State-of-the-art Geoinformation Technologies Use in the Road Traffic Management

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Abstract

New opportunities in the various processes' management in the frame of the last decades have formed on the base of information technologies development, their widespread use in various spheres of human activity. Road traffic management is one of the fields where information technology using is necessary and demanding. IT technologies are widely used to solve the transport problem, but for the traffic organization, which includes not only the transport network, but also all traffic participants, their use is not so widespread, but necessary.

In Kyiv, the capital of Ukraine, a project has been being implemented an automated road traffic management system creation during the past years. The modern approaches for data working (including technologies for their "production") and geoinformation technologies are lain on the base of the system. The solutions complex that this system provides allows analyzing the existing road traffic management with digital cartography and spatial analysis methods using. However, the successful implementation of any information project requires not only the problem formulation itself but also its support at various levels, i.e. various stakeholders. In the article, the authors analyze the project stakeholders, classify them based on the impact on the project and the interaction organization. They also describe the main approaches to the geographic information system design, analyze the external environment of the project, and, as a result of the analysis, describe the functionality and components of this system.

Keywords 1

Project management, project, stakeholder analysis, environment, the road traffic management, geoinformation system, geoinformation technologies

1. Introduction

The development of information technology has led to the expansion of understanding and processing of information, shaping the Industry 4.0 approaches and the digitalization concepts. The digitalization approaches help not only to copy, save and manipulate "hard" copies of information existing, but also create, transform and disseminate information in such means and ways that cannot be fully repeated in the "non-digital" world. Appearing these possibilities allow the information technology use in a wider sphere of human life, while creating more comfortable, ergonomic and safe living conditions for mankind.

The accumulated data, information obtained as a result of various activities and the appearing opportunities for their storage, processing, analysis, presentation and visualization give more possibilities for efficiently and rationally decisions-making in difficult situations with many correlated

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and unrelated factors. It becomes possible to obtain fast and high-quality forecasts in regard to processes development, systems, connections and relationships. The Road Traffic Management, especially within settlements boundaries, is one of the activity areas in which the demand of the informational (geoinformation) technologies using sharply increasing. Information about the quality, technical, spatial and operational of the street-road network characteristics is an information basis for transport modeling, which takes into account the diversity of road users with their goals, behavior patterns, various characteristics of mobility, environmental and financial indicators. The traffic modeling results are the basis for the planning and activities implementation related to the Road Traffic Management.

The main tasks that are solved by the road traffic management are ensuring the necessary, economically justified indicators of mobility, safety, comfort in the street-road network space for all road users. In the context of the rapid growth of traffic load on the city's street-road traffic network, the growing number of vehicles and road users, the solution of the main tasks, that relate to the road traffic management, is seemed enough difficult goal for authorities and other subjects responsible for the traffic organization and safety without geoinformation technologies using, modern methods of collection, systematization and analysis of initial data. However, it should be taken into account that the solution of the presented tasks is indissociably with the urban planning processes, territorial development, population migration, economic growth indicators, legislative changes, social processes, etc. Now, the term "the sustainable urban development principle" is used for a more shortly definition of the integration and solve complexity in the context of related and interdependent processes of urban development. The term defines an integrated (systemic) approach to ensuring a city (territory) development, taking into account the listed relationships.

In Kyiv, the capital of Ukraine, a project has been being implemented an automated traffic management system creation during the past years. The system is called "Municipal Traffic Management Scheme". It is the system's working name. The modern approaches for data working (including technologies for their "production") and geoinformation technologies are lain on the base of the system. The solutions complex that this system provides allows to analyze the existing road traffic management with digital cartography and spatial analysis methods using.

2. The Road Traffic Management as the approach to safety all road users

A city growing is a challenge not only for social, medical, educational, economic and financial spheres of life. This is a challenge to the city's “arteries” and “veins”, which are its street-road network.

In Ukraine, mainly urban development occurs due to the building’s compaction in large cities, in fact, "embedding" new residential buildings, business complexes, shopping and entertainment centers in the existing construction.

The existing approach of grouping management structures in the city center (state and local authorities, organizations' and enterprises' central offices) does not help to reduce the transport concentration in the city center and distribute its load throughout the city. City development, based on the concentration of most jobs in one city's selected part, and the design of "sleeping" areas leads to the daily movement of large numbers of people between the "sleeping" and "working" areas. It creates an additional burden on the street-road network, promotes the emergence of transport concentration places, which ultimately provokes traffic accidents.

