

## ANALYSIS OF RAW MATERIAL PARTICIPATION IN THE PRODUCTION PROCESS, PART II - PRACTICAL ASPECTS

Przemysław Niewiadomski\* and Natalia Pawlak\*\*

\* Poznan University of Technology, Faculty of Engineering Management and  
"FORTSCHRITT" - Spare Parts and Agricultural Equipment Production Plant,  
Email: niewiadomski@zpcz.pl

\*\* Poznan University of Technology, Faculty of Engineering Management,  
Email: natalia.pawlak@put.poznan.pl

---

**Abstract** Companies searching for a key to further development and maintaining an advantage over their competition pay attention to various factors. Some invest in technological innovations, other choose process and organisational structure optimisation, some focus on building an organisational culture promoting effectiveness or search for new market opportunities. This publication will focus on those companies, which build their position among their competitors based on properly implemented loss elimination strategy. Therefore, the purpose of this publication (a second part of an ongoing cycle) is to analyse the selected products focusing in the participation of raw material purchase cost in the total production cost of a given product. This will allow to propose a strategy in the upcoming part, which will have a measurable effect on lowering the production costs and increasing the value of the production plant.

**Paper type: Research Paper**

**Published online:** 29 January 2016

Vol. 6, No. 1, pp. 71-78

ISSN 2083-4942 (Print)

ISSN 2083-4950 (Online)

© 2016 Poznan University of Technology. All rights reserved.

**Keywords:** *lean management, raw material, loss elimination, cost management, production process, agricultural machinery market*

---

## 1. INTRODUCTION

The production plants operating in Poland, who wish to compete with foreign companies with strong and stable position who intensively and expansively enter our market, will have to consciously and flexibly shape their approach to changing conditions and market needs (Nowak, 2012).

A pressure is increasing to improve the broadly understood operating effectiveness (very often this means more than just the effectiveness in the form of sales profitability or assets profitability but also e.g. maximisation of the company value), as well as achieving and maintaining a competitive edge in the long run. This forces the companies to search for new methods and tools, which will allow them to reach those goals.

A company operating in specific conditions shaped by the economic environment must in its activities take into consideration the imposed requirements, especially those, which are the result of customer expectations and market challenges related to competitors. This means that a company has to adapt its structure and levels of resources at its disposal, especially the manufacturing technology, to those requirements, without forgetting that the basic determinant affecting it are the market expectations, technical capabilities and the financial potential of the company.

The purpose of this publication (a second part of an ongoing cycle) is to analyse the selected products focusing in the participation of raw material purchase cost in the total production cost of a given product. This will allow to propose a strategy in the upcoming part, which will have a measurable effect on lowering the production costs and increasing the value of the production plant.

When starting a discussion on individual questions, a conceptual thesis pattern has been formulated, which reflects the assumed purposes of this study: As the purchase cost of the raw material used in the production process of a given product amounts to no less than 70% of the total cost of its production, the manufacturer should make the raw material costs lean, while attempting to optimise the labour costs and other production costs at the same time.

## 2. ANALYSIS OF COST SHARE IN THE MACHINE PART PRODUCTION PROCESS

### 2.1. Research assumptions

Currently, much is being said about a system, which would improve productivity and effectiveness and limitation of production costs connected with general cost minimisation and broadly understood Lean Manufacturing philosophy is being discussed.

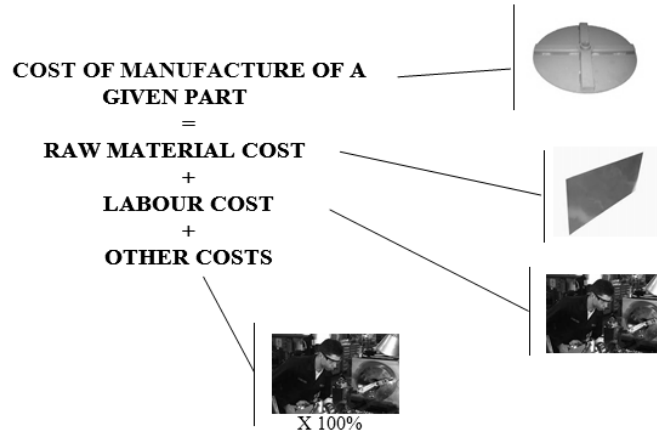
In context of the above, companies searching for a key to further development and maintaining an advantage over their competition pay attention to various factors. Some invest in technological innovations, other choose process and organisational structure optimisation, some focus on building an organisational culture promoting effectiveness or search for new market opportunities. This publication will focus on those companies, which build their position among their competitors based on properly implemented loss elimination strategy.

