Теорія і методологія наукових досліджень

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THE MATRIX METHODS AND MODELS
IN MARKETING ANALYSIS AND PLANNING

The genesis and mission of matrix methods and models in marketing analysis and planning have been identified. From the methodological positions a comparative characteristic of two- and three-dimensional models' capabilities in marketing analysis has been given. The typical errors in applying SWOT-analysis have been critically analyzed. The need for its direction to the selection, justification and implementation of an integrated business development strategy was underlined. An adapted option of matrix and an algorithm for SWOT-analysis have been proposed. A functionality, methodological principles and methodical peculiarities of "portfolio analysis" matrices were specified. With the use of the Boston Consulting Group (BCG) matrix model, the critical moments of marketing matrices implementation have been defined what can be considered as the basis for their further improvement.

Key words: *matrix, matrix methods, matrix models, multivariate scenarios, SWOT-analysis, matrices of portfolio analysis.*

Formulation of the problem

In modern science, matrix methods are an important tool for obtaining a growth of knowledge. This fully applies to the theory and practice of marketing management. For objective reasons, the outside influence on business practices is enforcing, the uncontrolled fluctuations in consumer demand are becoming regular, resource supply problems arise, the increase of tension within competitive environment occurs etc. As a result, marketing technologies have to become more complicated, business requires non-ordinary, creative decisions, and also the need to review some theoretical postulates looks unavoidable.

Under such circumstances, the marketing management decision making process is more and more removing from the limits of unquestioning uniqueness, it means the *multivariate scenarios* of business development are becoming more popular. Marketing managers have to constantly search for the optimum decision, systematically justify it, to convince colleagues and business partners in the correctness of their choice. The implementation of these objectives requires appropriate tools, which include methods and models in marketing analysis and planning.

The characteristics of matrix methods are based on a certain algorithm of their use, without special need for a significant accumulation of empirical data, the overwhelming reliance on abstract and logical thinking design and, of course, the construction of a visual matrix (model) with appropriate grounding for multivariate scenarios of the processes and phenomena development. However, the widespread use of such methods is only in the beginning, and thus the problem areas in their design and implementation become more visible. That is why the further improvement of these tools needs the support of a scientific discussion.

Analysis of recent research and publications

A number of the world known researchers should be regarded as the founders of the use of matrix methods in marketing management, among them I. Ansoff [1], P. Doyle [7], P. Kotler [10], J.-J. Lambin [11], M. McDonald [12], G. Panagiotou [20], M. Porter [22] and other. The methodological principles, conceptual approaches and models, worked out and offered by them, are widely spread among scholars and practitioners since 60-s of the last century. With the change of economic system in Ukraine, in the beginning of the 90-s the interest to the concept of marketing and, in particular to the possibility of using matrix methods in marketing analysis and planning, has greatly increased. Among domestic marketing researchers who have achieved substantial methodological results in this direction the names of V. Horyovyi [6], V. Tertychka [17], A. Starostina [13], Z. Shershnyova [2], T. Chechetova-Terashvili [18] should be mentioned first of all. Assessing appropriately their contribution, it should be noted that matrix methods require more attention of researchers because sometimes the intentions of their practical use are ahead of time comparing with their methodological reflection and adaptation to dynamic processes of market transformation in the country.

The aim and methodology of the study

The *aim of this study* is to attract the attention of researchers and marketing expects to the culture of using matrix methods in marketing, to improve their methodological excellence for the prevention of critical points and typical errors in their application. The author considers as insufficient the level of scientific debate on the theoretical justification of certain matrix methods and their complementarity with other research methods in economics and business studies, especially with mathematical background. The *research methodology* of the study is based on the fundamental works of marketing management classical theories, emphasizes the specificity and evolutionary nature of matrix models, leaving scope for further discourse in this direction. The abstract design and logic simulation in the construction of matrix models as well as the marketing and functional analysis associated with the critical assessment of some existing practices of marketing matrices application and the multivariate scenarios interpretation for the marketing management decision making are in the focus of this study.