The solution of the above problems is based on the correct and rational road traffic management that should be based on the data analysis and processing, a prerequisite for which is their referencing in space.

The Road Traffic Management, as a set of measures aimed at improving the safety and comfort of all road users, based on the analysis of the literature [1 - 9], is considered most often in the form of a transport model, which is based on the mathematical approaches of the queuing theory. Indeed, in this area, significant results have been obtained that have proven themselves in practice. However, the main con of such approaches is the fact that the road traffic management refers exclusively to the transport network. This does not take into account other factors that affect the very process of management such a movement.

If the road traffic management is considered from the position of all road uses on the street-road network (transport, pedestrians, cyclists, segways, unicycle, etc.), then the task takes on a completely different meaning. In this context, many different factors will influence road traffic. Transport, residents, places of inhabits concentration (residential and office buildings, shopping and entertainment centers, educational institutions, healthcare facilities, road infrastructure facilities), the location of working and sleeping areas, etc. are considered as factors. In addition, it becomes important not only information about the existence of objects, but also their spatial and temporal reference.

The road traffic management should take into account changes and keep the "history" of changes in the city's territory. Thus, it is necessary to have and operate with various data, analyze, generalize and predict the situation on the city's street-road network in order to effectively organize it to create comfortable living conditions for residents and people who come to the city. In this context, existing transport models cannot be used.

Considering the large amount of data, their temporal and spatial components, large daily, weekly and seasonal dynamics, the geoinformation system creation for the road traffic management in the city is possible only if modern technologies are used. These technologies should be based on the geoinformation mapping using, spatial DBMS, web cartography.

3. The basis of the Road Traffic Management Geoinformation System Development

The information processing speeding up and the means increasing for its accumulation has led to a wider and more diverse information technologies application in various spheres of human life.

Cartography is one of activity areas, which requires for decision-making the accumulation and processing of a large information amount. However, in turn, the cartography uses as a basis for management decisions making is also enormous. The most simple and well-known cartography using is the various maps of the area creation. But cartography here appears "explicitly". It can be said that this is cartography for cartography, which aims to replace hard copy on electronic ones.

Huge number of decision-making systems exist and are being developed, where cartography lays down in a base and is used for making decisions in an "implicit" form or is one of the elements. For example, there are meteorological systems, land management system, municipal management system, smart cities systems, transport system, utility services management systems, ecological systems, etc. In such systems, cartography acts as the basis to which various data are bonded for decision-making.

This use of cartography has led to the emergence of a new concept that is called a geoinformation mapping, which is cartography development in the information technologies environment [10].

Geoinformation mapping was formed at the intersection of automated cartography and geoinformatics and is used to process such data by geographic information systems (hereinafter - GIS).

The combination of digitalization and mapping approaches allows the information systems creation, the result of which is not only a digital representation of the area, but the possibility of management decisions making with binding to the area. For example, systems with geospatial data can include not only a representation of the area, but also an indication of the characteristics of objects in a given area, the presence/absence of utility services, soil characteristics, the number and characteristics of the population, etc. And an investor who makes a decision to purchase a land plot/production facility can immediately assess, for example, the presence absence of labor resources, the amount of money should be invested to carry out/modernize utility services. Thus, the systems become not only informational, but also analytical, and, in some cases, forecasting. For example, geoinformation mapping is widely used in forecasting changes in a river's bank relief (forecasting landslides, river floods, changes in river channels).

Geoinformation mapping has found its application in the road traffic management and design for a long time. It has proven itself well as a basis for the cities' street-road network design. But its application for the road traffic management (in the understanding presented in clause 2) is being implemented in Ukraine for the first time. Some important reasons of this situation are indicated below:

1. Legislative gaps in the data exchange problem regulation;
2. Low interest of the organization responsible for the Road Traffic Management;
3. Employees Resistance to the information systems implementation;
4. Weak employees' cartographic competence;
5. Weak interest of the city authorities;
6. Not enough financing;
7. Difficulties with the database filling and the data updating;
8. Low awareness of the population about the usefulness and necessity of the systems using and applying.

