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Scheduling of activities and optimisation of material consumption as the function of improving quality and developing business systems

Planiranje aktivnosti i optimizacija utroška materijala u funkciji unapređenja kvalitete i razvoja poslovnih sustava

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Abstract

The economic system encompasses a large number of systemic categories and activities, which have to meet user requirements and needs by means of efficient combination of knowledge, ideas, capital and technology. Economic subjects of the system include companies, as the goal-oriented system focused on the real and profitable market affirmation, which implies adequate acknowledgement and efficient satisfaction of user needs. The economic system has a high degree of interactivity with numerous systems, such as the system of science and technology, global economic system, socio-political system. Economic systems have various levels of development, various development dynamics, various operation efficiency. The overall objective of the economic system can be presented as the formation of a dynamic network of efficient business systems, part of the economic system, the operations which achieve the maximum possible degree of efficiency, expressed as the ratio of achieved results and the level of engagement of limited resources for its realisation. Ensuring and improving the operation quality of a certain system requires synchronization of a wide spectrum of activities within the system itself, enables the expression of business potency, and is reflected on the development of economic system as a whole. Business systems have various business concepts, business sensibility and business competence, and thus different improvement sources. Scheduling and coordination of activities in technologically demanding industries, as well as the optimisation of inputs in order to achieve a desired output, is based on the potential of optimisation model the adequate use of which enables the increase of system development level.

Keywords: effective business, scheduling of activities, coordination, optimization, system development

JEL classification: C6

Sažetak

Gospodarski sustav obuhvaća veliki broj kategorija i aktivnosti koje, kao glavni zadatak, moraju zadovoljiti zahtjeve i potrebe korisnika pomoću učinkovite kombinacije znanja, ideja, kapitala i tehnologije. Gospodarski subjekti gospodarskog sustava obuhvaćaju tvrtke, kao elemente usmjerene na ostvarivanje ciljeva i usmjerene na stvarne i gospodarski profitabilne tržišne afirmacije, što podrazumijeva odgovarajuće priznanje i učinkovito zadovoljenje korisničkih potreba. Gospodarski sustav u visokom je stupnju interaktivnosti s brojnim sustavima, poput sustava znanosti i tehnologije, globalnog gospodarskog sustava i socio-političkog sustava. Ekonomski sustavi imaju različite razine razvoja, različite dinamike razvoja i različite učinkovitosti rada. Cjelokupni cilj gospodarskog sustava može se predstaviti kao formacija dinamičke mreže učinkovitih poslovnih sustava, dijela gospodarskog sustava čiji rad postiže najveći mogući stupanj učinkovitosti, izražen kao omjer postignutih rezultata i razine angažmana ograničenih resursa za njegovu realizaciju. Osig-

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uravanje i poboljšanje kvalitete rada određenog sustava zahtijeva usklađivanje širokog spektra aktivnosti unutar samog sustava, što omogućuje izražavanje poslovne sposobnosti i odražava se na razvoj gospodarskog sustava u cjelini. Poslovni sustavi imaju različite poslovne koncepte, poslovnu osjetljivost i poslovnu sposobnost, a time i različite izvore poboljšanja. Planiranje i koordinacija aktivnosti u tehnološki zahtjevnim industrijama, kao i optimizacija ulaznih podataka u svrhu postizanja željenog rezultata temelji se na potencijalu modela optimizacije, čija odgovarajuća upotreba omogućava povećanje razine razvoja sustava.

Ključne riječi: učinkovito poslovanje, planiranje, koordinacija, optimizacija, razvoj sustava

JEL klasifikacija: C6

1. Introduction

Contemporary management conditions, as a minimum condition for surviving in the market arena of a turbulent economic system, require a permanent improvement of product and service systems quality as well as the quality of the organisational structure itself. Establishment, maintenance and improvement of quality systems in business systems requires the recognition of system resistance sources with targeted categories by the application of adequate and effective methods of their prevention and elimination.

