Spatial visualisation of stakeholders based on cartographic methodology in management systems

Abstract. This study presents a model of a tool for spatial visualization of processes occurring in the stakeholder environment concerning relationship management according to the ISO standards for management systems. Spatial visualization is based on cartographic methodology extended with technological capabilities used in GIS (Geographic Information Systems) systems.

Thanks to the method, different types of issues using environment maps can be presented. This paper proposes a model of a tool enabling multi-criteria spatial visualization of states, phenomena, processes and plans taking place in the discussed environment.

The proposed model of visualization is to be used in the future to present the results of research in the discussed field. They concern stakeholder relationship management according to the ISO management systems. Appropriate technology is required for the application of the model.

The study is part of a stream of works aimed at using the concept of space to describe various sections of reality. It may have both theoretical implications (visualizations based on spatial models), as well as practical ones related to popularizing the use of various types of space to describe phenomena and planning.

The originality of this study is that the present model-based visualization features selected stakeholders within the ISO standards. As part of the visualization example, heuristic spaces were defined, on which objects representing different types of stakeholders were placed, their significance as part of the ISO standard being determined according to each of the features: power, interest and predictability. The data was obtained in a branch of an international corporation operating in the packaging industry.

Keywords: Spatial Visualisation; Interested Parties; Stakeholder Relationship Management; Heuristic Space; Corporation; Packaging Industry

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Пространственная визуализация заинтересованных сторон
на основе картографической методологии управления

Аннотация
В данном исследовании представлена модель инструмента для создания пространственной визуализации процессов, происходящих в среде заинтересованных сторон касательно управления взаимоотношениями в соответствии со стандартами ISO для систем управления. Пространственная визуализация основана на картографической методологии, рассширренной технологическими возможностями, используемыми в географических информационных системах.

Данный метод поможет в решении разного рода задач с использованием карт среды. В данной статье предлагается модель инструмента, обеспечивающего многокритериальную пространственную визуализацию состояний, явлений, процессов и планов, наблюдаемых в обозначенной среде.

Предложенную модель визуализации следует использовать для получения результатов исследований, касающихся управления взаимоотношениями между заинтересованными сторонами в соответствии...
с системами управления ISO. Следует отметить, что для применения данной модели на практике требуется соответствующая технология.

Данная работа является частью исследований, направленных на изучение концепций пространств для описания различных аспектов реальности, следствием которых могут стать как теоретические результаты (визуализация на основе пространственных моделей), так и результаты практические, связанные с пониманием использования типов пространств для описания различных явлений и дальнейшего планирования.

Оригинальность данной работы заключается в том, что разработанная модель раскрывает взаимоотношения между заинтересованными сторонами в рамках стандартов ISO. В качестве примера визуализации были выбраны эвристические пространства с объектами, представляющими разные заинтересованные стороны, и указано их значение в части стандартов ISO с учетом обозначенных характеристик, таких как сила, интерес и предсказуемость. Данные, необходимые для проведения исследования, были получены на примере филиала международной корпорации, представляющей упаковочную промышленность.

Ключевые слова: пространственная визуализация; заинтересованные стороны; управление взаимоотношениями между заинтересованными сторонами; эвристическое пространство; корпорация; упаковочная промышленность.

1. Introduction

The application of ISO standards for management systems in business operations is based on various premises (Rodríguez-Mantilla et al., 2019; Kumar et al., 2012; Antilla & Jusilla, 2017; Barouch & Kleinhaus, 2015; Weckenmann et al., 2015; Cronemyr et al., 2017; Looser & Wehlmeyer, 2015; Rönnbäck et al., 2009; Lilja et al., 2017; Rönnbäck and Eriksson, 2012). The management of enterprises assumes that the application of these standards should make it easier for them to acquire customers, especially those who expect quality products and services. Building procedures based on best practices should lead to the effectiveness of operations. However, modern ISO standards for management systems affect more and more areas of activity. Their impact may include not only internal regulations but also refer to various types of external entities. It is even more important that contemporary business relations lead to the fluidity of the boundaries between various entities involved in the same business environment. That is why more and more often the stakeholder theory can be used to describe business processes taking place in multiorganization environments. Consequently, entities involved in business processes can be organized by types, roles and importance in applying or enforcing ISO standards for management systems.

