models of Erhard, Balcerowicz, Lee Kuan Yew, and so on. You can listen to other people's "prophets", but to trust and ask you can still from domestic ones. As pointed out by academician Y.N. Pakhomov, Ukraine since independence, has lost the strategic, the so-called "scenario" culture of the time, which directs the country (not only economy) into future. The approach "from annual budget to annual budget" has turned Ukraine into a "country of small business. It is not only detrimental to the future, but for the present, and even the past [5, p.61]. No matter which perfect plan was developed, it will remain just a great plan, if it will not realize (with mind).Third, society could be joined to do great things, first and foremost, by purified atmosphere of morality. Now moral values inculcated in the country is not even an alien culture, and lack of culture, ignoring the norms of morality. An immorality touches the law, order, basic norms of behaviour in society.Fourth, education system should be adjusted in serious. We are talking about the quality of education. Russia intends to "grow" three universities for top-100 universities ranking. Is Ukraine is not able to have its own Newton's and Nobel Prize winners? So far, graduates have decrease in the knowledge of the exact sciences (mathematics, physics and chemistry). Engineering degrees are devalued. But economists, lawyers, sociologists do not escalate a GDP without technicians and powerful production.Fifthly, the economic potential of powerful country ("G-7", BRICS, "E-7") is based on the achievements of science and technology. The continuation of this is to develop and manufacture products with high added value and competitive in the domestic and global markets. It is necessary to revive the respect for labour, for worker, engineer – a creator of innovative ideas and innovations. Seriously need to address the issues of public-private partnership in addressing key economic issues.Sixth, the strategy of innovative development of Ukraine in the conditions of globalization challenges requires investment in a balanced financial policy. Money should be directed primarily in the sphere of development. The philosophy of consumerism should change the philosophy of art, philosophy of creation. Share of consumption sphere increases in the world. But this does not mean that you can spend that you do not earn. Loans of IMF and World Bank and the EBRD should be repaid, and with great interest.

Seventh, the Ukraine should be clearly defined in the system of interest in foreign markets. Political decisions should be corresponded with economic activities. Dreams should be weighed against the possibilities. Friendship should be initiated, especially with its neighbours. Becoming stronger and richer, you can make friends and partners for the "distant lands". In conclusion, the traditional question: "What to do?" The country has the most experienced, intelligent and wise people, scientists and practitioners to formulate and successfully implement the variety of plans by society. One famous state leader (Vladimir Putin) said: "Lucky for those who are hard working! We have to work!" Supplement: each and every one of us has to work!

6. REFERENCES

[1] Liberalism and Modernization (based on the "round table"), Economy of Ukraine, 8 (597), 2011, P. 12.
[2] Revenko, A. "Minus twenty," of which there are many who say, Mirror Weekly, № 25, 2009, P. 4.
[3] Dickanov, J. Trends in World Income Distribution // Third Forum on Human Development. - Paris, 17-19.01. 2005. – P. 12.
[4] Mazur O., Shovkalyuk V.S. Technological parks. World and Ukrainian experience, Kiev,
[5] Prock-Business, 2009, P. 32.
[6] Geyets, V. Liberal and democratic principles: a course on modernization of Ukraine, The economy of Ukraine, 2010, № 3, P. 4-20.

Jelena R. Jovanovic[1,2,3],
Radisav D. Djukic[1,2],
Dragan D. Milanovic[3]

[1]Technical College of Applied Studies, Cacak, Serbia, jelena.jovanovic@vstss.com
[2]Office of the manufacturing and engineering management, Company "Sloboda" Cacak, radisav.djukie@vstss.com
[3]Faculty of Mechanical Engineering, University of Belgrade, Serbia, ddmilanovic@mas.bg.ac.rs

APPLYING SAVAGE CRITERION TO DECISION MAKING IN PRODUCTION MANAGEMENT

Abstract:

In circumstances of unemployed industrial capacities by current contracts and a lengthy production cycle the production management is mainly grounded on assumptions and predictions. The paper analyzes the possibility of applying the game theory and Savage criterion to production planning under conditions of uncertainty in business operations. Considering the intensity and rate of changes in the state of production system and relevant impact on the production program trends, the aim of the paper is to demonstrate a quantifiable basis for strategic decision making in production management.

