Modeling of Consumer Behavior for Business Sophistication

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ABSTRACT

In today's competitive business environment many different indicators influence business performance. In this research the authors analyze one of most important company stakeholders – their customers. The research is based on evaluation and analysis of existing consumer behavior models. On the basis of this research the authors have developed the mathematical model for modeling consumer behavior and investments in communication with customers. Model is based on assumption about the existence of two groups – people and goods. Each group is characterized by a series of parameters. Developed model contains only 3 parameters of each variable (a consumer and a product) and, in order to perform an accurate calculation, it is also necessary to determine the coefficients of mutual impact of each parameter, what should be indicated by experts. The model elaborated by the authors, would be suitable for practical application within business in order to analyze the return of the company investments, identify perspective and less perspective areas of investment towards business sophistication.

Keywords: Consumer behavior, modeling of consumer behavior, mathematical approach, business

1. INTRODUCTION

Today's competitive business environment requires more and more attention to planning, forecasting and analyzing business, especially for small and medium companies. Many authors of scientific publications had been devoted to topics of sustainability and business sophistication. The understanding of business sophistication has been analyzed since 1990, but still this is actual topic for business researchers.

In 1998 Rue and Ibrahim has wrote: "Numerous products in academic publications as well as practitioner-oriented journals have recognized the importance of planning for small businesses. Yet there is surprisingly little empirical work that has examined the relationship between planning sophistication and organizational performance among small businesses" [15]. And the same we can say today – there are small number of researches done on planning sophistication and organizational performance.

One of today's goals for every company is to perform all activities towards business sophistication. According to the authors' point of view business sophistication is more related to the process than to the result. Sophistication is not completed process, the same as quality, management, etc. For this reason it is important to understand from which components the business sophistication will be combined of in every industry and in every company. For each company these components might be different. At the same time there are processes and parameters what are similar for all industries, like market analysis, planning, evaluation of customers, forecasting, controlling etc. This assumption can be affirmed by analysis of existing publications about business sophistication.

For example, Stupak has analyzed marketing strategies and communication for business sophistication [18], Garry and Harwood have tackled the topic of client sophistication and they have founded out that the level of client sophistication has a moderating influence in a number of key areas. These are identified as: service evaluation criteria; interdependency and power; the atmosphere in which solicitor-client interactions take place and relationships develop; the nature of joint personal relational goals and the role of trust and extent of commitment. [6] Lace and Ciemleja have analyzed different business indicators and business performance within context of business sustainability what drives us to sophistication of the business. They have pointed out the

essence of the category «sustainable development» and characterized factors impacting on company's sustainable development, applying the methodology of «Golden section» [12]. Accordingly we may conclude that business sophistication can be provided in different ways and with different approaches.

One of key areas for the business is their customers. This area can be analyzed for many different reasons but always with one aim – to find out consumer behavior under different circumstances. The success of a company depends on understanding of their customers as well as on possibility to communicate with them. Accordingly, the authors of this research presume that modeling of consumer behavior may provide company with needed information for business sophistication.

2. MODELS OF CONSUMER BEHAVIOR

One can come across the concept of *consumer behavior* in several realms of science, however systems of perception differ. Psychology, for instance, is searching for explanation within biological, evolutionary and cognitive processes. Sociology examines the impact of social groups and society, while social psychology explores the role of an individual within a social group.

The beginnings of consumer behavior modeling are dating back to the 60-ies of the 20th century, when it started developing alongside the theory of marketing. Tracing back for the products of various types of consumer behavior *modeling boom* in the late 60ies of the 20th century, a British market research company developed a *modeling research* group to explore consumer behavior. The group elaborated and developed several classifications for various types of models.

The group also drew distinctions between the different ways in which the models might be displayed [14]:

- Verbally – most of us will put our assumptions about consumer behavior into words in order to explain them both to ourselves and other people.
- Algebraically – some of our ideas are best transmitted via an algebraic equation. Weber's Law or the Fishbein model of attitudes would fit into this category.
- Pictorially – almost every diagram can be viewed as model - a diagram illustrating some point about the topic under discussion.

