APPLICATION OF BAYESS PRINCIPLE OPTIMUM - OPTIMIZATION MODEL FOR MANAGERIAL DECISION AND CONTINUAL IMPROVEMENT

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Abstract: This contribution presents utilization of quantitative method of operational analysis - Bayes principle optimum in the area of utilizing alternative power sources. By this quantitative model we can find out solution of economic and technical difficulty in the area of biomass. Optimization of production processes brings lower cost and continual input – wood pulp for boiler plant. Following application of this model we can support decisions of processes and to optimize parameters of processes. Results of this optimization bring low cost, high quality and optimal processing time. It is direction to continual improvement in the firm that it brings competitive advantages for classification of the firm as" world-class business".

Key words: model, quantitative method, optimization, profit, business management

Introduction

Optimization of business processes is important part of continual improvement of production processes. Continual improvement it means to improve product, services, processes. Continual improvement is a meta-process for most management systems such as quality management, business process management, project management and program management. Continual improvement is a type of change that is focused on increasing the effectiveness and/or efficiency of an organization to fulfil its policy and objectives. It is not limited to quality initiatives. Improvement in business strategy, business results, and customer, employee and supplier relationships can be subject to continual improvement. Put simply, it means 'getting better all the time' (Imai, 2005).
Through optimal parameters of processes is possible to decrease costs of the firm and to economize business. It is the first step to eliminate waste of resources and to eliminate standing time. Quantitative methods are important tools for business management today. Choice of suitable alternative solution of economic problem and their application in praxis needs to know conditions of hazards and usefulness of alternative for process in the firm. We use model of optimization as instrument for decision in area of biomass.
Economic analysis of energetic potential from biomass is key factor for business and very important for optimal business is to know the technological, technical, economical requirements for manufacturing process for biomass (Tauš et al., 2011). Slovakia is obligated to achieve till 2020 rate of energy from renewable energy sources at the level of national goal of the country that is in our case 14%

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(Taušova et al., 2011). In Slovakia is starting to use biomass and to implement biomass. It is important to evaluate the economic efficiency of biomass.

Managerial decision can be supported by using of mathematical modelling which in practice can be done for example through products of company SAS, which provides a wide range of possibilities for creating optimization models for example descriptive modeling, optimization modeling and other.

Literature Review

Decision making is a very important and much studied application of mathematical methods in various fields of human activity. Quantitative methods of operational analysis enables job of managers during process of decision and they solve complex decision problems that have principle influence to the economic indexes of the company, representing tool, by which there is possible to achieve goal of the company. Since system of decision must be permanently improved, there is necessary to use operational analysis during solving of various economic problems. At the same time management of the firm must to determine in conditions of hazards, indefinites or definiteness (Ivaničová, 1997), since choice of suitable alternative solution of economic problem and their application in praxis needs to know conditions of hazards and usefulness of alternative for process in the firm.

Significant uncertainties are associated with decision-making, including consumer, market and regulatory responses, technology standards and competition, and future market conditions, etc. But according Kauffman, et.al (2015) all these things have an impact on organizations' willingness to adopt. As a result, traditional capital budgeting, investment experience, and intuition have not been very effective in investment decision-making. Studies of Stevenson and Vanharanta (2015) help to understand importance of decision making behaviour of managers, especially small companies. Decision making process can be used for cost information in production supporting processes in the industrial companies. For example Łęgowik – Świącik (2015) applied decision making process for chemical company with aim to present information flow in production by analysis of linear correlation and comparative analysis of cost information in production process.

Proper decision making has positive impact to improvement of activities of the company. For example Vörös (2013) studied attempts to identify all the factors that shape the dynamic nature of improvement activities and provides a complete analysis of when are the dynamics of improvement activities increasing or decreasing. When a decision model is used as a support for managerial decision making, it is very important to work with data, information and knowledge correctly (Beránková et al., 2011). Unfortunately, these terms are understood differently in various branches. For example in area of energy Tian et al. (2015) made model and optimization of energy network flow in industrial park by analyzing the characteristics of energy system, comprising multiple-energy carriers, such as electricity, heat, gas, etc. The modeling framework is based on the energy hub concept model and the idea of „energy flow network" (Tian et al., 2015). Konno and Yamazaki (1991) demonstrated optimization model for portfolio in stock market, using mean absolute deviation risk function that can remove most of the difficulties associated with the classical model, while maintaining its advantages over equilibrium models. Khir and Haouari (2015) presented research in area of distribution cooling system with aim to strengthen optimization efforts exhibited in this field. This work will help managers to design minimum cost in a more efficient, effective and operationally feasible manner. As for the hydrologic models, Vrugt et.al (2003) suggested that any single objective function, no matter how carefully chosen, is often inadequate to properly measure all of the characteristics of the observed data. They suggested to define several optimization criteria (objective functions) that measure different aspects of the system behavior and to use multicriteria optimization to identify optimal solutions. Hydrologic models use relatively simple mathematical equations to conceptualize and aggregate the complex water and energy processes, but model parameters often do not represent directly measurable entities and must therefore be estimated using measurements of the system inputs and outputs. Therefore Vrugt with another authors (2005) surveyed limitations of current hydrologic model, which treat the uncertainty in the input – output relationship and presented a simultaneous optimization and data assimilation method, which improves the treatment of uncertainty in hydrologic modeling.

