BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10, Sumy, 40022, Ukraine

www.businessperspectives.org

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MONITORING OF PROCESS PERFORMANCE BY MEANS OF FINANCIAL INDICATORS

Abstract

The paper deals with problematic nature of measuring of process performance. It includes a designed procedure of process performance monitoring, evaluation of logistic processes quality, and also measuring of the impact of marketing activities on the profitability of process output, i.e. a product, by means of appropriate indicator.
There are several performance indicators that companies use to monitor the performance of their processes and business strategies with respect to their objectives. To monitor these indicators, enterprises rely on dashboards that present one or more indicators along with contextual information to help decision makers identify deviations and their root causes. Associated benefits related to the process performance measurement system can be seen, for example, in better decision-making, flexible human resource management and process management structures. By using rolled steel sheets in a large metallurgical plant as an example, there will be shown how the performance of the rolling process can be improved by monitoring the tangible financial indicator. Subsequently, the experience was from case management companies presented to further incorporate a practical view of implementation and related issues. Finally, the reasons why the organization prefers the observed indicator during implementation of the process performance of measurement system is explored in order to understand the causes and consequences.

Keywords process performance, product, return on total assets, margin velocity

JEL Classification D24, L15, L25, M21

Received on: 2nd of November, 2017
Accepted on: 2nd of February, 2018

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INTRODUCTION

There are a number of procedures based on different economic indicators that can be used to estimate business performance in some way.

The review of the literature has highlighted various definitions of performance measurement and its management. Bititci, Carrie, and McDevitt (1997) show performance measurement like a process. According to Ferreira et al. (2009), performance management systems enable organizations not only to measure, assess, improve and reward workers, but also to support learning organization and engaging in informal controls.

Otley (1999), Neely (2005) and Sahoo et al. (2012) declare that the core of a performance management system supporting company´s strategy is performance measurement systems. Most of the commonly used frameworks of performance measurement systems include financial and non-financial performance measures (Kaplan et al., 1992; Neely et al., 2001; Ittner & Larcker, 2001; Bontis & Nikitopoulos, 2001; Venanci, 2010; Kádárová et al., 2014).

These are procedures mostly relying on the already achieved economic parameters mainly in the cumulative form and for the whole company. Therefore, the improvement of individual processes in a company is

rather oriented to non-financial indicators set in such a way that their improvement is reflected substantially in the performance of the entire company. Such non-financial indicators may cause the responsible staff to make decisions that do not comply with the business plan and only increase costs instead of focusing on gains in the implementation of individual processes. Therefore, it is necessary to create such procedures that could generate different financial and non-financial information about processes. Increased company's performance increases its value, because the value of any company is determined by its performance.

Therefore, it is possible to describe the performance associated with financial activity and related indicators as the lagging indicators that contribute to long-term improvements and outcomes (Hernaus et al., 2012).

In order to improve the performance of business processes, it is necessary to constantly look for such a set of business performance indicators (financial and non-financial) that the links between them can clearly reflect their performance and their interaction.

Wieland et al. (2015) noted that critical for the success of the business are the right amount and the right measures.

Increased business performance cannot be achieved by any simple ad hoc improvement of any indicator. This is a very complex process requiring systemic approach. The most common negatives hindering performance increase and thus the success of a company are as follows (Kassay, 2001):

- low productivity of work and underused skills of workers;
- long production times, and thus failure to meet deadlines;
- inefficient use of material, poor manufacturing structure, non-synchronized production, complicated material flows;
- lack of motivation of workers, inefficient communication, poor corporate culture;
- wasting in the field of business procedures and processes, inefficient logistics.