Research results

The semantic analysis of the "matrix" concept shows its relatively broad and fairly long-term use in various fields of knowledge and practice. The origin of the term is associated with Latin "matrix – uterus, initial cause, primary source". To the modern lexicon the word got around in the XVIII century from German, there from French, and there – from ancient Rome. At present, the similar terminology is common in metalworking, medicine, art printing, culture and, of course – in mathematics. An integrated system of knowledge about building an orderly and compact recording linear algebraic and differential equations in the form of lines and columns, creating a rectangular table, and operations with them was called matrix algebra or matrix analysis [5, p. 13]. In the matrix tables the number of equations determines the number of lines *(m)*, and the number of unknowns – the number of columns *(n)*. The matrix of $m \times n$ size, arranged as a rectangular table, is recorded in mathematics as follows:

$$A = \begin{pmatrix} a_{11} & a_{12} & ... & a_{1n} \\ a_{21} & a_{22} & ... & a_{2n} \\ ... & ... & ... & ... \\ a_{m1} & a_{m2} & ... & a_{mn} \end{pmatrix}$$

Hence, the matrix elements include the numbers as such, mathematical symbols and mathematical functions. This symbolism was recognized as very convenient for use in other, related fields of knowledge – physics, computer science, and certainly in the economics. First of all, it was a purely mathematical "functional load", i. e. the use of matrix to solve complex mathematical equations with many unknowns.

Although matrix methods in economics and business science are descended from mathematical analysis, the logic thinking in marketing matrix has been developed in a somewhat different direction. This is attested by the fact that in recent years these methods are increasingly used for general research purposes and referred to the abstract and logical group of methods. The examples can be founded in the well-known Ansoff's matrix of strategy selection ("market penetration, market development, product development, diversification") [1], the Porter's matrix of competitive strategies ("differentiation, overall cost leadership and focus on particular segment only") [22, p.39], the "Prisoner's Dilemma" matrix in the theory of cooperation [21] and other. Especially matrix methods began to be appreciated in the strategic planning in marketing when the process of management decision making faced with the likely emergence of a significant number of variant scenarios. Under such circumstances the numbers gave their place in the matrix tables for qualitative assessment based on logical arguments [18].

However, no reason to exceed the logical capabilities of matrix methods, because they are not a mean of accurately predicting the future but only a tool to select the vector of strategic thinking and precautions for simplified perception of the situation. We will try to explain this with the known matrix «Descartes Square» [23] which can be used in marketing management decision making. It takes into consideration two factors: 1) something may happen or not to happen (the cause), and 2) that as a result of this will or will not happen (consequence). Thus, four possible options (scenarios) are possible that graphically presented as four quadrants (q_1, q_2, q_3, q_4) in the same plane (Figure 1).

What if

	it will happen	it will not happen
if this happens	Scenario 1 (q_1)	Scenario 3 (q_3)
if it doesn't happen	Scenario 2 (q_2)	Scenario 4 (q_4)

What will happen

Figure 1. **Descartes Square (basic conditions)**

Source: own adaptation.

In this approach, the logic of the situation development forecast is sufficiently convincing. But for an experienced manager, or any other marketing expect, the construction of such matrix is unnecessary, because they must have in clear focus the opportunities and problems of the managed business. Therefore, this relatively primitive matrix becomes for the occasion only to those who just get into the business or who need to quickly convince the possible consequences of the situation (for example, newly recruited managers, shareholders meeting, foreign investors, the new Supervisory Board, etc.). However, if in a given matrix model number of result signs will increase to two, the graph already requires three-dimensional projection. The square will be converted into a cube, and the number of possible scenarios will increase to eight. But if the number of result

factors is greater than two, then use a graphical approach impossible, because the problem will go beyond three-dimensional measurement.

