INNOVATIVE EDUCATIONAL TECHNOLOGIES IN HIGHER EDUCATION – MARKETING ACTIVITY EFFECTIVENESS MEASUREMENT IN SYSTEM MAPLE

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Abstract: *Increased requirement of the practice for measurement of marketing activity effectiveness leads in higher education to the pressure on applying the methods of quantitative disciplines and on construing own methodologies when processing and evaluating researches of economic and social phenomena. Application of sophisticated methods of marketing measurement activities as the basic marketing tools for measurements enables inter alia creation of the communication harmony between different functional corporate sectors (marketing is thus encouraged to speak "in the same language" which stresses effectiveness of its planned and realized activities). The appropriate and competitive reaction of the companies and other subjects to the challenges of markets seems to be one of the key issues of current managerial decision making. That's why marketing as an area of market challenges solving should be prepared to communicate the problems with own tools and activities effectiveness. The aim of the paper is evaluate present situation in marketing literature regarding to the measurement of marketing activities effectiveness and advice of possibility to use sophisticated methods for their evaluation. The paper highlights certain possibilities of application of mathematical modelling in the Maple system for teaching, practice and research. General lack of the data and appropriate software for the improving level of the higher education in the area of marketing activities and their measurement open the space for deep discussion between theoretical and practical issues and possibilities to use this tool in the tertiary education, research and company managerial decisions. Results of the executed research in the companies in Czech Republic (2010) showed us interesting quantitative information regarding the application of the selected marketing metrics. The key conclusion seems to be turn to more attention into research in this area and deeply verify possibilities of the Maple in all of mentioned highlights in the paper.*

Keywords: *Marketing Activities, Measurement, Effectiveness, Innovative Educational Technologies, Higher Education, System Maple.*

JEL Classification: *C58, C87, I23, M21, M31.*

Introduction

Competitive struggle is nowadays the basic characteristics of each individual market. By the means, which the competitive struggle is realized through, we can perceive competition at the price level (different strategies and policies are mentioned in this respect, let us point out for instance price reduction, increase of purchase volumes and share in the market and/or cost reduction, thus increasing profit), at the non-price level (we are in particular speaking about the issues of quality of production, customer service, advertisement, sales marketing, etc.). The facts above force the

manufacturers and the sellers into effective and controlled behaviour. Consistent market analysis, analysis of real phenomena, measurements of market environment dependences, identification of economic relationship anomalies, impact of changes are understood explicit indicators hereof. Targeted, systematic and sophisticated researches and their assessment are inevitable practices for choice of management policy of each company. Each new approach or concept is important for the practice in particular if it increases corporate performance and is reflected positively in its economic results. Marketing can win a stronger status only provided that it offers transparent quantifiable instruments and tools for measurement of the funds invested into the proposed marketing strategies and programmes. Development and a wide user introduction of ITC and internet networks is considered a real challenge for application of the methods of quantitative disciplines (quick computations. modelling, improved means of visualization, animation and simulation of phenomena), search for the paths leading to optimization, construing own methodologies when processing and assessing researches in the economic and social environment. Especially, implementation of the approach to the higher education at the business and management faculties seems to be important in this educational phase of young people (incoming employees, managers, owners, researchers and so on). On the other side the turbulent environment (growing pressure of competitors, rising demands of the customers and other stakeholders dynamics of development, quick obsolescence of technologies and products, changing perception and behaviour of the customers as well as character of competition, etc) pushes the management and company owners to look for, inter alia, new a more effective managerial, marketing and business approaches enabling not only to develop successful business in the home market, but also penetrate into European, international and global markets. In order to preparation of managers, owners and researchers will be on the suitable level to face to the environmental challenges is necessity to turn over using of sophisticated methods in the managerial and marketing businesses.

1 Theoretical background

Assessment of effectiveness of marketing and marketing activities is a much wider issue than their simple measurement by the financial ratios only. Marketing activities represent a partial tactical and operational output of strategic decision-taking by the top management. Their effectiveness is connected at the general plane mainly with the overall marketing management process, arrangement of the marketing department, further on, with relations with other departments of the entity, with the level of marketing implementation and in particular with assessment and control. Besides measurement of effectiveness by the financial ratios, material level of marketing effectiveness control is inevitable; it consists in monitoring of the five main attributes: customer philosophy; integrated marketing organization; adequate marketing information; strategic orientation and operational effectiveness [14].