Keywords: strategy, criteria, decision making, production management, uncertainty, prediction

1. INTRODUCTION

Considerations of production activities, from program orientation over production program, and vice versa, require identification of external and internal determinants acting within the framework of the time axis, from prediction to short-term planning. Production program means making program orientation concrete, from the medium- to short-term viewpoint, with its design being based upon facts more or less susceptible to quantification. Given that the production program is defined by the type and quantity of products, to design it is a complex process with far-reaching outcomes. The paper presents a quantitative method that summarizes in itself a regression analysis and extrapolation of trends as a starting point for applying the rules and criteria used in the game theory. Considering that relevant decisions about production orientations are made at strategic level, with a high degree of uncertainty, a concept is offered to the top management enabling further quantitative analysis with the aim to make strategic decisions in the domain of production management.

2. PRODUCTION PLANNING UNDER CONDITIONS OF UNCERTAINTY

Business and manufacturing systems belong to a group of organizational, complex, dynamic, stochastic and open systems and as such tend to their own degeneration unless corresponding inputs are continuously provided. This means that entropy has a growing trend in these systems. The systems for manufacturing armament and military equipment (subject of investigations) have a specific position and role. The manufacturing of mentioned products is primarily organized for the needs of the country's defense and security, and for the sales on the world markets and domination in the region and the world. The prices of products, depending on the globalization level of business operations, can but need not be necessarily influenced by the law of supply and demand. Production is governed by special legal provisions and operating a business is determined by the range of products and reliability in the use of products, tight deadlines for delivery, demands for product

standard version modification, possibility of supplying specific materials and parts, material, financial, technical-technological and human resources for the system.

As for spatial demand, the globalization of business operations proceeds on the broadest, world scale. Consequently, it is needed to observe how external limitations are acting: scientific-research resources and achievements, international relations and legal provisions, capital circulation and integration processes at the regional and world levels. Offer on the market, with corresponding corrections imposed by import and inventories, indicates the volume and structure of production in its quality and range of products. In contrast, demand indicates the volume and structure of needs. The ratio of supply to demand, in structure and volume, can be used as an indicator of production orientation.

However, having in mind that the products of armament and military equipment are special-purpose products, global-level investigations of the market are difficult in respect of predicting demands by monitoring and analyzing all elements that are important. In addition, the fact is that production is often organized for the 'unknown customers'. As there are no reliable indicators of the market needs and possibilities of the product placement, and aiming to reduce the risk of failure in production orientation, the behavior of the market has to be monitored in the previous period, whereby future trends are more predictable. Identification of possible alternatives in the market behavior and their ranking, from the viewpoint of adopted criteria, makes possible to establish a quantitative basis for the corresponding simulation processes that are used to seek optimal solutions. Production planning under conditions of uncertainty, when the distribution of the future states of the system is unknown, can be treated as a process that consists of the following stages:

1. *Problem formulation.* This stage comprises the analysis of the system's production program over a longer period of time in order to define the time horizon for collecting statistical data (experimental area), time horizon for predicting the future states (prediction area) and selection of regression curves to describe alternative states for the production of articles or groups of articles. If the subject of analysis is a group of products or production program, a representative product should be chosen. In the experimental area the product placement should be analyzed, whereby a set of data is provided: {$(q_1, t_1), (q_2, \ldots, (q_n, t_n)$} for regression analysis. Using the production program analysis of 'Sloboda' Co. Cacak, in the 18 years' period, experimental areas (5 years) and prediction areas (1 year) [2], and types of regression dependencies (first-, second-, third- and fourth-degree polynomials, exponential and geometric regression) were determined [3].