It is important to be aware of the relationship between performance, quality and productivity. Performance is characterized as a degree of results achieved by a company, processes, groups, and individuals. Quality is characterized as a degree of set of internal indicators that meet customer requirements, and productivity can be characterized as a proportion between inputs and outputs. Product quality is the level of product capacity to meet customer requirements. Productivity is linked to the effective utilization of inputs and resources that are necessary to complete the process. Increased productivity is achieved by better use of information and material inputs and better use of material and human resources. Productivity also determines the degree of results achieved. If these results lead to meeting customer's needs, then productivity and quality directly affect performance in a significant way. Most productivity problems are associated with poor quality. To resolve this issue, we must first remove discrepancies occurring in the processes. If we want to increase performance, we also need to address the issue of increasing productivity and quality improvement. This shows that performance of the company and processes is a function of productivity and quality (Nenadál, 2001).

1. BUSINESS PERFORMANCE INDICATORS

A suitable selection of indicators by means of which a company wants to manage its processes is generally the basis for assessing the performance of the business and its processes. Subsequently, the expected values of these indicators are compared to the actual values that resulted from assessment. By such comparison, it is usually possible to identify the deviations between the plan and the reality in real time. Business management should correctly

identify and interpret the causes of the respective deviations. Corrective measures come as the next step leading to process improvement, as well as the change in performance, respectively, business strategy correction. As a rule, performance indicators are divided into financial and non-financial indicators. Their goal is to monitor performance, respectively, efficiency of cash flow, but also efficiency of product quality sale, productivity, production, etc. Business performance indicators can be categorized by using the themes of indicators of the company (see Table 1).

The themes of performance indicators presented in Table 1 in red represent financial indicators. Based on such indicators, the company can improve its competitiveness in terms of other companies and thus become more successful.

The principles of measuring the performance of business processes are defined as requirements for effective measuring the performance of business processes. All key processes, such as those pinpointing customer requirements, should meet all of the requirements of the performance measuring principles. We monitor other processes in terms of their performance only to the extent that outputs from the process can affect the performance of the main manufacturing process. Measuring the performance of company's processes should be based on economy, objectivity, and should be implemented and planned by qualified workers. Early timing of measuring is vital and also taking into account its repeatability, especially in the case of poor performance. We characterize performance measurement and performance assessment separately, because they are related, but have different goals. We determine reality by measuring and we evaluate it by assessing. When selecting measurement attributes and business processes performance assessment, it is appropriate that these attributes correspond to the system approach to their management. Therefore, their appropriate selection is very important in determining performance indicators. They should be comprehensible as regards to interpretation, but at the same time simple as regards to their calculation, as well as the collection of data necessary for their quantification.

Key Performance Indicators (KPIs) also mean such valuation metrics that help businesses define and quantify progress of meeting corporate goals set out in their corporate strategy more successfully. They are the key to success only if they are quantifiable and if they truly reflect the company's objectives.

In companies, we often encounter a kind of "inconsistency" in assessing performance. While Finance Department staff use almost exclusively financial indicators for assessment of company's performance, the Production staff tends to evaluate the performance exclusively by using non-financial indicators. When selecting indicators, it is inevitable to avoid indicators that are interdependent. They must be selected to cover all the important areas directly and indirectly affecting the performance of the business as much as possible. Choosing the right set of performance indicators leads to increased competitiveness through continuous performance growth.

It is possible to efficiently improve the performance of internal processes, ensure production quality, health and safety at work, even to minimize the impact on the environment by means of correctly set and mutually complementing financial and non-financial indicators. Such indicators include, for example, sales volume per individual customer in natural units, sales revenues per indi-

Table 1. Framework of themes of company's performance indicators

Source: Own processing.

Indicators of:	As a rule, it is:	Indicators of:	As a rule, it is:
time;	minimization	quality;	maximization
wastage rate;		flexibility;	
costs;		added value;	
losses;		productivity;	
malfunctions (errors)		assets utilization;	
		customer satisfaction;	
		good will	

vidual customer, feedback from customers – the ratio of the new customers to the addressed customers, the share of new products in total sales, etc.

