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# **COST RATIONALIZING ACTIONS IN THE SPARE PARTS PRODUCTION PROCESS – OPINION OF EXPERTS FROM THE MACHINERY SECTOR<sup>1</sup>**

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## **DZIAŁANIA RACJONALIZUJĄCE KOSZTY W PROCESIE PRODUKCJI CZĘŚCI ZAMIENNYCH – OPINIA EKSPERTÓW SEKTORA MASZYNOWEGO**

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**Summary:** The publication describes research aimed at answering the question: which actions rationalize the costs in the production process of spare parts for agricultural machines as well as which of the mentioned actions and to which extent should be taken by Polish manufacturing companies operating in the sector subject to the research? The article is composed of two parts, i.e. theoretical-design and empirical. Using the method of reconstruction and interpretation of the subject literature – supported by experience, participatory observation as well as creative discussion among intentionally selected experts – under the first part – a catalog has been defined of postulated actions significantly rationalizing spare parts production costs. In the empirical scope (the second part of the publication), the intention of the authors was to determine the degree to which the defined actions should be taken by the companies subjected to the study.

**Keywords:** production costs, cost rationalization, agricultural machines sector.

**Streszczenie:** W artykule próbowano odpowiedzieć na pytania: jakie działania racjonalizują koszty w procesie produkcji części zamiennych maszyn rolniczych oraz które z wymienionych działań i w jakim zakresie powinny podejmować polskie przedsiębiorstwa produkcyjne działające w sektorze poddanym badaniu? Artykuł składa się z dwóch części, tj. teoretyczno-projektowej i empirycznej. Wykorzystując metodę rekonstrukcji i interpretacji literatu-

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<sup>1</sup> The authors of the paper regard rationalizing actions to be all actions implying improvement, decrease, drop or optimization of costs incurred in the production of spare parts for agricultural machines.

ry przedmiotu – wspartą praktycznymi doświadczeniami, obserwacją uczestniczącą oraz twórczą dyskusją wśród celowo dobranych ekspertów – w ramach części pierwszej – zdefiniowano katalog postulowanych działań istotnie racjonalizujących koszty produkcji części zamiennych. W wymiarze empirycznym intencją autorów było ustalenie, w jakim stopniu zdefiniowane działania powinny podejmować – poddane badaniu – przedsiębiorstwa.

**Słowa kluczowe:** koszty produkcji, racjonalizacja kosztów, sektor maszyn rolniczych.

## 1. Introduction

New business management patterns stress an important role of economical resource management. According to E. Nowak [2017a, p. 328], entities running business operations strive to multiply their wealth by achieving as high performance as possible. Business operations result in costs necessary to obtain revenue, which determines continuation of the production cycle and the earned profit, being the source of development [Sadowska 2015, p. 421]. In the opinion of E. Nowak [2017b, p. 195] costs are one of the fundamental economic categories characterizing achievements of business entities. Therefore, information about the level of costs of operations have basic importance for management of the company. A concept is being sought to achieve a shorter production implementation time in practice, better quality as well as definitely lower production costs. In the context of the above, the research was started to attempt to answer the question (constitutive purpose of the thesis): which actions rationalize the costs in the production process of spare parts for agricultural machines as well as which ones from the catalog of the mentioned actions and to which extent should be taken by Polish production companies operating in the examined sector<sup>2</sup>?

Whenever the production (manufacturing) process is mentioned in the article, the authors mean the way of processing the raw material into the finished product, incorporating the content (parameters) and sequence of the course of operations comprising the given process. It results in generating products (spare parts) satisfying new needs of the customer (opportunity) or the previous (known) needs in a new (more efficient) way. It has been adopted in the paper that the production process consists of two types of processes: technological, manufacturing the product, which encompass all technological operations ordered according to the sequence of performing [Stolarek 1971, p. 24] as well as auxiliary, which do not directly manufacture the product, but are essential for the proper course of the production process.

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<sup>2</sup> A good moment for the discussion concerning different concepts and directions of development of the contemporary managerial accounting and controlling, with a particular focus on the problems of cost management in production processes, is the National Polish Scientific Conference from the cycle Accounting and Controlling organized by the Department of Cost Calculation, Managerial Accounting and Controlling of the Wrocław University of Economics.

The article is composed of two parts, i.e. theoretical-design and empirical. Using the method of reconstruction and interpretation of the subject literature – supported by practical experience, participatory observation and creative discussion among intentionally selected experts – under the first part – a catalog has been defined of postulated actions significantly rationalizing the production costs of spare parts for agricultural machines. In the empirical scope (the second part of the publication), the intention of the authors was to determine the degree to which the defined actions should be taken by the companies subjected to the study.

The problem area concerning effectiveness and rationality in production processes, in spite of a broad interest among researchers, is still insufficiently described and specified; according to the authors, it leaves some problems unsolved. In the subject literature, it is mainly characterized as an idea and, though there is a description of possible tools that can be applied, the need to conduct research in this area is still visible.

