

Preliminary Indicators of Port Development in Sensitive Environments

المؤشرات الأولية لتطوير الموانئ في البيئات الحساسة

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Abstract:

The objective of this article is to establish decision support system to break with preconceived solutions and adopt better governance of the project. In order to respond to the industrial problem, which is "what is the objective of the development of the territorial system around the port" For this, we support the need to undertake a multicriteria approach to address our problem. We developed three approaches: the territory approach, the project approach and the agent approach.

Keywords: Land development, port development, indicator, environment, project governance.

Jel Classification Codes : Q53, Q56.

ملخص :

الهدف من هذا المقال هو إنشاء نظام لدعم القرار لتفادي الحلول المسبقة و اعتماد حوكمة أفضل للمشروع. و من أجل الاستجابة للإشكالية الصناعية و التي تتمثل في ما هو الهدف من تطوير النظام الإقليمي للميناء ؟ لهذا فإننا نؤيد ضرورة إتباع نظرية متعددة المعايير للإجابة على إشكالتنا لأجل ذلك قمنا بتطوير ثلاث نظريات: نظرية الإقليم و نظرية المشروع و نظري الوكيل.

كلمات مفتاحية: تهيئة الإقليم، تهيئة الميناء، مؤشر، المحيط، حوكمة المشاريع.
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Introduction:

The positive effects of a century of technological revolution and economic development have been beneficial for humanity, but they are increasingly nuanced in terms of the ecological consequences they have generated.

The objective of development aims to enhance a territory, but the expected effects of development from the perspective of the economic development of the concerned territory do not seem to be automatic (Plassard.F, 1977, p. 342). The projected development objective is situated in an evolving context, and there should be complementarity between the territory and the project. This is necessary for society to participate in this evolution and to accept the project.

In other words, society's appropriation of the development objective is crucial in conditioning its structural effects. The development project must be complementary to the territory so that territorial development strategies can utilize the new infrastructure as a driver of territorial development. This interplay fosters the relationship of acceptability between populations and the project. If this relationship is not established, its absence can lead to the non-acceptance of the project and the emergence of territorial conflicts, which, in the case of Rhine ports, have already resulted in the abandonment of development projects.

Indeed, the response that the designer must provide to a territorial development issue is to avoid the project's evolution towards a point of no return, which would be the abandonment of the development project. Many researchers have explored the concept of the development project, positing the hypothesis that by attempting to influence it, improvements can be made to the final project.

The inclusion of research in a disciplinary field involves working on the design aspects related to territorial development. The relationships between the two domains are clearly identifiable: It involves applying theories and design models derived from sciences to a broader issue than a technical problem. However, the nature of the relationships between these two disciplines is rarely formalized.

Nevertheless, Le Masson et al.(Masson, P., & Weil.B, 2006, p. 76) emphasize that historically, the activity of design inherits traditions and know-how from fields closely related to territorial development. The primary design methods have been developed by architects, artists, and engineers. According to the authors, each body of expertise plays a role in the process, and its activity complements those of its partners.

In 2002, AFNOR (the French standardization organization) proposed the following definition of the design activity: "A set of processes that transform requirements into specific characteristics or specifications of a product, a process, or a system." (AFNOR, 2002, p. 127) The goal is to understand how, based on the formalization of design, as is the case in industrial engineering, for example, the territorial development project system can be improved. Thus, for a specific phase of the project, a design process is triggered by one or more individuals expressing needs. The identification of the need is therefore the source of all reflection.

1. The H-E-D Model

The question of selecting indicators for the model has been addressed based on two main ideas that underlie the research:

- The first idea is that the choice of indicators should reveal the fundamental structure of territories, its construction, its functioning, and its specific characteristics.
- The second idea is that this information should encompass a number of indicators capable of describing the biophysical support subsystem, as well as indicators capable of revealing the involvement of actors in the territorial system, notably through indicators that describe the organization of the territorial system (Ohresser, Piquette, Gartiser, & Wintz, 2010, p. 56) (Ohresser C., 26-28 mai 2009, p. 123).

For the development project to be carried out, it must correspond to the expectations of the current era and, in that sense, align with a sustainable development project. According to Mager (2008), development must meet the needs of present and future generations while respecting the natural environment, its diversity, and the sustainable use of resources. It will be based on the needs of the population, the necessity of ensuring the quality of rural and urban spaces, and a changing economy.

