STOCHASTIC MODELING OF OPTIMAL LOGISTICS IN THE FUNCTION OF MAXIMIZING INTERNATIONAL BUSINESS EFFICIENCY OF SMEs

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ABSTRACT

The concept of business activity conditions specific procedures and activities in order to maximize the difference between output and input variables while taking into account the uncertainty of the business outcome. The business outcome is determined by a number of factors that are under the control of the decision maker. However, a number of factors are conditioned by stochastic quantities, which obey the laws of probability of a random variable whose value the decision maker cannot influence but must anticipate and respect in the business decision making process. Conditionality of business results with the market component refers to user expectations, and it requires a model approach by which the uncertain business future is recomposed into business expectations, with a high level of reliability. Modeling of the system by the process of mathematical simulation enables the calculation of variants of business future in the present time without realizing business strategies before their selection and classification. The modeling process includes business system analysis, factor selection, qualitative and quantitative expression, classification of variables, functional linking, formulation of probability distribution of random variables, and the choice of time frame for simulation. The process of mathematical simulation indicates the management consequences of business alternatives, thus the decision maker is guided by business expectations and recruits business logistics in accordance with the decision. The simulation model is adapted to the specific management problem, specific conditions and circumstances of decision-making. It does not have a universal character and must be constructed specifically for each management situation.

1. INTRODUCTION

1.1. Review of literature

International market positioning requires rationality in the business decision-making process, which links the consequences of business decisions to the business future, and "recovery" from the consequences of suboptimal in relation to the optimal business strategy which is inversely proportional to the size and age of the company and its financial strength (Todorović, 2003).

Small and medium enterprises require subtlety in the process of choosing business strategies, especially in the field of assessing market segments, current and future demand, competitive position and available resources (Sudarević, 2009).

The sensitivity of this business segment of SMEs in total gross domestic product is significant, especially in terms the impact on total employment (Sredojević, 2016), which indicates the importance of optimizing business strategies to choose business strategy, and thus business competencies of a modeled system that will provide adequate responses to the challenges of the global economy.

New ways of doing business and trends have conditioned the emergence of new forms of organizational structure of the company, whose conceptual settings are based on information and communication at all levels of the company structure. The new organizational concept of the company creates the conditions for the development of the company in the global business environment (Mitrović, 2004).

The basic characteristics of small and medium enterprises and entrepreneurs, especially their size, flexibility, propensity for innovative and risky ventures, and greater opportunity for specialization allow these companies to adapt much easier than large business systems to continuous changes in consumer demands and business conditions in the global market (Erić et al., 2012).

Understanding the importance of improving the sector of small and medium enterprises is justifiably based on empirical data based on the environment. Although the accession of Croatia to the European Union has provided adequate benefits in terms of simplifying procedures for joining the global market, the desired prosperity in terms of business efficiency has not occurred.

This is evidenced by empirical data relating to the period from 2015 to 2019, and it shows the following results.

Data for 2019, as in previous years, indicate a lower level of productivity of micro, small and medium enterprises, compared to large enterprises. Also, compared to large enterprises, the sector of small and medium enterprises is still

characterized by insufficient capacity to internationalize and exploit the potential of the European Union's single market (Alpeza et al., 2020).

It is important to emphasize that in addition to the insufficient increase in business efficiency, a certain positive rate of change in business results is certainly realized, again, based on empirical results.

In 2019, the Croatian business sector recorded an increase in total profit by 4.2% compared to the previous year. The total consolidated result in 2019 was higher than in 2018 by 10.7%. Small, medium and large enterprises contributed to the positive consolidated result, while micro enterprises achieved a negative consolidated result in 2019, which confirms the conclusions about the lower level of productivity of this part of the Croatian economy (Alpeza et al., 2020).

It is certainly justified to look for sources of business efficiency in the sector of small and medium enterprises, especially in transition countries, but the traditional approach to business orientation needs to be enriched with significant contributions of management energy based on the results of theoretical models adapted to the business concept of a particular business system.

1.2. Economic-market and personnel aspects of inadequate positioning of small and medium enterprises (SMEs)

Economies of scale, as one of the possible strategic determinations of management structures that formulate and direct the behavior of the business system, globalization and market openness give the opportunity to reap all the benefits of business efficiency through business expansion and cost rationalization.

However, it should be taken into account that direction of business activities is not one-way, and that optimal management in the context of the concept of efficient operation of the business system will meet new aspects and requirements of an open market environment. This primarily refers to exposure to fierce competition from foreign business systems and taking the desired market position.

Reducing barriers to foreign trade provides a new dimension to the composition of decision-making systems that will be influenced by the abundance of choices made possible by globalization. Business systems aimed at reducing production costs through economies of scale will benefit from this business concept as long as the quality of production outputs is not compromised in order to reduce the possibility of parrying global market competition unreservedly encouraged by visibly growing diversification of consumption.

Long-term commitment to benefits based only on low prices without elements of the stated quality, and innovation and the right attitude towards customers and human capital does not promise the successful realization of the desired results. Gaining competitive advantage as a prerequisite for achieving defined business results is not exclusively related to the advantages of low costs, which confirms other recognizable business strategies aimed at creating competitive advantages, including product differentiation strategy and strategy of superior customer service with the ability to focus on certain specific market segments (Christian, 2006).