Nonetheless, the systems are necessary and useful. They help not only to maintain material objects control and accounting, but also to analyze and predict changes in the street-road network depending on changes in the external environment. For example, using the systems, it is possible, on the basis of data about road accidents on a certain section of the street-road network, to analyze the causes and develop approaches to reduce the latter. A new modern construction in the middle of the old residential area of the city leads to an increase in traffic and more traffic congestion in the area. It leads to an increase of the danger level in the frame of this territory, road accidents increasing, and population living space deterioration. Using the systems, all of the above can be predicted and foreseen in advance by taking appropriate measures and approaches to reduce or neutralize the impact of the emergence of new residential construction on the existing territory through the reorganization of road traffic.

4. Management of a geoinformation system creation: Kyiv Case Study

A geoinformation information system for the Road Traffic Management creation is a complex infrastructure project, in the implementation of which many stakeholders are directly or indirectly involved. The system creation is a complex process that a lot of time and resources require (both human and financial). In addition, the system introduction requires organizational changes not only at the enterprise's level involved in the Road Traffic Management organization, but also at the city authorities, as well as coordination with the patrol police units in Kyiv.

The article will analyze the environment, stakeholders are assessed and the Road Traffic Management geoinformation system main components are described, which is being implemented in Kyiv.

4.1. The Project's environment evaluation

Building any information system should start with a project environment analysis. There are many approaches that can be used. In our case, we believe that such an analysis can be carried out in the best way based on the use of the approach presented in Figure 1.

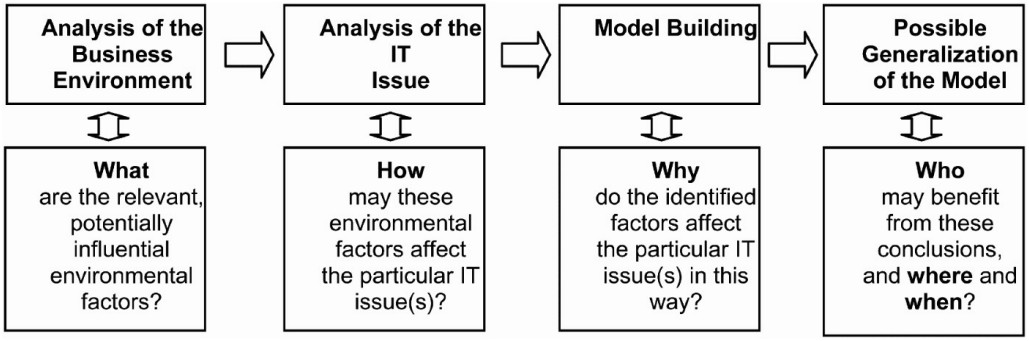

Figure 1: Analysis of the environmental factors to IT implementation success [11]

The most significant factors will be described that influence the Road Traffic Management geographic information system creation:

- A systematic understanding of the transport and citizen movement in the city - what are transport and citizen flows exist, what are the flows volumes, their intensity, dynamics, time fluctuations, etc.;
- State-of-the-art and planned traffic model - how is traffic organized now and what will be trends in the future (cycle routes allocating, safe traffic on segway and electric unicycle designing, citizen traffic flows changing, approaches to the city's urbanization changing, etc.);
- A Road style - if will be the Road Traffic Management global approaches introduced based on the sustainable "patterns" formation of road design, applied throughout the country (or at least within one city). As examples there are traffic islands, lanes increasing in front of intersections, smart traffic lights, etc.;
- The Legislative base - the system creation requires information receiving and exchanging between different structures (patrol police, civil society organizations, transport municipal departments, etc.), which must be regulated at the legislative level. The system creation requires the information presentation unification, approaches to its updating and reliability, taking into account the restrictions on the information use in the open domain. The quality of information directly affects the system analytical and forecasting functions, and, accordingly, the management decisions adoption.

The influence of the described factors on the information system results is situated in the relevance field, relevance and correctness of data; data acquisition frequency; update and sharing capabilities; the creation of rules for the street-road network design taking into account all road users for effective, safe the road traffic management; traffic lights programmability and "smart" traffic lights installation.

These factors influence is due to the fact that the system should make it possible to make relevant management decisions based on the relevant data used. Any changes in the external environment directly affect the system's result. In addition, the unification of the behavior rules in road traffic and their "stereotyped" / repetitiveness forms their unambiguous automatic mental patterns [12] for all road users, increasing the safety of the latter. Such approaches lied down on the basis of the national safety concept developed in different countries, for example, in the Kingdom of the Netherlands (Sustainable Safety [13]).

