capital (competencies, knowledge, and skills).
Corporate governance	Governance broadly refers to the mechanisms, processes and relations by which corporations and projects are monitored, evaluated and directed. Sustainability aspects should be covered and integrated in the areas of documentation, reporting and decision making and strategy formulation.

### 3. Research method

From the research question it is clear that the nature of this study is a case study. As case studies are an adequate research strategy for complex phenomena that cannot be studied outside their context<sup>21</sup>, this makes sense.

#### 3.1. Project description

The Romanian network of rail lines open to commercial traffic is about 11.000 km long. It comprises more than 1000 stations, almost 200 tunnels and around 6800 bridges. The network is in an advanced state of disrepair due to a chronic lack of maintenance: most of the track-related assets are on their last legs<sup>19</sup>. Romania is ranking 59 out of 144 economies for quality of railroad infrastructure within the 2014-2015 Global Competitiveness Report<sup>13</sup> and scores 2.86 for the same indicator in the EU Transport Scoreboard. Romania's public railway infrastructure is state-owned and it is concessioned to the National Railway Company (CFR SA) as infrastructure manager.

The European Commission envisions a Single European Rail Area (SERA)<sup>12</sup>. With SERA, the EU aims to achieve more competitive and resource-efficient transport system, and to address in parallel major societal issues, such as rising traffic demand, congestion, and security of energy supply and climate change<sup>3</sup>. As a result, EU plans for and implements infrastructure cross border programs, more specific Trans – European Transport Network (TEN-T), consisting of 9 core network corridors. Romania is crossed by two EU core corridors: the Rhine – Danube Corridor and the Orient East Med Corridor. Over the past years, Romania's railway infrastructure has benefited from investments financed through non-reimbursable European funds, loans from international financing institutions or national budget.

The objectives of the project Modernization of KM614-Curtici Romanian Railway Network project, is the rehabilitation and electrification of a section of 41,185 km railway, including implementation of signaling, ERTMS level 2 and GSM-R. Project budget equals EUR 240 million and project duration is from March 2012 to June 2016. The project is included in National Railway Company, CFR SA, projects portfolio.

The “4th Railway Package” of the European Commission, stresses the importance of achieving better value for money in rail. Europe is developing solutions for rail sustainability, such as Shift2Rail Joint Undertaking, in order to manage research and innovation efforts for reliability and quality in rail area especially for, but not limited to, sustainable infrastructure development and traffic management.

Following this growing attention for sustainability, several initiatives that support sustainability were started across the European rail transport sector. For the Modernization of KM614-Curtici Romanian Railway Network project, the most relevant sustainability initiatives are the European Rail Traffic Management System (ERTMS) and GSM-R. The implementation of these technical solutions are expected to reduce running costs and therefore to lower life cycle cost, to improve the system's efficiency on long cross-border distances, to increase ability to supervise every train according to its optimum characteristics, while providing greater safety and efficiency for passengers and greater revenue earning potential for operators. The scope of the project Modernization of KM614-Curtici Romanian Railway Network includes implementing these systems for the railroad section at hand.

#### 3.2. Research process

During February 2016, the contact between the research team and the National Railway Company CFR SA was established and the case project Modernization of KM614-Curtici Romanian Railway Network was selected. The research process included meetings, interviews and workshop.

The assessment of the project was based on the standard SPM3 questionnaire, as provided by Silviu and Schipper<sup>15</sup>. In the assessment, multiple methods of data collection were applied: documentation analysis, group interview, workshops and questionnaire. The documents analysis has been performed by the research team and, when required, clarified in meetings with project team members or the company's staff.

### 4. Findings

This section reports the data collected on how sustainability is considered in the Modernization of KM614-Curtici Romanian Railway Network project. Figure 1 summarizes the findings from the assessment. As the SPM3 model independently assesses the *process* of delivering/managing the project and the *product*/deliverables that the project realizes, this paragraph will present the findings separately.

