THEORETICAL FOUNDATION FOR MANAGERS' BEHAVIOR ANALYSIS BY GRAPH-BASED PATTERN MATCHING

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Abstract

Background. Nowadays many research results in management are not able to be compared to one another. Scientists seem to build isolated ontologies, use incompatible research methods and draw conclusions which are at least neutral to each other. Thus, a new methodological approach could allow us to overcome these obstacles.
Research aims. The goal of this paper is to make a contribution to a methodology of research in management science in the field of theoretical research and drawing theoretical conclusions, by presenting a new approach to the analysis of managers' behaviour.
Method. Presented approach to the analysis of managers' behaviour is based on facts theory and the system of organizational terms. Such a basis lets us use graph theory to recognize patterns in managers' behaviour.
Key findings. The graph-based pattern matching is useful to analyse managerial behaviour when the managers take part in management processes. Indispensable theoretical concept for this is the system on organizational terms based on the facts theory.

Keywords: System of organizational terms, Facts theory, Graph theory, Managers' behaviour, Pattern recognition

INTRODUCTION

For philosophers the main reason for doing research and sciences development is to know more and more about the world. Cordero (2009, p. 748) formed a figurative expression that scientific effort can be named as a rational journey on the way to reliable and profound cognition of the reality.

A field of cognition in management science is an organization, including all aspects of its existence. In most countries this discipline of science is related to organized people activities in the object which we called an organization (Cyfert & Krzakiewicz, 2009, p. 10). However, there are many statements which describe an increasing problem of building theories in management science. It concerns human influence on a theories' construction. It is even labelled as an additional load which every scientist carries in to that science. From the science development point of view it seems to be an adverse effect (Hicks & Goronzy, 1967, p. 383).

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The goal of this paper is to make a contribution to a methodology of research in the management science in the field of theoretical research and drawing theoretical conclusions. Nowadays many results of research projects in management are not able to be compared to one another. Thousands of scientists explore the organizational world and try to build a stable idea of phenomena. However, in many cases they seem to build isolated ontologies, incompatible research methods and draw conclusions which are at least neutral to each other. It is obvious that a new methodological approach could allow us to overcome these obstacles.

This paper presents a theoretical foundation of managers' behavior analysis. Based on the origin of management science and widely shared definitions of organizations there is a focus on the manager as the main being, which creates most phenomena in the organizational world. The concept is based on the system of organizational terms which allows us to use graph-based pattern matching. The system consists of a formal logic and the theory of facts which were developed for the reasons of using them within management science.

One of the roots of management science is practical managing which was, from the very beginning, a real reason for establishing this science. One of the movements when this science was established enabled it to be isolated from others and there was an opportunity to define rational relationships between phenomena. Other important necessities are: its own system of terms, laws as well as axiomatic and normative statements (Domejko, 1976, p. 120).

However, there are some opinions about a lack of this in necessity. Their authors indicate some troubles in developing management science according to these precautions. One of them we can find in the works of Zimniewicz (2008, p. 135), who claimed that there is an increasingly certain mess of terms, definitions and opposite theories (and not fully proved). He cited Koontz's and O'Donell's expression which they brought into the discussion about management science development and he called an up-today situation in this science as "a theory jungle" (Zimniewicz, 2008, p. 135).

A large number of theories, despite their negative influence on science cohesiveness, are not the only obstacles on the way to scientific development. Another thing is a meaning of terms which are used in statements. The terms are also crucial for building adequate theories. White and Taket (1996, p. 51) wrote "We create the sense of this world, we understand it and describe it through a language we use". Koźmiński and Zawiślak (1982, p. 15) stressed that different vocabulary in management science on one hand could create a wide perspective and sophisticated approaches to the same issue. On the other hand it gives a result "as if a botanist, a sales man, a gardener, a chemist and a poet talk about a rose" (Koźmiński & Zawiślak, 1982, p. 15).

