

# ANALYSES AND SYSTEM IMPROVEMENT OF OPERATIONS

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## **Abstract**

Contemporary period of business environment is often characterised by the statement that globalisation becomes concept and localisation becomes realisation. Therefore it is up to the businesses to create their own managing systems which will become the sources of comparative advantages, taking into account culture and environment. These systems also consist of the holistic approach to management of production operations stemming from system analytical activity which would map up meeting the requirements of stakeholders. Some possible approaches and their particular application in conditions of the Slovak businesses are dealt with in this paper. One of the decisive prerequisites for the dynamic reaction of businesses to the new requirements of internal and external environment is the analysis of a position of the business within the matrix of effectiveness versus efficiency of operations, mapping the value stream or other analyses. Good analysis can also become a systematic element of operations' improvement, increase in the value adding activities share and finally leading the business towards success.

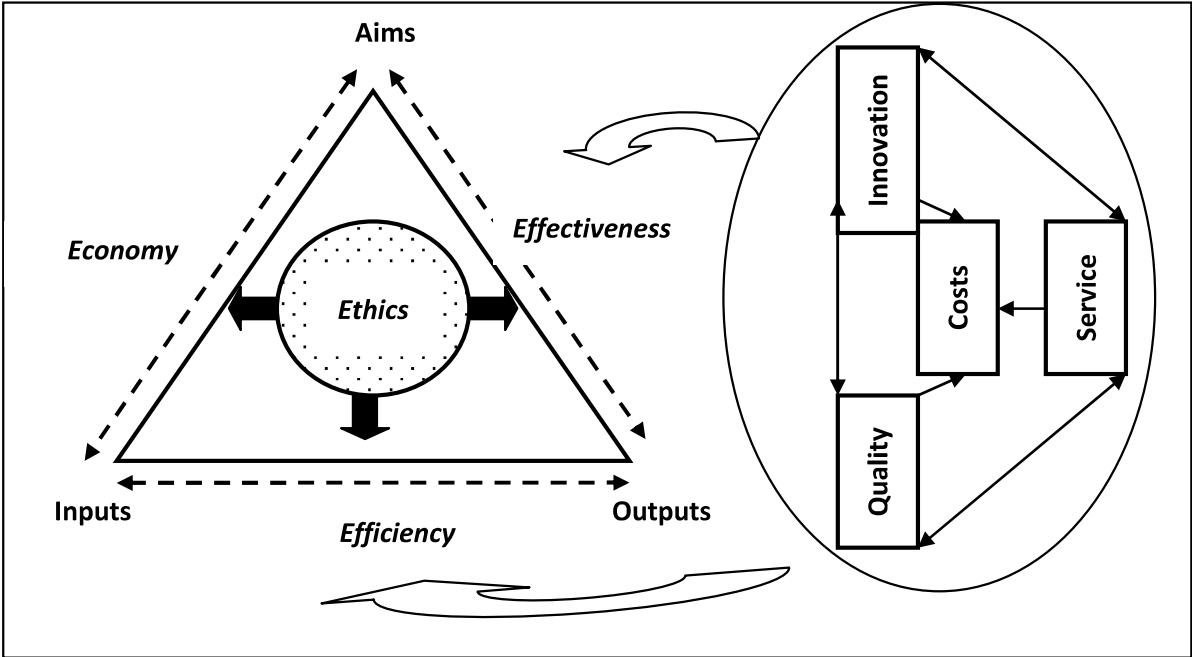
## **Introduction**

Decisive prerequisite for long-term success of the business or another organisational unit within market economy is satisfaction of customers' needs done with a better quality than direct or indirect competition. In contemporary turbulent times, we cannot assume that tomorrow will become extrapolation of today. Continuing individualism of the market, production (search) of goods for clients, not search of clients for products brings about shortening of life cycle of products with all its consequences, especially by the need of dynamic changes including innovation of the product and processes. Managerial approach in such a situation tells us that the dynamic changes in the environment should be perceived more as an opportunity than a threat. We could amend the famous slogan dealing with the certainty of uncertainty that the only certainty becomes change often the only chance for "economic survival" of a business. Currently, in a difficult time of crisis, some businesses prefer the trend of across the board cost cutting. These businesses cut costs of development of new products, marketing etc. These, however, decrease the possibility of revival in a short period of time as well as worsen perspective for the future. Cost cutting in operations especially regarding labour with no added value is not worsening the situation, quite the opposite, it creates the prerequisites for better satisfaction of customers' needs which in many cases is fundamental part of economic survival. The needs of operations' improvement become urgent, because huge pressure by the competition will become a permanent factor. "Turbulence becomes new normality interrupted by regular and fluctuating flushes of prosperity and decrease – including long-term bust leading to recession and crisis. Turbulence has two consequences. One of them is vulnerability against which the society urgently needs a protective system. The other is the opportunity which should be seized." [4] J. Dědková and I. Honzáková state within the difficult turbulent environment: "Every business has to deal with the future on regular basis and react to the fast changing social and economic conditions. It is