By introducing appropriate non-financial indicators into the rating system, the informative capacity of the evaluation will generally increase and consequently, it is possible to reduce various shortages related to complexity, respectively, worse interpretation of financial indicators. Monitoring of these indicators contributes to meeting other aspects of performance leading to long-term business success. For non-financial indicators, we need to build on their necessary connection to company's strategic and long-term goals. They must be set up in such a way that their change, either positive or negative, can be identified immediately. Generally, each production parameters generate a large number of such indicators. Their appropriate classification is vital, e.g. company's position on the market (brand, market share, prices of products), customers (customer satisfaction and loyalty), innovation (quality of products and services, percentage of unsuccessful projects), employees (corporate culture, employee satisfaction, percentage of overtimes).

We can use certain performance indicators across the whole range of measurement. These are indicators of universal character. The selected universal indicators of performance of processes are shown in Table 2 (Nenadál, 2001).

Table 2. Universal indicators of measuring processes performance

Universal indicators of processes performance	Continuous process duration
	Effective use of process duration
	Utilization of available process capacities
	The number of registered deviations within the process
	Total costs of the process
	Effective use of costs

We use measuring indicators of production processes performance for the purpose of operational management of production. The term manufacturing process can be understood as any process in which material inputs are transferred to material outputs at the production site. A summary of selected indicators for measuring the performance of production processes is presented in Table 3.

Table 3. Indicators of measuring performance of production processes

Source: Own processing.

Indicators of measuring performance of production processes	Machine productivity
	Employee productivity
	Capital productivity
	Utilization of inputs
	Overall device efficiency
	Average profitability per employee
	Ratio of work hours to performance
	Indexes of machines and processes capacity
	Value at the semi-finished stage of production
	Material turnover rate
	The number of days of keeping the stocks in storage
	Value of semi- finished production

Non-productive processes are all other processes that we perform as part of product manufacture. These include, for example, preproduction processes (marketing research), processes in the course production (maintenance), and after-production processes (servicing). Performance indicators of non-production processes are applied in different areas of these processes. Overview of the selected indicators is shown in Table 4.

Table 4. Indicators of measuring performance of non-production processes

Source: Own processing.

Design and development	The time of introducing a new product on the market
	ROI in design and development
	Ratio of profit to design and development costs
	Share of sales of min. One-year old products within company revenues
	Share of correction costs of design and development documentation to design and development costs
	User effect as a result of a new product use
	Productivity per design development worker
	Changes of value degree for customer

Table 4 (cont). Indicators of measuring performance of non-production processes

Purchase	Average commitment of stocks
	The share of the invoiced purchase price in total purchase costs
	Average response time to internal customer requirements
	The volume of performance per purchase department employee
	The average cost of finding one eligible supplier
	The share of supplier audit costs in total purchase costs
Sale	Customer profit
	Customer costs
	Turnover per customer
	The number of lost customers per year
	Daily order level per one year
	Number and value of lost customers due to failure to satisfy them
	The number of weekly faulty orders
	The cost of meeting different types of customers (ABC analysis)
After-sale service	The proportion of fulfilled customer service obligations to total obligations
	Average warranty periods provided to customers
	The proportion of the promotional service cost to the total service costs
	The proportion of new service requirements to the total number of requirements over the time
	Using the capacity of a service worker
Maintenance	Maintenance efficiency index
	Average duration of one maintenance operation
	Average time from detection of fault until the beginning of repair
	Share of repairs and maintenance intervals within the available workstation capacity
	Proportion of maintenance costs to production costs
	The share of external operations within the total number of maintenance operations
	The number of Maintenance staff to the number of production workers
	Capacity utilization of Maintenance staff

2. FINANCIAL PERFORMANCE INDICATORS OF A COMPANY

In practice, a large number of financial indicators are used to assess business performance as well as processes. These are, for example, the so-called financial health indicators that can be used to assess the performance of individual processes, as well as the company as a whole (Lipson, 2007; Schwarz, 2005).

These indicators also include a group of profitability indicators. In the following part, we will be focussing on one specific indicator known as Return on Assets (ROA). Return on assets is an indicator for the utilization of total assets.