Despite the fact that from Descartes's time knowledge has been treated as a product of an individual mind, expressed by shared languages, there is still a lack of meaningful definitions for terms used in management science (Dolby, 1998, p. 15). The third obstacle is a lack of a widely shared approach to building the essential states of knowledge in management science. Management science is a combination of different fields of knowledge deriving from other sciences. It makes this science eclectic and diversified (Sułkowski, 2004, p. 10).

These factors disposed many scientists to project new foundations of ontology and epistemological approach in management science. One of these attempts is the system of organizational terms based on formal logic and the theory of facts. The facts represent manager's behavior in the field of managing. Because the facts create a graph (it is going to presented in section 3) it is supposed that graph-based pattern matching can be used. Such a direction could lead to its use in the system of organizational terms to make research about phenomena in management science as well as implement automatic pattern recognition techniques. Then a quantitative analysis of parameters would be assessed.

Basing the system of organizational terms on formal logic would allow us to draw more precise and reliable conclusions. It is so because formal logic is a foolproof way of reasoning. It always gives a deductive statement. In some cases it is at least possible to build a statement with some degree of probability (Przybyłowski, 2002, p. 44).

The paper consists of two main parts. In the section 2 there is a description of the system of the organizational terms. This is the theoretical background of such a project and a model of ontology for it. The last part of this section presents terms as a graph which is the subject of section 3 which is a description of how to use the graph theory to analyze managerial behaviors.

REVIEW

The System of the Organizational Terms

Theoretical background. Quinn used to say that building ontology is a common challenge which every researcher encounters. For thousands of years exploration of the reality has always recalled one universal question: what is there? (Brink & Rewitzky, 2002, p. 543)

In the 19th century a positivist attitude to most of science disciplines appeared. This attitude also occurred in management science. The organization started to be an object with characteristic features and minor objects inside (Cole, Chase, Couch, & Clark, 2011, p. 141).

Meanwhile there started a discussion, mostly among psychologists, about the ways which let people know something about "these things

which are here". It was said that a perception is a process of creating the representation of a real object based on information which people get by their senses and get into their memories. However, even before Leibniz had noticed that human senses are not enough to validate statements about the world. The senses are too imprecise to proof or disproof some of statements

Meanwhile a discussion started, mostly among psychologists, about the ways which let people know something about "these things which are here". It was said that a perception is a process of creating the representation of a real object based on information which people get by their senses and get into their memories (Maruszewski, 2001, p. 32). However, even before Leibniz had noticed that human senses are not enough to validate statements about the world. The senses are too imprecise to prove or disprove some of these statements (Barnes, 2007, p. 495).

That is why in management science it is used to build some models of objects which are going to be researched. One such example of an organizational ontology was presented by Rao, Reichgelt, and Osei-Bryson (2009, p. 264). Such a graph was named by Collins and Lotus as the model of spreading activation. In this model the graph is being created in the time of action. The originator is a single man (Nowaczyk, 2009, p. 45).

In the ontology based on the system of organizational terms the originator is a manager. This is similar to the basic semantic net and from the linguistic point of view it can be understood this way. As time goes on in any organization or even a part of it (the part means any single object with a manager and its subordinates) there usually appears such a net of terms. This personal influence of a manager on creating the net is one of our main theoretical foundations for using graph-based pattern recognition in the field of manager's behavior.

Another main foundation on which this system is based comes from Wittgenstein's theory. He claimed that the world consists of nothing but facts (Brink & Rewitzky, 2002, p. 544). He understood facts wider than only material or physical objects. These objects had their own states and the whole world would be described as a matrix of these (Prechtl, 2007, p. 122). Despite the fact this point of view is crucial, it is still a stable view of the world. The organizational world is dynamic.

The system of organizational terms should represent the changes with time so that there is an enhanced version of Wittgenstein' theory used. According to Ingarden, the facts could be divided into three groups: things (with their own states), processes (lasting longer than a moment of time) and events (happening in a moment of time).