necessary to say that there is not a universal manual for dealing with the matters associated with production’s intentions, selling of products, pricing, etc., for all solutions can be both correct and incorrect. It is for this reason that the business has to draft its own strategy which would enable it to maintain its existence and achieve prosperity.” [3] One’s own unique strategy can lead to success only if it is supported by efficient, unified and unique management system and system of holistic approach to introduction of the necessary changes. The system approach presupposes a permanent analysis of the relevant elements of both external and internal environment and a dynamic reaction to the change in some of the system units. The management systems in our business that are being built are often results of copying of the systems of foreign mothers without taking into account cultural differences. A number of businesses thus lose their comparative advantage stemming from the difference due to the unique “tailor made” system. History has given us a number of examples supporting the better quality of such system which led to success by appropriately understood “imitation”, not plagiarism, as an acquisition of added value (by recognising national or regional culture).

**1 Customers and dimensions of operation system**

Globalisation, requirements from micro and macro-environment, high expectations of customers, growing direct and indirect competition poses a question regarding their future reactions to these phenomena for the business. One of the decisive possibilities is the increase in efficiency. Managing and improving efficiency has a number of interpretations according to particular aspects that are emphasised. The road to emotionally and socially mature society perceived through the broad and heterogeneous spectrum of customers hints at the multi-dimensional analysis of business operations. Every customer segment and the relevant stakeholders will prefer various priorities, therefore, the ultimate success is conditioned by broad system approach to satisfaction of requirements. One of the approaches is aimed at the dimensions of the operation system through the “4E” which are (Figure 1): economy, efficiency, effectiveness, ethics.



Source: own  
**Fig. 1:** “4E” Dimensions

The basis for a success of every business is to undertake operations in such a way that they are carried out **effectively** and **efficiently**, i.e. so that they would fulfill customers' expectations and bring them the highest value. At the same time, the operations would be undertaken efficiently, economically and with the best possible application of resources of the transformation process. It is obvious that the decisive prerequisite for this dual task is to learn the preferred values of customers, to be able to measure and analyse efficiency and balanced application of both dimensions and improve them systematically by application of such managerial tools and approaches as decrease of costs per unit, improvement in quality of products and processes, permanent innovation of products and operational processes and also reliable and flexible service. Measuring efficiency by application of a number of criteria, systematic approach and emphasising the future rather than the past and present is a condition for good follow up in managerial intervention into particular dimensions of operation systems in order to reach direction of the business in "Drucker" matrix into the quadrant designed as "success" (Figure 2). Given the complexity of causality of this topic, it is necessary to analyse efficiency exactly by the application of mathematical and expert estimate methods.

<b>Effectiveness</b>	High	Survival (under threat)	Success
	Low	Decay	Gradual decay
		Low	High