The achieved quality level is determined by the interaction of numerous factors within a business system, whereby each of them has different manifestations, consequences, frequency and type of mutual interaction. The recognition of system factors, their mutual influence, connection, their quantification and implementation into the system of permanent optimisation of the business process enables the maximisation of business effects.

The use of conventional quality tools enables good business results, but market positioning requires the best possible business results as the source of endurance and adequate competitive advantage. The source of competitive advantage in production-industrial areas of economy is determined by realised costs and labour productivity, the optimisation of which cannot be achieved by conventional quality tools. The improvement of business, and with it, the achieved quality levels, is acquired with the rationalisation of the volume of operative resources consumption, primarily basic raw material, as well as the volume of consumption of the direct production work and energy in the production process.

Mathematical models enable the realisation of the best business results in the existing management conditions, but their adequate application on concrete business systems requires the recognition of environmental factors and the system itself, their classification according to the degree of useful activity via established targets of the system, quantification and composing of adequate optimisation models. An adequate approach to business system modelling is determined by the choice of the problems that will be solved, as well as by the approach to modelling. The modelling process requires the achievement of compatibility of the model and the system on which the model is applied to, while the success of modelling is reflected in the degree of the achieved resemblance between the constructed model and the real system whose image it is.

2. Quality improvement as the backbone of business success of contemporary business systems

Contemporary management conditions place a company in a position which requires a multi-layered sensibility in the function of market positioning in the chosen area of business. Market competencies imply the composition of input vectors with the minimisation of business costs and maximisation of user satisfaction in comparison to the competition.

Bearing in mind that the quality represents "the level up to which the group of particular characteristics of products, processes and systems satisfies requirements of users and all interested parties" (International Standards Organization, 2014) each business system should and has to, with permanent, diverse activity, seek to satisfy the specter of users' requirements and to be "one step ahead" of everybody else.

User requirements differ depending on the product, management conditions and other factors, whereby the sources of (dis)satisfaction should be permanently tested, satisfied and exceeded with the stressed sensibility and subtle nuancing of needs and values of the appropriate product, service and organisational structure needed for their realisation.

The achievement of top product performances requires investments and engagement of additional resources, while the requirement to minimise business costs, the wide availability of resources and information, with the emphasis on limitations, significantly and directly limits the mentioned activities. The mentioned refers to the balanced competitive position of a company in a chosen or intended area of activity, whereby the differentiation is achieved with non-material resources only, primarily by involving intellectual capital.

Known quality tools enable the improvement of product and product system performances, but they often match market positions of competitors, so they are not sufficient enough for adequate market positioning of business systems in contemporary management conditions.

Optimisation models have the potential of solving many business-economic problems, among which the rationalisation of the use of raw materials in the production process can be achieved, and it is achieved by minimising waste. Along with the mentioned, the rationalisation of time needed for the realisation of the production process in the function of costs of its realisation, can be effectively achieved by using network programming models and methods.

The effects of the application of the mentioned methodology on the composition of the production process input vector in the function of the optimum level realisation of the output vector, can be illustrated on a concrete business system from the area of the production of upholstered furniture.

3. Program correction of the rationalisation of the degree of material consumption in the production process

Production process implies the transformation of particular input sizes into a desired form of output values, whereby the success of the process is reflected in the minimisation of the difference between monetary equivalents of mentioned sizes. Taking into consideration the fact that companies with similar business orientation realise production activities in given management conditions, the differentiation of business result can be achieved exclusively by engaging intellectual capital.

The basic raw material intended for the production of particular products, as a significant input vector element comes in a standardised form, whereby there is a class of raw materials whose manufacturing implies the adequate use for the purpose of business result optimisation, which is determined significantly by the level of production costs. There are raw materials the use of which is conditioned by a production recipe, while, on the other hand, there are raw materials the use of which requires a planned, rational approach for the purpose of optimum use. The basic raw material in textile, wood, metal processing and similar production branches comes in a standardised form and the production of finished products requires cutting of particular parts of already known shapes and dimensions.