For such related with human psychology area as marketing, this is highly undesirable. Thus, the study of dissipative economic systems, where the synergy of numerous factors interaction determines the condition of system stability, matrix models are eligible only up to a certain point – namely, their spatial modeling. Out of doubt, the abstract background of matrix methods makes possible to operate only with the quintessential issue, rejecting unnecessary details. At the same time it limits consideration of multifactor impact and opportunities for the perception of multivariate results.

How the visibility function is important can be demonstrated by a combination of matrix and functional analysis (Figure 2). Using Porter's approach [22, p. 43], let's divide the graphic representation of functional relationship between return on investments (Y) and market share (X) into four quadrants. Two of them (q_1 and q_2) illustrate the decline of profitability even with a growing market share. Point B seems to be critical (Figure 2-a), after the passage of which the profit rising is expected (quadrants q_3 and q_4). However, taking into account another factor (Z), which may be, for example, the volume of sales, it appears that critical point slowdown profitability falls even lower (Figure 2-b). This adds realism to the model and makes understandable the skepticism which sometimes expressed in relation to the two-dimensional models.
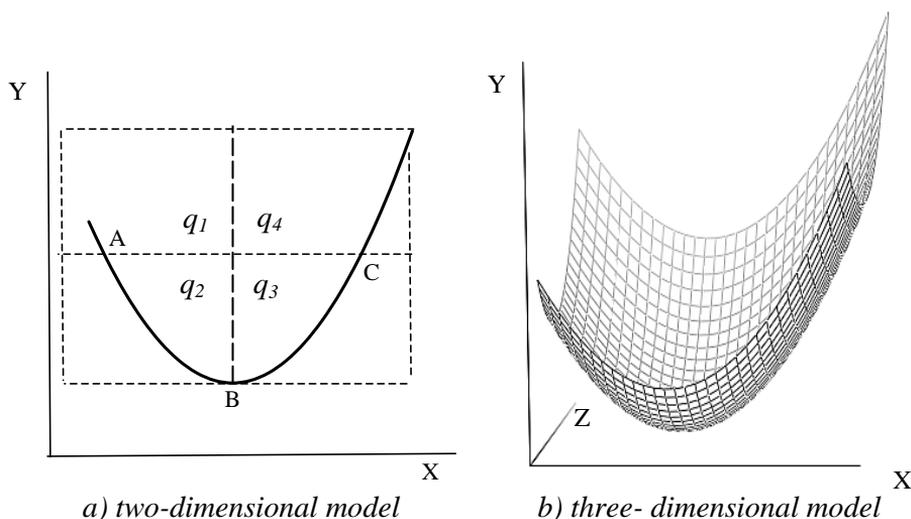

a) two-dimensional model   *b) three- dimensional model*

Figure 2. **The comparison of two- and three-factors models in matrix and functional marketing analysis**
Source: own research (developed together with A. Lapin).

Another problem of matrix methods is a target orientation of their use and ensuring the impartial selection of input data. This is especially true for such matrix method as SWOT-analysis which is often used in marketing strategic planning. Despite its popularity and setting the relative consensus as for general application methodology, some researchers prefer only to list the strengths and weaknesses of the research object, and the opportunities and threats to its development [2; 3; 8; 9, p. 90; 14; 16]. In this case there is a lack of analysis as a tool to obtain objective information.

It should be emphasized that the main purpose of this method is the economic evaluation of alternative scenarios of strategic development and finally justify an integrated strategy, i. e. it is the way to take into consideration the effect of various factors. So the final result of a SWOT-analysis application should be a strategy, especially in our case – a marketing strategy. In addition, the choice of the influencing factors and their rankings often depend on subjective opinion of the researchers [4, p. 82], as a result, there is skepticism in perception of this method [15].