In addition, they identified categories such as descriptive, diagnostic and predictive models and a rather more objective pair which were called successful and unsuccessful.

Perhaps the most used set of categories is that of low, medium or high-level models. In this case the level refers to the level of complexity – so a low-level model would be a relatively simple representation of the phenomenon, while a high-level model of the same event would be much more complex and detailed and include many more variables.

There are several theories explaining consumer behavior – diverse in their form, range, terms of a situation and application, as well as their level of complexity. These theories exploit all the social sciences – economy, psychology, sociology and anthropology.

The model of psychoanalysis was elaborated by Sigmund Freud. He discovered new dimensions within the consumer behavior by introducing psychological elements into the consumer's decision-making. Freud (1923) believed that a human psyche consists of three levels: ID (the deepest layer of subconscious propensities functioning in accordance with the principle of enjoyment and demanding immediate satisfaction), Ego (the aware subject functioning as a mediator between the ID and reality), and, finally Super Ego (the inner conscience of a personality representing viewpoints by adapting to social pressure – developing as a summary of ID desires rejected by the reality). [17]

In accordance with the theory of Freud, consumer behavior is the function of these three elements (1).

$$CB = f(ID, E, SE), \quad (1)$$

Where: CB – Consumer behavior,
ID – The deepest layer of subconscious propensities,
SE - The inner conscience of a personality.

The theory of Gestalt is based on the individual's perception of products and ideas. The core idea of Gestalt therapy is that a person's mental life does not depend on isolated feelings, which are mechanically connected by the principle of associations, but it rather develops as a retained entirety or an image. [5]

The theory of cognitive dissonance (1957) was developed by Leon Festinger who reckoned that a human being has a tendency to seek for coherence between his/her attitude, conviction and action. Cognitive dissonance is a sense of discomfort caused by two conflicting ideas emerging at the same time. Individuals in such situations develop motivation to reduce the dissonance by changing their attitude, conviction and behavior in order to justify and rationalize it. Dissonance

may manifest as a remorse, anger, disappointment or confusion [9, 10]. A salesperson, in compliance with this theory, should try to reduce the post-purchase dissonance of consumers by reassuring them about the correctness of their choice and by encouraging their trust into products. This can be achieved by means of advertisements, post-purchase service, product manuals and other marketing attributes [1].

Behavioristic model is based only on observations and measurable variables. Cognitive models (purchase related to cognition) of consumer behavior are related to information processing. Indicators such as activization, level of participation, emotions, motives and attitude are predominant. Information processing of long-term and short-term memory and variables – learning, reasoning and knowing – is related to decision making process – i.e. – information seeking, processing and selection [3]. All cognitive models, in their term, are part of decision making process reflected in successive stages and having various factors of influence (Blackwell/Miniard/Engel model (2001), Howard/Sheth model (1969), etc.). [2, 7]

In compliance to the theory of behaviorism, one or more hypothetical coherences between variables can be modeled by means of the so called theoretical models. According to behaviorists, all functions of an individual can be described by means of a scheme: stimulus-reaction (hereinafter – SR). It means that any type of human reaction can be achieved provided that the „ right" stimulus is applied. Even though the original opinions of the school of behaviorism have undergone a considerable development, they still exist as a version of theoretical model [16].

Section models (decision making models) are one of the commonly applied methods of consumer behavior research. The models are based on the following concept: by identifying the basis of purchase stages (preconditions), they can be arranged in a sequence, which means that the purchase decision making process can be divided into separate stages. Division into stages depends on the classic or the extensive decision making process and these processes can be modeled as follows [4]:

- the initial stage of the process,
- the stage of search and pre-selection,
- the stage of evaluation and selection,
- implementation (or realization) stage,
- post-purchase stage.

One classic example of a personal variable model is Fishbein model [11]. The model – it is summarized by the formula (2):

$$A_0 = \sum_{i}^{n} B_i a_i , \qquad (2)$$

Where: A_0 = the attitude towards object o;
B_1 = the strength of belief i about o;
a_1 = the evaluation aspects of B;
n = the number of beliefs.

