# Fourth dimension of spatial description in business processes

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***Abstract*—**The article is devoted to capture the time factor of descriptions of business processes. The issue in question is an extension of the problems of the use of descriptions of spatial tools (based on GIS technology - Geographic Information Systems) to describe the modeling and execution of business processes. This article assumes full development of business process models (not just the algorithm process, but also the semantic layer model, actors, documentation, necessary resources and performance indicators). Using standard tools (such as BPMN, UML), it can design business processes, and then deploy them in business entities. The solution proposed in the article assumes that it is possible to create a map of the organization, which will deploy the actors and resources available to them. The map is interactive and allows the registration of events taking place in the organization. All state changes resulting from the implementation of specific processes will be updated on a map of the organization. In this way you will be able to visualize the status of processes in any dimension of time.

***Keywords*—**Time factor in Business Process Modeling, spatial description, GIS methodology Information System integration.

## I. Introduction

MODELING business processes is one of the key elements in the implementation of process management in organizations [1], [2]. Developing algorithms of procedures should promote the increase in the efficiency of an organization. Assuming the Resources-Based Management, only modeling algorithms is not sufficient for efficient management [3]. In addition to the algorithms of process, it is important to define the actors involved, the required resources, created (required) documentation and performance indicators, both for the whole process, as well as individual operations. The aforementioned items should be treated comprehensively. This allows to create rules of organization and the support of corporate dictionary.

It seems that the first phase of the creation of process modeling tools has already passed. With the adaptation of the tools used to create computer systems and their adaptation to the needs of business process modeling, such as, among others, UML AD (Unified Modeling Language Activity Diagram) [4] and BPMN (Business Process Model and Notation) algorithms building process is no longer a problem [5]. Moreover, modern tools enable dynamic matching of processes to the needs to occur and the analysis of conflicts between different version of the some process.

Increasingly challenging for those managing processes becomes overseeing the implementation of the current processes. The point is the examination of the effectiveness of individual processes and their fragments, used resources, the involvement of actors or analysis of existing conflicts, unused resource bottlenecks like [6].

One of the key factors to be considered in these studies is the time factor [7]. In retrospect, one can examine the number of processes, their quality and compliance with the criteria of evaluation, the results of individual units and others. In this study, the analysis of subjects can be many different types of data-object classes described in the information systems. This can cause difficulties in their presentation.

A wide range of different types of visualization methods was developed. They are available including Cocpit as manager in BI (Business Intelligence) treaten system as a part of the ERP (Enterprise Resources Planning) [8]. They can also enrich the business process modeling and visualization of the status of their implementation.

This article discusses the problem of visualizing the effects of business processes, taking into account the time factor. In this regard, the GIS methodology (methodology of Geographic Information System) to build maps of organization and maps of processes was used. The aim is to describe the processes and effects of examination of the ongoing processes. Its goal is to be the current description of the various types of organizational resources.

The main theme of the article is to show how the time factor can be used to describe the current situation of the organization. Description of the time factor will be based on data collected in the information systems organization and business process modeling tools.

## II. Resource-Based Approch in Process Management

The success of modern enterprises depends on many factors. Considered to be the main factors are those associated with the skills of acquiring new customers and markets, or ability to enter into various types of economic activities. In other words, it is an appropriate setting for the reception of external factors and transforming them into new business opportunities.

The mentioned approach may be somewhat counter

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Resource-Based approach [9], [10]. Resources of the organization should be optimized in terms of its production capacity. It is very difficult that the modern perception of the organization's resources has been substantially expanded. In addition to traditional material resources, raw materials and financial increasing, the attention is paid to the soft resources such as: knowledge resources, relational or logos [11].

Soft resources become an important success factor. The problem is that in some situations, those resources instead of being a factor in the success may become unnecessary ballast in organization. It is essential therefore the issue of productivity of the resources contrasted with the potential costs of obtaining them, if necessary.