Various stakeholders will benefit from the Road Traffic management geographic information system implementation in the city:

- Economic development of the city. Pros will be injuries reduced, road traffic and environmental situation improved;
- City governments. Pros will be the road safety indicates, mobility, sustainability and management improved;
- Organizations that the Road Traffic Management ensure. Pros will be in city-wide traffic management scheme improving, monitoring and control of elements of traffic organization, accounting and movement of material values, road markings drawing, unification of rules of traffic behavior for road safety improvements;
- Citizens. Pros will be road safety improving, the ability to use ecological transport in the urban transport network (cyclists, segways, etc.), creating safe zones / city districts for children and teenagers;
- Vehicle drivers. Pros will be unified rules of behavior in road traffic in the city.

4.2. Stakeholders analysis

The success of any project is based not only on the right and correct application of methodologies, techniques, and methods of project management. Stakeholder management is a major success factor. To manage stakeholders, it is necessary to identify them and estimate them from the point of view of their influence on the project. The impact on the project will change during the project implementation. We will assess the stakeholders at the initiation and planning stage.

There are various models and techniques for stakeholder analysis. These include Internal/External Stakeholder Analysis, Primary/Secondary Stakeholder Analysis, Force Field Analysis, SWOT Analysis, Actor Impact Diagrams, the Power Legitimacy, Urgency Model, Stakeholder Mapping [14]. All of them are used for the different aspects of evaluation (it's depends on the project's "difficulty"

and needed deep of the evaluation) on different stages of project management. In the context of the article's case study, for the stakeholder analysis, we will apply the Power, Legitimacy, Urgency model (the Mitchell model) and the model "Power/ Interest" (the Mendelow model). The Mitchell model gives possibility to receive the first stakeholder evaluation. The Mendelow model gives additional analysis.

4.2.1. Using the Power, Legitimacy, Urgency model for Stakeholder analysis

The Power, Legitimacy, Urgency model is described by Mitchell, Agle and Wood in 1997 [15]. This model presents a 7 types stakeholder behavior map depended on the 3 parameters combination (fig. 2):

- "**Power**: the ability project stakeholders have to influence the outcome of an organization, deliverable or a project - essentially the ability of a stakeholder to impose their will" [16]. It defined as *P*;
- "**Legitimacy**: the authority and level of involvement project stakeholders have on a project and whether their involvement is appropriate and to what level" [16]. It defined as *L*;
- "**Urgency**: the time expected by project stakeholders for responses to their expectations and so the need for immediate action" [16]. It defined as *U*.

In general, stakeholder can have all of these parameters (characteristics). If a stakeholder is denoted by *Sh*, than the stakeholder with all characteristics can be presented as a set which is described as

$$Sh = \{P,L,U\} \quad (1).$$

According to the model, the stakeholder with such characteristics is called *definitive* stakeholder (7 in the figure 2).

If the stakeholder can be described using only two characteristics (is denoted it as Sh'), for example, $Sh_1' = \{P,L\}$, $Sh_2' = \{P,U\}$, $Sh_3' = \{L,U\}$, is called *waiting* stakeholder (4, 5, and 6 in the figure 2) and

$$Sh' = \{Sh_1', Sh_2', Sh_3'\} \quad (2).$$

In dependence on the combination of the parameters (2) he/she can be classified as

(2,a) if the stakeholder possesses Power and Legitimacy ($Sh_1' = \{P,L\}$) is called *dominant* (4 in the figure 2), i.e. he/she has power to require stake and legitimacy to lay a claim, but doesn't have rights to define deadlines;

(2,b) if the stakeholder possesses Power and Urgency ($Sh_2' = \{P,U\}$) is called *dangerous* (5 in the figure 2), i.e. he/she has power to require stake and define deadline of claims, but doesn't have lack the legitimacy for his/her rights;

(2,c) if the stakeholder possesses Legitimacy and Urgency ($Sh_3' = \{L,U\}$) is called *dependent* (6 in the figure 2), i.e. he/she lack the power to enforce his/her stake.