Very popular is the Rice Perceived Value / Perceived Probability of Satisfaction model. This model can be applied in practice by combining it with the theory of value (defining various dimensions of value), which is extensively described in the literature of economics, and analyzing the mutual interaction between the consumer values and the consumption volume.

Most famous of the consumer behavior models are comprehensive (large) models. These large models are the more complex formulations of consumer behavior, and they commonly attempt to encompass all the factors and elements which the authors feel to be relevant to the behavior.

Among most popular models we can name: classic Engel, Kollat and Blackwell model, the extensive Howard/Sheth model, The Nikosia model (1996) etc.

Bettman and Jones have analyzed these models and offered the idea that all formal consumer behavior models can be classified in four groups [8]:

- Stochastic models – consisting of two important components – „laws" intended for individual behavior and individual models;
- Information processing models – are based on an assumption that an individual constantly receives information from the environment and this information is an integral part in the process of choice;
- Experimental and linear models – have general mathematical structure (for instance, Fishbein model);
- Multisystem consumer choice models – represent a broad structure of relationships, usually verbal and contain various simplified formal models.

After examining the most crucial studies and models on consumer behavior elaborated before the beginning of the 21st century, the authors concluded that these studies mainly reflect the consumers' process of decision making, as well as view all the stages of decision making in a more or less detailed way. In the mean time, according to the authors' opinion, the factors influencing the consumer behavior and the intensity of their impact have not been analyzed sufficiently. Most of the above mentioned models characterize the purchase decision making process illustratively and, therefore, the authors

emphasize the importance of a complex approach towards assessment of consumer behavior- a combination of expert methods, marketing methods and methods of economically mathematical modeling.

Titko J. and Lace N. in their research has pointed out that the shareholders' value creation has become the primary goal of any company [20], therefore the authors of this research believe that modeling of consumer behavior and communication intensity would drive a company towards fulfillment of business performance.

3. MATHEMATICAL MODEL OF CONSUMER BEHAVIOR

Based on the previous studies, the authors suggest elaborate a mathematical model in order to forecast the consumption of goods and services having the impact of the external direct and indirect factors. By applying of this model the in praxis companies might reduce their expanses on communication with potential and existing customers as well as become more efficient in the market. The model is based on assumption about the existence of two groups – people and goods. Each group is characterized by a series of parameters. Besides, these parameters are temporarily fixed. It means that they can be measured. For instance, by investing goods into advertising (hereinafter within the model - parameter b_1), it is possible to determine the impact on consumption of certain goods or groups of goods.

The essence of the model is directed towards fulfillment of the needs of a consumer while purchasing a product α_x, with the characteristic parameters (all or part of the parameters). In other words, a purchase process can be described as a function of parameters characterizing an individual and a product – i.e. - $f(\alpha; \beta)$.

In its turn, it means that any product can obtain an indicator demonstrating its value or the price the consumer is willing to pay or pays in order to acquire the product (3.)

$$P = \sum f(\alpha, \beta), \qquad (3)$$

Where: P – Price of the product;
α - Consumers and their characteristic parameters;
β - Goods and their characteristic parameters.

By knowing these indicators, it is possible to model the consumption volume, considering the impact of various variable factors, and to take a decision as to whether, for instance, advertising costs need to be increased or not. This type of modeling allows the managers to take grounded and thought-out decisions.

In order to be able to convey a variable, it is necessary to carry out derivation of a parameter (see formula 4). After attaining a positive result, it is possible to continue investing, while a negative result give a signal that a decision needs to be taken on reduction of investment within the particular parameter.

$$\frac{\partial}{\partial b} = \left(\sum_n f(\alpha, \beta) \right) \Rightarrow \max , \qquad (4)$$

During the performance of modeling, in order to relieve the modeling process, the function mentioned above can be viewed as linear. Thus a matrix of parameters characterizing a product or a product can be composed and referred to as C (see formula 5).

$$\alpha^{+} C \beta = \sum_{i \neq 0}^{n} \sum_{j=1}^{m} a_i C_{ij} b_j \qquad (5)$$

Where: C – The matrix characterizing the parameters of a product;
α - Consumers and their characteristic parameters;
β - Goods and their characteristic parameters.