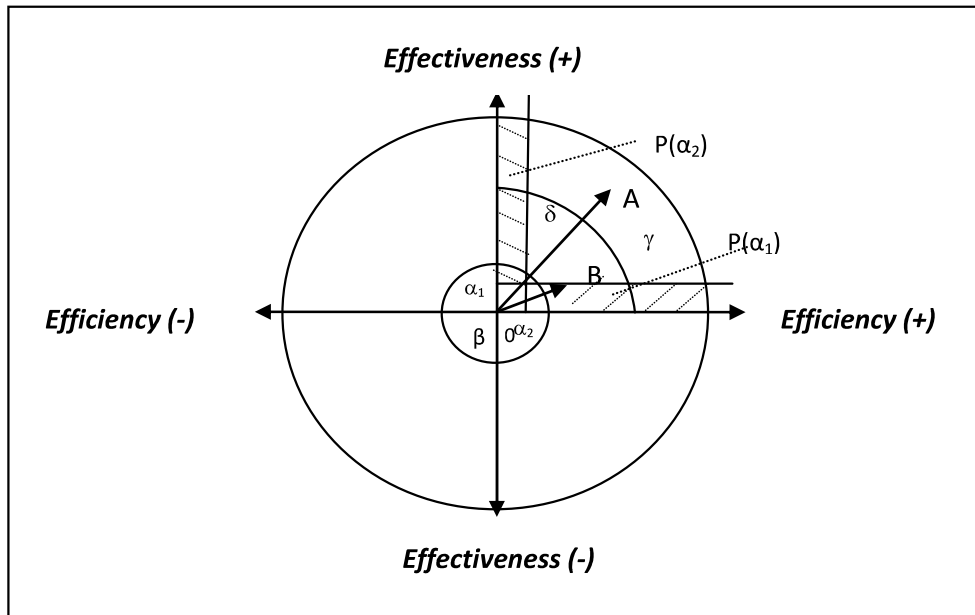
**Efficiency**

Source: [1]

**Fig. 2:** Matrix of "effectiveness" versus "efficiency"

Determining position of the business within the matrix or development of the position regarding external environment or the previous studied period can become a good starting point for defining the operation strategy and a system of managerial intervention. Drafting the model for analysing contemporary position of the business within the matrix and its application to the conditions of particular business is the subject of research within the project which we are dealing with on the basis of the requirements of several Slovak industrial businesses. Decisive prerequisite for effective and operative application of such model is irrational selection of factors and indices of evaluation of both basic dimensions and also determining "stability zones" (Figure 3).

Based on Figures 2 and 3, it is obvious that independent determining of the current, "gross" position of the business (expressed in figure 3 by points A, B) might not be sufficient for determining the degree of risk of the possible shift to some of the less favourable quadrant or position, expressed by the vector's direction ( $\overrightarrow{OA}$ ,  $\overrightarrow{OB}$ ). Around point "0" there is to some extent unstable environment expressed as the circle area  $\beta$ . Further instabilities are the areas  $\alpha_1$  and  $\alpha_2$ , which are located at marginal axes "effectiveness" and "efficiency". The degree of stability is characterised by the position within one of the particular "stability zones", which are expressed in the model (Figure 3) in the shape of concentrated sectors  $\beta$ ,  $\delta$ ,  $\gamma$ . The problem and possibility of degrading into the less advantageous sectors takes place in a situation when point of the coordinates  $(x_A, y_A)$  of point A is less than the limits of values  $\alpha_1$ , or  $\alpha_2$ .



Source: own

**Fig. 3:** Position stability in matrix “effectiveness” versus “efficiency”

The areas under threat are the zones described as the set of points for which the following equations (1) and (2) are true:

$$P(\alpha_1) = \{[x, y]; x \in R, y \in R, y < \alpha_1\} \quad (1)$$

$$P(\alpha_2) = \{[x, y]; x \in R, y \in R, x < \alpha_2\} \quad (2)$$

Stability zone (at least temporal)  $\gamma$  is part of the quadrant for which the following equation (3) is true:

$$\gamma = \{X = [x, y]; x, y \in R: \rho(0, X) > r, x > \alpha_2, y > \alpha_1\} \quad (3)$$

Complexity of solution under particular conditions is given by the sensitivity in determining marginal figures  $r, \alpha_1, \alpha_2$ , by analysing the behaviour in positions close to these margins and sensitivity of these margins regarding decision making. Certain possible variability is granted by modeling through the *fuzzy* space.