If the stakeholder can be described using only one characteristic (is denoted it as Sh''), for example, $Sh''_1 = \{P\}$, $Sh''_2 = \{U\}$, $Sh''_3 = \{L\}$, is called *hidden* stakeholder (1, 2, and 3 in the figure 2) and

$$Sh'' = \{Sh''_1, Sh''_2, Sh''_3\} \quad (3).$$

In dependence on of the character (3) he/she can be classified as

(3,a) if the stakeholder possesses only Power ($Sh''_1 = \{P\}$) is called *dormant* (1 in the figure 2), i.e. "little or no interaction/involvement" [17];

(3,b) if the stakeholder possesses only Urgency ($Sh''_2 = \{U\}$) is called *demanding* (3 in the figure 2), i.e. "those with urgent claims but no legitimacy and power, irritants for management but no worth considering" [17];

(3,c) if the stakeholder possesses only Legitimacy ($Sh''_3 = \{L\}$) is called *discretionary* (2 in the figure 2), i.e. "likely to be recipients of corporate philanthropy, no pressure on managers" [17].

(2) and (3) are a special case of (1). On the base of it, it is $Sh'' \subset Sh' \subset Sh$. Based on the stakeholders' characterists, which are presented above, they can be divided on the three classes of salience: (1) is High Salient Class; (2) is Moderate Salient Class; and (3) is Low Salient Class.

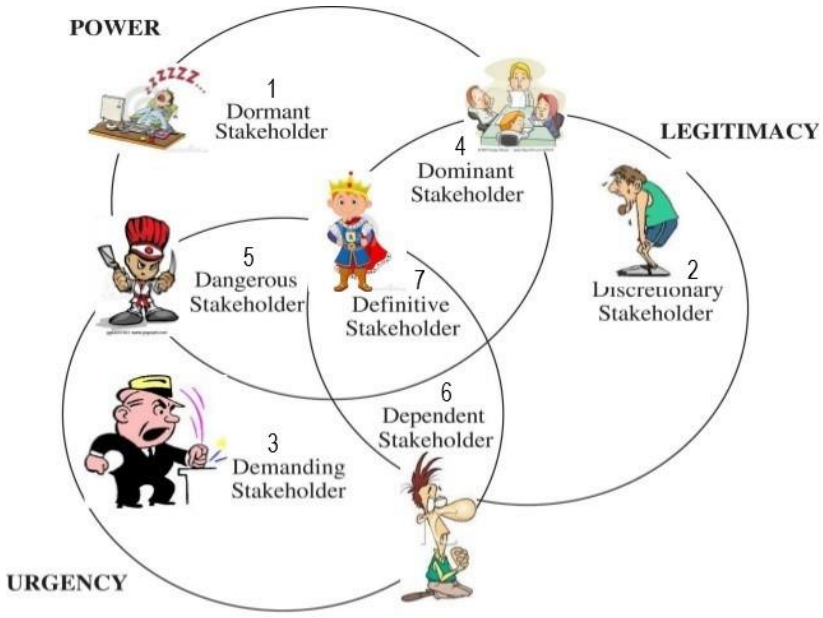

Figure 2: Mitchell's Model [16]

The Power, Legitimacy, Urgency model is used for the project stakeholder analysis. First of all, let's divide the stakeholders into two groups: internal and external. For internal stakeholders, "an organization" in the context of the model will be the initiators of the project, and for external stakeholders, "an organization" will be the enterprise that develops and implements the project.

The Internal Stakeholders are:

(I1) The management of the enterprise in charge of the road traffic management. In the model notation it is (1);

(I2) Employees of the enterprise in charge of the road traffic management. In the model notation they are (3,c).

Thus, (I1) are clearly *definitive* stakeholder; (I2) are *hidden* stakeholders and *discretionary*. In the context of project success, interaction with (I1) involves partnership and collaboration; interaction with (I2) is observe neutrality, but they should be under control that they do not move from *discretionary* to other categories and will negatively influence the project.

The External Stakeholders are:

(E1) City authorities in charge of the road traffic management. In the model notation they have power, legitimacy, i.e. (2,a);

(E2) Enterprises providing the road traffic management services (for example, pavement replacement/laying organizations). In the model notation they have legitimacy, i.e. (3,c);

(E3) Patrol police. In the model notation it has power, legitimacy, i.e. (2,a);

(E4) Car drivers. In the model notation they have urgency, i.e. (3,b);

(E5) Enterprises responsible for the urban transport organizing. In the model notation they have power, legitimacy, i.e. (2,a);

(E6) Population (people with moving restrictions (wheelchair users); with kinder in baby strollers, teenagers). In the model notation they have legitimacy, urgency, i.e. (2,c);

(E7) Public organizations that represent the interests of cyclists (and also electric unicycle, segway, and electric scooter owners, etc.). In the model notation they have legitimacy, urgency, i.e. (2,c);

(E8) Scooter and motorcycle drivers. In the model notation they have legitimacy and urgency, i.e. (2,c).

