THE ROLE OF RAILWAYS IN TERRITORIAL DEVELOPMENT IN RESPECT OF THE ENVIRONMENT

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ABSTRACT

Awareness of railway works as an opportunity to improve and enhance the areas they cross, in a search for continuity between the natural and the urban that cuts across both as far as possible, has led to the emergence of new design criteria that "integrates" environmental, economic and social goals.

A re-examination of the "traditional" themes and aspects has become essential, by means of a wider and integrated Environmental vision, beyond merely focusing on environmental impact, to identify a work's effective environmental balance: not just what is being taken away from the surroundings, but also the benefits a project brings.

In this perspective, Italferr, in collaboration with the IRIDE Institute, has developed a new method for integrating environmental sustainability into railway infrastructure design, or rather of the "railway system" in all its phases, in pursuit of an environmental balance that characterises the work's entire life cycle.

The method developed for assessing the environmental sustainability of railway infrastructures from the design phase thus represents a move from focusing on environmental compatibility towards one of environmental sustainability, becoming an instrument for self-assessing the performance of the work where the project manager can improve a project's features through continuous feedback serving to enhance the selected design in a sustainable development perspective.

By applying this method, Italferr is helping develop concrete actions to guarantee higher energy-efficiency and an increasingly rational use of assets.

Keywords: Environmental sustainability, integrated assessment, environmental balance.

INTRODUCTION

For several decades now, projects for the future have been bound to include a search for sustainable development, a balance between economic development and quality of life, between generating wealth and preserving the environment, economic interests and social issues.

In 2008, the "principle of sustainable development" was brought into national law by legislative decree no. 4, highlighting the need to change the common approach adopted in environmental assessments and to identify new design criteria for an integrated assessment of environmental, economic and social goals. This "Regulation of public works" (Presidential Decree 207/2010) clearly and explicitly introduces the need to push design towards more advanced environmental protection criteria associated with the concept of sustainability.

Thus, to promote an engineering vision aimed at eco-sustainability, where the environment is placed at the centre of development is now more necessary than ever.

Italferr has been dealing with environmental issues for years, and prioritises environmental protection during the design, realisation and implementation of railway infrastructure. Environmental responsibility is harmoniously integrated in all phases involving company activities, and potential repercussions on the ecosystem are carefully examined and evaluated during the design phase and monitored and supervised during the works' construction, management and operational phases.

The need to "translate" the principles in the aforementioned law into concrete applications that effectively integrate works with their physical surroundings, has led Italferr to define a method, that has been published as such[1], and is an instrument for:

- Determining the environmental, economic and social sustainability of a project through a tool for "self-assessing" the performance of the work where the project manager can improve a project's features through continuous feedback serving to enhance the selected design in a sustainable development perspective.
- Improving interaction with the local area affected by the project, promoting a sharing process for the project to emphasise local needs according to stakeholder concerns in every environmental location and context.

[1] *Sostenibilità ambientale nei progetti di infrastrutture ferroviarie* [Environmental sustainability in railway structures –Published by ARACNE– May 2011

METHOD FOR CALCULATING ENVIRONMENTAL SUSTAINABILITY

The method for assessing railway infrastructure environmental sustainability was developed on the basis of existing information on environmental sustainability, to transfer those concepts to the design and building of railway infrastructure and to identify the actual environmental balance for a work's entire life cycle.

This is a particularly innovative aspect considering the common approach adopted in environmental assessments, the increasingly widespread use of environmental impact analysis and assessment criteria which leads to strictly focusing on the negative effects associated with completing a project, resulting in a partial assessment which ignores the positive effects the work generates in a given area.

The first step to emerge concerned defining environmental sustainability goals suited to engineering works. There are many check-lists that show and report this kind of goal which are key to this type of analysis since the entire concept of sustainability revolves around them, however none of these check-lists seemed suited to the purpose in that they were all geared towards plans and programmes, which is to say management concerns, none of which of covered project planning.

The spirit of such lists was acknowledged, however, and their origin analysed, identifying the principles upon which they are based and attempts were then made to marry the internationally-recognised principles of sustainability to the case of railway works, identifying the most correct "core set" of goals upon which to base the "work tool".