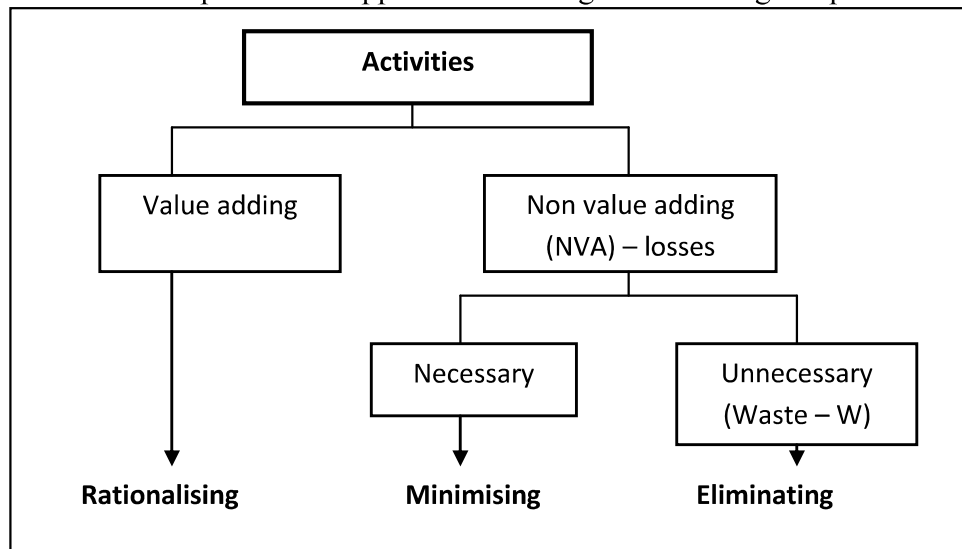
## 2 Analysis of operations and their improvement

By the application of methodology outlined in Chapter 1 or other sophisticated analytical methods aimed at the whole spectrum of relevant parts of the system, we might discover a need for change in every business, in particular, changes in a certain sphere. In the spirit of the Japanese maxim (Hitoshi Takeda): “Recognise the enemy who is threatening organisation on the inside”. It can give us ideas for “shift towards success” or for acquisition of comparative advantage through improvement of operations in which the inputs are transformed into outputs required by customers. Through the structured systematic analytical approach, it is necessary to determine and select value adding activities from other activities (Figure 4).

Time frames of the activities within an operation will help to determine the share of non-value adding activities and they will become incentive to changes in implementation and their optimising under the scheme in Figure 4. This can be achieved by the application of principles of Lean Production, Kaizen and other modern proven business philosophies and managerial methods applied especially in production processes in connection to “value stream”. Dealing

with the value stream as a sum of all value adding and non-value adding activities is aimed at removal of wasting which can be achieved through a number of basic approaches:

- *eliminating* of evident activity related losses which are non-value adding and not inevitable (W)
- *minimising* (reduction) of operation times (procedures) which are non-value adding but necessary for correct process solving (NVA)
- *rationalising* (optimising) of processes which are value adding (VA) but which require application of managerial methods and techniques, quality management tools, operation analysis and other sophisticated approaches leading to shortening of operation times.



Source: [2]

**Fig. 4:** Structure of activities and the ways of their improvement

Improvement of production operations (increase in efficiency) which follows analyses includes a broad spectrum of optimising possibilities dealing with the following:

- production planning,
- production scheduling,
- type and distribution of processes,
- amount of units and their transition among operations,
- structuring of work places,
- selection of technology regarding its extent, degree of automatisation and integration of sub-systems,
- work load – work designing regarding behavioural approaches, ergonomics, etc.[2]