On the contrary, this division of facts is too complicated. As it was designed in previous works, the facts which build the system of organizational terms can be distinguished into two main groups: things and events

(an event is able to last any period of time). Every one of them is able to be assessed as subjective an objective (McInerny, 2005, p. 14; Flak, 2007, p. 68). This division was done according to a logical division which means the "fact" term was divided into subranged terms (Przybyłowski, 2002, p. 170). These terms (things and events) are secondary to a general fact of any kind.

This division of facts creates separable classes of facts whose elements belong to one class only (Przybyłowski, 2002, p. 170). So we have two different classes of facts: (a) objective things, (b) subjective things, (c) objective events and (d) subjective events. Subjectivity (or in the opposite objectivity) is a matter of recoding the fact. The subjective fact can be recorded by only one person and nobody else is able to confirm that this fact appeared. The objective fact is able to be recorded by more than one man (by any tool to measure) and not only one man is able to admit the fact. This approach and its definitions were projected in the previous works of the author. Additionally, the facts represent most of the things which belong to the organizational "world" (Flak, 2012, pp. 9–18).

The thing is any object which is real or unreal. Whose states (in the meaning of graph-based pattern matching they are features) is stable within time (Krzyżanowski, 1985, p. 114). The event is any change of a state of the thing (Ziembiński, 2006, p. 64). It means that the event happened if in t_1 the thing has a certain feature called f_1 and in t_2 the same thing has another level of this feature called f_2 (or it does not have this feature at all).

These definitions are close to the understanding of resources and processes in the bases of management science (Kotarbiński, 1969, p. 37).

There is a need to underline the role of a manager. A manager creates events (Kotarbiński, 1969, p. 37). This case is binary. If there is a manager and he acts somehow, the event occurs. If a manager disappeared, events would not happen (apart from events which were caused by the manager before or events which have been automatized).

In Figure 1 there is an abbreviated view of a pattern of facts which is the basic principle of the system of organizational terms.

Of course, when there is a logical division of facts, it is necessary to understand it as a classifications. The first division was mentioned above. Facts were divided into four classes: objective things, subjective things, objective events and subjective events. However, there is the second division based on i.e. functions of management. Then there is a possible third division into classes which could be based on certain activities, etc.

It means that the classes of facts should have their own features which differ from one to another (Mouritsen, 2009, p. 155). There could be qualitative and quantitative features, nevertheless, the graph-based methods mostly need a representation of facts in values (or at least in any language

recorded as strings of letters). In order to use this concept in any empirical research it is necessary to make a feature vector of any of the facts.

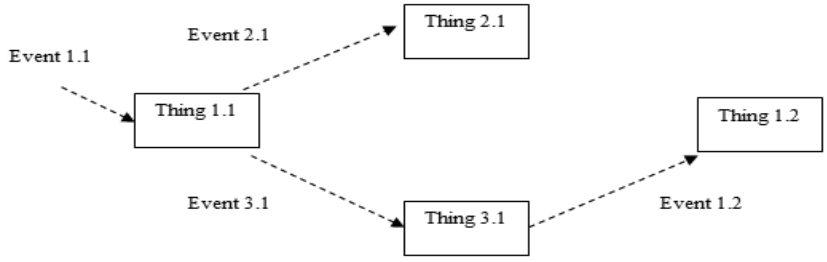

Figure 1. Pattern of Facts

Source: Adapted from Flak (2013, p. 192).

According to an approach to building ontologies presented by Niculescu and Trausan-Matu (2009) there is the next theoretical foundations. Firstly, it means that the names of facts are intentional and not real. This is the reason for precise definitions which the system of organizational terms is going to consist of. Secondly, the facts are able to be presented by a graphic model. Thirdly, the ontology of the system of organizational terms is scalable which means it is possible to add new objects into the model of ontology. Finally, the graph of facts is being created by a single manager (Niculescu & Trausan-Matu, 2009, p. 160). There would be some similarities between individual graphs which lets us conduct advanced recognition of manager's behavior analysis.