Research, discussed in the following part of the paper, has been conducted in 3 production plants operating in the agricultural machinery industry. The main activity of those companies is the production process of parts and subassemblies dedicated for manufacturers of complete agricultural equipment and used as equivalent replacement parts. The subject of the research conducted by the authors is the production process of 20 spare parts, which will be analysed regarding the participation of raw material in the production process. Based on participant observation, directed interview and documentation and market research the authors obtained the data required for use in the analytical part.

## **2.2. Research methodology discussed using an example of an agricultural trailer**

The cost calculating issues has been a subject of increasing interest in the recent years. The rapidly changing environment of enterprises and high complexity level of production processes, make the information provided by traditional cost calculation systems insufficient for use in the decision-making process. The authors, being aware of this fact, express their belief that the introduction of such models and solutions regarding cost calculation, which provide quick and reliable information is required.

According to the above, the calculation method using the raw material price, labour costs and the average costs in this sector or product has been applied in this article (Fig. 1). The authors believe that its use is mostly appropriate for small-scale production companies, manufacturing large and uncomplicated products. Thanks to the applied calculation method, the manufacturer obtains information on the assumed cost level and profitability. This calculation is performed for information purposes only. The reason for it is that it is being completed at a time when no precise design and technological documents exist. The calculation is of paramount importance for the decision making process as it allows to make a decision, whether the company should start manufacturing the element, although the calculation is not precise enough to control real costs related to making the parts based on it.



**Fig. 1** Methodology of cost calculation Source: own materials

When designing a tool for the evaluation of individual production cost items of a given product, the authors assume that for the purpose of analytical processing the applied tools and technologies should meet the requirements of different user groups, including persons who prepare reports and analyses on their own as well as those who use reports prepared by someone else. The program used by the authors for the purpose of the research conducted in the following part of this article is a simple tool based on the popular Excel program, which provides the technical capability of its implementation and use without excessive cost.

Figure 3 presents the application of such tool on the example of a sample product - a drive roller used in a spreader (cog wheel shaft) (Fig. 2).



**Fig. 2** Agricultural trailer transmission shaft

The total cost of manufacture of an agricultural trailer shaft is PLN 88.28. The raw material purchase cost, which comprises of the 57x7.1 pipe and a 55mm shaft, amounts to PLN 66.28, which is equal to 75.08% of the total production cost. The labour cost per 1 item made in the task-rate system (turning, milling, cutting, welding and painting) is PLN 11.00 (details are presented in Fig. 3). The labour cost and other costs amount to PLN 22.00, which is 24.92% of the total production cost of the shaft.

Part no.	Part name			Purpose	
203960580	Cog wheel shaft			T-088	
Raw material (semi-finished product)	Dimensions (mm)	Weight (kg)	Quantity (pcs.)	Raw material price (PLN)	Total (PLN)
57x7.1 pipe	1000		1	43.00	43.00
Fi 55 Shaft	250	4.6625	1	2.40	11.19
Fi 55 Shaft	270	5.0355	1	2.40	12.09
				TOTAL (PLN)	66.28

Labour type	Cost (PLN)
Turning	4.80
Milling	4.00
Cutting	0.50
Welding	1.50
Painting	0.20
TOTAL (PLN)	11.00

RAW MATERIAL COST	66.28
LABOUR COST	11.00
OTHER COSTS	11.00

PRODUCTION COSTS	88.28
------------------	-------

Fig. 3 Cost calculation tool Source: own materials

### 2.3. The Research

In this section, the authors have performed an analysis of 20 products using the methodology developed in the previous sections, which will allow verifying the assumed hypothesis. The detailed results are presented in the Table 1.

Table 1 Costs in the production process of spare parts. Source: Own materials

Item	Product name/code	Type of raw material	TPC [PLN]	Raw material cost		Labour cost	
				[%]	[PLN]	[%]	[PLN]
1	Support 203979500	Fi 45 shaft 88.9x5 pipe Fi 120 Shaft Angle bar 40x40x3 Standardized machine elements	108.92	75.21	81.92	24.79	27.00
2	Side extension 204022830	Fi 3 sheet metal plate Fi 2 sheet metal plate	65.29	83.15	54.29	16.85	11.00