In another area, Yang et.al (2007) developed the Hybrid Solar-Wind System Optimization Sizing (HSWSO) model, to optimize the capacity sizes of different components of hybrid solar-wind power generation systems. They showed the importance of the HSWSO model for sizing the capacities of wind turbines, PV panel and battery banks of a hybrid solar-wind renewable energy system.

Managers use today mathematical modelling to support managerial decision (Ivaničov et al., 2002). It is due to the improvement of large scale productivity and properties of producing strains that requires mathematical modelling and optimization procedures (Novak et.al, 2015). Optimization of problems in the firm mean to create a suitable model that provides the tools for optimal solutions (Jerz, 2010). Mathematical modelling had been used also in area of correlation between gross domestic product (GDP) and foreign direct investments (FDI) that is very important because it reflects the influence that FDI have on good GDP growth (Dinu, 2015).

Methodology

The main methodology of the contribution is using of quantitative model of operational research and utilizing various mathematical models by solution of optimization of processes in the firm. Operational analysis is science that dealt of optimization of processes in the firm through utilizing mathematical models and modelling (Gros, 2003). In this paper we shall utilize mathematical model Bayes principle optimum of theory of game for manufacturing processes. Decision - making situations are treated as a game. Decisions are variants of strategy. Benefits that will bring the strategy are referred to as gain for the firm. We will use for solving problem of construction of wood pulp store for boiler plant of biomass quantitative model Bayes principle optimum.

We shall utilize optimizing model:

$$O = \sum a_{ij} * p_j = \max \qquad (1)$$

a_{ij}- matrix of value , p_j- probability of existence of economical processes

Results and Discussion

We solve the problem of the construction wood pulp storage for the boiler plants of biomass. This model determines optimal station for construction wood pulp storage. In the area of residential buildings is provided heating by a biomass boiler plants. It is necessary to build between biomass boiler plants the central storage of wood pulp. The central storage of wood pulp must arrange continual material supply.

We have six biomass boiler plants (A, B, C, D, E, F) and we would like to discover where is important and effective to construct wood pulp storage for the boiler plants. We will use optimization model Bayes principle optimum. The distribution of boiler plants of residential buildings presets Figure 1.

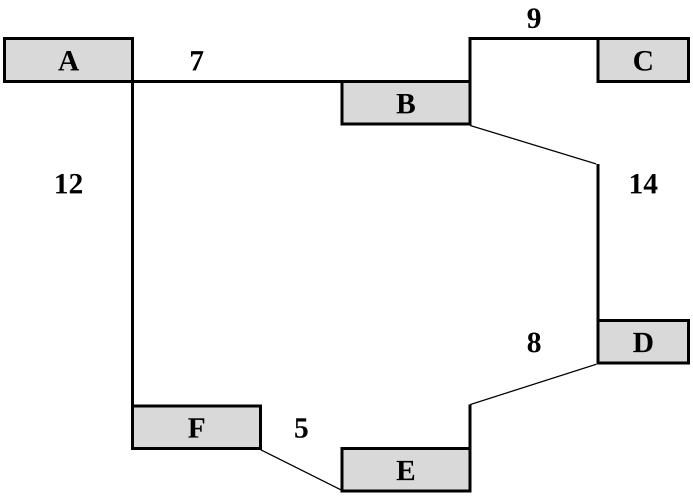

Figure 1. Spatial distribution of boiler plants

Distance between individual boiler plants means distance in kilometers for transport of wood pulp to individual boiler plants. This distance is important for economic situation in the firm. It means transport costs in the firm and distance for repair services of boiler plants. Consumption of wood pulps characterizes the probability of utilization of boiler plants. This probability was determined by measuring and statistical evaluation supplies of wood pulps to the individual boiler plants (Table 1).