The realised consumption of basic raw material is an important element of the product price and the overall business costs in the processes where the volume of raw material use is usually subject to cutting product parts from the raw material of a standard shape and dimensions. The problem of the rational use of basic raw material encompasses the requirement that the variant of cutting basic raw material should be defined in order to achieve a minimum use of the material in the process of the output vector realisation with the rationalisation of the basic raw material use.

The solution of the problem of optimum basic raw material use can be achieved by finding all possible alternatives of use via budget and by comparing economic efficiency of each of them, which is often a long, expensive and complex process. The problem of the rational basic raw material use in production processes of the mentioned type can be solved by constructing the appropriate mathematical programming model.

3.1. Integer programming and correction of business decisions as the efficient business rationalisation algorithm

Business process has to be organised in order for the planned volume and structure of the output vector ($P_1, P_2, \dots, P_n$) to be realised with the rational basic raw material use, choice of cutting alternatives of particular products from the basic raw material of a standard shape and dimensions while respecting market potentials, as well as, product and financial possibilities.

Production plan mandates the production of a particular amount of products $P_1, P_2, \dots, Pn$ in a planned period of time and in the amount of $x_{1i}, x_{2i}, \dots, x_{ni}$ product pieces, respectively. Basic raw material is used in the production process whereby it comes in i – variant and whereby the basic raw material consumption differs from product to product.

Basic raw material is procured in the appropriate standard, indivisible forms, regardless of the product consumption, and is procured in quantities of n_1, $n_2, \dots, n_m$ packages of particular raw material variants respectively. Basic raw material consumption depends on the cutting variant, whereby each particular variant corresponds to the number of units of particular cutting parts $k_1, k_2, \dots, k_k$, the amount of cutting parts per each cutting variant amounts to $kv_1, kv_2, \dots, k_{vk}$, whereby v – is the ordinal number of a cutting variant. Moreover, it is also known how many particular cutting parts make up particular products which amount to $k_{11}, k_{12}, \dots, {}_{k1k}, k_{21}, k_{22}, \dots, k_{2k}, \dots, k_{n1}, k_{n2}, \dots, k_{nk}$.

The production volume has to be within market possibilities of particular product, i.e. for every product it has to move within the interval from $t_{(min)j}$ to $t_{(max)j}$.

The possibility of financing the production process takes into consideration direct production costs that include basic raw material costs and direct labour cost which amount to $c_{11}, c_{12}, \dots, c_{1m}$ $c_{21}, c_{22}, \dots, c_{2m}, \dots c_{n1}, c_{n2}, \dots, c_{nm}$ monetary units per unit j – of the product made out of i – basic raw material variant. Available financial resources amount to c_0 monetary units.

Business efficiency implies defining rentability threshold that implies the definition of a minimum allowed income from finished products' sales, which amounts to p_0 monetary units with sales prices of particular products $p_1, p_2, \dots, p_n$ monetary units.

The objective to be achieved by solving this problem represents a minimum basic raw material consumption.

Bearing in mind that the basic raw material can be procured in standardised packages which are indivisible, as well as, that realised production volume is connected to finished products exclusively, classes of described problems are solved by means of integer programming models.