Analyzing the obtained results, we can get the following situation. The (E1), (E3), (E5), (E6), (E7), and (E8) are waiting stakeholders, of which (E1), (E3) and (E5) are dominant, (E6), (E7), and (E8) are dependent. In the context of the project success, the interaction with (E1) and (E3) can be organized as the base cooperation, with (E5), (E6), (E7), and (E8), the interaction is based on the using and manipulating. The (E2) and (E4) are hidden stakeholders, of which (E2) are discretionary,

(E4) are demanding. In the context of the success of the project, interaction with last both groups involve maintaining neutrality.

4.2.2. Using the model “Power/Interest” for stakeholder analysis

Mitchell’s model gives us an understanding what the stakeholders’ classes we have and how to interact with them. However, the project's success is also depending on the stakeholders’ influence on the project. During the project implementation, the project manager should evaluate and control the stakeholders’ influence on the project, because an influence changing can lead to the project failure. For the stakeholders’ influence evaluation can be used the model “Power/Interest”.

The model "Power/Interest" (Mendelow’s model or impact assessment) is used for stakeholder analysis mode detail. This model classifies stakeholders about the power they wield and their degree of interest in the organization's strategies. According to this model it is

$$\text{Impact} = \text{Power X Interest} \quad (4)$$

where Power is a possibility and capability to have an impact;
Interest is a desire to have an impact.
It can be presented on the Cartesian plane (Figure 3).

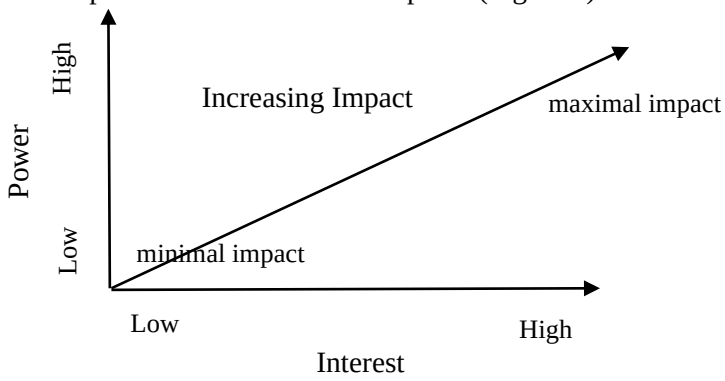

Figure 3: Mendelow’s model on the Cartesian plane

The "Power/Interest" model can be used to demonstrate the types of impacts on depending on their Power and Interests. Mendelow's model allows determining the stakeholders who will be most influential during the project implementation, as well as to identify in advance the potential conflicts of interest zones (as a rule, this refers to the parties falling into the intersection zone of high-level power and high-level interest) (Figure 4).

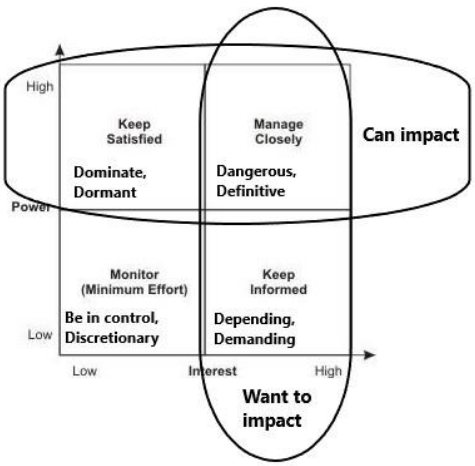

Figure 4: Mendelow’s model in matrix “Power/Interest” (combination [18] and [19])

Using Mitchell’s model approach the interaction with stakeholders can be organized on the base of their characteristics:

(1) stakeholders who $Sh''_3 = \{L\}$ are the group requiring minimal effort and controlling. They can't and don't want to impact the project [14]. At the moment they are "casual travel companion";

(2) stakeholders who are $Sh''_1 = \{P\}$ and/or $Sh_1' = \{P,L\}$ group are powerful, but their level of interest in the project is low. The project manager should keep their interest satisfied and remember that they can impact the project if they want to do it. They are generally relatively passive, but can suddenly become more important as a result of certain events by moving to $Sh_2' = \{P,U\}$ and/or $Sh = \{P,L,U\}$ groups on a matter [14]. Their demands must be met. At the moment, they are "sleeping monsters";

(3) stakeholders who are $Sh''_2 = \{U\}$ and/or $Sh_3' = \{L,U\}$ are the group needing to be kept informed at all times. They can be important for influencing stakeholders with more power [14]. At the moment, they are "interested";

(4) stakeholders who are $Sh_2' = \{P,U\}$ and/or $Sh = \{P,L,U\}$ are both influential and highly interested in the project. The acceptability of strategies from the perspective of these key players should be an important consideration in evaluating new strategies [14]. They can and want to impact. This is a potential conflict zone. At the moment, they are "key players".