However, the facts are not the only objects which are necessary to build an ontology for the system of organizational terms. The model of facts, presented in figure 1, still do not have relationships between them.

A model of facts adjusted to graph-based pattern matching. As it was claimed, the facts happen one after another when time passes by. The things (to be precise: their states) derive from events. When the reason for this is not being concerned, such an approach is enough to describe the manager's behavior by words. However if graph-based methods is going to be applied there is a deep need to indicate relations and rebuild this concept.

The ontology of the system of organizational terms, which describes a manager's behavior, consists of elements typical for the case of ontology development (Staab & Studer, 2009, p. 2–8). The definition of this ontology is as follow.

The elements of the universe of the organizational environment described by the system of organizational terms:

D = {factT1, factT2, factT3, ..., factE1, factE2, factE3, ...}

The elements of the ontology are facts. The abbreviation "T" means it is a thing, and "E" indicates events. It is possible to count facts by numbers. The facts appear within time. Their increasing values are not constrained by any number.

The set of relations on D is as follow:

R = {name of factT1, name of factT2, name of factT3,
..., name of factE1, name of factE2, name of factE3, ...,
creates, starts}

There are two different types of relations: reversible relations of elements and relations between elements. The first type represent, i.e. a goal for a factT1, a task for a factT2, a plan for a factT3, setting for a factE1, describing for a factE2, planning for a factE3. The things are described by nouns and the events are described by verbs. The amount of such reversible relations is equal to the amount of facts. The second type of relations (relations between facts) consists of only two relations, which are called: "creates" and "starts". These relations need to be described in details.

The "creates" relation is an unintentional, internal relation. It connects an event and a thing. For example, as the effect of setting (factE1) always becomes a goal (factT1). Such a relation ("creates") always occurs without any exceptions.

For the simplicity of this paper we do not take into consideration what features the goal is able to have, if this goal is "good" or if it was set in a proper way. Even for this sake there is no considering a goal's definition. This relation is independent from the human being. It means that only events derived from human activity and the thing are only their results.

The "starts" relation is an intentional, external relation from both facts – a thing and an event. For example, as the effect of having set a goal (factT1) there is a possibility of starting ("starts") planning (factE2), which makes ("creates") a plan (factT2).

Why is it only a possibility and we are not able to call it as "necessity"? Because the "starts" relation depends on many factors derived from a manager (generally: his reasons). The reasons can consist of or derive from knowledge, professional experience etc. It is compatible with the statement that a reason is a kind of relation ƽ between facts (Schroeder, 2008, p. 59). It means that only a manager as a human being releases the "starts" relation.

The principles of the ontology for the system of organizational terms:

1. Elements: The ontology for the system of organizational terms (focused on manager's work) consists of facts.
2. Elements: The facts represent the work of a manager with their co-workers (any kind).
3. Elements: There are two different facts: events (factE) and things (factT).
4. Relations: Things are unintentionally created by events.
5. Relations: This creation is the internal feature of the pair: one event and one thing.
6. Relations: Events can be started either by things or by events.
7. Relations: In any moment of time only one relation between elements appears ("creates" or "starts").
8. Relations: All reversible relations are stable and they appear during all considered time.
9. Relations: Between elements appear such relations: (a) factE creates factT, (b) factT starts factE, (c) factE starts factE, (d) factT – factT (the relation between the factT and another factT does not exist);
10. Relations: Every relation between facts appears one by one within time.

The reason for the 10th principle is the characteristic feature of a human life. For the matter of graph-based pattern matching it is necessary to describe this feature as "human activities are mostly serial".

In figure 2 there is the ontology for the system of organizational terms. For the matter of simplicity in reading elements and relations as well as their examples, they have been placed into one figure. Green squares are events, green ones are things. Blue arrows with labels mean the "creates" relations. Orange arrows with labels mean the "starts" relations. In orange labels moments of time when these relations happen are counted.