2. *Creating mathematical models.* A five-year dynamics of products' placement was used to define stochastic dependencies of a representative product as a function of time, and vice versa. The selected approximation curves (1)-(6) define the likely alternative states of the system in the experimental area (5 years) and by trend extrapolation in the prediction area too (one year). The game theory, i.e. the theory of statistical solutions represents a mathematical basis for the formation of a game matrix of the alternatives-states of the system at the interval comprising both intervals (Tabs. 1 and 2).

$$q_1 = a_0 + a_1 \cdot t \quad (t_1 = b_0 + b_1 \cdot q) \tag{1}$$
$$q_2 = a_0 + a_1 \cdot t + a_2 \cdot t^2 \quad (t_2 = b_0 + b_1 \cdot q + b_2 \cdot q^2) \tag{2}$$
$$q_3 = a_0 + a_1 \cdot t + a_2 \cdot t^2 + a_3 \cdot t^3 \quad (t_3 = b_0 + b_1 \cdot q + b_2 \cdot q^2 + b_3 \cdot q^3) \tag{3}$$
$$q_4 = a_0 + a_1 \cdot t + a_2 \cdot t^2 + a_3 \cdot t^3 + a_4 \cdot t^4 \quad (t_4 = b_0 + b_1 \cdot q + b_2 \cdot q^2 + b_3 \cdot q^3 + b_4 \cdot q^4) \tag{4}$$
$$q_5 = a \cdot t^b \quad (t_5 = a \cdot q^b) \tag{5}$$
$$q_6 = a \cdot b^t = a \cdot e^{k t} \ (k = \ln b) \quad (t_6 = a \cdot b^q = a \cdot e^{k q}) \tag{6}$$

Uncertain situations are of zero-ingredient-of-conflict because the states are the outcomes of the alternatives (regression curve) chosen by a decision-maker. In order to overcome the above

statement, apart from regressions $q_i = f_i(t)$, the regressions $t_i = f_i(q)$ were introduced. The integrated model contains regressions $q_i = f_i(t)$ and multi-functions $p_i = f_i(t)$ that are inverse to functions $t_i = f_i(q)$. Six types of alternatives' curves $t_i(q)$ can define, to the maximum, twelve multi-functions $p_i = f_i(t)$.

Table 1. A general game model $q_i - S_j$ (zero-ingredient-of-conflict situations)

THE STATES OF THE SYSTEM ALTERNATIVES	$S_j, j = \overline{1,n}$									
	EXPERIMENTAL AREA				PREDICTION AREA					
$q_i = f_i(t), i = \overline{1,m}$	S_1	S_2	S_i	...	S_j	S_{j+1}	S_{j+2}	S_{j+3}	...	S_n
$q_1 = f_1(t)$	a_{11}	a_{12}	a_{13}	...	a_{1j}	a_{1j-1}	a_{1j-2}	a_{1j-3}	...	a_{1n}
$q_2 = f_2(t)$	a_{21}	a_{22}	a_{23}	...	a_{2j}	a_{2j-1}	a_{2j-2}	a_{2j-3}	...	a_{2n}
.	.	.	.	...	.	.	.	.	...	.
$q_i = f_i(t)$	a_{i1}	a_{i2}	a_{i3}	...	a_{ij}	a_{ij-1}	a_{ij-2}	a_{ij-3}	...	a_{in}
.	.	.	.	...	.	.	.	.	...	.
$q_m = f_m(t)$	a_{m1}	a_{m2}	a_{m3}	...	a_{mj}	a_{mj-1}	a_{mj-2}	a_{mj-3}	...	a_{mn}

Table 2. A general game model $t_i - S_j$ (zero-ingredient-of-conflict situations)

THE STATES OF THE SYSTEM ALTERNATIVES	$S_j, j = \overline{1,n}$									
	EXPERIMENTAL AREA				PREDICTION AREA					
$t_i = f_i(q), i = \overline{1,k}$	S_1	S_2	S_3	...	S_j	S_{j+1}	S_{j+2}	S_{j+3}	...	S_n
$t_1 = f_1(q)$	b_{11}	b_{12}	b_{13}	...	b_{1j}	b_{1j+1}	b_{1j+2}	b_{1j+3}	...	b_{1n}
$t_2 = f_2(q)$	b_{21}	b_{22}	b_{23}	...	b_{2j}	b_{2j+1}	b_{2j+2}	b_{2j+3}	...	b_{2n}
.	.	.	.	...	.	.	.	.	...	.
$t_i = f_i(q)$	b_{i1}	b_{i2}	b_{i3}	...	b_{ij}	b_{ij+1}	b_{ij+2}	b_{ij+3}	...	b_{in}
.	.	.	.	...	.	.	.	.	...	.
$t_k = f_k(q)$	b_{m1}	b_{m2}	b_{m3}	...	b_{mj}	b_{mj+1}	b_{mj+2}	b_{mj+3}	...	b_{mn}