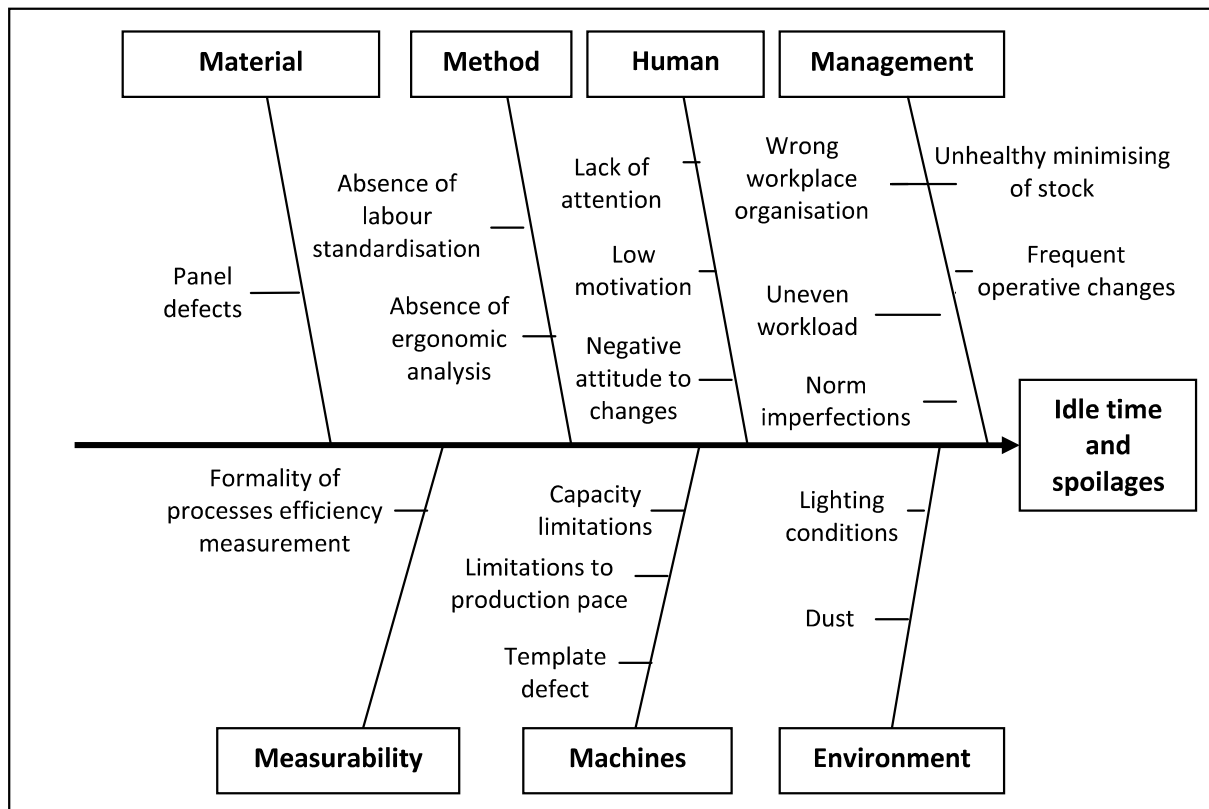
Value stream work means improvement of the whole and in the broad context optimising every part of the whole. Taiichi Ohno founder of TPS said the following regarding the topic: “We are only interested in temporal axis which begins at the moment of customer’s order and ends with the payment. Temporal axis shortens elimination of losses which have no added value”. Value Stream Mapping is one of the most efficient qualitative tools of description and analysis of operating systems for the improvement of fluency and efficiency of the production process. Teachers and students of our university in the study programme “Management” were incorporated in the process of preparation and implementation of this method within “lean” philosophy in a Slovak manufacturing business owned by a multinational corporation (situated in 67 production and technological centres of research and development at global basis). Selection of research in one of the sub-projects is presented in the following chapter.

### 3 Analysis and improvement in efficiency of selected process

Working on the project dealing with putting forward of the “lean” concept generated a number of various ideas and possibilities of processes’ improvement. This chapter presents results of research in the operation “panel impress”. It is an average difficult process from the point of view of the number of activities and quite stable from the point of view of variability.

Applied methodology included status quo analysis, drafting of the process map and value stream mapping as a tool of communication for determining narrow spots by utilisation of the following methodological approaches:

- identification of reasons for losses causing idle time and spoilages,
- workday snapshot – tool of aggregate nature serving as demonstration of production structure, its scheduling as well as for identifying of so called “gross” failures (e.g. long idle time between series),
- operation snapshot as a type of methodological mapping of processes with the aim to identify “fine” failures, causes of variability of particular activities of followed procedures from the point of view of its justification,
- disaggregation of particular activities which comprise the process into a set of activities and movements by the application of specific analytical tools (MOST methodology – Maynard Operation Sequence Technique), for the creation of ever better prerequisites for the identification of wasting and the following drafting of the system measures aimed at its minimising.