That's why Mager argues that in this perspective, a sustainable territorial indicators system must be integrated into the project system, enabling the strengthening of connections between the project, economic development, and environmental protection.

More concretely, a sustainable territorial indicators system must be built upon three dimensions of sustainable development that address three major multidimensional challenges: "economic sustainability, social sustainability, and environmental sustainability." The multidimensionality of a sustainable territorial indicators system is essential and unavoidable, but it is not the only aspect. We propose using the Human Space Decision (H-E-D) model to guide our exploration of the studied territorial subsystems (Rolland-May, 2000, p. 377). The H-E-D model is a semantic model that allows the representation of the territorial system's structure. The primary advantage of the H-E-D model is that it incorporates time and evaluation into the representation

of the state of the studied territorial system. It integrates elements of sustainable development into the design process.

H-E-D represents a simplified approach to the complexity of geographical systems through a targeted study of the indicators that constitute the system, aiming to identify the objects and relationships that characterize it. This model has already been tested in previous works (Ohresser C., 26-28 mai 2009, p. 77), and we support its effectiveness in revealing a territory's characteristics, particularly its sensitivity to specific phenomena.

For the author (Rolland-May, 2000, p. 115), the H-E-D model allows for the comprehensive understanding of the territorial system in its complexity and entirety through the systematic study of three sets (Humans, Space, Decisions). In this case, the notation for the territorial system's structure is:

To support these ideas, we present the table of indicators as proposed by H-E-D. Each theme is then broken down into substructures, named (in Table 1) with a letter, the initial of the substructure. These substructures gather a set of indicators, providing quantitative and qualitative information about territorial dynamics. Their content could be further developed (see rules on ecosystem environments).

Table 1: From Modeling to Characterizing the Required Information

General Themes	Substructures	Characterization
Hommes (Humans)	P	Population and settlement structures
	Es	Structures économiques et dérivées
	C	Community structures
Espace (Space)	G	Geographic space referred to as "natural" and environment
	O	"Organized" space according to technological, economic foundations...
	T	"Territory" experienced, perceived, and appropriated by a community
Structure Décisionnelles Officielles (SD0)	EL	EL: Local Scale
	EP	EP: Supra Scale
	EG	EG: Infra Scale
Structure Décisionnelles Officieuses (Sd0)	EL	EL: Local Scale
	EP	EP: Supra Scale
	EG	EG: Infra Scale

Source: Christiane ROLLAN-MAY, in "Evolution des territoires, concepts modèles et méthodes" - 2000; p.116.

2. The Evaluation Grid of Territorial Systems: A Tool for Project System Processors:

In this line of thought, we propose a grid of 40 indicators that, when interconnected, reveal the structure of the territorial system and provide relevant information to the project system processors.

This section is presented in the form of sheets that successively present:

The information sought to be obtained about a substructure of the territorial system, the questioning induced by the substructure in relation to the objective of the development system.

The corresponding ideal indicators, meaning the information one would wish to find, and ultimately, the indicators that, when associated, tend to highlight a trend.

2.1 Principles of the Tool to Ensure Knowledge Transfer about the Territory to Project System Processors

The objective of the territorial information system is to elevate the project system's understanding of the territorial system, so that this knowledge can be used as a updated resource in the project system. To achieve this, we suggest that project system processors identify structured information using the territorial analysis grid presented below.

- A Guide

The benefit of employing the H-E-D model is to guide the selection of indicators for comprehending the territory as a receptacle for the project system. More specifically, it involves creating a grid of indicators that inform project system processors about the host territory of the project and the complexity of the relationships that animate it.

Our contribution aims to operationalize the model for the designer, enabling them to integrate territorial logics relevant to the territory targeted by the project system, and adapting it to the theme of port expansion.

To accomplish this, we propose two objectives for selecting indicators specific to the territorial approach: detecting potential development conflicts and identifying dynamics on which the project system can rely.

- A Modifiable Semantic Information Grid by and for Users

The territorial approach takes the form of a semantic grid, which corresponds to a list of indicators ordered according to the H-E-D model and which gains meaning according to the objective stated by each sub-part of the model.