REFERENCES FOR CHARACTERISING ENVIRONMENTAL SUSTAINABILITY

Over recent decades, the concept of sustainability and sustainable development has been expressed through deeds, reports, documents, directives, laws etc. and the definition of sustainability indicators they introduced refers to different aspects, ranging from the more general to some highly detailed ones.

The principal internationally-recognised documents taken as a reference in defining the new method are listed below:

- The European Union's 10 sustainability criteria (1998) – to be considered before setting out a Programme of structural funds and then to be used as guidelines for assessing such a Programme;
- The Strategy of Environmental Action for Sustainable Development in Italy (*Strategia d'Azione Ambientale per lo Sviluppo Sostenibile in Italia* 2002) – an instrument conceived primarily for public players in a position to promote sustainable development of the territory through policy and action. This strategy is divided into four main thematic areas:
  - Climate change and protecting the ozone layer;
  - Protecting and sustainably enhancing nature and biodiversity;
  - Environmental quality and quality of life in urban environments;
  - Use of assets and waste production;
- Aalborg Commitments (2004) – a statement of commitments, subdivided into ten thematic areas, which identifies sustainable development goals and priorities to be pursued by working with all levels of government.

A careful reading of these instruments reveals the underlying theory and details.

A review of the strategies and goals identified by these instruments was therefore undertaken, in an attempt to relate them to the theme at hand, namely designing a railway infrastructure where the environment is mostly dealt with by ex-post verification of the negative repercussions that the planned actions might provoke.

THE METHOD

In order to ensure the sustainability of a work, a logic must be pursued which, in addition to "environmental compatibility" or comparison with a standard or strategically defined-reference, makes it possible to research the actual "load capacity" of the environment into which the work is built.

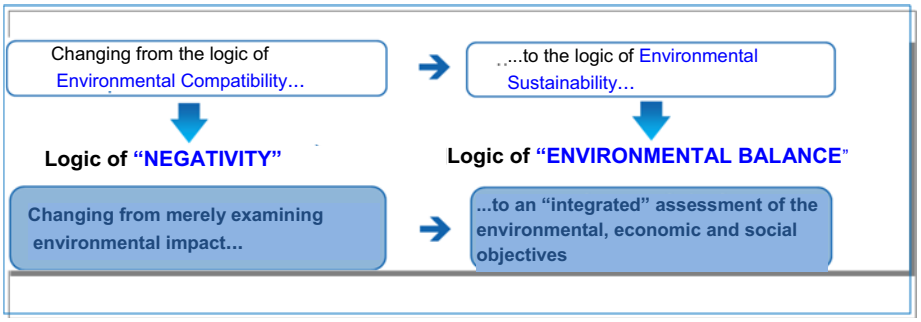

Figure 1: From "compatibility" to "sustainability"

The works-environment relationship represents a point of reference for defining the methodological approach, within which the environmental offer supplied by the surroundings is confronted with the demand (consumption) of the work's environment. The environmental sustainability of the project is established by balancing these two aspects.

Defining a new logic of sustainability allows the environmental Demand – Offer relationship to be restructured, which in turn makes it possible to optimise the project in environmental terms as part of an integration process that underlines the environment's capacity to receive and sustain the intervention without its balance being compromised over time.

The search for sustainable development means integrating three dimensions: The Environmental, the Economic and the Social that are essential and inseparable for development:

- Economic sustainability: the capacity of an economic system to generate long-lasting growth in economic indicators. Within a territorial system, economic sustainability means the ability to produce and maintain maximum added value within the territory.
- Social sustainability: the capacity to guarantee conditions of human wellbeing (safety, health) equally distributed by class and gender.
- Environmental sustainability: the capacity to maintain the environment's three functions over time – the function as a source of natural assets, the function of receiving waste and pollutants and the function of supplying the necessary conditions to maintain life.

The sustainability of the planned work is linked to identifying the sustainability goals the project must pursue to be able to determine the degree to which the response has met the predefined goals, once the work has been schematised according to working quantities.

Sustainability goals, derived from analysing the internationally-recognised documents of reference, were subdivided into macro-goals and specific goals.

Defined thereafter were the indicators for measuring the degree the design responds to the established sustainability goals of and objectively quantifying the phenomena investigated.

The process for calculating environmental sustainability is schematised in the figure below.