The application of ISO standards and the subsequent implementation of the procedures resulting from them is a complex task. It can be seen in a variety of ways. The application of ISO standards for management systems, in some cases, may result from the necessity imposed by business partners or environmental requirements. The need to use them is undisputed. However, the problem relating the effects and consequences of their use remains. In such situations, the application of standards is based on qualitative criteria. The economic calculation may be another factor in the application of ISO standards for management systems. Then the implementation of ISO standards is treated as an investment, due to the possibility of efficiently executed business processes while controlling the economic effects of its application. In general, all activities related to the implementation of applicable standards are subject to registration and can be used for economic evaluation.

Many parameters may appear under stakeholder relationship management within ISO standards for management systems. Some of them may be subjective and result from the assessment of their own responsible managers, while the value of others may be calculated based on the assessment of events or realized instances of the processes. In practice, the number of parameters can be large, and there may be problems with the interpretation of their values (both in static and dynamic terms).

This article tackles the search for an appropriate tool that would allow the calculation of the values of many parameters simultaneously and their presentations in a way that they can be easily interpreted. Therefore, this paper proposes the use of spatial visualization to describe issues related to stakeholder relationship management within the ISO standards for management systems. Spatial visualization involves the application of cartographic methodology extended to its use in GIS (Geographic Information Systems) for the presentation of the discussed issues (Stępniak, 2018).
2. Purpose
The purpose of the article is to present a model of a tool for spatial visualization of issues related to the stakeholder relationship management within the framework of ISO standards for management systems. As part of this research, the principles of building the space of the discussed environment will be presented along with indications of cartographic tools and ways of applying semantics and cartographic syntax, as well as assumed visualization goals. The article has been developed based on market analysis of GIS tools used today and information needs in the field of stakeholder relationship management as part of the application of ISO standards for management systems. Theoretical considerations will be supported by a case study based on the description of stakeholder relationship management obtained during research in one of the enterprises.

3. Theoretical assumptions of spatial visualization
Spatial visualization is used to present a selected reality piece using a cartographic methodology extended by the GIS technology (Sherin et al., 2017). In this case, a broad understanding of the concept of space is used. It can be treated as a feature (defined by means of relations - distances between objects), a construction (usually defined as a mathematical model) or an environment (where space is used to describe it). A broad understanding of space means that the concept is not limited to geographical or astronomical phenomena. The concept of space can describe any environment, provided that the following conditions are met:

- it is possible to define space dimensions;
- it is possible to specify the types of objects that are subject to visualization;
- it is possible to locate objects according to the defined dimensions;
- it is possible to define relations between various types of objects and objects themselves;
- it is possible to evaluate features describing particular objects according to how they will be visualized on the map.

Undoubtedly, the possibilities of visualization of various types of environments have increased along with the development of the GIS technology (Moscicka, 2017; Baños et al., 2016; Pigott & Hobbs, 2011; Albuquerque et al., 2018). Due to it, it was possible to create interactive maps (operating on-line or allowing manual objects to be applied (Kita et al., 2018) - e.g. operating on the principle of augmented reality (Skinner et al., 2018; Perez Jimenez et al., 2016; Bernardes et al., 2018; Sánchez Riera et al., 2015; Gardony et al., 2018; Jurado et al., 2017), describing the nD (n-dimensional) space with the possibility of changing the coordinate system, incorporation/disabling thematic layers, changing the features according to which objects are presented, objects moving on maps or collision detection.

In the modern GIS technology, the dimensions of space are defined by mathematical systems (a cartographic grid is one example of a mathematical model). Each axis of the dimension of space means some feature that is a reference point for each of the visualized objects. The mentioned trait can be real (e.g. longitude) as well as abstract (each object can be assigned a value according to a given feature). Values according to the features defining space dimensions determine the locations of given objects in the defined space. The mentioned features are spatial attributes. The number of describing attributes can be any, but the GIS technology allows 3D visualization only (Atila et al., 2014; Yang et al., 2016) taking into account the time factor.