There is no reason to abandon it at all, but it requires improvement of methodological support for selection, quantitative evaluation and establishment of the ranking factors [6, p.78]. Thus, from the methodological standpoint the algorithm of SWOT-analysis should be clearly defined. Its possible option is shown on the Figure 3.
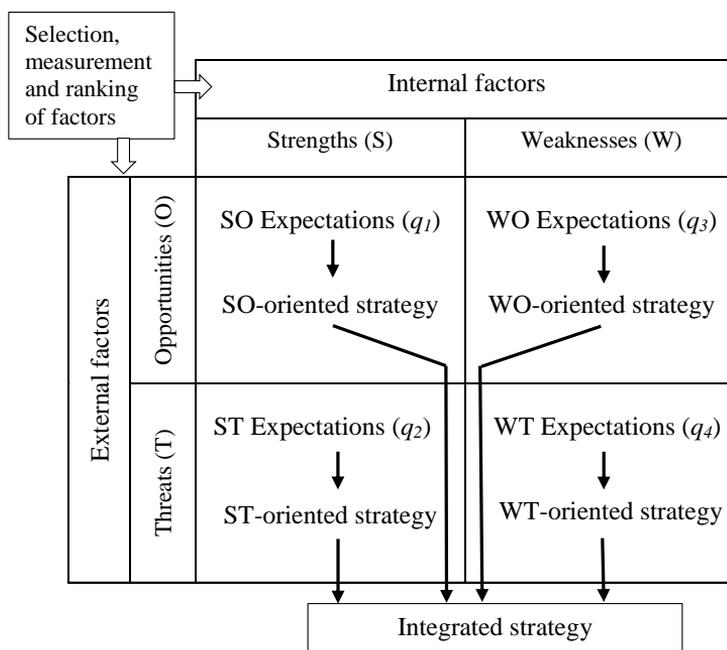

Figure 3. **The matrix and algorithm of SWOT-analysis in the marketing strategic planning**
Source: own adaptation.

A similar situation arises with practical use "portfolio analysis" matrices used in the marketing strategic planning – BCG (Boston Consulting Group), GE/McKinsey, Shell/DPM, ADL, Hofer/Schendel, etc. Despite their diversity, they differ slightly in their construction and methodological analysis. Typically, they are two-dimensional models and differ only in the set of parameters and the depth of analysis. But in each case it comes to evaluating market attractiveness and competitive position of the company.

The problems applying "portfolio analysis" matrices should be split into two parts. The first group of problems is related directly to obtain objective information input, prejudice its subjective interpretation and inappropriate use, inability sometimes to achieve a harmony of quantitative and qualitative indicators because of their uneven filling content. The problems of another group appear in the interpretation of the analysis results and the implementation of the recommendations which are logically predefined by the results. The conducted analysis is considered to be useful if the results are not superficial (i. e. apparent even without analysis), when it is possible to trace the dynamics of key indicators as well as guidelines take consistency and targeting. For example, let's consider the critical aspects of the BCG matrix which is most common in the marketing analysis since 1968 (Figure 4).
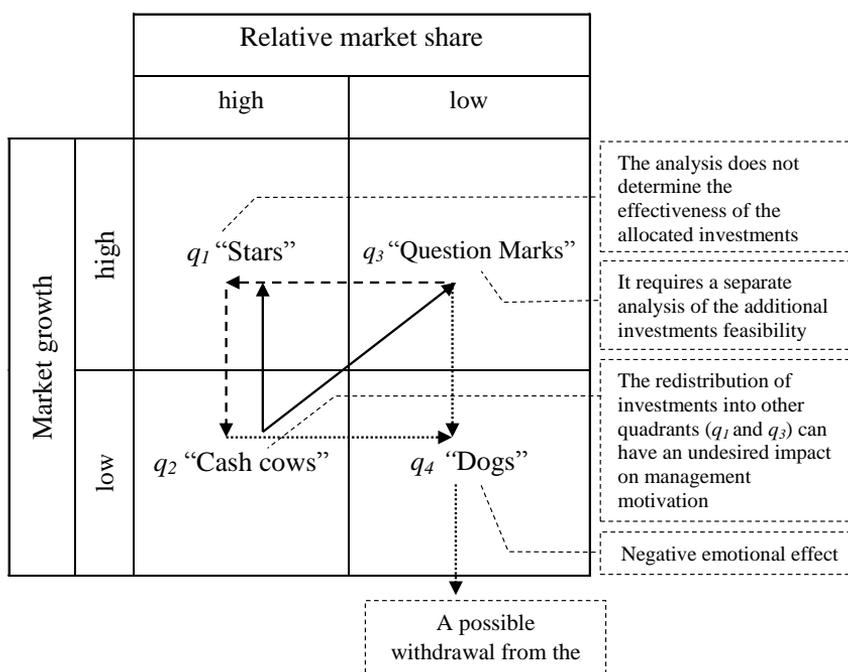