3.2. Principles of mathematical formulation of the optimality of basic raw material use in the production process

Analysed problems imply that in the chosen business portfolio basic raw material is procured in standard dimensions, that products have to be completely made during the planned production cycle and that problems are efficiently solved by applying integer programming model which can be written down by means of the following relations:

a. Target function:

$(min);\ z = \sum_{i=1}^{m} n_i$	1

b. Limiting factors system:

$n_i - \sum_{l=1}^{v} k_{li} \geq 0 \quad \forall i, i = 1,2,\dots,m$	2
$\sum_{j=1}^{n} k_{ji} - \sum_{l=1}^{v} k_{li} = 0 \quad \forall i, i = 1,2,\dots,m$	3
$x_{ji} \geq t_{(min)i} \quad \forall i, i = 1,2,\dots,m$	4
$x_{ji} \geq t_{(max)i} \quad \forall i, i = 1,2,\dots,m$	5
$\sum_{j=1}^{n}\sum_{i=1}^{m} c_{ji}x_{ji} \leq c_0$	6
$\sum_{j=1}^{n} p_j x_{ij} \geq p_0$	7
$x_{ji}, n_i \in Z+ \cup \{0\}$	8

Variables in the model indicate:

x_{ji} – number of j – products made from i – raw material

n_i – number of procured basic raw material packages of standard sizes (quantity).

Relations (1) – (8) represent integer programming model as the algorithm for generating management guidelines for the purpose of solving the previously described problem. With particular relations we:

(1) Represent a functional expression of the target whose requirement is the minimum basic raw material consumption in the production process

(2) Indicate the set of limiting factors used to express the number of realised cutting parts according to the established cutting variant and type of basic raw material. In the production of upholstered furniture it can be the type of used upholstered fabric

(3) Indicate the set of limiting factors that express the cutting parts consumption in particular products

(4) Indicate the set of limitations in relation to minimum market requirements in relation to the possibility of placing finished products

(5) Indicate the set of limitations in relation to maximum market requirements in relation to the possibility of placing finished products

(6) Express the possibility of financing business process

(7) Express business rentability threshold, as a minimum income from product sales

(8) The condition of integer variables in the model is expressed.

The analysed problem, translated into the integer programming model represented with relations (1) – (8), has its own common characteristics, whereby the optimum solution is achieved for particular values of variables in the model, that we indicate as business optimum assumptions. Solving the model requires its translation into a canonical form, whereby changeable variables added in the model will show the degree of use of particular resources in the sense of exceeding minimum or failing maximum requirements.

The optimum model solution contains a particular number of variables with positive value or value zero. The indicator of solution optimality are the differences $(z_j - c_j)$ (Landika, 2007), so in the optimum solution of the observed model, their value has to be lower than or equal to zero. The differences with the value zero correspond to all variables that in the optimum solution have a positive value, while negative differences and differences with a value zero can correspond to variables that in the optimum solution have the value zero.

If the difference, corresponding to the variable whose value in the optimum solution is zero, has the value zero, then the modelled business optimum has the adequate alternative which is important to bear in mind when finalising business decisions.

3.3. Modelling of managerial information for the formation of a company's strategies as the reality level

The mentioned methodology can be illustrated on the problem of optimisation of the use of cloth for upholstering furniture in the production company "Prima ISG" Gradiška. The manufacturing company has to plan production for the following structure:

- Sofa CANNES 58 pieces, product P_1
- Armchair MARY 32 pieces, product P_2
- Bed IVONNE 16 pieces, product P_3.

In the structure of production costs, the costs of cloth for upholstering furniture have a significant role. Each of the products is made out of cloth and the following elements are cut:

- Sides, two for each product, in the analysis they are marked as cutting part k_1
- Front sides for the product P_1, two different for each product, in the analysis they are marked as cutting parts k_2 and k_3
- Front sides for the product P_2, one for each product, in the analysis they are marked as cutting part k_4
- Front sides for the product P_3, one for each product, as well as one front cutting part for the product P_1, in the analysis they are marked as k_2
- Sitting part and backrests, 6, 1 and 3 pieces are needed for products P_1, P_2 and P_3, respectively, in the analysis, these cutting parts are marked as cutting part k_5.

