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A FRAMEWORK FOR TRANSPARENT AND PARTICIPATIVE GOVERNANCE ENHANCEMENT THROUGH SYSTEMATIC DECISION-MAKING

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Abstract. This article presents an innovative framework to support decision-making in investment projects in coastal cities in the state of Rio de Janeiro, Brazil, which receive royalties from the oil and gas extraction industry. The article proposes a systematic, methodology-based approach to decision-making, involving a technical team, committees of informants, and municipal managers. The methodology uses fuzzy logic to deal with diverse variables and data sources, incorporating uncertainties. The process includes location analysis, impact analysis, participation of expert committees, and the creation of predictive scenarios. GIS integration and Blockchain certification provide additional support for decision-making. This framework aims to promote transparency and collaboration in complex decision-making and contribute to the sustainable development of coastal cities.

Keywords: decision-making, fuzzy logic, coastal cities, sustainable development, Rio de Janeiro, blockchain, predictive scenarios.

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ПОДХОД К СОВЕРШЕНСТВОВАНИЮ ПРОЗРАЧНОГО И ОСНОВАННОГО НА ШИРОКОМ УЧАСТИИ УПРАВЛЕНИЯ ПОСРЕДСТВОМ СИСТЕМАТИЧЕСКОГО ПРИНЯТИЯ РЕШЕНИЙ

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Аннотация. В данной статье представлена инновационная методика поддержки процесса принятия решений в инвестиционных проектах на побережье городов штата Рио-де-Жанейро, Бразилия, которые получают роялти от предприятий по добыче нефти и газа. Статья предлагает систематический подход к принятию решений на основе методологии, включая в себя техническую команду, комитеты информаторов и муниципальных менеджеров. Методология использует нечеткую логику для работы с разнообразными переменными и источниками данных, учитывая неопределенности. Процесс включает в себя анализ местоположения, анализ воздействия, участие экспертных комитетов и создание прогностических сценариев. Интеграция ГИС и блокчейн-сертификация обеспечивают дополнительную поддержку принятия решений. Цель данной методики — способствовать прозрачности и сотрудничеству в сложных процессах принятия решений и способствовать устойчивому развитию прибрежных городов.

Ключевые слова: принятие решений, нечеткая логика, прибрежные города, устойчивое развитие, Рио-де-Жанейро, блокчейн, прогностические сценарии.

Introduction

The state of Rio de Janeiro, Brazil, hosts a coastal region of small and medium-sized cities included in economic regions entitled to royalties from the oil and gas extraction industry. Since the development of technologies enabling the extraction of pre-salt oil in deep waters at an economically attractive cost, these cities have incorporated resources that have added to tax revenue from commerce and services.

The surplus of resources has led to the rapid development of different cities, driven by the economic resources injected in a short period, resulting in social, economic, and environmental distortions. These distortions have arisen from the creation of economic incentives, social benefits, an expansion of human resource contracts in public services, and economic development planning detached from an efficient resource utilization strategy.

In response to these challenges, some of these cities, unable to execute the resources efficiently, established funds with substantial amounts of resources that are managed and allocated more cautiously. Their objective is to address infrastructure issues, urban development constraints, mitigate climate events, and promote long-term strategies. This was done with the recognition that royalties from non-renewable sources are expected to decrease, given the necessary energy transition in the contemporary sustainable world [1].

In this context, this article presents a framework proposal to support decision-making systematically and guided by a methodology. It aims to provide support for decision-making in investment projects involving a technical team [2], committee-based informants, and a city management strategy to ensure transparent, collaborative, science-based, and technology-supported decisions.

In the realm of public projects, organized in a portfolio format, the emphasis on public management and the association with a committee correlate a large amount of discrete, subjective data, often associated with uncertainty levels. The use of Fuzzy Logic [3] in algorithms has been suggested as a means to interact with different variables and data sources.

The challenge of governance in decision-making often lies in individual impressions, political pressures, conflicting logics, preferences, and the use of information without understanding its levels of uncertainty [4] and obsolescence.

When supported by a decision support system, adequately declared and supported by a method, a decision-maker can engage with different stakeholders and maintain technically sound positions, backed by scenarios available based on the recognition of computational limits [5] and data sources available at that moment. It's essential to be aware that these results carry levels of uncertainty.

The application of Fuzzy Logic for decision-making has been widely explored since it was introduced by Zadeh [6] and has been extensively incorporated into electronic devices in automation systems.

1. Methods and Tools

In Brazil, at UFRJ, since the 1980s, research on decision support algorithms associated with the field of economic regional planning has been presented by Cosenza [3]. It has applications related to the organization of urban space based on linguistic term relationships.

