

Opposition Variables as a Tool of Qualitative Analysis

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Abstract: The article reveals the concept and the subject matter of opposition variables. These variables are used in artificial intelligence and analysis of semi-structured information. Opposition variables serve as the basis of the qualitative and qualitatively-quantitative analysis. The article reveals the multidimensionality of the subject matter of opposition variables; provides examples of their practical application in strategic planning; shows the connection between opposition variables and correlates; shows the difference between attributive and categorical opposition variables; and provides an example of application of opposition variables for analyzing tacit knowledge.

Key words: Analysis • Qualitative analysis • Artificial intelligence • Semi-structured information • variables
• Opposition variables • Categories

INTRODUCTION

Currently, there is a tendency of increasing complexity of information collections [1]. The complexity of information collections causes information barriers [2], which hurdle processing, analyzing and taking decisions. Such a situation causes special problems at qualitative analysis and at analysis of semi-structured information [3]. One of the tools to address this problem is the opposition variables [4].

Methodology: Categorical analysis is the basis of construction of variables. Structural analysis is supplemental to it. Assessment of tolerance and difference is used for separation of oppositions. Semantic analysis is used for construction of opposition variables in the information aspect.

Body of the Work: Opposition variables are the attributes of certain substance, the opposite properties of which they represent. The *opposition variables* term requires specifying the object of the category, which they describe. Opposition variables qualitatively differ from many variables applied in mathematics. The area of their application is artificial intelligence, semantics, qualitative analysis and management.

Unlike mathematical variables, opposition variables are heterogeneous. Mathematical variables cover the area of quantitative analysis; they normally equal to a single qualitative value and their value is often expressed with a single figure. They can describe only a single characteristic: distance, speed, time, square, volume, density, etc. The vector of such values contains qualitatively equal elements. For example, the vector in the Cartesian space $R(x, y, z)$ is described with three component figures, which have equal dimensionality and belong to the same qualitative value- the distance from the origin of coordinates. Vector in mathematics has elements of the same dimensionality or the same qualitative content.

Opposition variables cover the area of qualitative-quantitative analysis. They can express either several qualities or a single quality. This determines their heterogeneity. The values of opposition variables can be expressed with the figures related to different quality characteristics. The values of opposition variables can be also expressed by qualitative values. For example, the target value [5] can contain values of various qualities as components. The presence of multiple qualities of opposition variables determines their polysemanticity and multidimensionality of their consideration. The vector in oppositional or qualitative analysis most often has

components of different dimensionality or different qualitative content.

Within the information analysis, opposition variables can be treated as information units [6].

Within the semantic analysis, opposition variables can be treated as semantic information units [7].

Within the systemic analysis, opposition variables can be treated as heterogeneous elements of the system [8].

Within the correlation analysis, opposition variables often can be treated as opposition correlates [9].

As for management practice, opposition variables are applied in SWOT analysis [10]. SWOT analysis is the analysis used in strategic planning. This analysis reveals two opposition pairs of variables. The first pair is Strengths- Weaknesses. The second opposition pair is Opportunities- Threats. This analysis is, first of all, qualitative and then only, quantitative.

If opposition variables are interrelated, they are called correlates. The *correlates* term was introduced by Aristotle [11] and it has a broader sense than the *correlation* term in statistics [12]. Opposition variables can be treated as a pair of opposition correlates, which have qualitative and quantitative values and reflect a property of an object, a process, a phenomenon, or a model. We need to remind that correlates can be linked by the relations of opposition or complement [9]. Opposition variables are interrelated only by the relations of opposition.

Opposition variables are categorical or attributional values. Therefore, they require specifying the substance, which they describe, or the category, which they belong to [4].

Opposition variables of qualitatively different substances can be incommensurable. For example, deficiencies of a car and a human are incommensurable. Advantages of a bicycle and a bird are incommensurable, too. Advantages and deficiencies of one human are normally commensurable with those of another human. Let us consider the requirements, which opposition variables must satisfy.

Opposition variables are called categorical if they belong to the same category. In this case, they have a composite designation, which includes the common category and their opposition quality. For example, the pair of opposition variables "explicit knowledge- tacit knowledge" or the pair "income- expenses". This type of opposition variables is called closely interrelated.

Opposition variables are called attributive if they reflect the property of the substance using sets of quality characteristics. This type of opposition variables is called weakly interrelated. Opposition variables have only one-word designation in this case, which includes the sets of quality characteristics. For example, the pair of opposition variables "advantages- deficiencies" or "opportunities- threats" can include different number of quality characteristics associated with each variable. The number of quality characteristics is not the dominant attribute at taking decisions.