The model is open, meaning that if the territory's structures it reveals are insufficient, the user can add their own "bricks," which refers to an organized set of indicators.

The presented table (Table 2) below explains the concepts presented in Table 1, with the content in the first column elaborating on the logics it takes into account (column 2), and illustrated by indicators (column 3) that, when combined, can translate the idea of column 2.

Table2: Explanatory Elements for Interpreting the Indicator Table Using the Example.

Sub-structures	Information sought	Possible indicators
		
Ec: Derived Economic Structures	On what elements does the local economy rely? Around which center of life are the practices of daily living oriented?	- Percentage of the active population employed in the AGRICULTURE sector - Percentage of the active population employed in the INDUSTRIAL sector (%) - Local unemployment rate (%) - Number of available jobs in the municipality - Active individuals employed within the area - Presence of business zones other than the port industrial zone(...)

2.2 The Grid

2.2.1 Expected Information about the "Hommes" Brick

The indicators of H define the role of humans within the territorial system (population, employment, trajectories). The selected indicators address the following questions:

P: The structure of the system from the demographic and population perspective.

Ec: The structure of the system from the perspective of business economics.

C: The structure of human communities within the territorial system.

The chosen indicators must reveal the values shared by explicit or implicit groups.

Expected Information	
This aims to understand the structure of the system from the demographic and population perspective.	
The collected data is both quantitative and qualitative.	
Questions Arising from the System	
What project for which population? Better understanding the population of the host territory, what interest the population finds (or doesn't) in the project.	
What reception for the project?	
Corresponding Ideal Indicators	
- Occupational structure (CSP) of the population. - Education level of the population. - Population's involvement in the territory.	
Indicator(s) that, when combined, could provide the desired information	
1	Total population in the last census.
2	Population change since 1990.
3	Average annual net migration since 1990.
4	Youth unemployment rate.
5	Presence of vocational training institutions (schools, etc.).
Expected Information	
Ec = The structure of the system is approached from the perspective of the economy, businesses, etc.	
The collected data is both quantitative and qualitative.	
Questions Arising from the System	
- What economic dynamism for the system? - What economic basis for the local economy? - What direct effects does the project have on the local economy?	

- Which centers of life are the daily life practices centered around?	
Corresponding Ideal Indicators	
Importance of primary, secondary, tertiary sectors (contribution to professional tax). Existence of activity zones. Links with the primary sector: agricultural operators. Type of businesses established in the territory (artisanal, international). Significance in terms of employment, sector of activity, local resources sought by businesses. Population's activity by gender and economic sector, especially agricultural.	
Indicators that, when combined, could provide the desired information	
6	Percentage of the active population with jobs in the AGRICULTURE sector.
7	Percentage of the active population with jobs in the INDUSTRIAL sector.
8	Unemployment rate.
9	Number of available jobs in the municipality.
10	Active individuals with jobs in the zone.
11	Presence of activity zones other than the Industrial Port Zone (ZIP).
12	Can the municipality be considered a center of life?
13	Does the municipality have a need for employment?
14	Sustainability of activities in the ZIP/existence of closure projects.

Expected Information
C = Determine the characteristics of the communities within the territorial system. Indicators that reveal the values shared by explicit or implicit groups can be selected. The collected data is both quantitative and qualitative.
Questions Arising from the System
– What are the political and social affiliations of the population? – Conditions or organization for nature conservation.

– Different views of nature based on membership in a social group.	
Corresponding Ideal Indicators	
Political and social affiliations of the population and, by extension, their sensitivity to economic activity and environmental protection.	
Conditions or organization for nature conservation.	
Different views of nature based on membership in a social group.	
Indicators that, when combined, could provide the desired information	
15	Percentage of votes for the outgoing municipal team.
16	Percentage of ecological votes.
17	Presence of local nature conservation or residents' association.
18	History of environmental mobilization.
19	History of employment-related mobilization.

In the end, the territorial substructure H is informed by 19 corresponding indicators, encompassing:

$$H = P(i_5), E_c(i_9), C(i_5)$$

2.3 Expected Information about the "Espace" Brick:

The indicators of E describe space, providing the user with information about the natural characteristics of the municipality's environment, and then about space as a backdrop for anthropic activity. The selected indicators address the following questions:

- G: Natural environments
- O: Organized space, meaning the space where humans have imposed a certain order, spatial logic, and coherence.
- T: Spaces appropriated by a human community.