Based on the characterization of location factors associated with enterprises: industrial zones, port areas, environmental protection areas, and special interest areas, it became possible to understand the regional synergy related to certain vocations that shape the master plan for land use, safeguarding industrial areas for possible expansion and avoiding disordered housing placement [7].

The application related to identifying vocations and developing support structures for these activities differs from the process of selecting industrial locations, in which an enterprise seeks a location close to the optimal qualification. It involves the analysis of the similarity of demand for regular levels of general and specific factors, characteristic of a defined-scale and technology enterprise, with the supply of candidate regions capable of offering the resource levels required by the enterprise's demand [7].

This association between supply and demand matrices allows the creation of a hierarchical list of candidates to receive such an enterprise. It also highlights the type of gaps existing in the general and specific factors of the candidates' supply. Under certain conditions, the location may be considered ready, feasible with additional investments, or impossible.

The use of Fuzzy Logic for evaluating groups of informants also represents a significant contribution to techniques for evaluating sets of informants regarding subjects treated with respect to their subjectivity [4].

The use of linguistic terms, in most cases, makes it possible to provide a more understandable conceptual separation for informants than applications related to numerical scales, such as the one proposed by Likert. Thus, fuzzy intervals and numbers support the incorporation of uncertainties in processing [8], allowing the informant to facilitate cognitive processes in conveying their opinion.

Informants can be characterized in a set of informants with different weights, resulting from the association of variables related to their maturity, experience, professional position, training, among other relevant aspects, creating different weights for different opinions and informants [9, 10].

The application of a systematic and regulated committee decision-making process is highly demanded in various situations, both in everyday life and in sensitive processes. Often, committees are not convergent, and the absence of a method and systematization [11] can influence opinions and decisions. In the case of systematization, parts of this judgment and effective results are safeguarded since the process must follow rules and methods.

Given the existence of possible scenarios, projecting indicators over time becomes feasible. Predictive scenarios carry complex and natural uncertainties, with direct, indirect, or induced influence, affecting local, regional, and national levels.

In this way, reviewing scenarios also constitutes an important activity associated with long-term planning, observing divergences, and allowing the creation of new scenarios [2].

New technologies related to data management, storage, transmission, and exchange between databases have emerged in recent years, with a definitive impact on the digitization process of entities and government. These technologies allow data validation from origin to destination and the recording of multiple data update steps.

Blockchain [12] has played a significant role in enabling transactions with economic impact, offering high security [. Thus, as a way to create a context for the fusion of technical data, committee information, and the manager's objective, in the creation of a scenario that supports government decisions, the use of Blockchain suggests registering a scenario based on a unique identification.

2. A Proposal for a Framework to Support Decision-Making

Given a Municipality M, with a group of P Projects proposed, a technical group of scientists or consultants, considering the technology and scale of the enterprise, characterizes General G and Specific S factors and records their demand levels, creating Matrix D.

Matrix D means: “What I need for my Project?”

Based on the survey of public, cartographic, and census data for Municipality M, the levels of service for general and specific factors are identified, creating Matrix O.

Matrix O means: "What the municipality M presents for my Project?"

By comparing Matrices D and O for the G and S factors of Project P in Municipality M, it is determined whether the G and E factors are met and at what levels. This result is presented in Matrix R.

Matrix R means: "How the municipality M attends to requirements for the Project?"

It is observed that some of the factors related to climate, natural soil characteristics, and resources are project-restricting, while infrastructure-related factors may, with additional investment, make the project viable, considering economic constraints.

Once the project's location is validated, along with its required investment levels, the technical group begins characterizing social, environmental, and economic impacts. They consider the specific nature of each project and its different possibilities of direct, indirect, or induced impacts.

This analysis includes forecasting investments over time, assessing their implementation in phases, sacrifices in the region due to temporary restrictions impacting roads, and the project's resulting returns in different dimensions: economic, social, and environmental. Thus, Project P is characterized by: General Cost, Cash Flow, Implementation Schedule, Restrictions, Sacrifice Levels, Impact Result in Dimensions, and Impact Variables. This information is recorded by technicians in Impact Characterization Matrices (I).

Matrix I means: "How my Project promotes an impact in M regarding environmental, social, and economic issues?"

Additionally, support databases are organized to clarify these data, along with information about the variables considered in economic, social, and environmental dimensions. These databases aim to support a committee with a recursive library of support data, census data, secondary data, and news. This information is added to the Library Matrix L.

Matrix L means: "Database about M regarding environmental, social, and economic issues ready for consultation."

The Municipal Manager, in turn, has support in defining the emphasis of their management. By selecting their investment policy, they will establish input parameters for the system, allowing projects to be prioritized in creating a scenario that seeks to optimize this management objective.