Within a visualized environment, there may be different types of communities that usually define separate classes of objects. In turn, object classes are described by the same features and create separate layers during visualization. Multiple objects can belong to individual object classes.

There may be different types of relationships between object types, or they may be similar. During visualization, the appropriate types of objects can be adequately selected to pursue presentational purposes and to keep the maps legible.

In addition to spatial attributes, object classes can also be assigned by description attributes. Descriptive attributes reflect the features, according to which visualization of individual object classes is made. The applied principles of cartographic visualization allow in certain circumstances to present objects according to their described features. Symbolization of individual objects on the map depends on the values of attributes describing by which the visualization is made. If the given values can change over time and the said variability can be reflected in the databases according to which the visualization is made then dynamic maps can be created, allowing variability in online mode (Carrizosa et al., 2019).
4. Possibilities of spatial visualization for the purposes of interested parties within ISO standards for management systems

If one treats the implementation of ISO standards as investments, it should be expected that the effect of this measure should be to improve the competitive position of the company. The implementation of these standards should constitute an additional factor affecting relations with both internal and external stakeholders.

Spatial visualization, as already mentioned, enables visualization of any environments, processes and phenomena occurring in them. It can refer to the past, the present and the future. Everything depends on the information resources that can be associated with the visualization tools. It is important to set the purpose and the possibly of the range of phenomena that will be subject to visualization, to define the scope of information resources that should be subject to registration and then processing.

Looking at the specificity of stakeholder relationship management in the light of the applied ISO standards, visualization can be used both in static and dynamic approaches. In this case, everything depends on the information needs of interested users and the applied technological solutions in the field of IT. The main users of spatial visualization within the discussed issue will usually be representatives of higher management and employees of services responsible for the application of ISO standards in enterprises. Different issues can be visualized:

• the subjective arrangement of the environment - a map of real entities - stakeholders involved in the management of standards;
• roles of objects under different standards;
• maps of procedures related to the implementation of standards;
• maps of process instance implementation as part of ISO procedures;
• effect maps (subjective or based on source data).

It depends on the user whether one wants to use only static visualization or have dynamic visualization as well. For a one-time description of the environment, static visualization is sufficient. However, the GIS technology enables dynamic visualization based on primary events occurring as part of activities related to the implementation of ISO standards. The construction of maps of environments related to the management of the implementation of ISO standards depends largely on available IT technologies to the user, thanks to which data can be collected and processed. It seems that the optimal minimum technological system should consist of at least the following four components:

• systems used to map ISO procedures (e.g. based on Business Process Modelling Standards);
• ERP/BI - Enterprise Resources Planning / Business Intelligence;
• GIS - Geographic Information Systems;
• Web-services supporting the implementation of ISO procedures in multiorganization environments or enabling the obtaining of data from the environment (mainly the Internet).

In this case, it is important not only to access these IT tools, but also to integrate them, at least at a level that allows the exchange of data between different types of IT tools.

Stakeholder relationship management within the framework of ISO standards also is a kind of environment for the enterprise. It is a multiorganization environment, because some objects (e.g. suppliers, recipients, shareholders or public administration bodies) may operate outside the management structures of a given company and its management has no decision-making powers over them. From the point of view of information needs of users of visualization of the discussed environment, the following are important:

• possibility to build an environmental space (structural aspect of space);
• determination of objects relevant to a given environment and their allocation in a space (space as a feature);
• description of phenomena and processes occurring in a given environment.

Spatial visualization in the discussed environment can be made at three levels of use. The first level refers to the visualization of the state for a specific moment of time. Within it, objects can be presented based on subjective declarative data or aggregates of data calculated based on primary events. Subjective declarative data can be obtained, for example, by carrying out surveys, where managers responsible for the implementation of standards can assess individual stakeholders according to their own feelings (Kaneko, 2016). Data aggregates, on the other hand, are based on the processing of source data, which allows for the adoption of criteria to assess individual stakeholders.
The second level refers to the assessment of stakeholders based on currently implemented instances of processes or events in which individual stakeholders are involved. This is an online visualization (assuming the integration of the relevant IT tools) based on current events.