We are going to demonstrate the way a new indicator can be created by combining financial and non-financial indicators in a particular example of a steel sheet rolling process, i.e. a major production process of a large metallurgical company. This indicator is simple, easy to interpret, and usable for real-time process performance monitoring, although its nature is based on a static evaluation characteristic of financial indicators. In the following part, it will be termed "margin velocity".

The aforementioned metallurgical company has the ambition to be a leader in the steel sheets production and to produce high quality products. By continual improvement of manufacturing processes and customer service quality, it meets its strategy plan of increasing business performance.

Therefore, the company is aiming to increase its performance by increasing productivity and reducing costs. It also increased its productivity by installation of a new galvanizing line, expansion of the high-voltage switchgear, as well as the reconstruction and modernization of rolling mills. The company achieves the reduction of production costs, which is a prerequisite for market success, through control systems, as well as through continuous improvement of processes.

There is strong global competition in the steel sheet market where the aforementioned metallurgical company sells its products. The above-men-

tioned ROA indicator is very closely monitored in this industry because the volume of assets with which these companies are doing business is extremely large. Even in the case of the metallurgical company mentioned above, these are manufacturing facilities worth several billion euros.

The role of finance, sales, marketing, and manufacturing managers is to seek ways to maximize company profitability, thereby increasing the efficiency of assets utilization and consequently business performance. Everyone will make efforts to contribute to achieving the common goal, but the ways and means used to achieve it will be different. Therefore, for example, sales revenue is considered to be one of the most important key indicators for Sales Department. The projected revenues, typically determined at the beginning of the year, are compared with the values achieved at the end of the year. The problem of such a performance assessment lies in the fact that the range of production is wide, and the revenues generally depend significantly on the so- order portfolio. These are individual types of products that are ordered in different volumes, have different prices, but also the production-related costs.

The aim of sales is to create a portfolio of orders in such a way that the company makes the best use of the available resources and increases the performance of its activities in order to make a profit.

The most common indicator of profitability in the sales segment is the gross trade margin. This is due to the fact that we can only calculate the net profit after the closure of the accounts, which is too late for possible business strategy corrections for the given period. The profitability indicator mentioned above is therefore the difference between the planned costs and the sales. The higher the gross margin, the higher the net profits. However, the absolute amount of profit is also important. When comparing individual components, each of which having different amount of assets, the unit margin has a higher reporting value.

The amount of steel produced in the metallurgical plant can be quantified by weight (how much weigh in metric tons) or by the area (what area in square meters is covered by a steel sheet). The second option is less common, but it depends on the industry which units are preferred. Next, we will be using the unit gross margin converted to metric tons as an indicator. We assume that higher unit margin is better than lower unit margin.

By linking the gross margin indicator to production line speed, we will get a new indicator that takes into account both important aspects leading to higher profitability. As we have already mentioned, we named this indicator as "margin velocity". It expresses the speed in which a company generates profit when producing a given product. Margin velocity is calculated by the following equation:

$$\text{Margin velocity} = \\ = (\text{Sales price-Cost}) \cdot \text{Production rate.}$$

The motivation for creating a margin velocity indicator is the fact that it can help to estimate in a very simple way in which manner a particular type of rolled sheet will influence the generation of profit. While any experienced salesperson, e.g. in food industry, can estimate the margins for each item in the shopping cart and hence determine his sales revenue, in the Production Department, the individual workers are focused on non-financial performance indicators only. This may result in their decision in favor of a less profitable order portfolio. The indicator created in such a way is particularly important if company's production assortment contains a large number of production items. Each of these production program items has a different unit margin and a different production rate. Moreover, the individual prices, costs and volumes of production constantly change. They respond to market demands, as well as to the external environment in which the company operates. The margin velocity indicator allows you to make the right decisions to solve such a complex issue as the optimization of the production assortment.