Matrix E means: "As Decision Makers, decision will have a focus on optimizing expected environmental, social, and economic levels."

The processing then recommends that a set of positive and/or negative impacts generated by a project in social, environmental, and economic dimensions be adjusted to the Manager's emphasis. This will result in a hierarchy composed of the comparison of the Supply and Demand matrices of the Portfolio that optimizes the decision.

In practice, the entry of emphasis data through Matrix E will act as a system of weighting associated with the emphasis levels applied by the Manager, who will infer about the impact variables of Matrix I.

A committee is invited to provide opinions on the future prospects of Municipality M. The practical procedure begins with characterizing the experience levels of the participants in the social, economic, and environmental dimensions. All committee members vote on all dimensions, but their opinions are balanced by their expert qualifications.

Committee informants are presented with questions aimed at capturing expectations, given a future time frame, about how variables and indicators will behave. The overall result of the Committee forms Matrix K.

Matrix K means: "Committee Opinion about future levels for variables related to environmental, social, and economic dimensions."

Given the predictive scenario obtained by the Committee, the economic, social, and environmental variables from the prediction module are considered. A Graphus is designed, suggesting to the decision-maker a sequence of implementations that maximize the management objective.

The result is a scenario of project realization with inferences about a set of future variables induced by implementation over a given time horizon, considering the location, technology, and scale of the enterprises.

Finally, interventions are located based on the data related to their impact geometries and presented on maps with heat scales for each dimension. This is achieved through the integration of databases with the Geographic Information System (GIS) of Municipality M.

The presented scenario is registered with a unique number, certified by origin information and processed through a Blockchain generated by the Fuzzy Logic algorithm, associated with an NFT.

3. Discussion

Recognizing the task of decision-making and the weight of responsibility involved in organizing large infrastructure projects, such as major sanitation works, road openings, transmission lines, ports, airports, railway networks, power plants, and others, all involving significant investments and positive and negative impacts due to their natural interference in implementation and operation throughout their useful life. In most situations, decisions are associated with complex analytical environments full of influences and interests.

The tool proposed in this work aims to encourage a structured practice to bring transparency and participation to management decisions. It desires the involvement of information agents, members of society, experts, and other stakeholders related to the municipal environment transformation process. Therefore, the city directs efforts and takes action to involve and align important agents in the progressive context of project development.

In particular, this scenario creation process with evident contributions to the decision support process safeguards the manager and their collaborators. It acknowledges that, at that moment, based on the available information, a set of assumptions was adopted that best served the management objectives.

Certainly, the term "obsolescence of the scenario" must be applied, observing that, in addition to representing a set of aggregated uncertainties, naturally intrinsic to predictive processes, it also includes an inferential set of variabilities related to the environmental interaction process at the local, regional, national, and even international levels. The predictive scenario is not immune to obsolescence, as new events can transform conditions in the generation of future scenarios. Therefore, in the updating process, data may be updated, new projects and relevant facts may be included, allowing the systematic review of perceptions for the updated requalification of a scenario.

Conclusions

The presented framework has a useful application in the planning context, allowing the analysis of structuring projects with a relatively straightforward monitoring condition of the implementation process and result monitoring. In addition to aiding in decision composition in a complex and predictive environment, it systematizes and supports managers in their decisions at a specific moment, associating all available data, involving stakeholders in the planning process.

The exploration of Blockchain, in addition to certifying the scenario, allows transactions related to server processing to be qualified in a differentiated business model in the Brazilian environment. This includes client requests, certifications, and effective use of systems through the issuance of NFTs.

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ПЛАТФОРМЕННАЯ РЕАЛИЗАЦИЯ АНАЛИТИЧЕСКОГО СОПРОВОЖДЕНИЯ ФОРМИРОВАНИЯ И РЕАЛИЗАЦИИ СИСТЕМЫ ГОСУДАРСТВЕННЫХ ПРОГРАММ РАЗВИТИЯ

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Аннотация. В работе рассматриваются проблемы управления государственными программами развития при трансформации экономки в инновационную. Предлагается переход от программно-целевого управления к программно-проектному. Обосновывается такой переход применением современной теории экономических систем к всей системе пространства формирования и реализации государственных программ. На основе такого перехода базовыми компонентами управления становятся четыре спирали развития: объекты, процессы, среды и проекты. Это позволяет осуществлять формализацию целей и критериев управления и перейти к построению/разработке системы поддержки принятия решений. В работе дан основной подход построения платформенной реализации управления государственными программами развития.

Ключевые слова: государственные программы развития, моделирование, аналитическое сопровождение, система поддержки принятия решений, платформа, мониторинг.