The third level allows planning. Planning may involve the implementation of new standards (including the identification of which stakeholders it will affect), planning new types of procedures, the number of their instances or other control parameters (for example, selected performance indicators or process performance indicators (PPI), as observed by del Rio-Ortega, 2010). Within this level, it is also possible to plan a stated goal (investments, desired results) that can be applied manually to maps (analogically to municipal maps, planned investments are planned at the time of their submission, before they are put into operation). It can be implemented by others due to the augmented reality technology. Data on maps are saved within normative databases or planned investment databases.

5. The procedure of spatial visualization application

Spatial visualization concerning the stakeholder relationship management within ISO standards may result from different needs. It can be implemented from the inside or the outside of the given environment. In this case, the starting point is to determine what the environment is.

In the present considerations, the environment should be understood as an abstract area within which all entities that stakeholders are in relation to ISO standards apply in a given company’s operation. The following typology of stakeholders was adopted in these considerations: internal stakeholders (employees, management and shareholders of the company) and external stakeholders (suppliers, clients, public administration offices, consulting companies related to ISO standards implementation, other organizations having some impact on the application and management of ISO standards, for example local or ecological organizations). In spatial descriptions, it is possible to visualize not only stakeholders but also their activity and relations that happen to be between them taking into account the management of ISO standards.

Visualization from the outside of the given environment means an attempt or the possibility of tracking how ISO standards are implemented in the given environment. This type of visualization may have, above all, control or research significance. Control issues are related to statutory rights and concern mainly selected public administration offices and certifying authorities. In turn, the research significance applies to scientific and research institutions whose aim is to analyze the states and effects of applying these standards. On the other hand, visualization within the environment is primarily aimed at studying the effects and effectiveness of the applied standards. It can also be used for day-to-day management of applicable standards as well as for searching for opportunities to improve the applied procedures.

Regardless of the perspective from which spatial visualization is prepared, the following stages should be distinguished:

- defining the space;
- classification of stakeholders;
- defining the rules for the location of objects (defining spatial attributes);
- identification of potential visualization goals;
- defining attributes describing objects;
- defining procedures related to the implementation of ISO standards;
- Visualization of instances of procedures;
- planning under ISO standards.

The starting point is defining the space of the visualized environment. In the case of geographical, astronomical or physical environments, the comprehension of space occurs when it is understood as a feature. The relationship of distances between objects determines their location in space. In turn, scattering of objects determines the size and the shape of the space. However, in the case of an environment describing the stakeholder relationship management within ISO standards, it is difficult to apply one of the aforementioned spaces. In this case, heuristic methods or a mathematical model is required for its construction. It is also acceptable to fold the space from several subspaces. In this case, the sum of subspaces will be the space of the environment.

When defining space, it is important to determine its dimensions, i.e. to choose the features that the axes will describe. In contrast to real space (geographical or physical), any number of dimensions can be defined in abstract theoretical spaces. It should be remembered, however, that only
three (3D image) can be used at the same time with the possible consideration of the time factor. Therefore, it is not always worth building $n$D spaces ($n$-dimensional).

In abstract spaces, i.e. heuristic or mathematical, the role of a cartographic grid usually assumes a coordinate system. Individual axes may, yet not necessarily, have the shape of straight lines (in the classical cartographic grid they approximate circles). However, the coordinate system based on simple axes is undoubtedly more convenient for visualization.

In this environment, the basic class of objects are stakeholders. From them, the basic thematic layer will be created during the process of visualization. The problem is that there are different groups of stakeholders involved in the management of ISO standards. In this situation, it is difficult to find features that would describe all types of stakeholders in the same way. Therefore, the next step is to classify the stakeholders. For this reason, a heuristic space, which is a composite of several subspaces, can be used for the discussed environment, allowing the allocation of objects according to their classification.