Variants of cutting parts, that refer to the number of cutting parts that can be realised from the quantity

Table 1 Rate of the realisation of cutting parts from one cloth packaging

Cutting variant	Cutting part	K_1	K_2	K_3	K_4	K_5
I		12	7	3	8	26
II		7	14	8	4	28
III		13	8	6	6	24
IV		8	12	7	5	30

Source: the authors.

of 10 running meters of cloth, can be illustrated in Table 1.

If delivering the complete packaging, then the manufacturer of cloth for upholstering furniture charges a 60% lower selling price in comparison to purchasing quantity lower than the overall package.

It is necessary to set the optimum plan for the product realisation which enables minimum consumption of the cloth for upholstering.

Integer programming model which corresponds to the described problem, written in a canonical form:

a. Target function:

$(\min);\ z = \sum_{i=1}^{4} n_i + 0 \cdot \sum_{k=1}^{9} y_k - M \cdot \sum_{k=10}^{18} y_k$	1

b. Limiting factors system:

$n_1 - 12x_1 - 7x_2 - 3x_3 - 8x_4 - 26x_5 - y_1 + y_{10} = 0$	2
$n_2 - 7x_1 - 14x_2 - 8x_3 - 4x_4 - 28x_5 - y_2 + y_{11} = 0$	3
$n_3 - 13x_1 - 8x_2 - 6x_3 - 6x_4 - 24x_5 - y_3 + y_{12} = 0$	4
$n_4 - 8x_1 - 12x_2 - 7x_3 - 5x_4 - 30x_5 - y_4 + y_{13} = 0$	5
$x_1 - y_5 + y_{14} = 212$	6
$x_2 - y_6 + y_{15} = 74$	7
$x_3 - y_7 + y_{16} = 58$	8
$x_4 - y_8 + y_{17} = 32$	9
$x_5 - y_9 + y_{18} = 856$	10
$n_i;\ x_j \in Z^+ \cup \{0\};\ y_k \geq 0$ $i = 1,2,3,4;\ j = 1,2,3,4,5;\ k = 1,2,3,\ldots,18$	11

Variables in the previously formed model indicate:

- n_i – number of tenths of meters of cloth for upholstering cut per i – variant, respectively
- x_j – number of realised j – cutting parts in the production process, respectively
- y_k (k = 1, 2, 3, 4) – unconsumed cloth per i – cutting variant, respectively
- y_k (k = 5, 6, 7, 8, 9) – number of unconsumed j – cutting parts, respectively.

The explanation of particular relations in the previous model is:

Relation (1) expresses the target business model wants to achieve by solving the problem, which here represents the minimum basic raw material consumption;

Relations (2) to (5) express the overall realisation of the appropriate cutting parts by using i – cutting variant, respectively;

Relations (6) to (10) express the number of realised

Table 2 Optimum solution of the linear programming model represented in relations (1) - (10); the value of variables and target functions in the optimum solution of the linear programming model

Value of real variables:	Value of levelling variables:
$n_1 = 25.748$	$y_1 = 0$
$n_2 = 28.080$	$y_2 = 0$
$n_3 = 24.432$	$y_3 = 0$
$n_4 = 28.830$	$y_4 = 0$
$x_1 = 212$	$y_5 = 0$
$x_2 = 74$	$y_6 = 0$
$x_3 = 58$	$y_7 = 0$
$x_4 = 32$	$y_8 = 0$
$x_5 = 856$	$y_9 = 0$
Value of the target function:	106,090

Source: the authors.

j – cutting parts in relation to the minimum needs, respectively;

Relation (11) expresses the condition of an integer of real variables, as well as the condition of the negativity of levelling and fictitious variables in the model.

Software generated model solution is illustrated in Table 2.

By respecting managerial information which resulted from the optimum model solution, the necessary consumption of cloth for upholstering furniture with which we achieve a planned production volume equals to 10.609 running meters. Having in mind that the same production programme has been realised with basic raw material consumption of 12.871 running meters (Evidenciono knjigovodstvo, 2015), we can see that it is possible to save 2.250 running metres of cloth for upholstering furniture.[1] Monetary consequences of the suboptimal solution are: $(86 - 71) \cdot 1.595^{2} = 23.925$ BAM.