Estimating the resources needed in the organization can be made in the course of business process modeling. The issue concerns the extended modeling comprising the following elements [12]:

1) The algorithm of the process,
2) Actors
3) Created documentation,
4) Identification of all the types of resources necessary for the performance of the process,
5) Performance of indicators of processes, fragments of processes and operations.

Modeling of the algorithm of a process creates outline organizational procedures. It specifies how to implement business processes. It should be assumed that the designer has developed a procedure for it in such a way that it is implemented as efficiently possible. The algorithms can be developed with the help of tools like UML AD and BPMN.

Algorithms can be applied to process as actors. For this purpose, it is possible to use, for example, DFC (Deployment FlowCharting). In this way, it is possible to identify the actors at any level of detail (specific employees, organizational units, branch offices, outsourcing, sub-contractors, etc.).

In developing process models, there should be semanthic order of organization. Actors marked in the DFC should be adequate to the list of OC (Organizational Chart) or a dictionary of partners (cooperating entities) [13].

DFC type diagrams and OC have different functions and can be relatively difficult to integrate them into a common visualization purposes. Moreover, some actors can perform many operations within the same process. Visualization can be even more complicated when it will refer to the description of the current status of ongoing multiple processes.

The condition for the visualization of the processes is the current registration of the carried out operations. At the stage of the modeling process, documents or conditions of them are defined. They will perform the following operations. Registration takes place by means of appropriate information systems, eg. ERP or AOT (Automatic Offices Tools) integrated with ICT tools (especially the Internet solutions) [14]. During the implementation phase of the operation, the responsible entity will be required to note the operation within the framework of the process and to describe its current state. As a result, the desription of each operation will be a source of data [15], [16].

The fourth element of the description is a definite description of resources. It is a multi-task. The starting point is to develop a classification of resources within the organization. In the literature, there are many classification of the organization's resources. They are mainly theoretical in nature. That classification of resources in the organization is of a practical nature. It creates a certain type of index, and on the basis of dictionary resources. This makes it possible to describe those resources in information systems (mainly ERP, but also include a GIS or CAD - Computer Aided Design). This allows to define resource needs, make an inventory of existing, as well as their allocation within the accepted rules. With the classification of resources and leading their records, it is possible to assign them to specific operations modeled processes. These actions constitute the extension of the use Technological Cards in Production module of the ERP. This allows then to evidentiate the use of resources during the implementation process. From the point of view of resource organization, it is said that action allows to specify the consumption of certain types of resources or estimate the level of their use in relation to other types.

The fifth element is the performance indicators. With it, it is possible to define the potential requirements for the designed processes and their operation and to evaluate the implemented processes. For the development of performance indicators it is necessary to develop the rules and dictionaries. On this basis, a formula to calculate them was developed, enabling to enumerate them and make use of the various types of ratings organization's resources (including human resources). The results can also be used to modify process models and the introduction of various types of organizational changes.

Development enhanced process models will require additional organizational effort, but at the same time will sort dictionaries organization, the organizational arrangements and integrate different types of information systems around a common data. Despite the use of different modeling tools for individual items, it is important to maintain consistency of terminology on all models.

This makes possible semantic networking between different elements of the model and define existing relationships. Defining these relationships is a prerequisite for the construction of tools for comprehensive visualization of the modeled and implemented models [17].

## III. Time Factor in Business processes

Time is an important factor in the success of any process [7]. It should be recognized both in the design of business processes and then in progress. A matter of time appears in the business processes in various aspects.

At the stage of modeling the time factor is seen mainly in three aspects.

The first aspect is the time of modeling. Process management is focused on the realization of its objectives,

which are usually associated with the desire to meet the needs of the customer. Often in the specification of the client's needs there is the time factor. It is the nature of limiting the duration of the project. This means that the designer of the process will not have unlimited time to develop a model of the process, and also with the process model should take into account the time factor specifying the conditions for implementation.