While selecting the problems being discussed, an attempt was made to preserve certain logical consistency of the conducted deliberations, at the same time showing the basic characteristics and difficulties associated with complex assessment of any actions taken. The presented considerations ignore conceptual and terminological problems. They concentrate on showing a catalog of cost-rationalizing actions in the parts manufacturing process, implemented by Polish companies in the machine sector.

## **2. Costs in the production process – starting point<sup>3</sup>**

Volatility as well as high dynamics of the close and distant environment force, in a way, a continuous pursuit of improving and popularizing organizational solutions as well as effective management systems, verified in the modern economy [Niewiadomski, Oleśków-Szłapka 2017, p. 63]. The increasingly demanding business operation conditions as well as the increasingly stricter business assessment criteria requested by customers, along with specific factors determining their operations, require changes to be introduced in the management processes, reaching for complex concepts encompassing, first of all, the cost-based management criteria.

Fast technological progress has rendered innovation being the main factor determining the competitive position of a company [Nowak, Wierzbiński 2010, p. 312]. Competitive advantage – in many cases – is achieved by innovative enterprises that can rationalize costs.

The ability to rationalize costs in the production process is therefore one of the key factors determining a high business position maintained by the organization. Any changes in the environment force changes in the production organization, which,

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<sup>3</sup> At this point, it is worth emphasizing that costs – as the most important items – are presented in detail in the income statement as indicated in the directive of the European Parliament and the Councils concerning microunits according to the financial reporting regulation [Nowak 2015a, p. 1012].

in turn, determine changes concerning resources, processes, products (within the so-called target productivity). Thus, it is not surprising that the agenda of the debate concerning implementation flexibility includes more and more often the problem of costs related to implementation of manufacturing processes.

In the perspective of actions, management should allow for assessment of the effectiveness of implementation processes and be a premise to take, or – owing to too high costs – resign from them. Using this approach, companies make efforts targeted at optimization of the resource allocation method, improvement in the efficiency of utilizing the company's resources and using them in the most profitable segments of business operations [Van Derbeek 2013, p. 2]. In the current market conditions, the management and owners of a company who intend to increase the economic effectiveness of the possessed resources and the implemented production processes should use modern methods and effective ways of costs management. On the one hand, this requires determination whether the previous activity has brought the intended effects, on the other – indication of the directions and ways of improvement in the operations in the near and further future.

On the industrial goods market, the pursuit of achieving a leading position in terms of manufacturing costs seems to be justified. Clearly, the leading cost position gives significant strategic freedom to the company [Nowak 2015b, p. 133]. An important element of strategic cost management is determination of long-term regularities in the costs being shaped as well as identification of the way and the direction of impact of various cost factors on their level. To make it possible, it is necessary to use product life cycle cost calculation, considering all costs starting from the production planning and product design phase, to product withdrawal from the market. The product life cycle cost calculation should be supplemented with target cost calculation. It is focused on measurement of costs in the early phases of the product life cycle and focused on the market and the customers. At the stage of production planning and product design, the future product manufacturing costs are determined in 80%. An important cost-forming factor of strategic nature is thus the design process of the manufacturing processes implying product formation<sup>4</sup>.

Production effectiveness is affected to a large extent by material factors. The application of a worn machine, use of inappropriate raw materials or materials, incorrectly selected instruments or tools, incorrect order of performing technological activities can create additional (unnecessary) costs in the conducted parts production process. Likewise, incompetent employees adversely affect the production process<sup>5</sup>.

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<sup>4</sup> E. Nowak is of the opinion that, due to a strong focus on the market and the customer, also the customer should be considered in the cost calculation, and their expectations should be the starting point for estimating costs in the long run. See: [Nowak 2015b, p. 140].

<sup>5</sup> Costs optimization in the production process is possible owing to their proper reconfiguration [Amin (ed.) 1994; Autio 1997; Carnabuci, Bruggeman 2009; Hirst, Zeitlin 2006; Teece 2012; Christensen 1995; Garrouste, Saussier 2005].

Therefore, it is important to ensure suitable planning and organization of actions related to the production process, inspire and motivate people towards professional training and taking new or extended tasks [Armstrong 2005, p. 155], as well as systematic supervision and control of the course of the related technological operations. Cost calculation can potentially be applied in supporting a series of decisions, both operating and strategic ones, concerning the assortment, clients, suppliers and processes. As a result, it can be a helpful tool in the implementation procedure, where cost assessment is key for the correctness and success in improving the production organization.

### 3. Material and methods

The research presented in the paper was conducted with regard to manufacturing companies operating in the agricultural machines sector. The subject of interest have been manufacturing companies based on the territory of Poland<sup>6</sup>. Rich scientific resources in this respect have been used in the empirical research, however, the research method and tools have been configured according to the authors' own methodological concept.

In order to achieve the postulated purpose of the study, preparatory [B<sub>SL</sub>, B<sub>TD12</sub>] and proper research [B<sub>ES7</sub>] was conducted. It consisted of both substantive and organizational activities. The immediate subject matter of the research have been actions undertaken by producers of parts for agricultural machines and, first of all, their assessment with a particular focus on expectations in this respect.