Source: own

Fig. 5: The Ishikawa diagram of causes and effects

### 3.1 Identification of loss causes

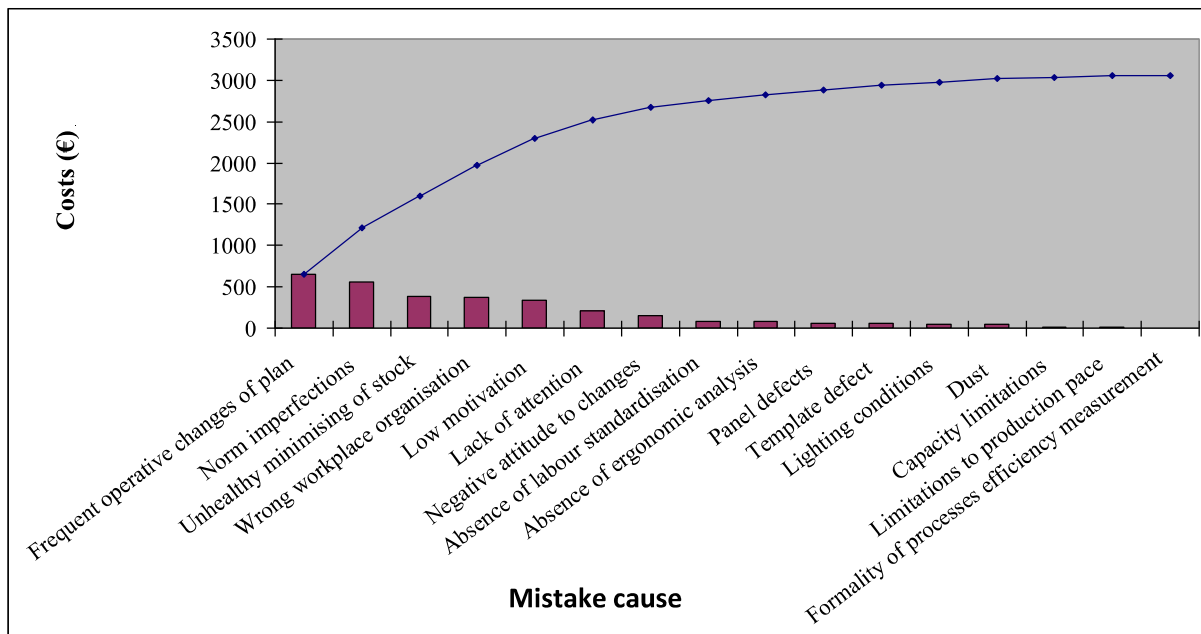
The first step of analysis of losses is identification of the main causes through the method of observation and structured dialogue. The result of such step is identification of loss causes in the form of idle time and spoilage (Figure 5).

### 3.2 Workday snapshot

Undertaking and analysis of workday snapshots was realised in the following steps:

1. Snapshots of processes in the designated temporal intervals including identification of causes of losses,
2. Undertaking of regress analysis and formulating of dependence equations,
3. Display of summary results of workday snapshots,
4. Calculation of mistake causes into costs and Pareto analysis.

Calculation of monthly costs according to particular causes of mistakes is displayed in Figure 6. From the diagram it follows that the greatest share of shortcomings has the causes group included in the group “management”.



Source: own

**Fig. 6:** Pareto analysis of mistake causes and effects

### 3.3 Operation snapshot

Operation snapshot stemmed from processes mapping applying the iterative way according to the following steps:

1. Identification of activities according to value creation and drafting of the process map,
2. Analysis of activities from the point of view of added value creation,
3. Identification and analysis of critical activities through the F-test,
4. The improvement potential analysis of unstable activities.

Results of the selected process activities analysis at creation of two products (Type 1 and Type 2) are included in Table 1 where “P” stands for the number of findings (measurements), “ $\Phi$ ” stands for the average value and “s” stands for standard deviation.

Such analysed process is a point of departure for the measures according to above mentioned procedures and structure displayed in Figure 4 with a special approach to the activities in “W” (Waste) category.