Figure 4. **The BCG basic matrix and its critical points**
Source: own adaptation.

Finally, matrix methods are important but not ideal. Therefore, in marketing analysis and planning they can be better applied within the system of other research methods, striving to objective assessment of input parameters in matrix models. The using matrix methods is justified by the need to ground multivariate scenarios of business processes, but primarily to select vectors for strategic development. Testing matrix methods in marketing has important methodological significance in general as it enhances their use by researchers in their fields of science.

Conclusions

1. Matrix methods and models have wide and increasing use in research, particularly in marketing analysis and planning. Their application is focused on the measurement and interpretation of various factors' impact within a dynamic environment in order to choose the optimal decision among possible multivariate scenarios of development. Matrix models, become especially useful in cases when the possibilities of other, especially verbal models are limited or less convictive.

2. Unlike mathematics, marketing matrix are based mainly on abstract and logical thinking constructions, while using the results of mathematical analysis and simulation as arguments is highly appreciated and indicates the depth in decision grounding. The use of marketing matrices and models is relatively new direction in the development of marketing concept which constantly enriched with new additions of methodological significance.

3. However, the illusory capabilities of matrix methods in marketing have certain limitations. First of all, marketing matrix models are usually two-dimensional, which reduces the accuracy of the analysis. The three-dimensional matrix models are possible but need much more efforts for their constructing. When the number of dimensions become more than tree, the illusory function of the marketing matrix model disappears, and therefore the feasibility of their practical application in this case is lost.

4. A special problem in the use of matrix methods in marketing is the influence of the subjective factor on the construction of matrix models. In particular, it concerns such a popular matrix method as SWOT-analysis. A typical error in its application is an absence of justification for selection, measurement and ranking factors of external and internal exposure. It is also important to be considered, the target orientation of this analysis is to formulate of an integrated strategy. Certainly, SWOT-analysis should not replace the quantitative methods of calculation variant scenarios, but it only serves as methodological basis for the choice of a further development vector.

5. At this stage, so-called "portfolio analysis" matrices are also obtained the growing popularity in marketing. Their appearance is a result of some successful companies' empirically proven creativity. Despite its increasing number and particularities they are rather monotonous because of their usually two-dimensional format, use mainly regarding financial performance and consideration of market attractiveness and competitive position of the company. Preferably, they lack of the

dynamic processes analysis, investment efficiency control and a monitoring of changes in the business environment, although this can be done separately for each situation. In general, it is important to avoid "modeling for modeling", do not transform it into a fashion fetish, but pragmatically to use matrix analysis in marketing for strengthening business.

Prospects for further research

Taking into consideration the unique geopolitical mission of Ukraine, as a new player at the world food market, it seems reasonable to direct further research on application of matrix methods and models in agribusiness marketing. Primary attention should be paid to the competitive conditions which Ukrainian companies, that have just integrated or are in the process of integration into the world economic space, have faced. As well, the economic situation within the country in a whole after its market transformation should a sobecome a subject of modeling in matrix analysis and planning.

<div align="center">Literature</div>

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