Graph-based pattern matching. Recognizing patterns by graphs in management activity needs simplification to make the units of fact presented in Figure 2. This simplicity is required to present facts in management by graphs. The simpler model of facts has been rebuilt by a classic two-object graph. This graph is in Figure 3.

As it was indicated, there was a pair of facts: factE and factT. Between them exists the relations "creates" which always occurs without any exceptions. Looking at Figure 2 from the vocabulary perspective we can remark that facts called factE are named by nouns and facts called factE named by verbs. From a graph theory point of view such a unit – a factE, a relation "creates" and a factT – is possible to be treated as one object. This object is called a node. Connections between nodes are called edges

and in the system of organizational terms they are represented by "starts" relations (Wilson, 2012, p. 8–17).

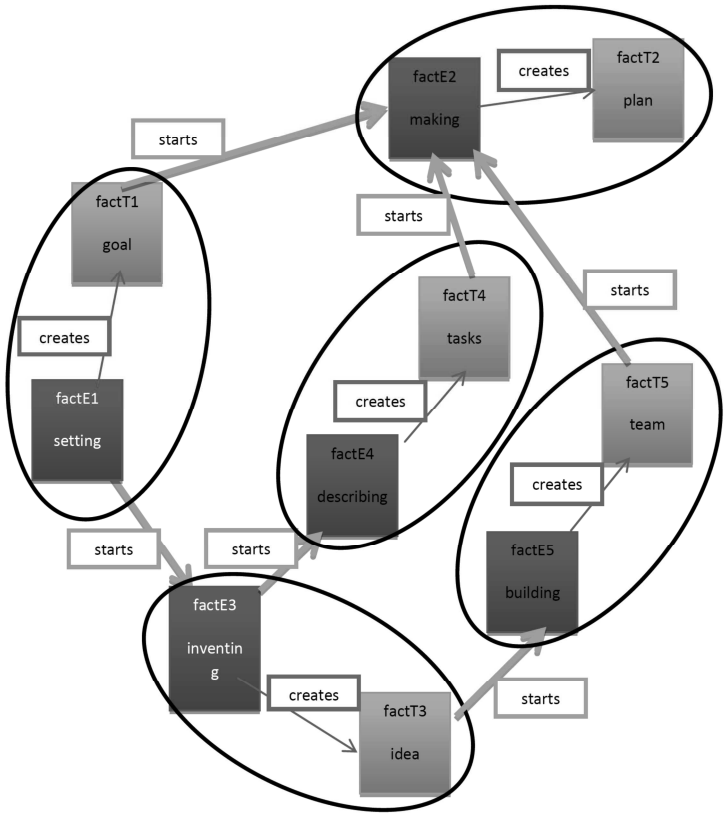

Figure 2. The Ontology for the System of Organizational Terms

Source: Own elaboration

In Figure 3 we have five different nodes (units: a factE, a "creates" relation and a factT) and six edges (t1, t2, t3, t4, t5, t6 – "starts" relations). Comparing Figure 2 and Figure 3 to one another it is possible to see the time which passes by. Every counted node appeared at a certain moment of time after the previous node. Of course, the node does not disappear without a certain reason ("starts" relations). The last in the line of time however, usually means they are not clearly seen or deeply experienced by humans.

Every act of management made by a manager leaves behind such a graph just like a path made by human feet. These graphs can be treated as personal patterns of managers' behaviors. According to the theory of graph there is a possibility of making several operations on a graph (Duda, Hart, & Stork, 2012, p. 51–52). First, it is possible to measure the simi-

larity of graphs. It means we can point to a level of similarities of different managers' behaviors. Second, recording the activities with the time dimension allows us to compare activities taken by one manager to others which were taken in the past. It let generate functions describing the most appropriate action in a certain moment of time. Third, having data about manager's activities it is quite easy to indicate the best practices in certain managerial environments and situations.