In the extended model, the time aspect of the process occurs mainly in two aspects: documentation and efficiency ratios. Each document is designed or used for describing of the processes that should be dated. Project's documents should be considered as a document dating the field, as well as any modification to it.

The time can be one of the determinants of the effectiveness of the proposed processes. Modeling can be determined the absolute time of implementation of the operation. Their transgression may result in penalties for actors implementing them. Penalties may be imposed automatically by the control functions of information systems supporting the realization of specific processes. You can also define a formula listing the duration of the whole process and the different activities depending on the specifications provided by the client.

Even more important is the importance of the time factor in the description of the processes. Time is important both for the current records of ongoing operations and processes, as well as for the purposes of reporting, analysis, control and planning.

As mentioned, each operation should be registered in the system. This allows to specify, for instance: status of implementation of the process, the actor as a contractor of the operation, duration of the operation, the resources involved, and to verify the compliance with the execution of the operation agreed performance indicators.

The data collected allows to make all sorts of analysis which could include issues like: the number of processes performed in a specific unit of time, the number of operations carried out by the various actors in a given period, the volume of waste or used resources, the effectiveness of ongoing operations and so on. The individual analysis can be made for any unit of time [18].

Business process models can also be used to plan future activities. It, inter alia, indicate the performers of the planned processes or to reserve the necessary resources for a specified period of time models.

## IV. Assumptions of Spatial Description

Spatial description allows for visualization of different types of phenomena, processes, fragments of reality with the help of GIS methodology. Visualization can be done using a geographic area or heuristic (arbitrarily defined space with its own coordinate system and the logic of the allocation of objects).

Spatial visualization is a significant advantage. It allows the simultaneous presentation of many different types of class-object, specifying the weight of the objects presented within the accepted criteria and an indication of the relationship between different types of objects [19].

For visualization is necessary to define:

1) Space - S,
2) cartographic grid - G,
3) classes of objects - C(O)
4) spatial attributes of individual objects - $A_S$
5) describing attributes of individual objects - $A_D$
6) symbolization rules,
7) data sources.

By using GIS methodology it is possible to define and integrate different types of space including the use of hypertext. In this way, the geographical spaces and the heuristic ones can complement each other, or visualize various aspects of the presented processes.

Cartographic grid determines the logic of the allocation of objects in space by creating a reference system and determining the dimensions of the presentation. With the adoption of universal cartographic grid resources it is possible to transfer data between different geographic GIS tools.

ClassObjects C(O) defines layers on the maps [20]. These classes of objects can be defined in other classes such as information systems such as ERP and CRM (Customer Relationship Management). Different types of objects form separate layers. From the point of view of Resources-Based Approach, different types of resources may be distinct C(O).

As a part of each ClassOobjects, instances representing a single object are distinguished. Individual objects can participate in a number of events (for example, participate in the implementation of operations in different processes). Thus, their states can dynamically change with the participation in subsequent operations. That variability over time can cause changes in the values of selected attributes describing $A_D$. The mentioned variability means that in order to preserve the visualized objects it is necessary to keep the access to the DB (data bases) or DocB (DocumentBases) in which data is stored on the implementation of individual operations [21]

As mentioned, individual objects are determined by spatial attributes describing $A_S$ and $A_D$. $A_S$ spatial attributes are responsible for the locations of objects on a map [22]. They should be constant in the case of stationary objects and variables in the case of mobile. An example of variables $A_S$ may be the GPS coordinates of the object.

$A_D$ attributes describing the object determine the states of a given object according to the preset criteria. The values of these data can be a constant value (eg. Employee's date of birth), variable (number of completed courses) or be a function (eg. Sales value, which is calculated on the basis of invoices assigned to a given employee).