For example, we can detect 10 advantages and 3 deficiencies of a certain substance. But, as applied to its application, or to the solution of a task, the three deficiencies can be of greater importance than the larger number of advantages. For example, if a car has only two deficiencies: the engine is broken and the tires are ripped, it cannot be operated despite any advantages.

Opposition variables are called simple if they are determined by a single qualitative or quantitative characteristic. Opposition variables are called complex if they are determined by a total of qualitative or quantitative characteristics.

Complex opposition variables are called homogeneous if each of the variables has equal number of characteristics with equal qualities. Complex opposition variables are called heterogeneous in the opposite case.

Simple opposition variables are always homogeneous. Simple opposition variables are always measured by a single scale and in the same units. Due to this reason, they are often represented using dichotomous values: "Yes-No" or numeric values "0-1". If we denote one opposition variable as A and the other as B , the probability P of existence of the property, which they describe, can be determined as:

$$P(A \text{ or } B) = 1 \quad (1)$$

The expression (1) determines opposition variables from the perspective of semantics as values linked by paradigmatic relations. Consequently, in terms of hierarchy, opposition variables serve as the basis of analysis at the same hierarchic level. In terms of classification, the opposition variables serve as the basis of construction of binary relations and respective binary classifications.

Opposition variables exclude comparative degrees ("good- better", "accurate- highly-accurate"), i.e. the ordinal variables. Logically, they conform to alternatives and that allows applying the first order logic.

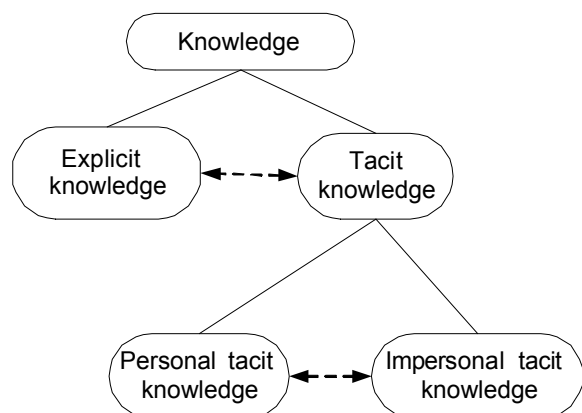


Fig. 1: The opposition variables describing tacit knowledge.

The *opposition variables* term is not a standalone substance, it is always associated with some other substance. Therefore, this term requires specifying the object, with respect to which the opposition variables are introduced. Otherwise, assessment using opposition variables will be inadequate.

As an example of application, we can provide the application of opposition variables for studying the tacit knowledge [13] (Figure 1).

The *Knowledge* category in opposition analysis creates the pair of opposition variables "explicit knowledge- tacit knowledge". The opposition relation is designated with a double arrow. The hierarchy relation is designated with a single continuous line.

In its turn, the tacit knowledge, as evidenced by the studies [14, 15] allows creating an opposing pair "personalized tacit knowledge- impersonalized tacit knowledge".

Such division allows obtaining commensurable results of different researchers and, based on that, develop the concept and the theory of tacit knowledge.

The research work [15] tries to introduce the pair "codified knowledge- non-codified knowledge" as a match to the pair of opposition variables "explicit knowledge- tacit knowledge". To our opinion, it is an aberration.

Cryptography uses only codified knowledge. It remains tacit due to its destination. At computer-aided processing, machine codes are used, which are also the codified knowledge. These codes are tacit knowledge for the vast majority of PC users and other people. These authors confused the concept of formalization with the concept of codification and do not take into account the property of interpretability.

CONCLUSION

The contemporary state of the theory of opposition variables indicates that the theory falls behind the practical application of these variables considerably. In many cases, application of opposition variables is based on intuition, rather than on logic or on structural analysis of the situation. At the same time, the broad and differentiated application of opposition variables in management and qualitative analysis requires drawing attention of experts to theoretical research in this area of knowledge. This should primarily works in the sphere of artificial intelligence.

Summary: Usage of opposition variables allows providing structural, qualitative and other types of analysis with better apparency. Opposition variables can be efficiently applied at information management [16] and in systems of artificial intelligence. Opposition variables reduce the information load by generalization of information collections by key attributes. Opposition variables possess high flexibility, which allows using them in intelligence systems.

Credits: The author encloses gratitude to Academician of the Russian Academy of Sciences A.S. Sigov and Professor I.V. Solovyev for discussion of the article.

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