It is therefore recommended to apply the following combination for monitoring of marketing effectiveness:

- Financial ratios (e.g. financial analysis tools, marketing performance control - analysis of sales, share in the market, analysis of marketing expenses with respect to the turnover, effectiveness of use of individual marketing mix tools -

operational effectiveness etc., SVA - Shareholder Value Analysis [14], [21], [22].

- Marketing audit assessing degree of effectiveness of the marketing function performed by the company [9], [13], [14].
- And other non-financial ratios (e.g. customer philosophy; integrated marketing organization; adequate marketing information; strategic orientation [14], lifelong customer value [15], stakeholder value analysis; SVA- Stakeholder Value Analysis [18], [25].

Each new approach or concept is significant for the company in particular if it increases the corporate performance and is reflected positively in its economic results. Marketing can thus win a stronger position only provided that if offers transparent quantifiable tools of measurement of the funds invested into the proposed marketing strategies and programmes.

1.1 Quantification in marketing activities measurement

Publications and specialized papers resolving the issue of measurements based for instance on Return on Investment (ROI) appear nowadays [1], [14], [23]. It seems to be the method how marketing can win a more explicit status in the companies. Application of ROI as the basic marketing tool for measurements enables inter alia even creation of the communication harmony between different functional corporate sectors (marketing is thus encouraged to speak "in the same language" which stresses effectiveness of its planned and realized activities). It improves planning, measurement and optimization of the marketing strategies. Another approach to measurement is based on the necessity to monitor marketing costs. Each marketing programme should be subject to calculation of the costs broken down into individual activities (e.g. the method of Activity Based Cost accounting (ABC)), to establish whether these activities will most probably lead to the results justifying the costs. The companies, focused on a high level of customers' satisfaction by offering higher-quality products and services, are aware that this is the way leading to higher customer satisfaction. Repeated purchases, growth of profit and thus satisfaction of other stakeholders, individuals as well as, further investments, etc. is the positive consequence hereof. It is the cycle bringing profits and growth. Focus on profit maximization seems to be a short-sighted approach according to certain authors [3]. In the majority of cases the companies were focused on the shareholders. The marketing approach incorporating creation and building relationships stresses that it is necessary to change this perception even towards other key stakeholders. The Stakeholder approach is wider and responds to the conditions of the current environment, in addition to the profit target it also reflects other objectives, e.g. responsibility to society and partnership, which are included in the strategic goals and in all corporate activities. We are based on the premise:"should the company fail to care for its key stakeholders and fail to create advantageous and long-lasting relations with them, it will never reach adequate and in particular long-time profits"[6], [10], [14], [24]. The issue of the level of focus of the company on the key stakeholder groups is connected with intents and strategies to be realized by the company for development of relations with them. The companies, focused on a high level of customer satisfaction by offering higher-quality products and services, are aware that this is how they increase their satisfaction. Repeated

purchases, rising profits and satisfaction of other participated groups, individuals as well as further investment, etc. is the consequence hereof. It is a cycle bringing profits and growth.

On the other side, value maximization for the shareholders is a quite different approach that will most probably be more and more topical in the future, as it recommends, when selecting the marketing strategy, to apply analysis of the value for shareholders (SVA-Shareholder Value Analysis) [14]. Application of such analysis is based on the premise:"higher corporate value is hidden in its intangible marketing assets - brands, market knowledge, relations with customers and relations with partners". These assets lead to long-time profits. The analysis itself enables to establish, what alternative behaviour and action will maximize the shareholder value, thus guaranteeing that management will understand marketing as the integrated part of the overall process of its activities (and not as a specific function concerned only with increasing turnover or market share).

Incorporation of the prospective long-life customer value [15] into the sector of marketing measurements should lead to understanding of the basic marketing opposites, i.e. that reach of a higher customer value does not necessarily have the profit form. These two approaches indicate that not all marketing activities can be quantified and measured easily in the marketing sector. Finding more sophisticated tools, enabling their measurement and modelling, is the long-time objective even for these types of marketing activities and intentions.