Spatial visualization can be developed for different purposes. For the same data, the set can generate many different maps. Therefore, in the construction of a particular map, it is important to indicate which layers are displayed, and according to which $A_D$ will present individual objects. The use of interactive map allows to change layers (on some, off others), to change the symbolization of individual objects (in

the case of changes in the visual criterion C(O), as well as responding to further entries made in the DB Or DocB under which individual objects are presented [23].

It should be noted that in the case of using interactive maps, the maps are visualized on-line with a change, making another entry in computer systems. The time factor in this case will be crucial for visualization of the presented phenomena. models.

In today's market, spatial information began to emerge as three separate but cooperating groups of actors [24]:

1) Providers of GIS technology
2) Spatial Data Providers
3) Spatial Analysts

This division means that GIS technology suppliers provide only a tool to help build a map and possibly basic thematic layers in the case of geographical space. To recover the maps, spatial data is necessary. Their collection and sharing deals with many subjects. Increasingly, they are available on-line via the Internet. In addition to the file formats strictly geographical spatial data, are increasingly turning to GIS. It can import data from publicly available software packages (eg. Office) or different types of systems (eg. ERP / BI, CRM, CAD) [25]. GIS technology expands the possibilities of entities engaged in the provision of tools for spatial analysis, aimed, inter alia, to model spatial phenomena of nature. While maintaining the spatial visualization of business processes, it is possible to build models of execution of business processes in specific time periods.

## V. The Fourth Dimension

Application of the use of GIS technology has changed the rules of cartographic visualization. The existance of 2D maps were unchanged. It was only manually to to change the data on a map or print its subsequent revised versions. To use the map it was necessary to carry it.

GIS Technology has allowed for the introduction of 3D by using transparent layers. In this way, it is possible to visualize in 3D reality providing that the relevant data is available (an example [26].

Theoretically, it is possible to create mathematically nD spaces. It is a question of defining the relevant $A_S$. However, the visualization can be carried out for technical reasons only in 3D. However, it is possible to switch axis dimensions, what change will also be presented to the map.

Generally, it is assumed that the fourth dimension is time. Modern GIS technology allows its use in spatial visualization. One can imagine an interactive map that shows the history of Europe, and actually change the borders of Europe in any defined period and speed of moving along the timeline (or also do back) [27]. The only requirement is to have the access to the relevant data.

The use of spatial visualization of descriptions of business processes is designed to provide a tool to facilitate the modeling process and handle their implementation. The proposed tool can also schedule during the execution of individual processes, for instance, by planning the use of resources of the organization.

The present discussion is limited to the factor of time (the fourth dimension) in drawing tool used to of descriptions of business processes.

The starting point is to determine the importance of time in the modeling and implementation of business processes in the organization. Adequately to this you can choose the solution to use the issue of time.

If it is planned to use a specific time issues they should be considered in the three interrelated phases:

1) process modeling,
2) execution plans
3) recording and control of the effects of the processes.

In business process modeling time issues included in the project will focus on the documentation and efficiency ratios. Assuming the extended modeling of processes, the documents should be identified, the ones which will reflect the implementation of subsequent operations. From the technological point of view, each newly created document should be saved in the DB or DocB, to the appropriate system which will register and implement operations (usually this will be ERP). Each entry is also subjected to the dating and the user who made it should be identifiable [28].

When designing procedures it may be determined by the expected duration of individual operations and / or process as a whole. It should be assumed that the duration of the process or a fragment therefore can not be shorter than the sum of its parts operation times. It can also impose conditions limit on the time factor, imposing time constraints and specifying the conditions under which it makes it possible to refuse to accept the order (eg. due to too short lead time required).

Expected timing indicators for individual operations may implicitly define the time you book different types of resources assigned to specific operations.

Defining indicators of time means that for some systems will need to impose a verification procedure. The most common ERP systems, but also include in WMS (Warehouse Management Systems) or CRM can be built and control procedures counting the execution time of each operation based on the registration of relevant documents. These procedures will be recognized during the conversion of business process models for system procedures [29].