Table 1.Probability of utilization of boiler plants

Index	A	B	C	D	E	F
p_j	0.12	0.41	0.10	0.02	0.30	0.05

We define distance between boiler plants – matrix of value (a_{ij}) (Tab. 2). This distance must be shortest because distance means transport costs and management want to minimalize transport costs.

Table 2. Matrix of value – distance between boiler plants

	A	B	C	D	E	F
p_j	0.12	0.41	0.1	0,02	0.3	0.05
A	0	7	16	21	17	12
B	7	0	9	14	22	19
C	16	9	0	23	31	28
D	21	14	23	0	8	13
E	17	22	31	8	0	5
F	12	19	28	13	5	0

The most utilization of boiler plants is in boiler plant B and at least utilization of boiler plants is in boiler plant D. We would like to determine place of construction of wood pulp storage for boiler plants of biomass with technical and economic aspects. The central wood pulp storage will supply all boiler plants. In case of failure of the normal stocks they will be drawn from central wood pulp storage and the distance for all boiler plants must be shortest. Optimal wood pulp storage location is calculated by model of optimization in area of biomass – quantitative model Bayes principle optimum. The calculation procedure is multiplication of distance and probability of utilization of boiler plants (Tab. 3).

We close mathematical model of optimization. Now we move to the economic model. Transport costs represent a reduction of financial sources in the firm. We will consider the costs as a negative item. Using mathematical equations identify the best alternative based on max values, but here it is important to assess the economic model because distance are transport costs and is important costs to minimize. We consider the negative values in index because solution of optimizing is to reduce transport costs.

Table 3. Optimizing model for wood pulp storage

	A	B	C	D	E	F
p_j x a_{ij}	**0.12**	**0.41**	**0.1**	**0.02**	**0.3**	**0.05**
A	0	2.87	1.6	0.42	5.1	0.6
B	0.84	0	0.9	0.28	6.6	0.95
C	1.92	3.69	0	0.46	9.3	1.4
D	2.52	5.74	2.3	0	2.4	0.65
E	2.04	9.02	3.1	0.16	0	0.25
F	1.44	7.79	2.8	0.26	1.5	0

Optimal wood pulp storage location will define the function MAX= SUM (a_{ij} x p_j) - (Tab. 4).

Table 4. Optimizing model – economic aspect

	A	B	C	D	E	F	SUM
p_j x a_{ij}	**0.12**	**0.41**	**0.1**	**0.02**	**0.3**	**0.05**	**MAX**
A	0	-2.87	-1.6	-0.42	-5.1	-0.6	**-10.59**
B	-0.84	0	-0.9	-0.28	-6.6	-0.95	**-9.57**
C	-1.92	-3.69	0	-0.46	-9.3	-1.4	**-16.77**
D	-2.52	-5.74	-2.3	0	-2.4	-0.65	**-13.61**
E	-2.04	-9.02	-3.1	-0.16	0	-0.25	**-14.57**
F	-1.44	-7.79	-2.8	-0.26	-1.5	0	**-13.79**

Based on the optimization is to find the best alternative. The best alternative solution for the firm is to place central wood pulp storage at the production line B because transport costs are lowest. This alternative is excellent for the firm because it accept economic aspects. We can use other mathematical model of optimization named “Wald criterion”. We can obtain results of different view. The steps of optimization are similar but function is defined MIN= SUM (a_{ij} x p_j).

This formula solves technical aspect of this problem. It is necessary to build between biomass boilers plants the central storage of wood pulp and the distance between central storage and individual biomass boiler plants must be shortest. Distance has impact to economic aspect of this problem and it is transport costs. We must connect economical and technical aspects and results are positive for the both parties. For technical aspect is important information about distance between biomass boilers plants (Tab. 5).

Table 5. Optimizing model – technical aspect

	A	B	C	D	E	F	SUM
p_j x a_{ij}	**0.12**	**0.41**	**0.1**	**0.02**	**0.3**	**0.05**	**MIN**
A	0	2.87	1.6	0.42	5.1	0.6	10.59
B	0.84	0	0.9	0.28	6.6	0.95	**9.57**
C	1.92	3.69	0	0.46	9.3	1.4	16.77
D	2.52	5.74	2.3	0	2.4	0.65	13.61
E	2.04	9.02	3.1	0.16	0	0.25	14.57
F	1.44	7.79	2.8	0.26	1.5	0	13.79

We used mathematical model of optimization named "Wald criterion". The result of solved problem is the same. Central garage service station needs to construct near the biomass boiler plant B. The both mathematical model confirmed the same results.