Competitive advantage exists when the company is (Tipurić, 1999):

– more effective than the competition,
– more successful in attracting customers and convincing them that its products have superior value,
– better in offering a quality product at a low price or the one that has a higher actual or perceived value for customers.

On the other side, economies of scale as a concept give additional space to the management structure of the business system in formulating business goals aimed at creating a positive and stimulating business climate within the business system. This primarily reflects on human satisfaction with generally accepted principles optimal balance of productivity and flexibility in horizontal and vertical specialization, as well as adequate motivation and reward policies as unavoidable system categories of optimal management process.

Human capital is characterized as a key component of the success of modern business systems, and special emphasis should be placed on the importance of management decisions in the context of achieving and maintaining optimal business results. Therefore, it should be reiterated "that human resources represent a competitive advantage of a company if they are managed wisely" (Tipurić, 1999). "The importance and complexity of human capital implies adequate prior knowledge of relevant subjective factors from the aspect of the selected group or individuals whose emphasis ensures maximizing business efficiency, and thus contributing to business results." (Vokić, 2004)

The wide range of management solutions offered for a particular business system aimed at lower costs per unit of production output only further confirms the importance of model selection, and in order to choose the most optimal variant with emphasis on respecting the consistency of selected strategies with the environment and organizational structures.

2. MATERIALS AND METHODS

2.1. Metric aspects of business success and stochastic correction of business result of SMEs

The complexity of the business result arises from the structure of the business process, market-institutional challenges, and inevitably a competitive position in the chosen field of business. The calculation of the business result includes the following steps:

– Breakdown of the business system into components that enable a complete and purposeful understanding of the analyzed process;
– Approximation, selection and systematization of the relevance of business process components and definition of variables;
– Distribution of probability of random variable;
– Deterministic component of the simulation model as a metric of the output/criterion variable;
– Selection of simulation time frame;
– Mathematical simulation procedure;
– Comparison of business outcomes of selected management options.

Mathematical simulation models are adapted to specific business systems, designed specifically for selected business systems and their management problems. The selection of business strategies allows the recomposition of input resources in the function of reproducing the desired business result.

3. RESULTS

3.1. Stochastic selection of business strategies

The business result is conditioned by a large number of factors, among which the selling price of the product (PP), production costs (PC), demand for the product (Qt) stand out. The managerial challenge refers to the formulation of a business strategy, which would enable the best business result. Model linking of these business efficiency indicators is possible by using the comparative analysis of strategies to improve product performance, as opposed to cost rationalization strategies.

The modeling process includes the following:

– Formulation of random variable probability distribution - the recommendation refers to the use of empirical probability of demand from the previ-

ous period, corrected by predictions of development tendency in the analyzed time period, and linking cumulative probability of product demand with random numbers;

– Strategy 1. Examination of the sensitivity of demand to improvements in product performance, as well as the correction of sales price in accordance with market opportunities;

– Strategy 2. Rationalization of production costs refers to savings in the use of production materials or production work, commercialization of production surplus in the form of marketable output;

– Strategy 3. Keeping the production process at the usual production regime.

Business outcome modeling refers to the creation of the following worksheets:

Table 1. Translation of empirical frequencies into the probability of a random variable, and linking the cumulative probability with the interval of random numbers

Qt	F(Qt)	P(Qt)	$P(Q \leq \Sigma Qt_i)$	The interval of random numbers
Qt_1	$F(Qt_1)$	$F(Qt_1)/\Sigma F(Qt_i)$	$P(Qt_1)$	$0 - [P(Qt_1)\%-1]$
Qt_2	$F(Qt_2)$	$F(Qt_2)/\Sigma F(Qt_i)$	$P(Qt_1)+P(Qt_2)$	$P(Qt_1)\% - [P(Q\Sigma \leq Qt_2)\% - 1]$
⋮	⋮	⋮	⋮	⋮
Qt_n	$F(Qt_n)$	$F(Qt_n)/\Sigma F(Qt_i)$	$\Sigma P(Qt_i)$	$P(Q\Sigma \leq Qt_{(n-1)})\% - 99$
Σ	$\Sigma F(Qt_i)$	1,0000	-	-

Source: Authors (Landika et al., 2021)

Table 2. Conducting a simulation

Day	Next number	Qt_i	Business strategy (ordinal number of criteria)			
			Qp_i	Qr_i	Qz_i	Pf_i
0	-	$E(Qt)$				
1	S_1	Qt_1	Qp_1	Qr_1	Qz_1	Pf_1
⋮	⋮	⋮	⋮	⋮	⋮	⋮
M	S_m	Qt_m	Qp_m	Qr_m	Qz_m	Pf_m
Σ	-	ΣQt_j	ΣQp_j	ΣQr_j	ΣQz_j	ΣPf_j

Source: Authors (Landika et al., 2021)

Conducting the simulation involves determining the indicators shown in the previous table, and refers to:

– The time frame for conducting the simulation includes m time units;

- Random numbers are generated by the RAND or RANDBETWEEN function;
- The random variable Qt (demand) is adjusted by the interval of random numbers according to the data in Table 1;
- The input variable Qp (quantity produced) results from the chosen market positioning strategy;
- Output variable Qr (realized quantity) = $\min_i$(Qti;Qpi), represents a smaller value between the requested and produced quantity;
- Output variable Qz (unsold produced quantity - stocks) = (Qpi - Qri), represents the difference between produced and sold product quantity;
- The criterion variable Pf (realized profit) is calculated as the difference between the realized and invested value and is adjusted to the chosen strategy.