At the stage of planning processes the role of the time factoris increasing. The spatial visualization may also be used. When planning the execution time of specific processes, one of the essential elements of a resource management organization. Spatial visualization can be useful mainly when the forecast will be the implementation of multiple processes in parallel. Using the map of the organization with the presentation of the available resources and the use of intelligent technologies can be booked map specific resources to complete the process. Description the individual objects on the map can be combined with the technology hypertext so directly on the map allow applied the relevant records in databases describing the object. Dynamic Visualization may

indicate that the facilities will be available at an assumed within the process.

The application of these solutions will require the integration of GIS with ERP (or others), where it is recorded by a description of the required facilities, and business process modeling tools in which you saved the process model. GIS tools should have functions such as spatial simulation, visualization and intelligent periodic maps of hypertext.

The key benefits of the time factor can be achieved in the implementation phase and process control. Using the integration of GIS with DB (and DocB) of ERP, CRM, CAD-to-date, you can visualize the map with the registration documents describing projects following operations processes. Creating a process map, you can track the status of each of the processes. In addition, using GIS technology it is possible to overlay map of the processes. In this way, the involvement of individual organizational units (actors) in the functioning of the organization can be indicated. On the basis of the documents describing the implementation of the operation should be a description of the state of the resources used to implement the operation. Thanks to this it can be specified, inter alia, the state of resources and their consumption, availability and more. On this basis it is possible to indicate the usefulness of the resources or the level of consumption. With various types of data processing functions can be of different types of parameters to calculate, which could provide the attributes describing the AD for each object. United visualized resource can be presented on one definite point in time, on-line updated or animations can be carried their states at a given time, as well as the simulation of expected conditions in the future by using the assumed planning data.

Visualization of the spatial can also be used for control purposes. Assuming a specific period of time, any defects, deficiencies can be visualized that occurred in a given period of time. This allows to build an incentive system of the organization. Animations of specific processes, phenomena, or fragments of reality may indicate emerging negative or positive phenomenon and that outlines the trend. It seems that it is much easier to interpret than the map is a dynamic set of tables. The data can be collected in distributed DB systems [30]

With maps visualized it is possible also to find what is currently available, and whether they can be used (appropriate symbology may indicate that the resource is reserved within a specified period). Therefore, the application of the time factor significantly larger usefulness of the proposed tools.

The use of the proposed solutions require the use of appropriate technology. The starting point is the integration of different types of information systems (including GIS, ERP / BI, CAD / CAM, CRM, SCM). Appropriate interfaces must be able to communicate on-line with the wide area network (especially the Internet). This allows data stored in different systems can be imported into GIS and processed, and then visualized. GIS tools should provide appropriate analytical functions, taking into account the time factor allowing the current animation and simulation predicted phenomena.

From the point of view of design and planning processes of resource use animation time (dynamic visualization of the level of use of specific types of resources) may be a factor in stimulating entrepreneurship. It can manifest itself new project business processes in order to develop the unused resources.

The use of the time factor is a relatively new development in order to visualize phenomena. So far, dynamic modeling was adjusted to simulate phenomena in geographic environments. In relation to business processes, the main problem is the need for multiple calculation procedures for different issues seems that in this case will be the future of the object-oriented technology DB followed for the development of GIS,

## VI. Conclusion

The thematics taken into consideration in the article is a research section in the larger whole, whether it is the use of GIS technology in description of business processes. The main current research is thus aimed at the integration of different types of information systems, data formats and tools of ICT (Information Communication Technology). However, it is difficult in this time of a skip a factor in the development of the proposed tools.

Taking into account the time factor, will make it easier to visualize the phenomena or more dynamic business processes. It should also influence the perception of better presented maps.