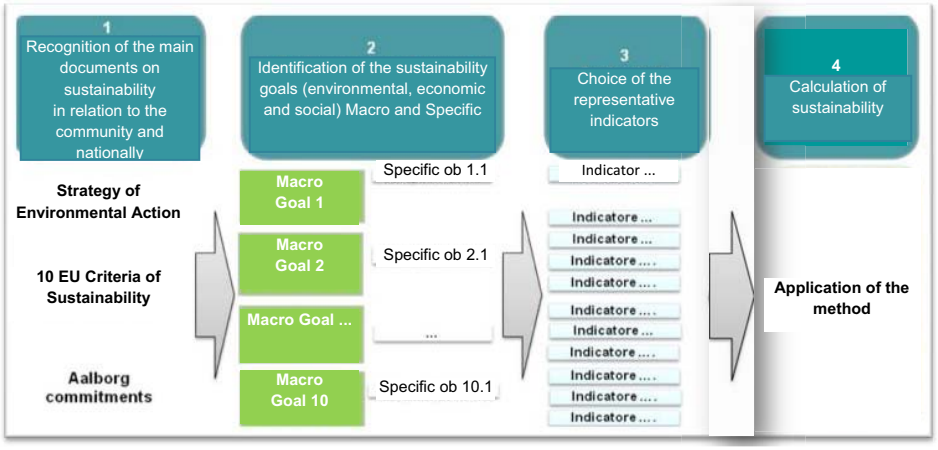

Figure 2: Phases of the method

The sustainability of the work is thus linked to identifying indicators structured according to the actual quantities of the planned actions, specifically:

Qp = basic quantity of project data which expresses environmental demand;

Qp0 = project quantity representing the possibility of inserting innovative elements contributing towards reducing environmental demand at the stage of defining the design.

Once these quantities were known, the reference quantities (Qr) were identified in relation to the environmental offer, to refer to in order to carry out a project sustainability assessment.

A procedure for understanding the final result was established, excluding overall classification to avoid using the logic of comparing multiple goals which necessarily introduces subjective judgement and does not therefore permit the achievement of a univocal result. It was therefore decided that each indicator would be structured in a way such as to attribute a numerical value to the result obtained in terms of meeting the specific goal. In this way a list of values ranging from "0" to "1" is obtained which represent the project's sustainability. Evidently, the more the numbers near the unit, the more sustainable the project.

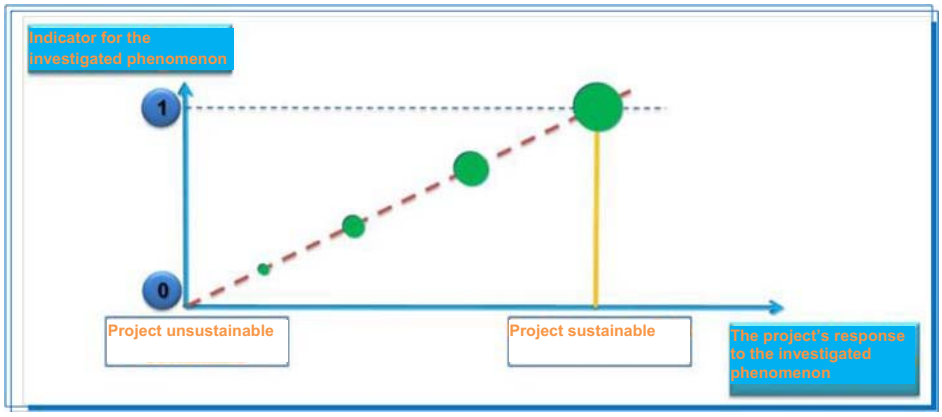

Figure 3: Measuring sustainability

Sustainability goals

Defining the sustainability goals for the "Promoter" of a railway line is the first step in the method, setting the working goals. The sustainability of the work is tied to identifying the sustainability goals the project must pursue to be able to define the degree to which the response has met the pre-established goals, once the work has been schematised according to actual quantities,.

The sustainability goals, derived from analysing the internationally-recognised documents referred-to, were subdivided into macro-goals representing the international criteria analysed and specific goals, defined for the various

fields (Social, Economic and Environmental) to be able to unify all the questions associated with building, operating and decommissioning a piece of transport infrastructure. Lastly, indicators were established for measuring the degree to which a project meets sustainability goals established and objectively for quantifying the phenomena investigated.

In the new logic of sustainability one must consider not only what is removed from the surroundings but also the benefits gained from completing the works in question.