Thus, internal stakeholders, (I1) have a lot of power and interest. They are "key players" and the interaction should be on a high level. (I2) have low interest and low power. At the moment, they are "casual travel companion", however, it is important to pay attention that they can change their interest and they can be dangerous or demanding.

External stakeholders (E1), (E3), and (E5) have high power but low interest. The project manager should be more attentive and control these stakeholders because if their interest change they will move to "key players" in the interested project's aspects. (E4), (E6), (E7), and (E8) have low power but great interest. They want to impact, but they don't have power. The project manager should keep them informed and control changing power force. (E2) is the same as (I2).

4.3. Describing the geoinformation system from the components and functions position

The creation of an active geographical information system of the Road Traffic Management is a hard infrastructure project. Its implementation requires realization of the various activities complex that can be grouped in the next areas: (i) Organization activities; (ii) Methodological support; (iii) Software-Technical support; (iv) Informational support.

Organizational activities included project purpose and objectives defining, the main directions defining of the project implementation, setting interaction and communications between the organization's divisions that is a responsible for the road traffic management in the city, preparing and providing meetings and presentation of the results obtained [20].

"The Project's Methodological support consisted of the study of the current regulatory framework for the Road Traffic Management design [21 – 23], study of modern technologies in working with spatial data, the study of domestic and foreign experience, the technological solutions development [24 – 28]" (for study and cartography of the street-road network elements, data processing of the archives and formation of the electronic documents archive), "methodological documents preparation, and training of the organization's staff" [20].

"The Software-Technical support for the project was carried out as the part of development and administration using open-source software (QGIS, PostgreSQL, PostGIS, MapServer, MapServer, Inkscape): the municipal database of the technical elements of the Road Traffic Management; the spatial data management tools; the repository of symbols; information web-portal" [20], and access of the divisions to data.

"The Project's Information Support included the preparation base digital map, the street-road network elements surveying in Kyiv, office studies of the survey results, data entry into the database" [20], using the base scheme of the Road Traffic Management for current tasks solution in the city.

The geoinformation system of the Road Traffic Management provides local governments, service utilities, enterprises and other entities whose activities influence on the urban space development and conditions, relevant and reliable information about the Road Traffic Management for:

- territories planning;

- planning activities for the Road Traffic Management, including in suburban areas;
- the Road Traffic Management designing;
- the street-road network elements condition monitoring;
- the street-road network elements certification;
- the road traffic level safety analysis and the effectiveness of the Road Traffic Management measures implemented;
- a locality transport model development.

The geoinformation system of the Road Traffic Management will be used to inform road users.

The main functions of the geographic information system of the Road Traffic Management are:

- display of the street-road network elements, planning and cartographic basis, additional design elements in the accepted symbols in certain scales;
- the Road Traffic Management new spatial elements information;
- entering, editing and displaying attribute data;
- conducting a comprehensive spatial and statistical analysis of the street-road network elements locations and urban infrastructure objectives, the street-road network, accident concentration sites;
- establishing relationships between objects, processes and factors that influence them;
- the information exchange possibility with other information systems implemented in the framework of urban concepts "smart city".

An important functional component is the information web portal, which provides open access to data and services using the Internet.

Note that the implementation of the project in the future is the base for others projects initialization that can be concerning on the organizational structure changes and employee trainer to use the system.

5. Conclusions

Managing an infrastructure project creation at the institutional level is a complex and multifaceted task. At this stage, a prototype of the system has been implemented, which is being tested and approved. The widespread implementation of the system throughout the city requires joint actions of not only one enterprise, but also of the city authorities, as well as the active participation of public organizations.

In addition, the results of this project stimulate the initiation of other projects related to the implementation, training and dissemination of the system not only in Kyiv, but also in other cities of Ukraine.

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