The nature of the relationships between the indicators within E and the relationships between H and E contribute to the conditions for the emergence of a development conflict.

Expected Information
G = sub-structures "geographical space, organized space, territory." To understand the geographical positioning of the village in relation to its environment and to inquire about the mechanisms of urban diffusion. The collected data is both quantitative and qualitative.
What questions arise about the system?
What are the relevant pieces of information about the natural system to consider: Presence of sensitive or unique natural environments, Existence of protected areas, Measures necessary for their preservation. Environments capable of accommodating reinforcement measures nearby as part of compensatory measures. Identify conflict zones and areas suitable for potential conversion. Indicators to assess the quality of natural environments nearby.
Corresponding ideal indicators:
Designated zones, similar zones, areas near the river free from constraints for potential development to accommodate compensatory measures.
Indicators that can provide the sought-after information:
20. Presence of designated natural area. 21. Nature of plant or animal spaces requiring designation measures. 22. Presence of zones similar to designated areas but not designated themselves.

Expected Information
O = Set of indicators revealing the sub-structure related to organized space, that is, the space in which humans have imposed a certain order, spatial logic, and coherence. The collected data is both quantitative and qualitative.
What questions arise about the system?
What are the dynamics that promote the movement (or lack thereof) of goods and people? (Urban planning and networks)
Corresponding ideal indicators:
Quality of the transportation network, quality of nodes and connections, Network growth capacity and available surfaces for accommodating activities, Multimodal capacity, Flow of people to businesses, Congestion, Transport of hazardous materials.
Indicators that can provide the sought-after information:
23. Availability of space within the port area. 24. Presence of multimodal connections: road, water, rail. 25. Nature of road connections. 26. Current port infrastructure. 27. Quality of connection to Germany. 28. Possibility of transit for exceptional convoys. 29. Distance of residences from the road used for road transit.

- | |
|---|
| <p>30. Active railway service.</p> <p>31. Distance of residents from the railway used for road transit.</p> |
|---|

Expected Information

<i>T = This involves defining spaces appropriated by a human community.</i>

<i>The collected data is both quantitative and qualitative.</i>

What questions arise about the system?

What rural or peri-urban identity? Integration into a city network or agglomeration?
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Corresponding ideal indicators:
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Areas under influence: scale of influence, local, regional, international. What rural or peri-urban identity? Integration into a city network or agglomeration?
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Indicators that can provide the sought-after information:
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| <p>32. Nature of the project's interlocutor (municipality or inter-municipal cooperation).</p> <p>33. Distance to the agglomeration (in terms of time and kilometers).</p> <p>34. Development of housing developments.</p> <p>35. Level of commercial facilities.</p> |
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In the end, the territorial substructure E is informed by 16 corresponding indicators, encompassing:

$$E = G(i_3), O(i_9), T(i_4)$$

2.3.1 Expected Information about the "Décision" Brick:

The indicators of D derive supra decisions that can durably modify the structure of a territory. This involves looking at "the set of structures that allow humans, based on knowledge, and thus an information matrix, to express a desire, and therefore decide to use this information in a specific action, to legally or illegitimately appropriate certain power through competencies that

are either explicitly assigned to them, implicitly recognized and/or granted, not recognized, but nevertheless claimed and seized." The selected indicators address the following questions:

- SDO: Administrative, political, and judicial structures with competencies over a territory and that are active in this regard. The indicators are organized into three levels of scales that the author qualifies as local, supra, and infra.
- Sdo: Unofficial decision-making structures (lobbies).

Expected Information
<i>SDO = This involves identifying administrative, political, and judicial structures with jurisdiction over a territory and that are active in this sense.</i> <i>The collected data is qualitative.</i>
What questions arise about the system?
What rural or peri-urban identity? Integration into a city network or agglomeration?
Corresponding ideal indicators:
Projects at local, regional, national, and European scales? Viewpoints of elected officials?
Indicators that establish a relationship are likely to provide the sought-after information:
36. Existence of economic development projects. 37. State-regional planning contracts... / cross-border projects? 38. Willingness to convert a site.
Expected Information
<i>Sdo = This involves identifying structures that hold a certain de facto authority. Unofficial decision-making structures operate at three levels of scale described earlier.</i> <i>The collected data is qualitative.</i>
What questions arise about the system?
Projects at local, regional, national, and European scales? Viewpoints of elected officials?
Corresponding ideal indicators:

Who can influence decisions without having real power: companies, market forces (customers), environmental lobbies?
Indicators that establish the relationship are likely to provide the sought-after information:
39. Expansion or establishment projects of a firm.
40. Ecological reserve projects.