Although theoretical considerations have character, their preparation was based on empirical research conducted with many interviews and research with representatives of different environments. Application basic problem stems from the difficulty of finding entities, which is, in conscious way, introducing management process undertaken by the extended business process modeling. Companies engaged in the development of GIS tools have just become the subject of the application of their products, not only for geographical purposes. Companies producing other systems (eg. ERP / BI) assume that their functions are analytical and planning level is adequate to the needs of the client and so far they are afraid to invest in the proposed technologies. Large traders so far not yet fully coped with the integration of all the applicable systems.

Therefore, the analyzes were carried out on the base of technological possibilities of these tools. In contrast, application options discussed should come to the end of the fourth dimension.

## References

[1] J. Freund, B.R..Rucker, "*Real-Life BPMN : Using BPMN 2.0 to Analyze, Improve, and Automate Processes in Your Company*". Published by Createspace 2013.

[2] M. Havey, "*Essential Business Process Modeling*" Ed. By O'Reilly 2005.

[3] Jelonek D., Stępniak C., *Dynamic Business process Modelling in Organization*, In *"People Knowledge and Modern Technologies in the Management of Contemporary Organizations. Theoretical and*

*Practical Approaches*. Ed. By. Csaba Balint Illes and Felicjan Bylok. Goddolo 2013.
[4] W. Dąbrowski, A. Stasiak, M. Wolski, „*Modelowanie systemów informatycznych w języku UML 2.1 w praktyce*". Wydawnictwo Naukowe PWN SA. Warszawa 2007.
[5] F. Schonthaler, G. Vossen, A. Oberweis, T. Karle, "*Business processes for Business Communities. Modeling Languages, Methods, Tools*". Ed. by Springer.-Verlag Berlin-Heidelberg 2012.
[6] Gerth C., "*Business Process Models. Change Management*". Ed. By Springer.-Verlag Berlin-Heidelberg 2013
[7] M. Laguna, J. Marklund, "*Business Process Modeling, Simulation and Design*", Second Edition Ed. by Taylor & Francis Group LLC, 2013
[8] *Mendeleev table-types of visuasization*. http://www.visual-literacy.org/periodic_table/periodic_table.html).
[9] J.B. Barney, "*Resource-based theories of competitive advantage: a ten-year retrospective on the resource-based view*". In *Journal of Management*, 27/2001 , 643–50.
[10] R. Krupski, *Orientacja zasobowa w badaniach empirycznych. Identyfikacja horyzontu planowania rynkowych i zasobowych wielkości strategicznych*, Walbrzyska Wyzsza Szkola Zarzadzania i Przedsiebiorczosci, Walbrzych 2011.
[11] M. Mach-Król, *Narzędzia budowy systemu z temporalną bazą wiedzy wspomagającego twórczość organizacyjną*. W „Informatyka Ekonomiczna, Business Informatics" Nr 2(32) 2014. Wyd. UE Wrocław 2014 s. 179-187.
[12] D. Jelonek, C. Stępniak, *IT Support for Resource - Based Approach in Enterprise Management*. W:*Contemporary Economies in the Face of New Challenges. Economic, Social and Legal Aspects*. Edited by Ryszard Borowiecki, Andrzej Jaki, Tomasz Rojek. Publishing House: Foundation of the Cracow University of Economic. Cracow 2013.
[13] D. Howard, *The Basics of Deployment Flowcharting &Process Mapping. A User's Guide to DFC for Know-how Capture and Process Design*. Ed. Management New Style http://www.flowmap.com/documents/booklets/dfc.pdf (last view 12.03.2015).
[14] R. Stair, G. Reynolds, "*Information Systems Esentials*". Fifth Edition. Edited by Course Technology 2010.