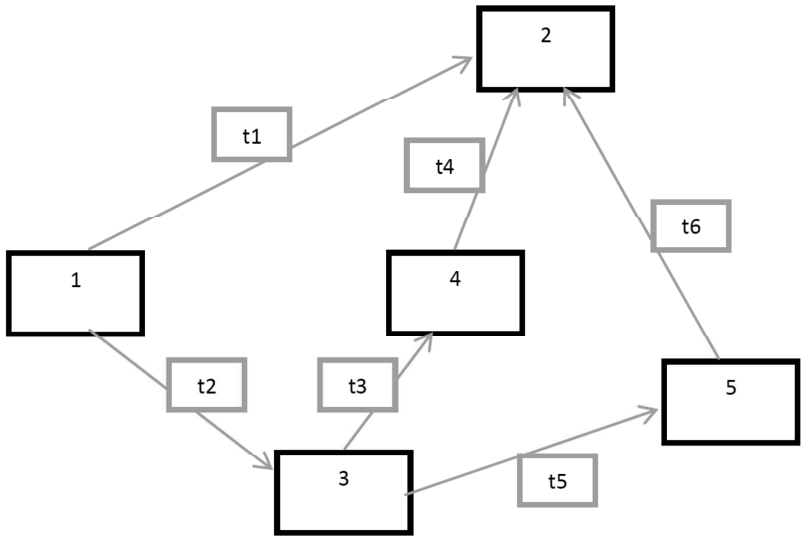

Figure 3. Graph for the System of Organizational Terms

Source: Own elaboration

An example of a visual representation of two different managers' behaviors is in Figure 4 and Figure 5. In Figure 4 and Figure 5 we can see two different ways of managing a small project. The symbols used in figure 5 mean:

U1 – writing a tasks (factE – writing, factT – tasks)

U2 – making a plan (factE – making, factE – a plan)

U3 – setting a goal (factE – setting, factE – a goal)

U4 – informing a team about a goal (factE – informing, factE – a goal in teams' head)

U5 – recognizing resources (factE – recognizing, factE – recognized resources)

U6 – creating an idea (factE – creating, factE – an idea)

Edges of the graph and their numbers represent the following "starts" relations and when it happened in different moments of time.

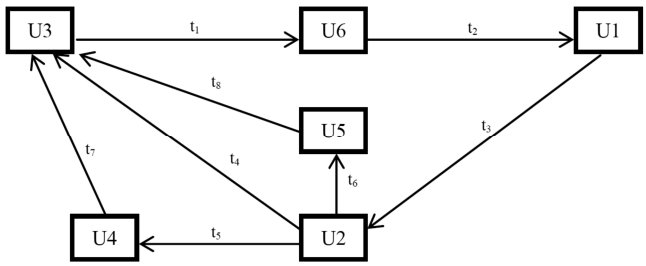

Figure 4. An Example of a Visual Representation of the First Managers' Behavior

Source: Own elaboration

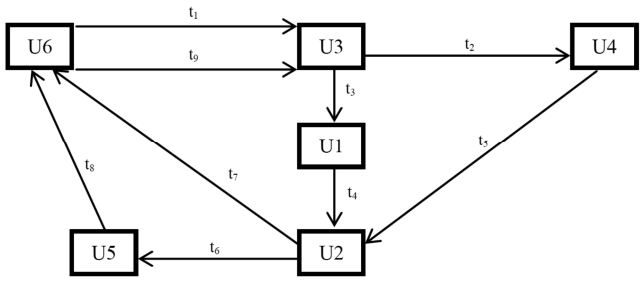

Figure 5. An Example of a Visual Representation of the Second Managers' Behavior

Source: Own elaboration

As it is displayed in the figure 4 and the figure 5, the same management processes are able to be set in time in different directions. It is difficult to claim which order is better. We can imagine two managers who perform in the same project in different ways and both obtain results as they designed.