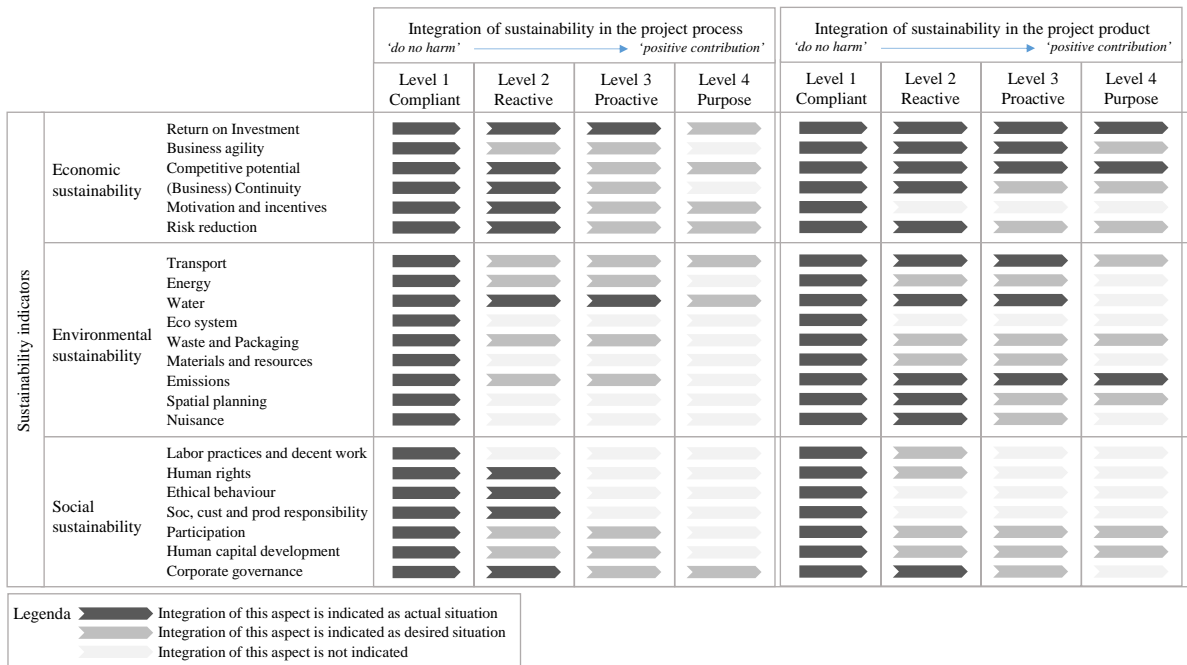


Figure 1: Consideration of sustainability in the project’s process and product.

#### 4.1. Sustainability in the project’s product

From the assessment of the consideration of sustainability in the product/deliverable of the project, visualized in the right half of Figure 1, the following observations can be made.

- The project appears to be mainly economically driven. Both in the actual and the desired situation, the economic variables show the strongest presence and determine the purpose of the project.
- The consideration of environmental variables also shows a reasonable level, although in this set of variables, the difference between the actual and the desired level of consideration is highest. The participants in the study clearly saw potential to pay more attention to sustainability, for example in the energy and the materials used, the nuisance of the railroad and the spatial planning.
- The consideration of social variables shows remarkable low levels for a project that has a high societal function. This seem to be recognized by the participants in the study, as may be indicated by the high levels of ambition on the variables human capital development and participation. On the variable human capital development it was remarked that this aspect should be addressed in the project objectives and the identified benefits of the project in exploitation. This is of extreme relevance for the right functioning of the implemented systems.

Based on the assessment of the project’s product/deliverable, it may be concluded that most attention is given to the economic dimensions of sustainability, together with some of the environmental variables. Potential to enhance the consideration of sustainability, and thereby increasing the value of the project for all stakeholders, can most of all



be found in an elaborated view on the environmental aspects of the project and by considering also the social perspective on the project. For the project at hand, it has to be noted that the specifications and requirements of the project's product are for the larger part defined by European standards and regulations.