Table 6. Result of optimizing model for construction garage service station

Compare economic aspect and technical aspect		
MAX	**MIN**	
-10.59	**10.59**	**A**
-9.57	**9.57**	**B**
-16.77	**16.77**	**C**
-13.61	**13.61**	**D**
-14.57	**14.57**	**E**
-13.79	**13.79**	**F**

Conclusion

Optimization of production processes in area of alternative power sources demand to know quantitative methods that are facilitated for decision–making. Use of modeling and mathematical methods in solving economic problems in practice today is necessary because the companies are burdened with high costs and the need to optimize - minimized by optimizing business processes.

Quantitative methods are tools that managers can use in decision-making and support decision-making based on facts available. Optimizing the outcome is not always in practice can be just optimal strategy for the company, because the process of decision making is affected by many other factors. Given that the decision remains with the manager, it is advisable to verify the various alternatives through mathematical modeling respectively. Modeling in practice, however, requires systematically examine the whole problem solving, to define the objectives and scope of solving the problem, analyze alternative solutions verify the model and its benefits in practice, implement the model in practice and proceed to change the organizational structure, the change of management. Sebej et al., (2004) present the same methods of numeric evaluation of the production plan under design in order to compile optimally the structure of production based on the range.

Results of quantitative mathematical model achieve the highest production effect and output. These methods realize optimalisation. Created algorithms of these methods are applicable to managing control as well as to technological and non-technological plans optimalisation. The same methods used Huzsvai and Nagy (1995) in area of agricultural to achieve economic efficiency in the plant production. They used mathematical and statistical criteria because the optimization is very sensitive to changes input data. They achieved very good value of criteria. Sujova and Marcinekova (2015) present these quantitative methods as tools for management of business processes. These methods are used in industrial enterprises. Continual process evaluation and their optimization are important goals for continual improvement.

We can point out that these methods are used in all area of industry. These methods create tools of optimization and to achieve economic efficiency in the firm. In addressing the economic problems of daily practice is important to realize the importance of risk and its modeling in the enterprise. The level of risk depends on the conditions in which we solve a particular problem. Future direction is focused on new quantitative mathematical modeling and another technological innovation that bring effectiveness and continual improvement in the firm.

The paper is part of project Vega 1/0961/13 and Vega 1/0669/13.

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ZASTOSOWANIE ZASADY OPTIMUM BAYESA - MODELU OPTYMALIZACJI DLA DECYZJI KIEROWNICZYCH I CIĄGŁEGO DOSKONALENIA

Streszczenie: Niniejszy artykuł prezentuje wykorzystanie metody ilościowej analizy operacyjnej - zasady optimum Bayesa w zakresie wykorzystywania alternatywnych źródeł energii. W tym modelu ilościowym możemy znaleźć rozwiązanie ekonomicznej i technicznej trudności w zakresie biomasy. Optymalizacja procesów produkcyjnych przynosi niższe koszty i nieprzerwaną moc wejścia - pulpę drzewną do kotłowni. Po zastosowaniu tego modelu możemy wspierać decyzje dotyczące procesów i optymalizować parametry procesów. Wyniki tej optymalizacji przynoszą niskie koszty, wysoką jakość i optymalny czas przetwarzania. Jest to kierunek do ciągłego doskonalenia w firmie, który przynosi przewagę konkurencyjną klasyfikującą firmę jako " biznes światowej klasy".
Słowa kluczowe: model, metoda ilościowa, optymalizacja, zysk, zarządzanie przedsiębiorstwem.

應用貝葉斯原理優化–優化模型管理決策和持續改進

摘要：本文介紹了貢獻，利用業務分析的定量方法貝葉斯原理優化在利用替代能源的領域。通過這種定量模型，我們可以發現經濟和技術難度在生物質領域的解決方案。優化生產流程帶來更低的成本和持續的投入木漿為鍋爐廠。隨著應用這個模型，我們可以支持的過程決策和優化的過程參數。這種優化的結果帶來的低成本，高品質和最優的處理時間。這是方向，它帶來的競爭優勢，為公司的分類為“世界級企業”的公司持續改進。
關鍵詞：模型，定量分析方法，優化，利潤，經營之道。