3. *Choice of the optimal alternative (alternatives).* In the choice of the optimal alternative a number of methods and criteria can be used, from extremely pessimistic to extremely optimistic. The argumentation for decision making is most dependent of the manager's methods and style of work. In ranking the alternatives, the Savage criterion will be applied.
4. *Qualitative analysis of the solutions obtained.*
5. *Creation of plans for the adopted volume of production.*
6. *Preparation and organization of production.*
7. *Analysis of the outcomes of decisions made.*

3. SAVAGE CRITERION

In the choice of optimal strategy the criterion advises risk-orientation. The choice is the production strategy *(i)* for which the level of risk is, in the worst of conditions, minimum. The application of Savage criterion requires the choice of maximum value A_j in accordance with relation (7), for each state of the system in the future (S_j).

$$A_j = \max_j \{|a_{ij}|, i = \overline{1,m}\}, j = \overline{1,n}\} \tag{7}$$

So, if a given (optimal) state happens to occur in the future, and a decision-maker chooses the best alternative, then there would be no regret for the opportunity loss, i.e. regret equals zero ($k_{ij} = 0$). However, if a decision-maker chooses any other alternative, then there would be regret for the opportunity loss. The elements of a regret matrix will be calculated using relation (8). In this regard, the initial matrix of P game effects (a_{ij}), relation (9), is transformed into a regret matrix (risk) R, relation (10).

$$a_{ij} \Rightarrow k_{ij} \left\{ \begin{matrix} (i) \\ (ii) \end{matrix} A_j - a_{ij} \right\}, i = \overline{1,m}, j = \overline{1,n} \tag{8}$$

$$P = \begin{bmatrix} a_{11} & a_{12} & ... & a_{1n} \\ a_{21} & a_{22} & ... & a_{2n} \\ ... & ... & ... & ... \\ a_{m1} & a_{m2} & ... & a_{mn} \end{bmatrix} \tag{9}$$

$$R = \begin{bmatrix} k_{11} & k_{12} & ... & k_{1n} \\ k_{21} & k_{22} & ... & k_{2n} \\ ... & ... & ... & ... \\ k_{m1} & k_{m2} & ... & k_{mn} \end{bmatrix} \tag{10}$$

The k_{ij} elements of regret matrix (loss) R are derived from the elements of a game matrix (a_{ij}) in such a way that for each state of the system – column (j) the maximum value of A_j is sought, taking the value of zero, at a corresponding position, in a risk matrix. Other elements of a regret matrix k_{ij} are obtained by subtracting the elements of the column (A_j), in accordance with relation (8), from the maximum value in the observed column (A_j). The Savage criterion (K_l) is essentially the *min-max* principle applied under conditions of uncertainty. In other words, it is needed to define maximum 'regrets' for each opportunity loss and then to choose the alternative that has a minimum 'regret', relation (11).

$$K_1 = \min_j \left\{ \max_j \left\{ k_{ij}, j = \overline{1,n} \right\}, i = \overline{1,m} \right\}, i = \overline{1,m} \tag{11}$$

4. MATHEMATICAL MODEL FOR DECISION MAKING

In order to predict market demands for anti-aircraft ammunition, investigations were carried out on the dynamics of production of 32 products manufactured in more than one variant for different weapon systems. A 5-year production dynamics is expressed in 10^3 pieces/year of a chosen representative product [1] described by relation (12):

$$Q = \{\{1,234.3\},\{2,566.4\},\{3,256.3\},\{4,222.5\},\{5,350.6\}\} \tag{12}$$

Depending on the choice of dependent and independent variable, regression curves can be defined by relations (13) – (24).