As part of this study, stakeholders were divided into five groups. The mentioned classification, together with the proposed location rules within individual groups, is presented in Table 1. As part of the presented environment, for the purpose of visualization, the classification of stakeholders is not enough. In this case, it is required to consider relationships between the different groups. In the developed model, it is proposed to use the system approach with its classic INPUT - SYSTEM - OUTPUT layout (see Bentley & Whitten, 2008). For this purpose, adequate symbolization of subspaces was used in which particular groups of stakeholders were deployed.

The location of the objects on the map within the described environment has two levels. The first level results from the object belonging to the group of stakeholders. This is how its subspace is defined. The second level is location within the subspace. For this purpose, spatial attributes, which must be in the coordinates of a given subspace, are required. Although subspace creates one space, the location depends on the subordinates of each subspace.

Submission of a subspace enables the construction of the space as a whole. The construction of the space proposed in this study is presented in Figure 1.

Further, particular types of stakeholders are assigned to particular subareas, as shown in Figure 1. Due to the fact that there is no single space for all types of stakeholders, it is necessary to specify the location rules for each type separately. When defining the dimensions of the space, any methods can be used depending on the expected visualization effects. 2D visualization was proposed for this environment, and the following methods for allocating spatial attributes were selected (Table 1).

### Table 1:
| Symbol of Subspace | Name of stakeholder type | Attribute by X axis | Attribute by Y axis |
|--------------------|--------------------------|---------------------|---------------------|
| 1                  | Suppliers                | Distance from the supplier | Processed symbol of the main delivery item |
| 2A                 | State offices, other organizations, certifying bodies, etc. | Randomization of the type of organization | Randomization of the organization’s name |
| 2B                 | Shareholders             | Geo location assignment | Geo location assignment |
| 2C                 | Management and employees of the enterprise | Based on the coordinate system superimposed on the official diagram of the organizational structure | Based on the coordinate system superimposed on the official diagram of the organizational structure |
| 3                  | Recipients               | Distance to the recipient | The processed symbol of the main sales item |

Source: Compiled by the authors

![Figure 1: Space model of stakeholder relationship management](source: Compiled by the authors)
The presented suggestions may change when defining visualization goals. In such a case, it is not recommended because changes in the features defining the dimensions of space cause the displacement of objects on the map. Therefore, after determining the dimensions and rules of allocation, consistent application is advisable.

In the case of abstract spaces, one of the basic problems is the allocation of objects. The aforementioned allocation is to ensure the implementation of the visualization goals, on the one hand, and to maximize the readability of the prepared maps, on the other. In this proposal, different rules for allocating objects on the map have been adopted, depending on the types of stakeholders.

It can be assumed that the suppliers and recipients are a symmetrical community in their own way. Therefore, similar allocation rules have been applied in Subspaces 1 and 3. Selection of spatial attributes in abstract spaces should allow for scattering of visualized objects to facilitate the readability of the map. On the other hand, the allocation of objects should be governed by some logic. It can be assumed that the location in the 1st subspace will be carried out in accordance with the second co-worker of the coordinate system, while in the 3rd subspace in accordance with the 1st quarter. In the first case, \( x = 0 \) will be the right boundary of the subspace, and in the second case it will be the left one. Selecting the \( x \)-feature in both subspaces means the physical distance from the indicated reference point. This may be the headquarters of the company’s management, the main factory or other indicated location. However, once made, the choice must then be consistently applied. In this way, the \( x \)-feature will indicate physical distances both in terms of suppliers and recipients important from the point of view of ISO standards. Due to the fact that the visualization is two-dimensional, a second feature is needed. Here, it is possible to choose different features. In this study, the symbol of the most important item of delivery (for suppliers) and the symbol of the most important commodity (for recipients) at a given moment of time were taken as the determinant. In the latter case, another feature should be found if the production or services provided are of one assortment nature (in which case the objects will be lined up). If there is no other feature, then in the 3rd subspace can be used as the usual geographical space in the cylindrical representation (covering the whole world or its segment depending on the scope of the market impact of the given enterprise). The adoption of these spatial attributes is permanent, i.e. should remain unchanged even if the elements of delivery or rendered services or delivered goods change in the future. From the point of view of visualization, it is important that the object is always in the same place on the map.