[15] D. Cohn, R. Hull, "*Business Artifacts: A Data-centric Approach to Modeling Business Operations and Processes*"., In "*Bulletin of the IEEE Computer Society Technical Committee on Data Engineering"*. Volume 32, Number 3, September, 2009, pp. 3-9.
[16] M. zur Muehlen, "*Volume versus Variance: Implications of Data-intensive Workflows*". In "*Bulletin of the IEEE Computer Society Technical Committee on Data Engineering"*. Volume 32, Number 3, September, 2009, pp. 42-47..
[17] I. Pawełoszek, *Technologie semantycznego Internetu w kreowaniu przedsiębiorczości nowej ery*. W „*Wiedza i technologie informacyjne w kreowaniu przedsiębiorczości*". Monografia. Red. nauk. A. Nowicki, D. Jelonek. Sekcja Wydawnicza WZ Politechniki Częstochowskiej. Częstochowa 2013.
[18] H.-L.Truong and S. Dustdar "*Integrating Data for Business Process Management*". In "*Bulletin of the IEEE Computer Society Technical Committee on Data Engineering*". Volume 32, Number 3, September, 2009, pp. 48-53.
[19] F. Harvey,. "*A primer of GIS. Fundamental Geographic and Cartographic Concepts*". The Guilford Press. New York London 2008.
[20] P.A. Longley, M.F. Goodchild, D.J. Maguire, D.W. Rhind, "*GIS Teoria i praktyka*",. Wydawnictwo Naukowe PWN. Warszawa 2006.
[21] Wieczorkowski J.*: Big data – aspekt technologiczny i ekonomiczny vs. aspekt społeczny*. W *Ekonomiczno-społeczne i techniczne wartości w gospodarce opartej na wiedzy* .t.2, red. Jacek Buko, Zeszyty Naukowe nr 113 *Ekonomiczne Problemy Usług,* Uniwersytet Szczeciński, Szczecin 2014, s. 399-408,
[22] C. Stępniak, *„Integracyjna rola przestrzeni informacyjnej w modelowaniu procesów biznesowych"*. W Zeszytach Naukowych Uniwersytetu Szczecińskiego nr 702 - Ekonomiczne Problemy Usług nr 87, Wyd. USz. Szczecin 2012, część I, s. 513-521
[23] C. Stępniak, *Mapy interaktywne jako narzędzie wspierania procesów inwestycyjnych*. W „*Roczniki Kolegium Analiz Ekonomicznych*". Oficyna Wyd. SGH. Warszawa 2015, to be Published
[24] C. Stępniak,: „*Kartograficzne rozszerzenie dynamicznego modelowania procesów biznesowych*". Zesz. Nauk. Uniwersytetu Szczecińskiego nr 808 Tytuł zeszytu: Ekonomiczno-społeczne i techniczne wartości w gospodarce opartej na wiedzy. T.1, Wyd. USz. Szczecin 2014, s. 441-448.
[25] D. Jelonek, C. Stępniak, T. Turek, 2013, "*The Concept of Building Regional Business Spatial Community*", In *ICETE 2013. 10th International Joint Conference on e-Business and Telecommunications. Proceedings*, 29–31 July 2013, Reykiavik, Iceland.
[26] M. Pietruszka, M. Niedźwiedziński: *Third dimension of e-commerce W* W *„Informatyka Ekonomiczna, Business Informatics*" Nr 2(32) 2014. Wyd. UE Wrocław 2014, s. 198-212.
[27] MapMaker http://mapmaker.edukation.nationalgeographic.com/ (last view: 26.11.2014).
[28] P. Polak, J. Wieczorkowski, "*Rozwój metod modelowania procesów biznesowych dla potrzeb wytwarzania systemów informatycznych In Podejście procesowe w organizacjach*", red. Stanisław Nowosielski, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu nr 169, 2011, s.266-272
[29] D. Jelonek, J. Nowakowska-Grunt, L. Ziora, *The Assessment of Construction Project Management Maturity Level in the Silesian Region in Poland*, Advanced Materials Research, 2014, Vol.1020, pp.796-802.
[30] M. Tamer Ozsu, P. Valduriez, *Principles of Distributed Database Systems*. 3rt Edition, Springer Science+Business media. New York, Dordrecht, Heidelberg, London 2011.

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