$$q_1(t) = 359.41 - 11.13 \cdot t \tag{13}$$

$$q_2(t) = 293.56 + 45.312857 \cdot t - 9.407143 \cdot t^2 \tag{14}$$

$$q_3(t) = -83218 + 1626709524 \cdot t - 612.482143 \cdot t^2 + 67.0083 \cdot t^3 \tag{15}$$

$$q_4(t) = -26914 + 513119167 \cdot t - 27459125 \cdot t^2 + 583.4583 \cdot t^3 - 43.0375 \cdot t^4 \tag{16}$$

$$q_5(t) = 301.73704546686 \cdot t^{0.01233317152} \tag{17}$$

$$q_6(t) = 317.3009762 \cdot 0.9872533173 \tag{18}$$

$$t_1(q) = 3.44049 - 0.001351 \cdot q \tag{19}$$

$$t_2(q) = -8.512162 + 0.06839 \cdot q - 0.0000878495 q^2 \tag{20}$$

$$t_3(q) = 65.29945 - 0.5947887 \cdot q + 0.0017808 q^2 - 1.638395810^{-6} \cdot q^3 \tag{21}$$

$$t_4(q) = 2890026 - 37.345485 q + 0.17505 \cdot q^2 - 0.00035 q^3 + 2.49656 10^{-7} \cdot q^4 \tag{22}$$

$$t_5(q) = 2.1556391448 \cdot q^{0.031059257} \tag{23}$$

$$t_6(q) = 2.7527817870 \cdot 0.9998309645 \tag{24}$$

Data for production trends and corresponding regression curves are presented in Figs. 1-4.
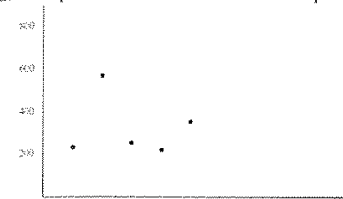

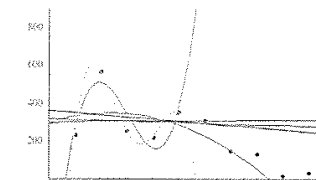*Fig. 1 Production trends in experimental area, in accordance with relation (12)*

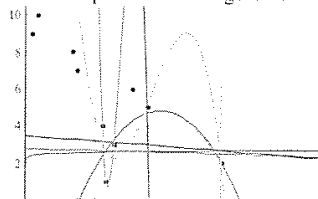*Fig. 3 Regression functions t$_i$(q) presented in experimental and prediction areas*

Fig. 2 Regression functions q$_i$(t) presented in experimental and prediction areas
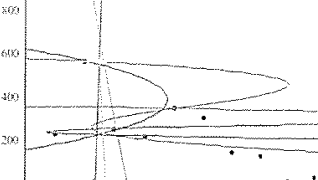

Fig. 4 Multi-functions p$_i$(t) inverse to regress. functions t$_i$(q) presented in both areas

Six adopted types of approximation curves define a set of alternatives $q_i = f_i(t)$ and $t_i = f_i(q)$ in a game matrix and they can be used to determine the states of the systems S_1-S_5 in the experimental area (5 years), while by trend extrapolation the state of the system S_6 in the prediction area (1 year) can be determined. Fig. 1 shows the achieved dynamics of the representative product production analyzed for 5 years. Fig. 2 displays production trends and regression curves $q_i = f_i (t)$ described by relations (13)-(18). Fig. 3 gives production dynamics and regression curves $t_i = f_i(q)$ described by relations (19)-(24) and Fig. 4 multi-functions $p_i = f_i(t)$ that are inverse to functions $t_i = f_i(q)$. Situations where little is known about the future states of the system and where the probability distribution of the occurrence that decision is made about is unknown are referred to as uncertain. Solving a prediction model implies the choice of one of the alternatives offered (regression curve). The choice of optimal alternatives (alternative) will be performed using the Savage criterion (K_l). Integrated mathematical model for predicting and decision-making is shown in Tab. 3. Linear (t_1 – relation 19), geometric (t_5 – relation 23) and exponential (t_6 –relation 24) regressions define the states of the system by the functions p_1, p_9 and p_{10}. Regression by the second-degree polynomial (t_2 –relation 20) is not involved by the model because it does not define the likely states (S_6) in the prediction area. Regression by the third-degree polynomial (t_3 – relation 21) defines three values of the state (S_6) by the functions p_2, p_3 and p_4. Regression by the fourth-degree polynomial (t_4 – relation 22) defines four values of the state (S_6) by the multi-functions p_5, p_6, p_7 and p_8. Given the fact that real values of the volume of production (Q) range from zero to ideal exploitation capacity (C_e), the states of the system (S_6) defined by the functions q_3, q_4, p_1, p_9 and p_{10} should be omitted in decision-making. This means that the prediction model consists of two game matrices of the formats (4x6) and (7x6). The Savage criterion will be applied to the alternatives defined by relation (25). A set of optimal alternatives (q^*, p^*) is defined, based on data from Tab.3, using the software package [4], relation (26).