Subspace 2 is an element composed of three subspaces. Objects belonging to individual subspaces differ and have different roles in managing ISO standards. The proposed solution adopts a hierarchical system based on the legal system. Offices and institutions are treated as superior because they can be legal norms, issue administrative decisions or undertake external actions in relation to enterprises or ISO standards applied in them. The second level includes shareholders who constitute the founding body for the company and have the right to decide on its existence or further activity. The third level is the company management and organizational units.

In Subspace 2A, hierarchy of offices and institutions can be used to define individual objects relative to the X axis, while the name of the unit after its mathematical coding determines the value of the Y feature. An alternative may be geographical location unless the objects accumulate too much on the map. The geographical location can also be applied to shareholders (Subspace 2B), provided it is possible (e.g. when the data of shareholders are known). If it is not possible, two different algorithms for mathematical coding of the shareholder’s name can be used, and in this way, the values of spatial attributes X and Y can be determined. Subspace 2C can be created based on the imposition of the coordinate axes on the approved scheme of the company’s organizational structure.

The proposed solution is not the only one possible. Different location methods that fit the business needs can be used. However, one should strive to make the adopted definition of the environmental space unchangeable, while the objects that will be visualized may change.

When developing maps, one should be guided by the purpose of visualization. This rule has been somewhat weakened by the GIS technology. Analogue cartographic maps had a disadvantage that they were static (unchangeable) and represented only selected thematic layers and the most important objects within them. The GIS technology not only enables or disables selected thematic layers, but also can change the scale of the map or allow it to be updated on a current basis, if a suitable database is available.

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In stakeholder relationship management within the ISO standards, visualization can relate to various aspects. It can be static or dynamic, present various issues from the discussed range, and even allow interactive planning and study the degree of its implementation. Static visualization can be based on subjective assessment of the role of individual stakeholders or result from the aggregation of source data, based on whether it will be possible to calculate the weight of individual objects. Dynamic visualization may, for example, reflect the state of the implementation of the process instances performed according to specific ISO procedures. As part of interactive planning, planned objects or estimated future values of attributes describing individual objects can be applied manually. There can also be visualization of the effects of decisions made in this environment.

As mentioned, spatial attribute values determine the location of objects in defined spaces. However, the method of visualizing objects is determined by the value of the described attributes. The value of specifically described attributes determines the role of given objects within the entire object class. An insignificant role attributed to an object may cause the object to be omitted during the visualization or it will be less visible in the presented map. When visualizing, objects can be presented as objects that have more than one feature. According to cartographic syntax, each object is usually presented as a set of two elements: a symbol and a signature. Both elements can represent the values of two different features (the signature determines the size of the client’s turnover and the symbol shows its importance in stakeholder relationship management). If histograms (the ones based on time sequences) are used as part of the symbol, then even more features can be presented. This should be kept in mind to make the map legible.

The use of the GIS technology also allows the use of dynamic visualizations. In this environment, this may concern, for example, the implementation of procedures within individual standards. For example, the algorithm of the procedure related to the implementation of ISO standards can be applied to the environmental map. Consequently, implementation of each instance of a given procedure that will be performed in a given company can be followed. Of course, the condition is to link the ERP/BI system, where the results of each operation with the visualization system are usually saved with the use of a tool based on the GIS technology.

An additional advantage of the GIS technology is interactive maps. New elements saved in normative databases after approval can be applied manually. These elements can be inserted on the principle of changing the symbol to the shape corresponding to the assumed values or through augmented reality technology by inserting a new object (for example, this can be an equivalent of the planned investment required due to the implemented ISO standard). Additionally, by setting time attributes for the assumed values or planned investments, it is possible to check whether the assumed goals have been achieved, for example, by using appropriate colour schemes of the objects.