This perspective "turns" the railway works into an opportunity to improve and enhance the areas crossed, for which indicators have been defined, among others measuring the social benefit gained from surveying potentially contaminated sites carried out during the design phase for all the areas interfering with the planned works to return previously deteriorated areas to the community or preventive assessment activities of archaeological interest aimed at both protecting ancient heritage and the primary goal of constructing public works and to enhance existing cultural heritage.

Such aspects were certainly dealt with but never sufficiently stressed at the time of the environmental analysis and consequent assessment. The new proposed line thus becomes another element in the landscape, a further anthropogenic load, a potential "impact" on the environment which however also brings advantages allowing the project to be analysed from another perspective.

Building major infrastructure also represents, for example, an exceptional opportunity for scientific research aimed at learning the historical processes of how the area was used and inhabited and the consequent enhancement of the sites. Faced with increasing awareness of cultural heritage as rich as Italy's, new methods and approaches have been studied to combine the protection of ancient heritage with the primary goals of constructing key public works

The archaeological "risk" was thus preventively faced, with the aid of specialist studies and analyses aimed at assessing the impact of the new railway network on the historical-archaeological heritage, as early as the design phase, using an approach similar to the environmental impact assessment procedure as contemplated by environmental protection legislation. Prior verification of archaeological interest makes an evaluation possible before the conclusion of the approval procedure for the specific project, of any clashes between the work to be contemplated and the archaeological situation, defining the activities to be carried out to ensure the findings are understood, protected and conserved. A significant example of preventive archaeology is represented by the project for the new Messina – Palermo line, in the section between Campofelice di Roccella and Termini Imerese, in correspondence with the ancient city of Himera, founded in 648 B.C. by Greek colonies on the mid-western coast of Sicily. The "Himera" railway line which led to a thorough campaign of archaeological digs is the result of more than twenty-five years of studying and analysing the territory and the continuous and collaborative relations between the Superintendency of the Cultural and Environmental Heritage of Palermo and the top management at Italferr and Rete Ferroviaria Italiana. Based on the Archaeological Study, the movement of the tracks towards the outside of the ancient city was designed parallel to the current motorway embankment, with a coexisting plan for the archaeological digs in the area of one of the necropoles surrounding the city that stood in the way of the railway works. In this way it was possible to reconcile the pressing need to modernise the island's transport system in a manner respectful of the past and safeguarding historical memory.

Railway works also constitute an opportunity to improve and enhance the areas crossed. When building major works is the best time to seek solutions aimed at providing answers it would not ordinarily be possible to provide. Suffice to consider the surveying of potentially contaminated sites which Italferr carries out during the design phase on all the areas standing in the way of the planned works to ascertain any contamination of the soil, subsoil or water matrices and where necessary initiate clearing procedures to resolve environmental criticalities identified before works begin. A measurement of the project's ability to help re-balance the area was thus proposed, by enhancing the deteriorated areas concerned by the project infrastructure.

Doubtless also of importance is the macro-goal "Use environmental assets sustainably, minimising what is removed". This was divided into specific goals aimed at highlighting the optimisation of the use of assets, reducing consumption of the latter and the option of introducing the use of alternative assets. It is therefore important to attribute a significant role to the specific goal of reducing energy consumption and increasing the quota of renewable and clean energies used in building and especially in operating the railway line. Railways naturally consume a lot of energy but train traffic is not the entirety of the project. Alternative energies do not of course significantly contribute to the energy balance of a railway line but for some sections of the work the ratio is inverted. Suffice to consider railway stations, goods centres, etc. in this case the instrument for calculating sustainability also becomes a mechanism for stimulating a

virtuous project and automatically obtaining approval at certain times of environmental assessment. The specific goal should also be considered in this logic to improve the water quality and use it more efficiently compared to the offer concerning the environment in question as well as that of improving the soil and containing soil loss, especially in sensitive areas, as well as the possibility of minimising the quantities of materials consumed and increasing their re-use. Many of these aspects are already in the project and in some way are also dealt with in the standard environmental impact assessments (or the entire treatment of materials balances) but of interest here is to organically organise all aspects aimed at sustainability according to a same logic, which does not necessarily have to mean reducing impact, but rather, if possible, increasing the environmental quality of the surroundings concerned by the works.