According to the graph theory applied to the pattern recognition it is possible to classify such graphs by certain features. By using this classification we are able to get a feature vector which describes an object (Theodoridis & Koutroumbas, 2009, p. 261). Management is not so different from physical objects. The only distinction is the time line, nevertheless recognizing moving objects also uses a time line. Therefore, such an approach can be applied in management science provided there is a stable system of terms based on the ontology described in this paper. The system of organizational terms lets us make a pattern recognition in management in three areas:

1. Making comparisons of the behaviors of a certain manager in a time line;

2. Comparing the behaviors of several managers;
3. Outlining the most common behaviors of managers in certain situations.

CONCLUSIONS

As it was presented above, graph-based pattern matching is useful to analyze managerial behaviors when the managers take part in management processes. An indispensable theoretical concept for this is the system of organizational terms based on the facts theory. Such a system has been created by the author of this paper. The ontology of the system is presented in figure 2. Making the model of ontology a little bit simpler, as it was indicated, allowed it to be represented by graphs. Applying graph theory, as it was written, created a potential opportunity to analyze managerial behaviors. However, one obstacle for getting quick scientific results had to be overcome. This was a method of research and its tools.

Since 2012 such a method and tools have been implemented in order to overcome this obstacle. Readers can find two prototypes in the platform www.transistorshead.com. There are two managerial tools – a goaler and a tasker – which have two main functions. The first is to let a manager make the managerial processes (setting a goal and describing tasks). The second function is to record data about how and when the manager does it. Previous experiments in little groups of managers, which were carried out in 2012, proved that this method of research and such tools gives a big amount of data about managerial activities. When this paper was being written the graph theory was being applied to make analysis of managerial tools in the area of setting goals and describing tasks.

In order that the reader could check how the method of research and tools work it is possible to login to transistorshead.com. The first account was created so that a reader could see the results of an anonymous manager – John Smith. A login name: john.smith, and a password: smith were set up. The second account is open to changes and any reader can create examples of goals and tasks. It is also possible to modify goals and tasks created before under the login name: anonymous.manager, and password: manager.

REFERENCES

Barnes, G.P. (2007). Necessity And Apriority. *Philosophical Studies*, *132*, 495–523.

Brink, C., & Rewitzky, I. (2002). Three Dual Ontologies. *Journal of Philosophical Logic*, *31*, 543–568.

Cordero, A. (2009). Contemporary Science and Worldview-Making, *Sci & Educ*, *18*, 747–764.

Cole, C., Chase, S., Couch, O., & Clark, M. (2011). Research Methodologies and Professional Practice: Considerations and Practicalities. *The Electronic Journal of Business Research Methods*, *9(2)*, 141–151.