#### 4.2. Sustainability in the project's process

From the assessment of the consideration of sustainability in the process of the project, visualized in the left half of Figure 1, also a number of observations can be made.

- Also in the assessment of the process of the project, the economic variables dominate, although less strong than in the project's product. On the variable return on investment it was commented that a well-developed cost-benefit analysis is a prerequisite for all EU financed projects. On the variable business agility it was remarked that the low score of the actual situation should be considered in the context of the Romanian culture, that has high uncertainty avoidance.
- The assessment of the variables of environmental sustainability showed some potential for improvement of the consideration of these variables. On the variable transport, consideration can be given in terms of local content in procurement and to the use of digital communication in project management process. On the variable nuisance, the scores are remarkably low. This aspect is considered for improvement by the project organization.
- Also in the assessment of the project's process, the social aspects of sustainability score relatively low, although on some variables a higher ambition was indicated.

Based on the assessment of the project's process, it may be concluded that the sustainability aspects of the project are mostly considered in relation to the project's deliverable. Less attention is given to the sustainability of the process. When considering the sustainability of the project's process, again the economic dimensions of sustainability are considered most. However, potential to enhance the consideration of sustainability in the process is found in all three groups of variables.

#### 4.3. Discussion

Regarding the level of consideration of sustainability, the largest 'shift' between actual level and desired level is on level 3: Proactive. This follows the pattern that also Silviu et al.<sup>16</sup> found. Project managers and other stakeholders around projects first of all indicate that a more proactive consideration of sustainability aspects is desired. Whether this more proactive approach also leads to including sustainability aspects in the 'purpose' of the project is less clear. Quite logically, the strategy of the organization that commissions the project will be an influencing factor in this.

Regarding this strategic alignment, the website of CFR SA states that "Sustainability is at the core of strategic concerns of the company. The company acts for increasing the role of a green rail transport and of a rail transport in the service of citizens." Furthermore, it mentions that the priorities of CFR SA are connected to: (1) Increasing of accessibility in all regions, (2) Encouraging the industrial innovation, (3) Creation of a sustainable economic model and (4) Integration of the railway network in the daily life (of citizens).

The findings of our assessment align with the more environmentally oriented ambition of "green" rail transport. The more social and societal oriented priorities, such as accessibility and service to the citizens, were less apparent in our assessment.

### 5. Conclusion and reflection

This paper reported a case study into the consideration of sustainability in the project Modernization of KM614-Curtici Romanian Railway Network, located in Romania.

The participants of the study agreed that the assessment of the project with the SPM3 model provided a holistic analysis of the sustainability of the project, both regarding the process of the project and the product. Moreover, the assessment formed an essential step in the further development and improvement of the project. Participants agree that the reflection around the findings of the assessment provided rich information for further discussion for the project team and for the organization in respect of robust strategic thinking in the area of sustainability.

Participants in the study also agreed that the reality of the assessed project is complex and required a deep understanding of the context, interactions and dynamics in the project. Assessing the sustainability perspectives triggered the integration of new knowledge, improvement of the existing understanding and the learning of addressing and documenting sustainability aspects in all phases of the project life-cycle.

Revisiting the project management process and the project results from the sustainability perspectives delivered valuable insights. Considering the multiple perspectives, there are many potential aspects that could be explored in the context of future projects at the company level, such as documenting a stakeholder-centric approach starting with project initiation and planning phase, or embracing change management for sustainability strategic issues.

Some learning extracted from the case study, regarding the project management process:

- Environmental and social sustainability aspects should benefit of the same consideration as the economic sustainability in order to secure the integration of sustainability in project and project management.
- The planning of project stakeholder engagement should be considered in the future at the core of project management process in all stages of the project life cycle. However, this involvement of the stakeholders should not jeopardize the independence of the decision making process in projects at the company level.
- The management of environmental and social project objectives and deliverables should benefit of the same consideration as the economic one over the entire project lifecycle, starting from initiation and planning to post-project review.
- Agility is a dimension that should be explicitly considered in the project management process in order to cope with the already acknowledged agility feature of the projects in the area of rail infrastructure.

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