$$Q \in [0,Ce] \Leftrightarrow \left\{ q \in (q_1,q_2,q_5,q_6) \wedge p \in \left(p_k \middle| k = \overline{2,8} \right) \right\} \tag{25}$$

$$K_1 \Rightarrow \left(q^* = q_5 \wedge p^* = p_8 \right) \tag{26}$$

Table 3. Integrated mathematical model (alternatives-states of systems-criteria for decision-making)

q$_i$,p$_k$	S$_j$K$_i$	SYSTEMS STATES (S$_j$, j = 1,2,....6) – CRITERIA (K)						
		S$_1$	S$_2$	S$_3$	S$_4$	S$_5$	S$_6$	K$_1$
ALTERNATIVES q$_i$(t)	q$_1$	348	337	326	315	304	293	1059
	q$_2$	330	347	345	324	285	227	1125
	q$_3$	249	507	345	164	365	1352	160
	q$_4$	234,3	566,4	256,3	222,5	350,6	-507	1859
	q$_5$	301,7	304,3	305,8	306,9	307,8	308,5	1043
	q$_6$	313	309	305	301	298	294	1058
		PRINCIPLE "MIN-MAX":						MIN
		VALUE OF CRITERIA K$_1$:						1043
		OPTIMAL ALTERNATIVE q$_i$(t):						q$_5$
ALTERNATIVES p$_k$(t)	p$_1$(t$_1$)	1806	1066	326	-414	-1154	-1894	92893
	p$_2$(t$_3$)	573	566,39	224	206	349,5	184	90815
	p$_3$(t$_3$)	573	566,39	224	206	349,5	369	90630
	p$_4$(t$_3$)	573	566,39	224	206	349,5	534	90465
	p$_5$(t$_4$)	234,3	566,4	256,3	222,5	350,6	218	90781
	p$_6$(t$_4$)	234,3	566,4	256,3	222,5	350,6	267	90732
	p$_7$(t$_4$)	234,3	566,4	256,3	222,5	350,6	349	90650
	p$_8$(t$_4$)	234,3	566,4	256,3	222,5	350,6	567	90432
	p$_9$(t$_5$)	-0,008	0,104	21674	33333	66666	98999	5990
	p$_{10}$(t$_6$)	5990	1890	-509	-2210	-3530	-4609	95608
		PRINCIPLE "MIN-MAX":						MIN
		VALUE OF CRITERIA K$_1$:						90432
		OPTIMAL ALTERNATIVE p$_k$(t) :						p$_8$
IDEAL EXPLOITATION CAPACITY:		Ce = 600 000 kom/god						

5. CONCLUSION

On the grounds of data from Tab. 3, graph in Fig. 5 and relation (26), the limits within which the volume of future production trends for a representative product (Q) relation (27) can be predicted.
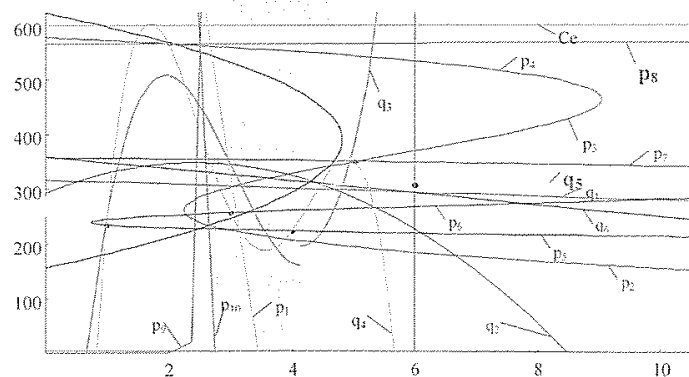

Fig. 5 Exploitation capacities (C$_e$), achieved production level S$_1$-S$_5$, regression curves q$_i$(t), multi-functions p$_k$(t) and achieved volume of production in the prediction area (S$_6$)

$$\left\{ (q^*, p^*) \Leftrightarrow (q_5, p_8) \right\} \Rightarrow 308500 \leq Q \leq 567000 \tag{27}$$

Using a 5-year analysis of business operations, the production program was designed for the next (6th) year that ranges, based on adopted criteria, within the limits defined by relation (27). With time flow, it is found that the volume of production of Q = 306 700 pieces/year (designated on a straight line t=6 in Fig. 5) has been achieved.