Cyfert, S., & Krzakiewicz, K. (2009). *Nauka o organizacji*. Poznań: TNOiK.
Dolby, R.G.A. (1998). *Niepewność wiedzy*. Warszawa: Amber.
Duda, R.O., Hart, P.E., & Stork, D.E. (2010). Pattern Classification. New York: John Wiley & Sons, Inc.
Domejko, K. (1976). *Prakseologia – nauka o sprawnym działaniu*. Warszawa: PWN.
Flak, O. (2007). Układ wielkości organizacyjnych jako obiekt badań. In A. Nalepka (Ed.), *Organizacje komercyjne i niekomercyjne wobec wzmożonej konkurencji oraz wzrastających wymagań konsumentów*. Nowy Sącz: Wyższa Szkoła Biznesu.
Flak, O. (2012). Management Sciences. In A. Nalepka, & A. Ujwary (Eds.), *Business and Non-profit Organizations Fading Increased Competition and Growing Customers' Demands*, Nowy Sącz: Wyższa Szkoła Biznesu.
Flak, O. (2013). Concept of Managerial Tools Based on The System of Organizational Terms. In R. Knosala (Ed.), *Innovations In Management And Production Engineering*, Opole: Polskie Towarzystwo Zarządzania Produkcją.
Hicks, H.G., & Goronzy, F. (1967). On Methodology In The Study Of Management And Organization. *Academy of Management Journal*, *10(4)*, 371-384.
Kotarbiński, T. (1969). *Traktat o dobrej robocie*. Wrocław-Warszawa-Kraków: Zakład Narodowy im. Ossolińskich – Wydawnictwo.
Koźmiński, A., & Zawiślak, A. (1982). *O organizacji*. Warszawa: PWE.
Krzyżanowski, L. (1985). *Podstawy nauki zarządzania*. Warszawa: PWN.
Maruszewski, T. (2001). *Psychologia poznania*. Gdańsk: GWP.
McInerny, D.Q. (2005). *Nauka logicznego myślenia*. Warszawa: Wydawnictwo KDC.
Mouritsen, J. (2009). Classification, measurement and the ontology of intellectual capital entities. *Journal of Human Resource Costing & Accounting*, *13(2)*, 154-162.
Niculescu, C., & Trausan-Matu, S. (2009). An Ontology-centered Approach for Designing an Interactive Competence Management System for IT Companies. *Informatica Economica*, *13(4)*.
Nowaczyk, A. (2009). *Układy złożone w naukach społecznych*. Warszawa: Wydawnictwo Naukowe Scholar.
Prechtl, P. (2007). *Wprowadzenie do filozofii języka*. Kraków: Wydawnictwo WAM.
Przybyłowski, J. (2002). *Logika z ogólną metodologią nauk*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.
Rao, L., Reichgelt, H., & Osei-Bryson, K.M. (2009). An approach for ontology development and assessment using a quality framework. *Knowledge Management Research & Practice*, *7*, 260–276.
Schroeder, M. (2008). Having reasons. *Philosophical Studies*, *139(1)*, pp. 57–71.
Staab, A., & Studer, R. (2009). *Handbook on Ontologies*. Berlin: Springer-Verlag.
Sułkowski, Ł. (2004). *Metodologia nauk o zarządzaniu. Przegląd organizacji*, *10*.
Theodoridis, S., & Koutroumbas, K. (2009). *Pattern Recognition*. Burlington: Elsevier.
White, L., & Taket, A. (1996). The End of Theory? *International Journal of Management Science*, *24(1)*, 47- 56.
Wilson, R.J. (2012). *Wprowadzenie do teorii grafów*. Warszawa: PWN.
Ziembiński, Z. (2006). *Logika praktyczna*. Warszawa: PWN.
Zimniewicz, K. (2008). O potrzebie dyskusji na temat metod zarządzania. In J. Rokita (Ed.), *Ku nowym paradygmatom nauk o zarządzaniu*. Katowice: GWSH.

TEORETYCZNE PODSTAWY ANALIZY ZACHOWANIA MENEDŻERA Z WYKORZYSTANIEM ROZPOZNAWANIA WZORCÓW OPARTEGO NA TEORII GRAFÓW

Abstrakt

Tło badań. Obecnie brakuje możliwości porównywania wielu rezultatów badań w zarządzaniu. Naukowcy tworzą odrębne ontologie, korzystają z niekompatybilnych metod badawczych i wyciągają wnioski, które w najlepszym przypadku są wzajemnie neutralne. Dlatego potrzebne jest nowe podejście metodologiczne, które pozwoli przezwyciężyć te przeszkody.
Cele badań. Celem pracy jest zaprezentowanie nowego podejścia do analizowania zachowań menedżerskich i tym samym wniesienie wkładu w rozwój metodologii nauk o zarządzaniu.
Metodyka. Zaprezentowane podejście bazuje na analizie zachowań menedżerów opartej na teorii faktów i układzie wielkości organizacyjnych. Daje to podstawę do wykorzystania teorii grafów do rozpoznawania wzorów w zachowaniach menedżerów.
Kluczowe wnioski. Porównywanie wzorców zachowań menedżerskich na podstawie grafów jest przydatne kiedy menedżerowie biorą udział w procesie zarządzania. Wymaga to osadzenia w teorii faktów i stworzonym na jej podstawie układzie wielkości organizacyjnych.

Słowa kluczowe: układ wielkości organizacyjnych, teoria faktów, teoria grafów, zachowania menedżerów, rozpoznawanie wzorców