In the end, the territorial substructure D is informed by 5 corresponding indicators, encompassing:

$$D = SDO (i3), Sdo (i2)$$

It is clear that the objective of this focused research is to establish a multicriteria decision support system that breaks away from preconceived solutions and adopts better project governance. In order to address the industrial issue of what the purpose of territorial system development around the port is, we propose a three-step approach: Territory approach, Project approach, and Agent approach.

3. The territory approach

The objective of this approach is to define the objectives that "the territory approach" should allow. The chosen methodology should enable the project system to build knowledge about the territorial system by evaluating it.

The territorial system is considered here as a SES, meaning a socio-ecological system.

3.1 Building Knowledge about Socio-Ecological Systems

The systemic approach allows the analysis to associate two components that are often opposed: nature and society, to demonstrate their interdependence and reciprocity. This kind of reasoning aligns with work on SES (socio-ecological systems) which refer to integrated systems that couple societies and nature, ultimately aiming to redefine ecosystems by explicitly considering all actors, including humans, as active components of the ecosystem. Consequently, the project system can be seen as a complex system, incorporating a wide variety of physical and human phenomena whose interactions construct a system not exhaustible through classical analytical approaches. Planning a territory through a significant project such as establishing a port necessarily involves the concept of evaluation.

3.2 Evaluating Territorial Systems Suitable for the Project

Evaluating a project, understanding its compatibility with the supporting territory, emphasizing connectivity advantages to networks, anticipating alignment with various spatial scales and challenges—these are aspects that lead to an evaluative approach. Indeed, in economic, social, political, environmental domains, as well as in health domains, wherever strategic decisions are made and actions are taken, the need to support strategic initiatives and action projects with a multicriteria evaluative approach becomes evident. The industrial application of such work involves studying a complex system where evaluation is a prerequisite or requirement. Reflection on management strategies refers to the density of impacted knowledge domains and the richness of available information—entwining economic, legal, environmental, sociological, and even psychological aspects. "The territorial system, subject of evaluation, is imprecise and/or uncertain, as, on the one hand, geographic space is imprecise and/or uncertain, and, on the other hand, knowledge about this space is also uncertain." Territorial action increasingly necessitates evaluation of both the territory affected by the project system and the project itself. The goals of this evaluation are to prevent errors that become increasingly costly in terms of resources at the beginning of the planning and conception process (ex-ante evaluation), minimize discrepancies between planned actions and ongoing actions (follow-up evaluation), and to assess achieved results in relation to set objectives and expected outcomes (ex-post evaluation).

The objective of this approach is to characterize the territorial system capable of accommodating the development project. It aims to offer decision-makers a model of the territory that encompasses social, economic, and ecological components. The purpose is to confront this model with various possible development strategies. In the following section, we will delve into the steps to promote the emergence of alternative projects.

4. The agent approach

The second step of the approach involves assisting the actors of the project system in selecting strategies. The goal is to enable the stakeholders to grasp the tools of knowledge (territory approach) and problem-solving (project approach) and to create a conducive setting for discussion, with the objective of decision-making.

This final step establishes a link between the knowledge about the territory and the developed strategies. It allows for the visualization of strategies spatially and, more importantly, facilitates the simulation of actor reactions based on different strategies.

To achieve this, we propose employing multi-agent simulation, where the computational system follows instructions to execute a model and generate its behaviour. Multi-agent models can be developed to make the various actors in the project system react to the likely dynamics of the territorial system due to the development of new port areas or the absence, consolidation, or disappearance of existing ones. To stimulate the emergence of viewpoints regarding the compatibility between possible strategies and actors, and with the intention of fostering coordinated territory management, the simulation tool is constructed to represent the complexity of space and the occupying actors (through the territory approach) and evolves based on the strategies (obtained through the project approach).