In order to calculate the turnover or the profitability a company may obtain in the result of investing into a particular parameter (for instance, advertising investments), it is necessary to derive from this parameter (see formulae 6 and 7.)

$$I = \frac{\partial}{\partial b_n} = \left(\sum_{\alpha} \left(\sum_{i=1}^{n} \sum_{j=1}^{m} a_i C_{ij} b_j \right) \right), \qquad (6)$$

or:

$$I = \frac{\partial}{\partial b_n} \left(\sum_{\alpha} \alpha^T C \beta \right) \qquad (7)$$

Where: I – profitability of the parameter for the company

The composed model can be applied in order to carry out more profound studies of consumer behavior or purchase habits. For instance, a company may collect information on the consumers' income, their cultural level, etc. Therefore, a matrix of mutual interaction of

parameters can be composed i.e. to examine the impact of the advertisement or brand of a certain product on people with low income. Consequently, by means of derivations of certain parameters, a conclusion can be drawn as to profitability provided by advertising investments, improvement of salespersons' work, and choice of location of the company and other parameters for the company.

The above model can be examined by means of a specific product, for example, a car. Therefore, matrixes describe expenses of a person α when purchasing a productβ, i.e. a car. In order to compose a matrix, it is necessary to determine the parameters and their impact on the decision making by means of an expert method (see formula 8).

$$\alpha\begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} and \beta\begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix} \qquad (8)$$

Where: α - an individual x;
a_1 – parameter characterizing the individual – income;
a_2 – parameter characterizing an individual – age;
a_3 - parameter characterizing an individual – gender;
β - a product (car);
b_1 – parameter characterizing a car – advertising investment;
b_2 – parameter characterizing a car – brand popularity;
b_3 – parameter characterizing a car (the brand).

Further, it is necessary to determine the interrelation of these parameters (see formulae 9 and 10.).

$$P_{\alpha\beta} = (a_1, a_2, a_3)\begin{pmatrix} c_{11}, c_{12}, c_{13} \\ c_{21}, c_{22}, c_{23} \\ c_{31}, c_{32}, c_{33} \end{pmatrix}\begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}, \qquad (9)$$

Where: P – Expenses of an individual α for the product β;
a_1-a_3 – Parameters characterizing an individual;
b_1-b_3 – A parameter characterizing the car;
c_{11} – c_{33} – Mutual impact of the characteristic parameters.

By means of shortening formula 9, mutual interaction can be described as follows:

$$P_{\alpha\beta} = \sum_{i=1}^{3}\sum_{j=1}^{3} a_i C_{ij} b_j \qquad (10)$$

In the process of research, the mutual impact of the parameters should be defined. In order to perform an accurate calculation, it is also necessary to determine the coefficients of mutual impact.

Thus, by means of derivation regularity is obtained, demonstrating the volume of revenue gain for the company, provided that the expenses will increase by 1 monetary unit. It provides company to stay more competitive among rivals within the industry as well as to guide a company towards business sophistication.
This model can also be used in situations when precise statistical data on the volume of consumption for a certain group of goods and indicators characterizing a consumer are known.

Despite the fact that a model contains only 3 parameters of each variable (a consumer and a product), the model describes the main idea of modeling and demonstrates the approach elaborated by the author as regards modeling of the consumer behavior. Since modeling requires a large amount of output data, each company planning to carry out modeling, has to be capable of providing the necessary information about their clients and their consumption habits. It, thus, means that a company has to carry out regular market and consumer research.

4. CONCLUSIONS

Modeling of consumer behavior is just one step towards business sophistication but it may provide a company with possibility to become more efficient in communication with their customers.

Also the model elaborated by the authors, would be suitable for practical application within business in order to analyze the return of the company investments, identify perspective and less perspective areas of investment. This information also provides a company with information needed for further development, efficient and effective performance in the market.

There are various approaches as regards modeling of consumer behavior. Among them there are many theoretical models that cannot be put into practice.

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