Model prediction of business outcomes implies comparison of the cumulative value of the criterion variable in the selected time interval.

4. CONCLUSIONS

The driving power of any socio-economic system is based on the development potential of small and medium enterprises, whose optimal functioning requires starting of model support. This implies a careful analysis and adequate inclusion of relevant factors in the model, which shifts the boundaries of business outcome from uncertain to expected values.

Quantitative predictions of business results enriched with model selection of competitive strategic commitments enables maximum utilization of resource opportunities and their optimal direction to market opportunities.

The protocol of the conducted research selects business strategies adapted to specific business problems and business conditions, the generality of which enables application to various business systems and characteristic problems.

The modeled information configuration provides a solid foundation for composing input components in virtual space while projecting a reliable business outcome without materialization, and requires a high degree of agreement of real system and its model projection (Landika, 2021).

Adequately modeled logistics platform enables the establishment and permanent harmonization of the optimal mode of operation with consideration of the management consequences of suboptimal choices, and thus the permanent improvement of business efficiency.

Modeling optimal strategies is not the final process, because every change in business conditions requires model adjustment, which permanently relaxes the efficiency and effectiveness of business with resource opportunities and market opportunities, and thus converts business results from business uncertainty to business expectations.

Recruitment and functional application of decision-making models require consulting services, the effects of which significantly outweigh the costs of acquisition. Initiating the potential of mathematical models and the effects of modeled management harmonizes internal and external factors, relaxes the logistics platform and optimizes the results of business processes tailored to concrete business systems.

Conflict of interests

The authors declare there is no conflict of interest.

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СТОХАСТИЧКО МОДЕЛИРАЊЕ ОПТИМАЛНЕ ЛОГИСТИКЕ У ФУНКЦИЈИ МАКСИМИЗАЦИЈЕ МЕЂУНАРОДНЕ ПОСЛОВНЕ ЕФИКАСНОСТИ МиСП – а

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САЖЕТАК

Концепт ефикасног функционисања пословног система темељи се на оптималном управљању, а реализује скупом сврсисходних акција усмјереним достизању пословних циљева. Формулисање пословних циљева подразумијева идентификацију скупа тачака којима се тежи свјесним и управљивим поступцима организоване групе појединаца балансираних са идентификованим факторима окружења диферентних дубина и граница, њихове адекватне квантификације и преференције по мјери утицаја на анализирани систем.

Квалитет управљачких одлука директно кореспондира са њиховим капацитетом да дугорочно контролишу и усмјеравају понашање пословних система, тако да континуираним, комплексним и свеобухватним поступцима компонују адекватан управљачки модел. Композиција унапријед заданих циљева, умрежених са аспектима и захтјевима окружења захтијевају висок степен сагласности између нивоа реалитета пресликаног у управљачки модел. Моделска апроксимација дијела реалитета подразумијева селекцију теоријског модела као вјерне копије оригиналног система, а тиме и сврсисходну експлоатацију моделираних управљачких информација на задацима повећања функционалне потентности, а тиме и адекватног позиционирања. Сврха моделирања односи се на повећање квалитета функционисања и контроле одабраног пословног система, те на општи контекст пословног система као системске компоненте глобалног економског система. Компоновање система одлучивања обухвата управљачку идентификацију фактора релевантних за конкретан управљачки проблем чиме се, реалном метриком и моделском предикцијом, постиже, одржава и унапређује тржишна позиција и конкурентска компетенција. Тржишне компетенције темеље се на поузданости моделских предикција, тангентних са потентношћу конструктора и креатора модела одлучивања да реалном метриком обухвати, квантификује, селектује факторе системских категорија релевантних за достизање и одржавање оптималних пословних резултата. Логистика пословног

система подређена пословним и управљачким захтјевима омогућава тржишне компетенције, одрживост и перманентну међународну конкурентност заснива се и на трошковној рационализацији, а постиже моделском селекцијом управљачких рјешења. Оживотворење пословног система математичком симулацијом, у оквиру одабраног временског интервала, омогућава сагледавање консеквенци управљачких рјешења у контексту прорачуна пословних резултата стохастичких процеса. Предикција управљачких консеквенци понуђених управљачких рјешења елиминише субјективизам доносиоца одлуке, непотребне и неоправдане консеквенце субоптималних управљачких рјешења, али и метрику диференција у односу на оптималне изборе, а тиме и утемељеност моделских преференција у односу на пословне стратегије.

Кључне ријечи: *ефикасно функционисање, оптимално управљање, моделска предикција, реална метрика, међународна конкурентска позиција.*