The algorithm presented above is only an example of the possibility of using spatial visualization in the discussed environment. Detailed solutions depend on the information needs of users and the technical capabilities of IT tools.

6. Case study

These considerations are supported by an example case study. The study was carried out in April 2019, with over a dozen entities participating. Enterprises with more than one ISO standard from various industries were invited to participate in the study. The respondents of the questionnaire were business quality managers. The study was of a qualitative character. Since the presented solutions are mostly dynamic in nature and are difficult to present in a static article, the proposed example was limited to the first 5 points. For the purpose of visualization, we used the data received from one of the respondents during the research on relations with stakeholders as part of the implementation of various ISO standards conducted by the research team.

The respondent selected for development as part of the case study is an international corporation operating in the packaging industry that has branches on several continents and employing tens of thousands of employees. The information was obtained on the basis of observations carried out by managers of one of the branches located in Central Europe.

The research was intended on managing relations with stakeholders in Slovakia and in Poland under various ISO standards. This study dealt with comparing the perception of individual stakeholders under various ISO standards. The questionnaire concerned the importance of different
types of stakeholders when applying ISO standards. As part of the questionnaire, the stakeholders were divided into seven groups: A - customers, B - suppliers, C - state institutions and associations, E - shareholders, F - managers, G - certifying institutions and institutions of knowledge, H - environment. The respondents were asked to enter a minimum of one stakeholder for each of the aforementioned types of stakeholders, and, where possible, to enter the five most important. It was not necessary to provide a specific stakeholder name.

The description of each stakeholder within a given standard refers to the following three characteristics:
1) power, i.e. the impact of a given stakeholder on the enterprise within the given standard;
2) interest, or how important is the use of a given company by a given standard for a given stakeholder;
3) predictability, understood as the ability to change the attitude or behaviour of a given stakeholder in matters related to a given standard.

Evaluation of strength and interest was on a scale from 0 to 100 (0 - no interest, 100 - key / essential), while predictability was on a scale from -100 to +100 (where 0 means invariability of interest within the norm, -100 means extreme drop in interest in applying the standard, and +100 shows an extreme increase in interest in the standard). A simplified version of the research questionnaire for ISO 9001 is presented in Table 2.

Considering the purpose of this article, the presentation of the research results is most important in terms of their interpretation. For the purpose of visualization, the results were obtained from one of the Polish enterprises, which has only one implemented standard and does not meet the requirements for further research projects. Therefore, it was decided to use some of its data to present practical aspects of visualization. Since the data were insufficient, they were also used for the description of potential facilities and additional data that will enable the location of the discussed objects.

To define the space of the environment, we used the layout presented in Figure 1. The space in question consists of five subspaces arranged in the indicated way.

Further, the coordinates were assigned to the individual subspaces according to which the location of the objects would follow. The developed coordinates are presented in Table 3.

From the above coordinates, all subspaces are closed. It is possible to change coordinates, however this should be avoided because it would change the location of objects on the map.

In accordance with the accepted classification of space, we proposed a classification of entities assigned to particular subspaces. Then, based on the data about the subject, its spatial attributes were determined. Consequently, each of the entities has become an object that will always appear in the same place on the map. The spatial attributes assigned to the entities are the 3rd and the 4th columns of Table 4.

Table 2:
A simplified version of the research questionnaire for ISO 9001

| Code of the stakeholder according to template X-9999 | Power | Interest | Predictability |
|--------------------------------------------------|-------|----------|----------------|
| Customers                                        |       |          |                |
| Suppliers                                        |       |          |                |
| Regulation offices                               |       |          |                |
| Shareholders                                     |       |          |                |
| Managers                                         |       |          |                |
| Certification bodies                             |       |          |                |
| Environment                                      |       |          |                |

Source: Compiled by the authors

Table 3:
Subspace coordinates

| Symbol of space | Range of coordinates X | Range of Y coordinates |
|-----------------|------------------------|------------------------|
| 1               | -1000; 0               | 0; 20                  |
| 2A              | 0; 5                   | 0; 10                  |
| 2B              | -10; 40                | 30; 70                 |
| 2C              | 0; 10                  | 0; 10                  |
| 3               | 0; 1000                | 0; 20                  |

Source: Compiled by the authors
Based on the data in Table 4, we can visualize the location of objects. The relevant map has been presented in Figure 2.