1.2 Mathematic modelling and Maple system

Use of quantitative methods (i.e. the methods based in particular on mathematic discipline outputs) is nowadays supported firmly by introduction of numerous PC software unit. The latest scientific computations are connected with solution of the real problems by applying information and communication technologies (ICT). The requirements, like accuracy of computations, comprehensible visualization and interactive communication, have enforced creation of universal complex programme software, e.g. the Maple[12] system of the company Maplesoft Inc. (Canada), MathCAD[13] of the company PTC Corporate Headquarters (USA), Mathematica[14] of Wolfram Research, Inc. (USA), MuPAD[15] of SciFace Software GmbH & Co. KG (Germany), etc. Outputs of the researches acquired by collection of empirical data are based in particular on modelling of phenomena, dependences, on measurement of parameters and characteristics in the researches of both quantitative and qualitative character [11]. The mathematical model helps to understand behaviour for future planning better. The models approximate the real behaviour. Modelling is a process [5]. Search for new methods and development of algorithms for corporate activities measurement nowadays seems to be the inevitable prerequisite. "Mathematization" is supported by ICT, thus enabling to apply theoretical results in practice within a wider scope [11]. Points of view of researchers, academicians and practitioners regarding application of the methods for economic analyses, search of economic patterns,

[12] http://www.maplesoft.com/
[13] http://www.ptc.com/appserver/mkt/products/home.jsp?k=3901
[14] http://www.wolfram.com/
[15] http://www.mupad.de/products/

possibilities of prediction of economic phenomenon development, etc., vary on this point, though "mathematization" of the issues, application of statistical and other quantitative methods is supported by steeply developing means of information and communication technologies (ICT) and by their more and more easy availability. This way they support possibility of application of results of the theories in practice (underestimated to a certain degree after the revolution in 1989, nowadays again discussed more actively) within a wider scope [12]. Even the economic theories nowadays utilize methods of quantitative disciplines more and more frequently. Creation of quantitative models of economic phenomena, their visualization, animation and simulation can thus set meaningful conditions for decision taking. The researchers are based on the pre-defined means built in the system. Nowadays it is therefore necessary to pay adequate attention to these facts as early as in the process of education. For successful practice and employability of each graduate it is necessary to support not only acquisition of new practices and knowledge from the sector of quantitative disciplines, but also to develop emotion, experience and necessity of control. Natural (not overestimated) development of computer literacy, utilization of information sources and communication networks plays certainly an important role. Solution of a real problem of a specific company can become a suitable opportunity for realization of the knowledge gathered in practice.

Maple commands:

```
restart : with(Statistics) :
X := Vector([2002, 2003, 2004, 2005, 2006]) :
Y := Vector([0.148765·100, 0.093558·100, 0.126174·100, 0.123812·100, 0.111934·100]) :
ROI := LinearFit([1, t, t^2, t^3], X, Y, t); evalf(%, 4)
MROI := diff(ROI, t); evalf(%, 4)
pointROI := [[2002, 0.148765·100], [2003, 0.093558·100], [2004, 0.126174·100],
             [2005, 0.123812·100], [2006, 0.111934·100]] :
with(plot) :
plot([pointROI, pointROI, ROI, MROI], t = 2001..2007, y = -2..14)
```

System response:

The regression model of economical index ROI and its derivative MROI (also shortly), empirical values ROI and the visualization:

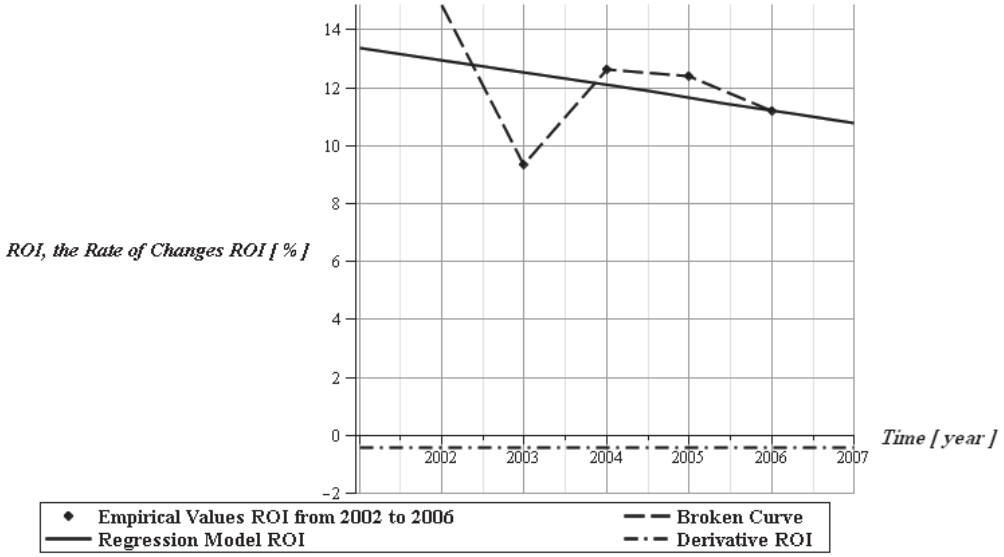
$$ROI := 1.68358708340080398\ 10^{-10} + 2.24927167258199714\ 10^{-7}\ t + \\ + 0.000225376999519890742\ t^2 - 1.10961938957564419\ 10^{-7}\ t^3$$

$$ROI := 1.684\ 10^{-10} + 2.249\ 10^{-7}\ t + 0.0002254\ t^2 - 1.110\ 10^{-7}\ t^3$$

$$MROI := 2.24927167258199714\ 10^{-7} + 0.0004507539990\ t - 3.328858170\ 10^{-7}\ t^2$$

$$MROI := 2.249\ 10^{-7} + 0.0004508\ t - 3.330\ 10^{-7}\ t^2$$

Fig. 1: From Maple Document: ROI - regression model and its derivative from empirical values in the period 2002 to 2006 before change of the marketing strategy



Source of data: own work in Maple[16]

Let us present the Maple document for modelling of one of the profitability ratios as a quick example of work in the working environment: *Return on Investment* (*ROI=profit/invested capital . 100%*) and its percentage development in the period 2002 to 2006 as the regression cubic model (Fig.1). This was the integral part of the analysis focused on identification of performance of a specific company in the process of decision taking concerning change of the marketing strategy. ROI is connected with the overall corporate effectiveness and reflects profit to capital employed ratio. The document also determines rate of changes of ROI development as derivation of the regression model in question. The Maple document utilizes the library Statistics, where the whole process can be managed very simply and/or modified by the built-in regression functions, visualization of models and by possible further statistic diagnostics.

Discussion

Results of the professional sources review [2], [4], [6], [7], [8], [16], [17], [27] and also the latest presented studies [19], [28] stress that capability of measurement of marketing effectiveness and/or marketing activities affects positively the overall corporate performance; on the other side the results also point out inadequate attention paid to elaboration of these approaches, methods and metrics of measurement. Based on this knowledge the sector of approaches, methods and metrics of measurement of marketing effectiveness and marketing activities seems to become a very topical field of scientific investigation, which a targeted attention should be paid to.

[16] Note: In this model case, situation is presented in the form of cubic regression function created in Maple; the visual evaluation in the practice we simply can used the linear regression model.

It is also possible to state that individual approaches, methods and metrics have not been elaborated adequately and systematically and that the status of their application in practice has not been verified yet. The performance managed marketing must have certain mechanisms, through which it can apply continuous improvement. Application of the Six Sigma method is one of the latest discussed complex methods how to improve quality of marketing contribution in the organization. The Six Sigma method identifies and also eliminates different mistakes in the structure, data management, solution of problems connected with utilization of different methods of data collection and statistic analysis [20].

When investigating the fields of approaches for measurement of marketing effectiveness and marketing activities of the companies it is necessary to link individual approaches, methods and metrics with the material side of the current state of marketing concepts and status of their implementation in the companies.

As show us the current review of literature and level of the knowledge the question of the measurement of effectiveness of marketing activities has a several areas of problems:

- Different level of marketing management implementation in the companies Dissimilarity also according to sectors, markets and so on (for example differences between B2B and B2C markets, or between industrial and services sectors).
- Tendency to measure just quantitative phenomena, accent to the usual financial metrics and lack of understanding of the interconnection of qualitative and quantitative side of marketing effectiveness.
- General lack of the data and appropriate software for the improving level of the higher education in this area (in the Czech environment).
- Pressure to competitiveness, innovativeness of market offers and overall corporate effectiveness grows materially are developing the press to use sophisticated methods.
- Using and experiences with work in Maple system in the higher education, modelling of the research data show the way how support and teach students, researchers, managers to be more effective in marketing decision making.
- On the base of the executed research in companies (in 2010) we observed, that just small sample of the companies use for the marketing activities effectiveness measurement self-contained system of the quantitative and qualitative indicators.