**Tab. 1:** Analysis of activities from the point of view of value creation

Number of activity	Activity	Category	Time – duration [seconds]						
			Type 1			Type 2			
			P	Φ	s	P	Φ	s	
Preparatory operations	1	Programming of the imprint machine	NVA	36	8.6	1.47	38	9.8	1.00
	2	Taking the template from the machine	NVA	36	29.8	4.83	38	33.1	1.76
	3	Inserting of the required template	NVA	36	24.5	3.76	38	24.5	1.36
	4	Paint preparation	NVA	36	42.6	8.88	38	32.5	1.55
	5	Inserting of the setting panel	NVA	36	1.3	0.64	38	1.8	0.16
	6	Setting of the machine	NVA	36	374.5	52.6	38	384.5	58.4
	7	Taking the setting panel	NVA	36	1.3	0.20	38	1.6	0.26
Process of impress	8	Inserting the panel into the solution	NVA	120	1.3	0.23	120	1.9	0.22
	9	Wiping of the panel	NVA	120	1.0	0.20	120	1.1	0.21
	10	Impress of panel	VA	120	4.5	0.00	120	5.2	0.00
	11	Taking the panel out of the solution	NVA	120	1.2	0.18	120	1.7	0.24
	12	Visual check 1	NVA	120	3.4	0.42	120	3.3	0.58
	12a	Wiping of wrongly impressed panel	W	2	17.8	3.20	1	16.3	0.00
	12b	Correction	W	2	9.9	1.30	1	12.6	0.00
	12c	Repetition (8+9+10+11+12)	W	2	11.4	0.95	1	14.1	0.00
	13	Inserting of the panel into UV tunnel	NVA	120	1.2	0.16	120	0.9	0.21
	14	Preparation of 2 pieces	NVA	120	1.8	0.19	-	-	-
	15	Hardening of paint in the UV tunnel	VA	120	8.0	0.00	120	8.0	0.00
	16	Taking the panel out of the UV tunnel	NVA	120	1.2	0.18	120	1.1	0.21
	17	Visual check 2	NVA	120	3.5	0.42	120	3.7	0.82
	17a	Storing of the spoilage	W	2	1.2	0.10	1	1.3	0.00
18	Inserting the panel to transporter	NVA	58	0.9	0.19	51	1.0	0.16	
19	Transporting of the panel (automatic process)	NVA	-	-	-	-	-	-	
20	Storing of the panel	NVA	120	1.0	0.29	120	1.2	0.16	
Irregular operations	21	Intra-factory transportation – supply of material	NVA	22	68.2	17.10	23	53.7	7.44
	22	Intra-factory transportation – expedition of material	NVA	22	51.9	14.40	23	50.2	5.39
	23	Filling up of the paint	NVA	6	31.8	6.09	14	28.8	4.90
	24	Detailed check	NVA	49	7.4	0.94	50	7.6	1.11

Source: own

## Conclusion

Analyses as the point of departure of the system approach to operations’ improvements should be perceived as part of the puzzle of building one’s own tailor made and wholesome business management system. For a number of reasons, we can look for an example and inspiration in philosophies and models that are part of the Japanese “economic wonder”. We should not be



scared to implement these models into the Czech and Slovak environment, for a number of these elements originated in our cultural environment, e.g. in the management system of Tomáš Baťa. Some of the elements of TQM, stimulation, personal development, rationalisation of economy were well-known and applied successfully in Zlín, Svit and other Baťa towns as early as 80 years ago.

A more serious problem is the fact that in our geopolitical environment the traditional value system is also changing. Success is reduced to material success only and its superiority over morality results in the absence of humbleness and thriftiness, stress and often emptiness. According to J. Porvazník, “professionals declare that the following century in the new millennium should become a century of wisdom and they believe it will happen. In this century once the humanity has managed to leave the industrial era it will advance from the information and knowledge based society to the emotional society, socially mature society. An individual will behave not only as *homo economicus* but more like *homo sapiens*”. [5]. New era requires new quality of human resources, strengthening of “classical” human potential by adding the emotional and moral intelligence. In such a way prerequisites for qualitative changes will be created, in the form of “ecologisation”, humanisation and further requirements for operation improvement. It will surely require innovation of procedures and analysing of operation efficiency in that aspect that the ethical dimension is not neglected. Global acceleration of business processes efficiency improvement stimulates and brings about new business models. The experience from the past decades shows us that the correct direction of efficiency improvement, including positive impact on the whole society should not neglect the local, cultural and ethical dimension which means creation of unique managerial systems bringing the necessary comparative advantage.