2.1. Implementation of the margin velocity indicator in the company

We are going to use the margin velocity indicator to determine how much more advantageous for a company are contracts on higher diameter rolled sheets than contracts on lower diameter rolled sheets. The aim is to find such a cross-sectional limit value that significantly separates more

advantageous contracts from those less advantageous. Based on internal company data, we determined that the cross-sectional limit value of the sheet is 670 mm^2. Next, we are going to show that if we take into account the classical unit margin indicator, the values above and below the above-mentioned threshold may be very similar. For example, a product with a cross-sectional area of less than 670 mm^2 has a unit margin of EUR 257 per ton and a product with a cross-sectional area exceeding 670 mm^2 has a unit margin of EUR 245 per ton. The average unit margin difference is only EUR 12 per ton. The difference in price is EUR 15 per ton and the difference in costs is $3 per ton. These differences are practically negligible. It is only about 5% difference in margins, which we might have hardly noticed in a classic way without using the margin velocity indicator.

After calculating this figure (see Figure 1), which we obtain from the detailed technological specification for a device, we can see that the margin velocity is different in both cases.

What looked almost the same in terms of unit margin, looks different with the use of margin velocity. Margin velocity enables us to see that margin velocity in sheets with a cross section higher than 670 mm^2 is EUR 866/min, which is almost double the value than in metal sheets with a cross-section of less than 670 mm^2 where it reaches the price of only EUR 484/min.

Margin velocity can be used for different product types or customers. As an example, we will calculate the margin velocity of the products of the above-mentioned metallurgical company. We will use the so-called bubble graph (see Figure 2), in which the x coordinate represents the margin velocity values, and the y coordinate represents the unit margin.

The size of the bubble corresponds to the volume of sales of the given product, respectively, to volume of orders per customer. The values of unit margins and margin velocity are shown in Table 5.

For easier interpretation, we will mark the central cross being the intersection point of two lines parallel to the axes. Their intersections with individual axes are as follows. The x-axis intersection is represented by average value of margin velocity, and the y-axis intersection point is represented by the value of average unit margin. The graph (see Figure 2) is thus divided into four quadrants (I-IV). Connection to each of these quadrants is characterized by different pair of values related to the x- and y-axis variables:

Source: Own processing.

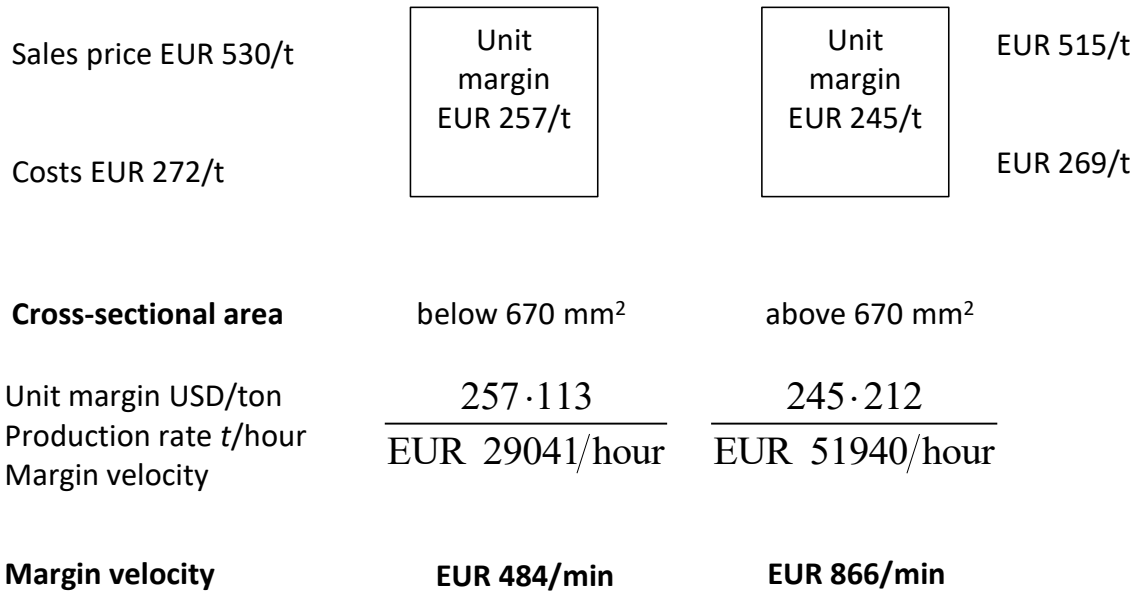

Figure 1. Cross-sectional limit value

Table 5. Calculation of margin velocity

Source: Own processing.