Conclusion

In competition of the computer systems an important place has been won deservedly by the Maple system (http://www.maplesoft.com/), product of the Canadian company Maplesoft, Inc. In the Czech Republic its user support is provided by The *Czech Maple User Group* (http://www.maplesoft.cz). From the very beginning of development of the Maple system its core line is created by the: student - teacher - practice and/or research. A number of interactive means during computations and visualizations, clickable calculus, easy modifiability, possibility of animation,

simulation ad virtualization, a number of built-in and pre-defined functions, procedures and libraries directly in the system contribute to deeper understanding of content of the curriculum, to teaching with the time effect, to the possibility to resolve examples of the practice, to support of team and interdisciplinary cooperation, etc. The company Maplesoft, Inc. develops versatile activities as support thereof by operating the following centers at its websites:

- The Student Help Center (http://www.maplesoft.com/studentcenter).
- The Teacher Resource Center (http://www.maplesoft.com/teachercenter).
- The Application Center system (http://www.maplesoft.com/applications/).
- The Applied Research: Financial (http://www.maplesoft.com/applied_research/Financial/index.aspx).

It has to be pointed out that status of ICT cannot be overestimated. Solution of the issue must be supported by logic and meaningful management and control of the process by the man. Quantification has thus a chance to penetrate step by step not only into purely quantifiable sectors or issues, but also into the sectors and problems of qualitative nature.

From analyses of economic sources, specialized publications, analyses and reports of completed research it follows clearly that coordination and effectiveness of business and marketing activities of the company is - besides the sector of strategic management - the key issue of the Czech companies, despite application of different new methods and approaches to marketing management. In the period of the economic crisis, affecting more or less all advanced economies and branches, pressure to competitiveness, innovativeness of market offers and overall corporate effectiveness grows materially.

In connection with the growing pressure in the European and international competitive environment the corporate and business entities in the Czech countries thus face a number of challenges which they have to cope with; these challenges do not affect only the field of marketing activity measurements, but even the fields connected with the status of marketing management and real marketing concept implementation. The Czech economy represents a small and relatively saturated market with a rather high degree of industry specialization. It is therefore necessary to look for new approaches enabling the traditional industrial branches to stand the new conditions. Some of the observations from the executed research in 2010[17] show us selected results in the area of application of marketing metrics by companies in Czech Republic:

- Just small sample of the companies use for the marketing activities effectiveness measurement the indicators as are ROI (19,7% companies), ROS (19,7% companies), ROMI (10% companies).
- The most used indicators of marketing activities effectiveness measurement seems to be:

[17] The research has done in the framework of the specific project "Measurement methods of marketing activities effectiveness and their application" reg. No.FP-S-10-21 (supported by Faculty of Business and Management BUT). The sample was 147 companies in Czech Republic.

a) Financial
   - Number of the customers (68%), profit (47%), net profit (62%), market share (40,8%), profit on customer (43,5%), marketing expenditure (30,6%).

b) Nonfinancial
   - Customer satisfaction (54,4%), level of the product cannibalization (8,2%), loyalty (25,2%), benchmarking (16,3%), Balanced Scorecard (14,29%).

- The most observed marketing activities for the searching of business opportunities in researched companies seems to be: analysis of the needs, observation of marketing goals, customer satisfaction and price strategies.

The question is whether or not the current marketing concepts and the approaches to measurement of marketing activities as above reflect the current reality and situation of our companies and business entities adequately. The theoretical review and practical knowledge form the research creates a base for further research in this field.

Acknowledgments

The paper was supported in the framework of the specific research projects: "Innovative approaches in management and marketing in global European environment" reg. No.FP-S-11-3/1417 and "Measurement methods of marketing activities effectiveness and their application" reg. No.FP-S-10-21 (supported by Faculty of Business and Management BUT).

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Received: 31. 07. 2011
Reviewed: 04. 11. 2011
Approved for publication: 30. 11. 2011