Due to the limitations in this study, visualization of the environment only will be made due to two of the three features described at the beginning of this section. The first one is the power contained in Column 5 of Table 4; the second is predictability, contained in Column 6 of Table 4.

The visualization of individual objects on the map depends on the objectives of the map and the values of the features according to which they will be presented. The value of a given feature will cause the selection of the appropriate symbol that will represent the given object.

Figure 3 shows the environment map due to power. The map is static and reflects the status of the study day.

Figure 4 shows the state of the environment due to its predictability. This map is of a planning nature because it assumes predicted potential changes in the behaviour of the visualized objects.

As already mentioned, a map can be developed in a way that will verify the accuracy of the assumptions shown on the map from Figure 4.

There is also a possibility of building dynamic maps; however this would require access to the integrated ERP/BI systems that would register the current source and GIS data for online visualization on the current basis.

![Figure 2: Location of stakeholders of the analyzed entity as part of spatial visualization](image)

Table 4:
Spatial attributes and describing attributes of individual objects

| Subspace | Symbol of the object | Spatial attributes | Describing attributes |
|----------|----------------------|-------------------|----------------------|
|          |                      | X     | Y     | Power | Predictability |
| 1        | C1236                | -900  | 12    | 50    | 0              |
|          | CA080                | -350  | 17    | 40    | 10             |
|          | CA090                | -700  | 14    | 40    | 5              |
|          | CA100                | -850  | 3     | 40    | 5              |
|          | CA110                | -200  | 11    | 30    | 10             |
| 2A       | D1237                | 4     | 3     | 50    | 0              |
|          | G1241                | 3     | 2     | 90    | 0              |
|          | H1242                | 1     | 7     | 50    | 0              |
| 2B       | E1238                | 0     | 52    | 80    | 0              |
|          | EA050                | 10    | 60    | 60    | 0              |
| 2C       | F1239                | 5     | 9     | 90    | 10             |
|          | B1245                | 8     | 6     | 50    | 0              |
|          | BA060                | 1     | 8     | 20    | 0              |
|          | BA070                | 2     | 6     | 20    | 0              |
| 3        | A1234                | 100   | 15    | 100   | 0              |
|          | AA010                | 400   | 4     | 100   | 10             |
|          | AA020                | 550   | 9     | 100   | 10             |
|          | AA030                | 200   | 3     | 90    | 10             |
|          | AA040                | 650   | 6     | 90    | 10             |

Source: Compiled by the authors
7. Conclusions

Modern management faces many dilemmas to solve, both at the theoretical and practical levels. Theoretically, one of the important aspects is the issue of access to required information resources and management options. Practically, a number of implemented business processes, which are becoming increasingly difficult to manage, is one of the basic problems. Therefore, both theorists and practitioners are looking for new tools that would facilitate the management of many processes implemented simultaneously.

The issue of space in management appeared not so long ago and mainly in the geographical aspect (for example, when organizing transport in logistics, or when planning expansion in distribution). Legal requirements, as well as ecological and ergonomic issues, have put modern managers before aspects related to physical spaces. However, the modern GIS technology also allows working in abstract spaces. These considerations show that it is possible to use heuristic spaces to describe management processes. In such a case, they were used to describe selected stakeholder characteristics (power, interest, predictability) as part of the ISO standards used at enterprises. Currently available GIS class systems can exchange information resources with other systems, for example the ERP class or ICT tools available on the Internet. The presented model and the tool based on it can also be used in other fields of management and constitute a kind of complement to business intelligence systems, which is the basic tool for business analytics today.
This model and its exemplification in the form of visualization characteristics of stakeholders within the ISO standards is an introduction to further work. This example presents static mapping of power, interest and predictability. Meanwhile, the future of the modelled tool will relate to dynamic support of management processes, and further research will go in this direction.

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