Product	Sales price (Eur/t)	Costs (Eur/t)	Production rate (Eur/hour)	Margin* (Eur/t)	Margin velocity** (Eur/hour)	Margin velocity (Eur/min)	Volume (t)
HRC	303	222	650	81	52650	878	188533
HRSh	336	227	683	109	74447	1241	154946
HRSt	312	219	643	93	59799	997	21848
P&O	351	234	631	117	73827	1230	60071
CRC	365	234	635	131	83185	1386	113884
CRSh	384	237	669	147	98343	1639	40826
CRSt	387	242	582	145	84390	1406	13431
Fullhard	389	242	598	147	87906	1465	193
HDG	462	327	641	135	86535	1442	63735
Dynamo	432	281	570	151	86070	1435	50619
Color	577	420	614	157	96398	1607	23056
Tinplate	490	289	454	201	91254	1521	69622

Notes: *Margin = Sales price-Costs. **Margin velocity = (Sales price – Costs) × Production Rate. In which: HRC – hot rolled coils, HRSh – hot rolled sheets, HRSt – hot rolled strips, P&O – pickled and oiled sheets, CRC – cold rolled coils, CRSh – cold rolled sheets, CRSt – cold rolled strips, DN – dynamo sheets, HDG – hot dip galvanized sheets, Color – plastic-polished sheets, Tinplate – tinplate sheets, Fullhd – Fullhard.

1) quadrant I – above-average unit margin and above-average margin velocity;

2) quadrant II – below-average unit margin and above-average margin velocity;

3) quadrant III – below-average unit margin and below-average margin velocity;

4) quadrant IV – above-average unit margin and below-average margin velocity.

All bubbles in the quadrant IV present the products for the metallurgical company as above-average profit products in terms of unit margin, however, from the point of view of margin velocity, they are products the profit of which is below

Source: Own processing.