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## ANALÝZY A SYSTÉMOVÉ ZLEPŠOVÁNÍ OPERACÍ

Aktuální doba v podnikovém prostředí je charakterizována tak, že globalizace se stává koncepcí a lokalizace realizací. Pro podniky vystává úkol vybudovat vlastní ucelené řídicí systémy, které svou jedinečností, zohledněním kultury prostředí, budou zdrojem konkurenční výhody. Součástí těchto systémů musí rovněž být holistický přístup v managementu výrobních operací, vycházející se systémové analytické činnosti, která bude mapovat plnění požadavek širokého podnikového zákaznického spektra (stakeholders). Některé z možných přístupů a jejich konkrétní aplikace v podmínkách slovenského výrobního podniku jsou popsány v příspěvku. Analýza pozice podniku v matici „účelnost“ versus „účinnost“ operací, mapování toku hodnot, popř. další analýzy jsou jedním z klíčových předpokladů dynamické reakce podniků na nové požadavky interního a externího prostředí. Dobré analýzy mohou být také systémovým prvkem zlepšování operací, zvýšení podílu činností přidávajících hodnotu, v konečném důsledku nasměrováním podniku k úspěchu.

## ANALYSE VON SYSTEMISCHEN VERBESSERUNG VON VORGÄNGEN

Die heutige Epoche der Unternehmerwelt kann man so charakterisieren, dass aus der Globalisation ein Konzept wird und aus der Lokalisation Realisation wird. Eine der Aufgaben der Unternehmer ist, ihre eigene komplexe Verwaltungssysteme auszubauen, die Dank ihrer Eigenartigkeit, Berücksichtigung des Kulturmilieus einen Konkurrenzvorteil haben. Solche Systeme müssen auf systemanalytischer Basis mit einem holistischen Zugang zur Leitung von Produktionsprozessen verfügen, der die Erfüllung von Wünschen eines weiten Spektrums von Geschäftspartner (stakeholders) registrieren. In dieser Studie werden einige Zugriffsmöglichkeiten und ihre konkrete Verwendung unter den Umständen einer slowakischen Herstellerfirma vorgestellt. Die Geschäftspositionen im Rahmen Zweckmäßigkeit versus Leistungsfähigkeit, Flow-Werte und andere Analysen sind entscheidende Voraussetzungen der dynamischen Reaktion von Firmen auf neue interne und externe Herausforderungen. Gute Analysen können Systemeinheiten von Verbesserung der Vorgängen, Erhöhung der wertzugebenden Tätigkeit und letztendlich Erfolg des Unternehmens ergeben.

## ANALIZY I POPRAWA SYSTEMOWA OPERACJI

Obecne czasy w środowisku przedsiębiorczym bywają określane również w ten sposób, że globalizacja staje się koncepcją i lokalizacja realizacją. Dla przedsiębiorstw więc powstaje nowe zadanie budowania całościowych systemów zarządzania, które będą poprzez swoją niepowtarzalność, uwzględnienie kultury środowiska, źródłem zalety konkurencyjnej. Częścią tych systemów powinna być również postawa holistyczna, która będzie śledzić spełnianie wymogów szerokiego zakresu klientów z pośród przedsiębiorstw (stakeholders). Niektóre możliwe postawy i ich konkretne zastosowanie w warunkach słowackiego zakładu produkcyjnego są zarysowane w artykule. Analiza pozycji przedsiębiorstwa w macierzy celowości w porównaniu do skuteczności operacji, śledzenie przepływu wartości, ew. inne analizy są jednym z decydujących założeń reakcji dynamicznej przedsiębiorstw na nowe wymogi środowiska zewnętrznego i wewnętrznego. Dobre analizy mogą być elementem systemowym poprawy jakości operacji, podniesienia udziału działań dodających wartości, w wyniku końcowym mogą ukierunkować przedsiębiorstwo na sukces.