In this supportive approach, modeling can be utilized in three ways:

- As an educational tool to raise awareness about congestion in space and competition between uses, as well as the importance of environmental preservation.
- As a mediation tool among partners.
- As a collaborative decision-support tool to sort out development scenarios.

It goes without saying that the agent approach involves representing behaviours in space based on potential development strategies to highlight the advantages and disadvantages of a strategy. The use of multi-agent systems to support decision-making has been developed and tested in the domain of natural resource management.

5. The project approach

In territorial planning logic, what may be perceived by stakeholders as a "spatial constraint" needs a technical solution to overcome it, turning the constraint into an advantage. The search for a solution is often influenced by what we term as instinctive conception. Our goal is to assist in breaking away from this mindset and working within the partnership of elected officials and technicians to develop a range of solutions.

5.1 Breaking Away from Pre-existing Strategies: Destruction, Development, Compensation

To determine solutions that either address the constraint or enhance the resource, elected officials are surrounded by specialists capable of finding a means to achieve the objective. Technicians are then responsible for devising a solution to resolve the issue.

Methodologically, this approach draws on trial-and-error methods such as brainstorming, morphological analysis, synectics, forced associations, and more. These less restrictive methods aim to explore various solution-carrying avenues.

For Nicola Maranzana, this proliferation of ideas is both the biggest advantage and the biggest drawback of these methods. "Indeed, the greater the quantity of generated ideas, the higher the chances of finding a solution to the problem." (Maranzana, 2009, p. 58) However, in territorial planning, the range of possible solutions is relatively limited. Furthermore, the need to innovate in defining the requirements is not felt by the initiating and project-carrying actors, as these actors already have a presupposed solution: the goal is to commercialize the water resource, and the solution is the establishment of a port. This implies that the focus is not on inventing alternatives to the port, but on the way to create a port. Therefore, the emphasis is on developing a strategy that encompasses the classic approach of "destruction, transformation, compensation." In concrete terms, the idea we aim to develop in this approach is to resort to a formalism of past projects, whether successful or not, and position them in relation to the definition of needs.

Conclusion:

The systemic approach allows researchers to materialize relationships between abstract elements that were previously insufficiently integrated into the decision-making system.

Similarly, information systems provide assistance in collecting, processing, and delivering information of diverse nature. Reflecting on the social composition of a territory when the goal of the development system is to lead to the establishment of a port facility is an idea already imposed by the 1983 Impact Studies Law.

However, in the realization of our Spatial Information System (SIT), the aim is not to determine the positive impacts associated with the implementation of the development on the territorial system. Instead, the aim is to help anticipate how the local population perceives its territory and, by extension, how it views the implementation of a project at a time when environmental and sustainable development themes are evolving mindsets. This involves, well in advance of the technical phases, equipping the project system with a level of "useful" knowledge about the supporting territorial system. It is also not about evaluating the environmental impact of the project, but rather about providing information to the project initiator on how to conceive the project while respecting the impacted local environment.

Thus, we advocate the necessity of adopting a multicriteria approach to address our problem. To achieve this, we have developed three approaches: the "territory" approach, the "project" approach, and the "agent" approach.

The territory analysis framework proposes basic indicators that are easy to provide but, more importantly, guides the user on how to approach the territorial system. It allows the processor, in a sense, to acquire analytical reflexes for understanding the dynamics of territorial systems that could benefit from similar investigations within the same time frame, without excessively inflating the cost of studies.

Furthermore, the limited number of selected indicators is another advantage, accommodating a range of territorial systems that can benefit from similar investigations within the same timeframe.

Viewing the territory as a system is an integral part of the project system. Entering project development solely from a project-centric perspective, without simultaneously conducting the territory and project approaches in parallel, can lead to the emergence of contradictions detrimental to the project system, resulting in delays or failure. This is why it is opportune to break away from the pre-existing strategy of "destruction, transformation, compensation."

In order to achieve concrete results and explicit steps, it is imperative to address the final encompassing approach, the "agent" approach.

The agent approach is built as a tool capable of illustrating, in other words, visually representing and thereby aiding the processor and transducer in recognizing the interaction between the territorial system and the project system, enabling the virtual testing of different strategies.

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