International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 14 (2015) pp 34532-34534

Knowledge engineering based on big data for enterprise project management

Anton Ivaschenko
(Samara State Aerospace University, 443086 Russian Federation, Samara, Moskovskoe shosse, 34)
Oksana Dvoinina
(Samara State Aerospace University, 443086 Russian Federation, Samara, Moskovskoe shosse, 34)
Michael Andreev
(Samara State Aerospace University, 443086 Russian Federation, Samara, Moskovskoe shosse, 34)
Pavel Sitnikov
(SEC Open Code, 443001 Russian Federation, Samara, Yarmarochnaya, 55)
Dmitriy Martyshkin
(SEC Open Code, 443001 Russian Federation, Samara, Yarmarochnaya, 55)

Abstract- The paper presents a new aspect of project management at a research and development enterprise. The analysis of information in common information space is taken into account in the process of enterprise's activity. Levels of information objects' presentations were marked in common information space. There is also proposed the architecture of project management system, which is based on analysis of key performance indicator's combination in a Big Data context.

Keywords- Big Data, knowledge engineering, common information space, human resources management. research and development enterprise.

Introduction

Big data analysis is a hot topic for research in different fields of science and engineering. Modern manufacturing enterprise is a complex organizational and technical system, all functioning processes of which are being reflected in common information space. Engineering data and information of product life cycle, full details of all events that characterize the processes of enterprises' staff interaction in a common information space form big data. This data can form a basis for knowledge engineering to provide effective operational analysis and decision-making support. In this paper, we propose to use big data for project management at manufacturing enterprises.

1 Current Trends

The problem of computer aided project management implementation at the modern manufacturing enterprises is still relevant in the context of new software products' developments. However, current trends in the field of administrative management require consideration of new aspects of the common informational space formation.

One of the solutions can be close to subject-oriented approach for business processes management (S-BPM), which conceives a process as a collaboration of multiple subjects organized via structured communication [1]. There can be proposed a model for interaction of actors (subjects) in integrated information space, which can be implemented using multi-agent software [2, 3].

To ensure high efficiency of manufacturing enterprise in terms of time and costs there is a request to implement modern technologies of business processes management based on decentralized architectures and distributed intelligence. This happens because of the increasing number of decision makers, high uncertainty and dynamics of changes, and flexibility of decision-making logic. The example of using multi-agent technology for business processes simulation can be found at [4].

The process of interaction of users in integrated information space at modern manufacturing enterprise generates a sequence of events of the exchange of documents, messages and other information objects. The number of the events is big (large physical data volume); they vary and require high-speed processing. In this regard, the task of managing the collection and processing of information data in the system of acquisition and processing system with a stratified architecture may be referred to the Big Data problem [5, 6, 7, 8].

Our experience of Big Data analysis for knowledge engineering in multi-agent software and decision-making support systems development is presented in [9, 10].

2 Levels of Integrated Information Space

The common information space of the modern research and development enterprise can be decomposed into several levels depending on the particular type of information objects. Existing Product Data Management (PDM) and Product Lifecycle Management (PLM) systems in accordance with the CALS concept provides with engineering data management and project data management in their proceeding. The level of Product Configuration Management (PCM) provides with the configuration of the common information space and contains ontological data about the attribute types and connections, user roles, document formats, etc. At the level of Product Event Management (PEM) it is proposed to implement the functionality of the analysis and processing of big data and configuration of the common information space components based on the results of the processing.

Such division requires a new approach to the architecture composition of the project management system of the enterprise. On the one hand, it is necessary to provide hierarchical control according to an organization structure. On the other hand, it is required to realize the project-based approach that involves creation of the temporal project teams integrated for succeeding particular results. As a solution of the problem, the management system architecture is proposed and described below.

3. Solution Architecture

The operational efficiency of enterprises is defined by different factors in the conditions of the market economy which can be classified by a number of key performance indicators (KPIs). Conditionally, they can be divided into the production factors (production capacities, technological effectiveness of production, etc.), economic factors (resources, commercial reserves, etc.) and administrative ones. Thus, the actual performance of the enterprise is a complex concept.

For succeeding the required level of efficiency of administrative decisions acceptance, it is necessary to develop the organization structure (organizational management system) of the enterprise that should be the closest to optimum one (in particular, project management structure). The structure of the system, in this case, is considered as a set of communications and relations between its elements.

Nevertheless, organizational project management system represents set of the subdivisions and positions connected by relations and subordinations. In the case of management structure creation, it is necessary to consider specifies of enterprises' activities and features of theirs interactions with an external environment. The process of formation of the organization structure of project management usually includes three main stages: determination the type of the organization structure (direct subordination, functional, matrix, etc.); separation of structural subdivisions (administrative staff, independent subdivisions, applications programs, etc.); delegating/devolution of the authority and responsibility for parts of the project to the subordinate authority levels (governance relation – subordination, the centralization relation – decentralization, organizational mechanisms of coordination and monitoring, a regulation of subdivisions' activities, development of regulations in structural subdivisions and positions).

The offered architecture of the decision is presented at Fig. 1. This architecture affects the organization structure of enterprises' functioning, project part, management system, units of the analysis and analytics, product life cycle events, the functional relations.