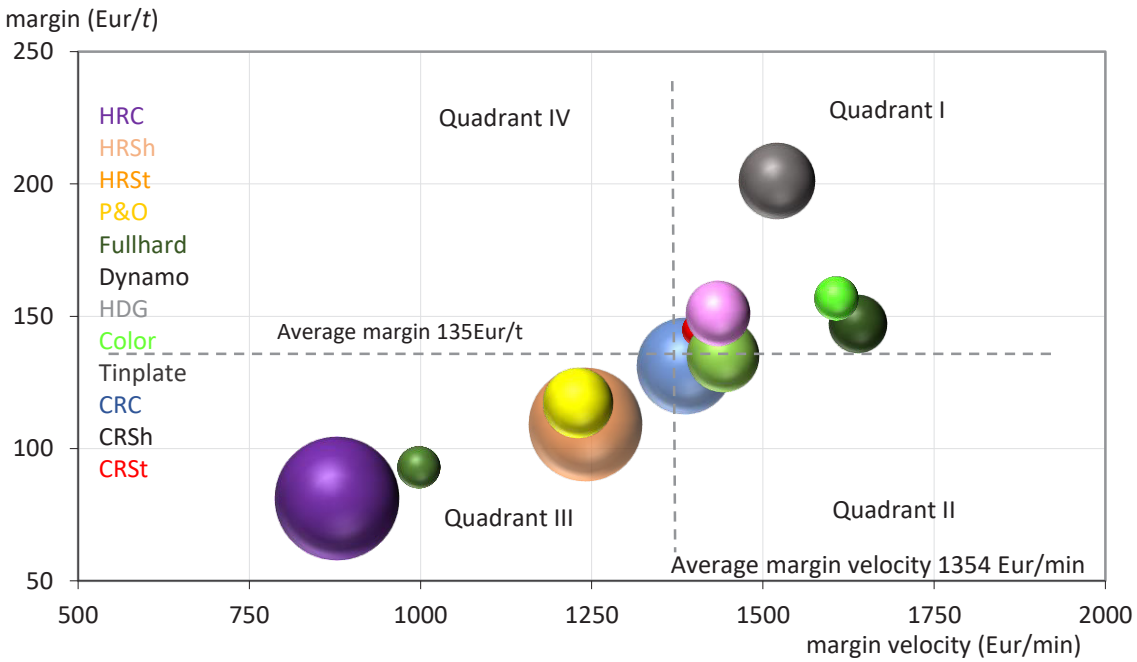

Figure 2. Graph of margin velocity of products

Table 6. Calculation of the change in margin velocity of products

Source: Own processing.

Product	Sales price (Eur/t)	Costs (Eur/t)	Production rate (Eur/hour)	Margin* (Eur/t)	Margin velocity** (Eur/hour)	Margin velocity (Eur/min)	Volume (t)
HRC	303	222	556	81	45036	751	188533
HRSh	336	227	583	109	63547	1059	154946
HRSt	312	219	715	93	66495	1108	21848
P&O	351	234	695	117	81315	1355	60071
CRC	365	234	735	131	96285	1605	113884
CRSh	384	237	546	147	80262	1338	40826
CRSt	387	242	490	145	71050	1184	13431
Fullhard	389	242	620	147	91140	1519	193
HDG	462	327	730	135	98550	1643	63735
Dynamo	432	281	550	151	83050	1384	50619
Color	577	420	580	157	91060	1518	23056
Tinplate	490	289	395	201	79395	1323	69622

Notes: *Margin = Sales price-Costs. **Margin velocity = (Sales price – Costs) × Production Rate. In which: HRC – hot rolled coils, HRSh – hot rolled sheets, HRSt – hot rolled strips, P&O – pickled and oiled sheets, CRC – cold rolled coils, CRSh – cold rolled sheets, CRSt – cold rolled strips, DN – dynamo sheets, HDG – hot dip galvanized sheets, Color – plastic-polished sheets, Tinplate – tinplate sheets, Fullhd – Fullhard.

average. Therefore, these are products that appear very profitable in terms of unit margins so they are highly recommended by the Sales Department. However, the interpretation of the margin velocity indicator proves that the preference of such products is non-profitable within the range of products offered. On the contrary, everything that appeared to be less effective is shedding a new light in the quadrant II after applying a new indicator.

The content of this quadrant could also be called the "hidden reserves". If the company attempted to replace each bubble (product, client, contract) from the quadrant IV by the bubble (product, client, contract) from the quadrant II, it would undoubtedly contribute to increased profitability and thus sales performance.

2.2. Margin velocity as a quality indicator of logistic processes

Production rate indicator is the part of calculation of the margin velocity indicator. This indicator can be calculated as follows:

$$\text{Production rate} = \frac{\text{number of manufactured tons of a given assortment}}{\text{time for which it was manufactured}}.$$

It is typically a non-financial indicator of process performance. In the next part, let us consider the time needed for production of a particular product. It is a parameter that is influenced by the rolling speed but also by the time necessary for adjusting rolling mill when switching to another assortment. Assuming the rolling speed given by the technological process is approximately the same for each rolled coil within a given assortment; the total rolling time of all the coils of the assortment depends significantly on the time needed for adjustment of the rolling mill. Such an operation is always carried out only at the beginning of the manufacture of production batch, which contains only products of the same type. Excessively prolonged time for manufacture of particular assortment at approximately the same volume typically characterizes the deterioration of quality of logistic processes when determining the order of production of individual products in the order book.

Table 6 presents a change in the margin velocity of the metallurgical plant products as a result of change in production rate caused by a change in logistics in the production of the individual types of products described in Table 5.