<b>3</b>	Transmission gear 200212630	Aluminium casting Fi 52 Shaft Bevel gear Standardized machine elements	972.31	91.47	889.41	8.53	82.90
<b>4</b>	Conveyor cog 203960660	Iron casting 8088/M10	21.00	80.95	17.00	19.05	4.00
<b>5</b>	Conveyor bar 203961700	Sheet #3	5.33	88.18	4.70	11.82	0.63
<b>6</b>	Side extension 204090070	Sheet #2 40x40x3 profile Fi 20 shaft Fi 12 shaft	312.02	87.82	274.02	12.18	38.00
<b>7</b>	Casing 203914630	Iron casting GW-8	74.70	92.37	69.00	7.63	5.70
<b>8</b>	Drive shaft 203975320	48.3x5 pipe Fi 45 shaft	65.20	89.26	58.20	10.74	7.00
<b>9</b>	Drive shaft 203975400	48.3x5 pipe Fi 35 shaft Fi 45 shaft	77.90	92.17	71.80	7.83	6.10
<b>10</b>	LAN-100 Disc	Rubber 17.2x2.3 pipe Fi 14 washer	10.16	94	9.56	6	0.60
<b>11</b>	Conveyor chain 203960250	NK 11 chain	130.66	96.44	126.01	3.56	4.65
<b>12</b>	TGL-26053 catch	Fi sheet metal plate	133.30	82.52	110.00	17.48	23.30
<b>13</b>	Suspension beam 203910200	Sheet #8 80 x 12 flat bar	415.00	82.17	341.00	17.83	74.00
<b>14</b>	Cover 203905010	Fi 3 sheet metal plate Fi 2 sheet metal plate	82.61	86.68	71.61	13.32	11.00
<b>15</b>	Floor 203908230	Fi 3 sheet metal plate	1074.96	92.56	994.96	7.44	80.00
<b>16</b>	Cast iron driver 204023630	Iron casting	8.30	81.93	6.80	18.07	1.50
<b>17</b>	Bushing 203912130	BSC C-22 pipe	23.65	94.08	22.25	5.92	1.40

Analysis of raw material participation in the production process, part II - strategic cost implications

<b>18</b>	Cover 203967070	Fi 2 sheet metal plate	14.77	81.72	12.07	18.28	2.70
<b>19</b>	Cover 204022910	Fi 2 sheet metal plate Fi 3 sheet metal plate	62.67	78.30	49.07	21.70	13.60
<b>20</b>	Strut 204082150	48.3x5 pipe Fi4 sheet metal plate	60.80	95.89	58.30	4.11	2.50

Based on the percentage participation of the raw material cost in the total production cost of a given item, each part that was subject to research was classified in the following scale:

- Category I - 90-100% participation of raw material cost
- Category II - 80-89% participation of raw material cost
- Category III - 70-79% participation of raw material cost

The results presented in table 1 confirm the authors' hypothesis, that the cost of purchasing the raw material used in the production process amounts to no less than 70% of the total production cost. Only in case of two products out of twenty (support 203979500 and cover 204022910), the raw material participation in the total production cost fits into the 70-79% range (category III), which is equal to 10%. Eleven products were qualified in category II (80-89% of raw material participation) - 55% and as much as seven were qualified in category I (90-100% raw material participation) - 35%. The biggest raw material cost participation occurred in case of the conveyor chain 203960250 – 96.44% and strut 204082150 – 95.89%. These products require relatively little work to complete. However, the market entry criteria for competitors are in this case relatively easy to meet, so, according to the authors, the advantage must be sought in implementing more "demanding" products. A good example is the transmission gear 200212630, which requires relatively large amounts of raw material - PLN 889.41 and labour - PLN 82.90. In this case, the criteria for new entities to enter the market are more stringent, which is confirmed by the high product price, reaching about PLN 2200.00 per item.

### 3. CONCLUSION

The research conducted by the authors allows them to present these important conclusions:

- In order to increase the probability of success of the production strategy for the given product, the company should also create appropriate conditions, which to a large extent determine the effective management of the process.
- The cost of purchasing the raw material used in the production process amounts to no less than 70% of the total production cost, therefore the manufacturer should strive to make the raw material costs more lean:

- A) When making implementation decisions, the manufacturer should meticulously analyse the raw material cutting method in order to minimise waste. The waste created during the production process should be used to the highest possible degree in other implementation processes. This way, the manufacturer can generate additional income, which undoubtedly have an impact on the final profit.
- B) The manufacturer should strive to purchase the raw material at the lowest possible price, of course taking into account the quality parameters. The research conducted by P. Niewiadomski and B. Nogalski confirm the importance of proper selection of supplier, where pricing flexibility is one of the more important factors, which influence obtaining superior income margin from the implemented product.
- C) A strategy of making the final product more lean based on engineering knowledge may bring considerable benefits in the form of lowering the cost of the manufactured product. However, it must be remembered that each time the product is made leaner, its quality decreases. The importance of this strategy seems confirmed by the research conducted by P. Niewiadomski i N. Pawlak on the lean product concept regarding the aspects of cost and quality (Niewiadomski & Pawlak, 2012).

## REFERENCES

- Niewiadomski P. & Pawlak N., (2012) Lean product concept and its implications in terms of cost and quality, *Production management. Contemporary approaches - selected aspects*, Ł. Hadaś (Ed.), Publishing House of Poznan University of Technology, Poznan.
- Nowak D., (2012), *Zarządzanie międzyorganizacyjnymi relacjami kooperacyjnymi w przedsiębiorstwach przemysłowych*, Wyd. Uniwersytetu Ekonomicznego w Poznaniu, Poznań, p. 5.