4. Program correction of the rationalisation of the degree of time consumption in the function of production costs

Production process represents a complex managerial process characterised by the division of labour, specialisation and cooperation between many participants in its realisation. Greater division of labour and narrower specialisation in production lead to the respective increase of productivity and quality of performance, raising the level of product quality with the simultaneous strengthening of harmonisation, communication and coordination of participants and resources necessary for the operationalisation of the established managerial task (Landika, 2010).

Respecting the targets established in advance by the decision-maker to optimally use available resources with the help of complex inclusion of all activities from production planning to the delivery of finalised products, whereby market positioning is identified with the optimum duration of the production process and timely adjusted managerial task.

4.1. Network programming and correction of business decisions as the efficient algorithm of business rationalisation

The realisation of a complex managerial task requires the realisation of a particular number of activities that are interconnected, whereby one or more of them influence the start of the other activity. The complex managerial task has to be rationally analysed and logically segmented into separate units in the context of the established managerial task. The previously mentioned enables

1 Cloth for upholstering furniture is procured in rolls that contain 150 running meters of cloth, therefore for the use of 12.871 running meters 86 rolls of cloth have to be procured (12.871 : 150 = 85.81 ≈86); analogous to that, for the use of 10.609 running meters of cloth it is necessary to procure 71 rolls of cloth (10.609 : 150 = 70.73 ≈ 71)

2 BAM represents purchase price expressed per roll of cloth for upholstering furniture

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programmed inclusion of time dimension of the complex managerial task along with the respect towards the realisation costs.

Network models are based on the application of a modern algebra, graph theory and mathematical statistics and they enable the analysis of structure, duration and realisation costs of the complex managerial task (Petrić, 1983).

Network programming models enable the optimisation of realisation costs of the complex managerial task with the respect towards previously established time frame for its realisation. The analysis structure of a managerial task in network programming models is separated from other analyses and it implies the establishment of a logical schedule with respecting interdependency of particular stages of the complex managerial task.

Analysed problems imply that in the chosen business portfolio production process is realised from $E_1, E_2, \dots, E_n$ of clearly defined stages, whereby each of them requires the engagement of appropriate resources and the appropriate time flow. The analysis of structure enables the generation of managerial information with regard to the order of particular stages within the set task in the sense of order, interdependency and conditioning among them.

Each particular stage of the managerial task is realised in the time interval $[t_j^{(u)}; t_j^{(n)}]$, duration of each stage of managerial task can be neither longer than its maximum, nor shorter than its minimum duration.

The managerial task as a whole has to end in the targeted time frame which amounts to T time units. The project as a whole starts in the moment in time marked as zero. Each stage of the managerial task requires the initiation of appropriate resources whose value moves within the interval $[c_j^{(n)}; c_j^{(u)}]$. Costs of each particular stage of the managerial task are determined by the time spent on their realisation $c_j = f(t_j)$, whereby it is necessary to recognise and define the type of functional dependency among them.

The realisation of the complex managerial task has to respect an estimated budget in the amount of C monetary units.

4.2. Principles of mathematical formulation of optimality

Problems of time optimisation for the realisation of the managerial task with the minimisation of realisation costs can efficiently be solved by applying network programming models which can be written down by means of the following relations:

a. Target function:

(min); $z = \sum_{\forall E_{ij}} (a_{ij} t_{ij} + b_{ij})$	1

b. Limiting factors system:

$t_j^{(1)} - t_j^{(0)} - t_{ij} \geq 0 \quad \forall E_{ij}$	2
$t_{ij} \leq t_{ij}^{(n)} \quad \forall E_{ij}$	3
$t_{ij} \leq t_{ij}^{(u)} \quad \forall E_{ij}$	4
$t_n^{(0)} = t_n^{(1)} \leq T$	5
$t_1^{(0)} = 0$	6
$\sum_{\forall E_i} (a_{ij} t_{ij} + b_{ij}) \leq C$	7
$a_{ij} < 0, b_{ij} > 0, t_{ij} \geq 0, \forall E_{ij}$	8

Variables in the model indicate:

- t_{ij} – the duration of a particular stage of the managerial task
- $t_j^{(0)}; t_j^{(1)}$ – the earliest, i.e. latest possible beginning (ending) of a particular activity, i.e. project as a whole.