The bubble chart (see Figure 3) describes a change in margin velocity of products as a result of some other production logistic solution over a given period.

For example, the graph evidently shows that the HRC product (hot rolled coils) changed its mar-

Source: Own processing.

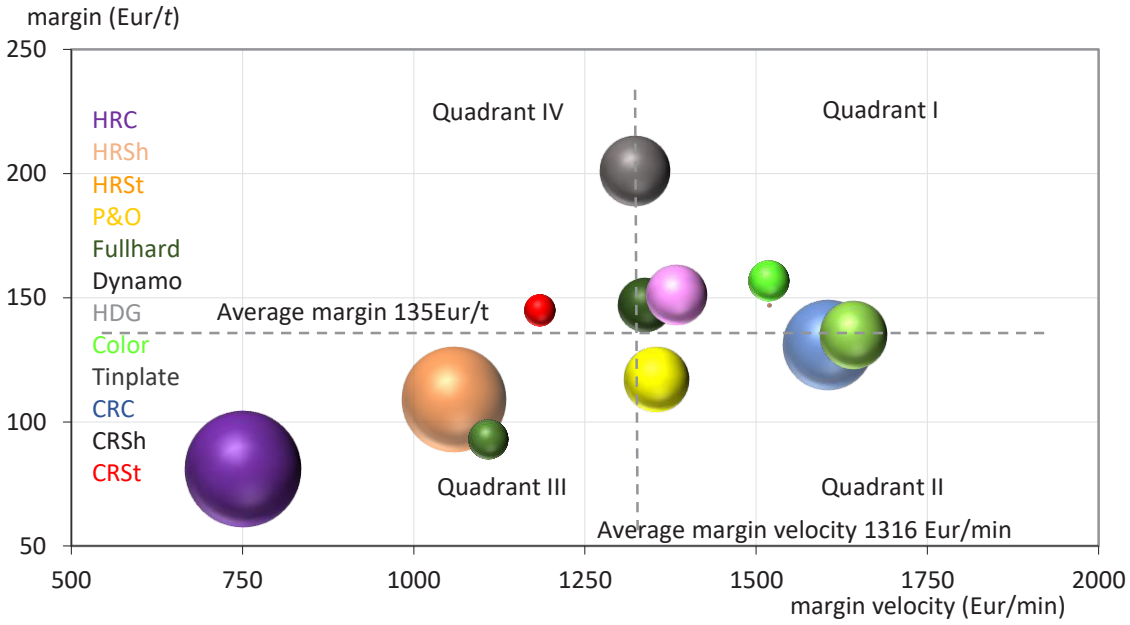

Figure 3. Graph of change in margin velocity of products

gin velocity from EUR 878/min to EUR 751/min. Contrarily, the HRSt (hot rolled sheets) process changed the margin velocity from EUR 997/min to EUR 1108/min. The first case can be interpreted as a deterioration of the logistics processes within the hot rolling. Conversely, in the case of hot rolled sheets, logistics has been improved. As can be seen from the graph, the above-mentioned changes have been reflected in the graph of the margin velocity of the metallurgical plant's products. Therefore, monitoring of achievable margin velocity in real-time can be used for assessment of logistic processes within the production organization.

CONCLUSION

Practical experience shows that monitoring and subsequent improvement of individual key indicators significantly affecting the performance of processes will be reflected positively in the performance improvement of the company. The problem is that there are a number of important indicators, both financial and non-financial, the impact of which on performance of processes cannot be considered as insignificant. Since tracking a large set of indicators is both time consuming and hard to interpret, it is essential to create indicators that combine the benefits of financial and non-financial performance measurement of processes. Moreover, if such an indicator is also easy to interpret and is not hard to calculate, then there is a high probability that it will be used in an informal manner in practice. It can help to detect discrepancies and their correction in real time, but also to determine deviations from the financial plan.

Acknowledgment

This contribution is the result of the project implementation: VEGA Nr. 1/0150/15 "Development of implementation methods and verification of integrated machinery safety, machinery systems and industrial technologies".

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