Last but not least is a specific goal associated with this macro-objective, which is to research design phases with a view to greater use of more eco-compatible material. Depending on the phase in which the method is applied, this may translate into an indication of specific materials to be used or, in a more strategic but certainly no less important manner, the indication of design specifications for the use of the most suitable procedures.

In this way, railway works also become an opportunity to use environmental assets sustainably, for which indicators have been used that promote reuse of waste material and collection of "local" material ("brand new" material) to reduce the quantity of material to be provided and reduce interference with traffic. Such a procurement method makes it possible to reduce pollution linked to transporting material, at the same time as favouring the local economy, thus meeting a dual goal, both environmental and social.

Railway works also become an occasion to reducing greenhouse gas emissions, for which indicators are defined to quantify what emission may be avoided during construction for example by adopting more sustainable technical solutions and materials. In fact, through Italferr's method for measuring the "carbon footprint", for which certification of conformity to standard ISO 14064-1 was achieved, it is possible to measure CO2 emissions during the design and completion phases of the works, also highlighting the option of implementing activities for reducing or avoiding the greenhouse gas emissions by adopting environmentally more "virtuous" design solutions with the same performance.

The macro goal to "Reduce the product of waste, increasing its recycling and promoting short-distance transport" is also important. This essentially refers to two specific goals: reducing the production of non-hazardous waste to be taken for disposal by activating recovery/recycling processes and maximising re-use of the soil. With reference to the latter, it is important to consider soil reuse, especially for non-hazardous waste. In this regard there should be a tendency to maximise the percentage of recovered/recycled material and then consider the indications of sector programming, especially for non-hazardous waste. The second conversely concerns the theme of excavation soil and rocks. These can be reused in construction or at external sites. The specific goal was therefore set to maximise reuse of the soil in order to enhance deteriorated areas situated near to the areas affected by the project. In this way, not only is it possible to reduce the quantities of soil to be managed as waste, but, the opportunity can also be seized to improve or enhance the areas crossed, reducing distances and consequent impacts in terms of atmospheric emissions and interferences with traffic.

Finally, the macro-goal "Promote participation in decisions on infrastructural development" should be noted. This is certainly not a standard project goal but it is considered particularly important in that increasingly a project must always be carefully planned with local authorities and stakeholders effectively involved, as well as properly laid out and developed.

The frequent need to integrate works within the public urban fabric has led to designing new projects as a response not only to railway travel needs, but also as elements as additional urban functions. Thus, working with the municipal administrations involved is paramount, precisely due to the chance to bring together urban areas and railway transport, transforming the city and renovating entire districts in one overall design.

Promoting participation in infrastructural development decisions as early as the design phase, involving institutional and non-institutional stakeholders in fact makes it possible to improve in interaction with the area in question, focusing on local needs in every area and environment. For Italferr, environmental communication policies represent an awareness that its own growth must be compatible with the needs and expectations expressed by the public, a tool for providing a complete and transparent picture of the beneficial social effects of its decisions. Databases and Websites have been designed and developed for this purpose in collaboration with the Ministry of the Environment and the Protection of Land and Sea, with local Administrations and Bodies, to keep citizens constantly informed on the environmental quality status of the area affected by construction, environmental and/or compensatory mitigation works connected to a project, on environmental monitoring activities performed by Italferr in the pre-operational phase, during

the course of the works and at a post-operational stage, in relation to specific Environmental Monitoring Projects. These systems also provide valuable support to the ARPA/ Environmental Observers in environmental control terms during the construction phase.

CONCLUSIONS

Italferr has for some time employed a proactive approach in its activities in environmental terms and more generally in sustainable development terms, giving environmental protection a primary role during railway infrastructures' design, construction and operational phases.

In this vein, in collaboration with the IRIDE Institute, it has developed a new method for assessing environmental sustainability in railway infrastructures as early as the design phase, aimed at integrating environmental sustainability in designing a railway infrastructure.

The research carried out provides a tool for defining the environmental, economic and social sustainability of a project, giving the project manager the elements needed to improve the features of the works by means of a continuous feed-back process aimed at enhancing the design chosen. It also facilitates improvement in interaction with the area affected by a project, promoting a sharing process for the project to emphasise local needs according to stakeholder concerns in every environmental location and context.

From this point of view, Italferr represents engineering that is continuously evolving, in the knowledge that infrastructural development must emerge from a constant search for increasingly environmentally friendly solutions.

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