Coefficients in the target function indicate:

- a_{ij} – the direction coefficient in the function of costs, expresses the increase of costs for the reduction of time needed to realise a particular stage of managerial task per unit and it is expressed as: $a_{ij} = \frac{c_{ij}^{(n)} - c_{ij}^{(u)}}{t_{ij}^{(n)} - t_{ij}^{(u)}}$
- b_{ij} – free coefficient in the cost function, expresses maximum realisation costs for a particular stage of managerial task and is expressed as: $b_{ij} = c_{ij}^{(u)} - \frac{(c_{ij}^{(n)} - c_{ij}^{(u)}) \cdot t_{ij}^{(u)}}{t_{ij}^{(n)} - t_{ij}^{(u)}}$.

Table 3 Elements for planning the production activities schedule

Managerial task stage	Name of the plant	Massif	Coining	Cutting	Sponge	Sewing	Upholstery
	Mark	A		C	D	E	F
Depends on		-		-	-	C, D	B, E
Duration (working hours)		50		10	20	3	25

Source: Radni nalog (2015).

Relations (1) – (7) represent the network programming model as the algorithm for generating managerial guidelines for the purpose of solving the previously described problem. With particular relations we:

(1) Represent a functional expression of a target whose requirement is a minimum production process realisation cost in the function of its duration

(2) Indicate the set of limiting factors used to express the requirement that stages of managerial task have a negative time reserve

(3) Indicate the set of limiting factors used to express the requirement that the maximum length of each particular stage of the managerial task is the same as its normal duration

(4) Indicate the set of limiting factors used to express the requirement that the minimum duration of each particular stage of the managerial task is the same as its forced duration

(5) Express the requirement of scheduling integral managerial task

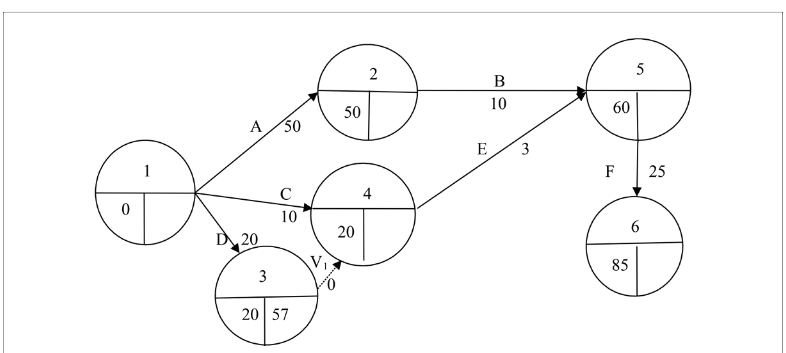
(6) Express the requirement for the realisation of financing of a business process within the predefined budget

(7) Express the condition of the negativity of variables in the model.

The analysed problem translated into the network programming model, represented with relations (1) – (7) has similar characteristics with it, whereby the optimum solution is achieved for particular values of variables in the model, marked as business optimum assumptions. Solving the model requires its translation into canonical form, whereby variables added into the model will show the degree of use of particular resources in the sense of exceeding minimum or failing maximum requirements.

The optimum model solution contains a particular number of variables with positive value or value zero. The indicator of optimality of the solution represents differences (z_j – c_j), so that to the optimum solution of the observed model their value has to be lower than or equal to zero. The differenc-

Figure 1 Network diagram of upholstered furniture production process with particular stages, their earliest and latest possible beginnings (endings)



Source: the authors.