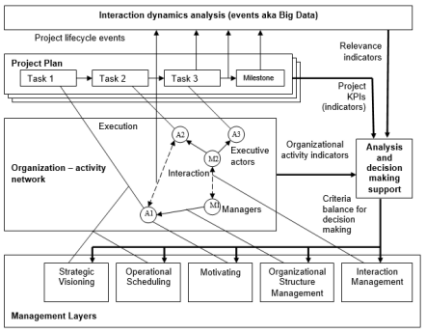

Fig. 1. Solution Vision Architecture

Resource assignment is provided according to the performed project specification (tasks) in the form of the oriented organization – activity network. The nodes represent the staff of the enterprise (performers and their principals), and the links – the relations between the employees.

Based on the proposed solution there can be introduced the following process of project management using Big Data analysis for knowledge engineering.

At the first stage, the enterprise management makes decision in implementation of a certain project. Then, it makes a decision about the decomposition of the project in a number of tasks. The project implementation (elaboration of each task) is followed by the set of project life cycle events, and the efficiency of all projects' implementation depends on effective activity. It is worth mentioning that for large enterprises, project life cycle events form the big data. Therefore, the processes of the overall performance analysis of the enterprise and the processes of finding the closest optimal decision are more complicated at each stage.

The accounting of interaction key performance indicators and a complex index (superposition of indexes given above) in the given time points will allow to carry out monitoring and adjustment of the management process. The analysis of indexes is carried out in the unit of analytics. The decision-making process takes place in the control unit that is generally consists of several layers characterizing certain types of management influences.

The balance of the key criteria that is used in management layers is developed (modifications of the organization structure, actions directed on formation of motivation, strategic and operational jobs re-planning and information control of interaction staff management). It is a result of combination of analysis of correlation indexes, project and organizational activities.

Conclusion

The aspects of project management in common information space of manufacturing enterprise in the context of Big Data are considered in the paper. The results of implementation of the proposed architecture confirm possibility of controlling of complex projects under the conditions of uncertainty and high dynamics of changes.

Acknowledgements

This work was supported by the Ministry of education and science of the Russian Federation in the framework of the implementation of the Program of increasing the

competitiveness of SSAU among the world's leading scientific and educational centers for 2013 – 2020 years.

References

[1] Fleischmann, A., Kannengiesser, U., Schmidt, W., Stary, C., 2013, "Subject-oriented modeling and execution of multi-agent business processes". In proceedings of 2013 IEEE/WIC/ACM International Conferences on Web Intelligence (WI) and Intelligent Agent Technology (IAT), 17-20 November 2013, Atlanta, Georgia, USA, p. 138 – 145

[2] Gorodetskii V.I., 2012, "Self-organization and multiagent systems: I. Models of multiagent self-organization", Journal of Computer and Systems Sciences International, vol. 51, issue 2, pp. 256-281

[3] Wooldridge M., "An introduction to multi-sgent systems", John Wiley and Sons, Chichester, 2002, 340 p.

[4] Onggo S., 2013, "Agent-based simulation model representation using BPMN 2013". In: Formal languages for computer simulation. Fonseca i Casas, P. (ed.). Hershey, Penn. : IGI Global pp. 378 – 399

[5] Manyika James et al., 2011, "Big data: The next frontier for innovation, competition, and productivity" [Online] / McKinsey Global Institute, 2011. McKinsey (9 August 2011).

[6] Baesens B., 2014, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications" / B. Baesens. – Wiley, 232 p.

[7] Mayer-Schönberger V., Cukie K., 2014, "Big Data : A Revolution that Will Transform How We Live, Work, and Think", 240 p.

[8] Thomas H., 2014, "Davenport Big Data at Work : Dispelling the Myths, Uncovering the Opportunities" / H. Thomas.-Harvard Business Review Press, 240 p.

[9] Ivaschenko A., Syusin I., Fedosov A., 2014, "Agent-based management for intermediary service provider", Proceedings of the 2014 IEEE/WIC/ACM International Joint Conferences on Web Intelligence (WI) and Intelligent Agent Technologies (IAT), Warsaw, Poland. – pp. 428 – 432

[10] Ivaschenko A., Minaev A., 2014, "Multi-agent solution for adaptive data analysis in sensor networks at the intelligent hospital ward", LNCS 8610, pp. 453 – 463

Author Biography

Anton Ivaschenko, Doctor of technical sciences, professor at Samara State Aerospace University (Samara, Russian Federation)
e-mail: anton.ivashenko@gmail.com
Oksana Dvoinina, Postgraduate student at Samara State Aerospace University (Samara, Russian Federation)
e-mail: dvoinina_oksana@mail.ru
Michael Andreev, Postgraduate student at Samara State Aerospace University (Samara, Russian Federation)
e-mail: michael.v.andreev@gmail.com
Pavel Sitnikov, PhD, Project Management Director at SEC Open Code (Samara, Russian Federation)
e-mail: sitnikov@o-code.ru
Dmitriy Martyshkin, Analytics Director at SEC Open Code (Samara, Russian Federation)
e-mail: martyshkin@o-code.ru