REFERENCES

[1] Jovanović R. J., Milanović D. D., Đukić D. R., „*Applying the criteria of decision making trends under uncertainty situations*", XIII International symposium, SymOrg 2012, Facultiy of Organizational Sciences, Zlatibor, 2012.,

[2] Đukić R., Žižović M., Jovanović R. J., „*The impact of the time horizon on the research of the production trends*", Journal - Tehnika i praksa, No 1, VŠTSS Čačak, Čačak, 2010.,

[3] Đukić R., Fetahović A., Trivković S., Jevremović B., „*Production menagement based on predicting future situation and trends*", Journal - Tehnika i praksa, No 2, VŠTSS Čačak, Čačak, 2010.,

[4] Đukić D. R., Jovanović R. J., „*Program for rating alternatives according to selected criteria of decision - making*", YU INFO 09 Conference, Information Society of Serbia, Kopaonik, 2009.

CENTER FOR QUALITY

UNIVERSITY OF MONTENEGRO
FACULTY OF MECHANICAL ENGINEERING

7th International Conference

ICQME 2012

(Quality, Management, Environment, Education, Engineering)

Proceedings

Tivat, Montenegro
19. - 21. 09. 2012.

Center for Quality
Faculty of Mechanical Engineering

7th International Conference

ICQME2012

(Quality, Managament, Environment, Education, Engineering)

19.09.-21.09.2012
Hotel Palma-Tivat
Montenegro

Conference Committee

Adolfo Senatore,	*University of Salerno, Italy*
Aleksandar Vujovic,	*University of Montenegro, Montenegro*
Alireza Lari,	*Fayetteville State University, USA*
Andjelko Lojpur,	*University of Montenegro, Montenegro*
Baki Karamis,	*Erciyes University, Turkey*
Darko Petkovic,	*University in Zenica, (BIH) Federation of B&H*
Jaroslava Hyrlova,	*University of Pardubice,Czech Republic*
Jelena Jovanovic,	*University of Montenegro, Montenegro*
Jovan Filipovic,	*University in Belgrade, Serbia*
Marc-Arthur Diaye,	*University d'Evry, France*
Marti Casadesus	*University of Girona, Spain*
Milan Perovic,	*University of Montenegro, Montenegro*
Milan Vukcevic,	*University of Montenegro, Montenegro*
Mikolaj Kuzinovski ,	*University in Skoplje, Macedonia*
Miladin Stefanovic	*University in Kragujevac, Serbia*
Miodrag Bulatovic,	*University of Montenegro, Montenegro*
Mirko Sokovic,	*University of Ljubljana, Slovenia*
Miroslav Bobrek,	*University in Banja Luka, Republic of Srpska*
Mitar Perusic,	*University in East Sarajevo, Republic of Srpska*
Nikos Vaxevanidis	*Dept. of Mechanical Engineering Educators, Greece*
Nedeff Valentin,	*Universitatea din Bacau, Romania*
Obrad Spaić	*University in East Sarajevo, Republic of Srpska*
Pavel Castka,	*University of Canterbury, New Zealand*
R.A.Mahdavinejad,	*University of Tehran, Iran*
Slavko Arsovski,	*University in Kragujevac, Serbia*
Stanislav Karapetrovic,	*University of Alberta, Canada*
Svetlana Cicmil,	*University of the West of England, UK*
Veijo Kauppinen,	*Helsinki University of Technology, Finland*
Vesna Cancer,	*University of Maribor, Slovenia*
Vidoje Vujic,	*University of Rijeka, Croatia*
Vladimir Modrak,	*Technical University of Kosice Slovakia*
Zdravko Krivokapic,	*University of Montenegro, Montenegro*
Zora Arsovski,	*University in Kragujevac, Serbia*