Table 4 Scheduling of time moments of beginnings (endings) of particular production phases in the function of production process completion on 31.10.2015

Activity	A		B		C		D		E		F	
Beginning/ ending	t_1^0	t_1^1	t_2^0	t_2^1	t_4^0	t_4^1	t_3^0	t_3^1	t_5^0	t_5^1	t_6^0	t_6^1
Time units	0	0	50	50	20	57	20	57	60	60	85	85
In relation to the planned ending	18.10.		25.10.		22–27.10.		22–27.10.		27.10.		31.10.	

Source: the authors.

es whose value is zero correspond to all variables that in the optimum solution have a positive value, while negative differences and differences whose value is zero can correspond to variables that in the optimum solution have the value zero.

If the difference, corresponding to the variable whose value in the optimum solution is zero, has the value zero, then the modelled business optimum has the adequate alternative which is important to bear in mind when finalising business decisions.

4.3. Modelling of managerial information for the formulation of company's strategy as the reality level

The mentioned methodology can be illustrated on the problem of optimisation of the use of cloth for upholstering furniture in the production company "Prima ISG" Gradiška. The manufacturing company has to plan its structure production defined in chapter 2.3. Planned production volume has to be delivered to the client on a precisely defined date of agreed delivery. Planned production has to be realised so that the agreed deadlines are respected, but also to maximally reduce storage time. Timely and rational scheduling of production completion is efficiently solved with the application of network programming models and methods.

In the structure of production activities for the production of the observed contingent of upholstered furniture of the contained stage, their duration and interdependency can be illustrated with Table 3.

Network diagram corresponding to the described problem is illustrated in Figure 1.

The solution of the network model contains information about scheduling possible beginnings and endings of particular phases, which can be translated into terms that correspond to the requirements of planned deliveries via simple procedure, which is illustrated in Table 4.

The previous table illustrates the terms used for expressing beginnings of particular production process stages in the function of the timely end, as well as the delivery of product assortment to its client.

5. Conclusion

A scientific approach to the model optimisation represents a valuable theoretical product by the use of which business problems are noticed in the form of suggested alternatives, and whose application enables their optimum choice. The mentioned approach enables previous level of knowledge, beliefs, business practices and achieved results to increase and thus enable desired business result. The consideration of initial beliefs, defining business goals, quantification and logical connecting of particular internal and external factors enriched with empirical data, enables the construction of adequate mathematical programming theoretical models which then enable testing of business sensibility and its connection to market positioning in real business surroundings. The construction of mathematical programming model, corresponding to the concrete business system, as well as its solutions, reveal new insights into the intellectual capital necessary for achieving significant competitive advantage expressed via marginal efficiency of a business result. The rationalisation of basic raw material use enables the introduction of an optimum variant of basic raw material use which significantly contributes to the quality of the business result, whose monetary consequences in the concrete case are expressed in the reduction of costs in the amount of 23.925 BAM. The rationalisation via time resources enables respecting of agreed deadlines for delivery with the simultaneous elimination of storage costs. It also enables cost savings even during working hours. The working task, by means of a standard business procedure is realised in 118 working hours, but with an adequate organisation of activities and the engagement of same resources, can be realised in 85 working hours. Program optimisation symbolises the connection between input and output repertoire of the business process in the observed business environment, whereby a more desired level of realised business result is achieved, and with it a significant competitive advantage. Mathematical models used in this paper represent the formalisation using a mathematical description which formalises structure, behaviour and consequential matrix of symbolic connection of constants and variables in the problem. Constructed models, with adequate modification, can be adapted to problems of numerous business systems. They, without exception, enable positive business result change rate in which business surroundings is accounted for as well, and their application requires modest investments in the form of hiring consultants and widely available software support.

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