In the first stage of the research, the authors applied the method of literature studies [B<sub>SL</sub>] and comparative analysis supported by creative discussion [B<sub>TD9</sub>]. Such procedure has made it possible to create the basis for the deliberations focused on constructing a theoretical set of actions taken to rationalize manufacturing costs of spare parts for agricultural machines<sup>7</sup>.

Persons with various competencies and experience were invited to participate in the meeting<sup>8</sup>. The research was carried out among 12 intentionally selected representatives of manufacturing companies operating in the agricultural machines sector<sup>9</sup>. Starting

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<sup>6</sup> Defined as a registered business in Poland.

<sup>7</sup> An attempt has been made to determine actions, affecting reduction in manufacturing costs, taken by manufacturers from the automotive industry. It has been assumed that both sectors can be compared with each other. Sectors with a lower level of development (agricultural machine sector) should develop taking into consideration the solutions observed in the more developed sector (automotive industry).

<sup>8</sup> While selecting the experts, first of all their business experience was taken into account. In any case, they are professionally active persons, actively participating in the business management process in the company they come from or in which they work.

<sup>9</sup> In each case these were professionally active persons, actively participating in strategic management of the company they come from (9 persons – owners) or in which they work (3 persons – management personnel). Persons coming together from 8 enterprises were invited to the research [4 – medium (9 – persons); 2 – small (1 – person), 2 – large (2 persons)].

the research, it was assumed that the discussion in the group of intentionally selected experts may result in creating new associations or relations convergent with the already existing ones; the purpose was to obtain original and realistic solutions.

Two stages were separated in the discussion: in the first stage original ideas were reported, in the second one, on the contrary, the general catalog of potentially taken cost-rationalizing actions reported and presented by the authors was assessed. As a result of this research, the list of most often mentioned categories has been prepared. This stage of research was conducted in August-September 2017. The discussion was conducted in the seat of the Industrial Institute of Agricultural Machines in Poznań and Agricultural Machine Spare Parts Production Plant "Fortschritt" in Września. As a result of the research, the tool focused on the proper research [B<sub>w57</sub>] was developed.

Within the framework of the proper study, interviews were conducted among 57 experts representing intentionally selected enterprises – 49 persons (85.96%), research and development institutions – 2 persons (3.51%)<sup>10</sup>, scientific environment – 3 persons (5.26%)<sup>11</sup>, and business support organizations – 3 persons (5.26%)<sup>12</sup>.

The research was conducted in two stages. The first stage of the proper research [B<sub>w57[1]</sub>] was completed on 22–25 September 2017. It was conducted at the time of meetings and direct conversations with 38 experts representing manufacturing companies from the agricultural machines sector – 34 persons (89.47%)<sup>13</sup> and representatives of research and development institutions – 2 persons (5.26%), scientific environment – 2 persons (5.26%)<sup>14</sup> during the International Agriculture Exhibition AGRO SHOW organized by the Polish Business Chamber of Agricultural Machines and Devices.

The second stage of the proper research [B<sub>w57 [2]</sub>] was conducted on 18–21 January 2018 in Poznań. Conversations with 19 experts [33.33%] were conducted at the International Agricultural Fair POLAGRA-PREMIERY. The research was attended by: 8 business owners (42.11%), 7 representatives of the management staff (36.84%) and 1 representative of a research and development institution (5.26%) and 3 representatives of business support organizations (15.79%).

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<sup>10</sup> The group of interlocutors included 2 persons being members of the Scientific Council of the Industrial Institute of Agricultural Machines. Additionally, one of the persons represented a University (Faculty of Machine Construction).

<sup>11</sup> 3 representatives of universities were invited to the research. The experts represented: the Poznań University of Technology (Faculty of Working Machines and Transport – 1 person; Faculty of Management Engineering – 1 person) and the University of Life Sciences (Department of Theory of Agricultural Machines – 1 person).

<sup>12</sup> The study was attended by representatives of the Polish Association of Production Management, the Polish Business Chamber of Agricultural Machines and Devices and Business Centre Club expert in management strategy and SME innovation development.

<sup>13</sup> The research was attended by: 16 business owners (47.06%) and 18 representatives of the management staff (52.94%).

<sup>14</sup> What constitutes 66.67% of all the studied experts.

Altogether, the proper research (2 stages) was attended by experts representing the following enterprises: micro – 3 persons (6.12%), small – 13 persons (26.53%), medium – 27 persons (55.10%) and large – 6 persons (12.24%), including: 49.12% of the examined subjects had higher education, 35.09% – secondary education, 15.79% – professional education<sup>15</sup>.

When making the decision to select an expert, an important criterion was his or her direct acquaintance with the researchers, supported by partner cooperation with Zakład Produkcji Części Zamiennych i Maszyn Rolniczych (Agricultural Machines and Spare Parts Production Plant) “Fortschritt” as the partner of the research. It made it possible to determine whether the representative of a given enterprise had sufficient knowledge with regard to the undertaken problem area, supported by a grounded position in the industry.

The study was attended by all the invited experts. Considering communication barriers, persons with whom direct meetings were planned and it was possible to hold a conversation, were invited to the research. The application of the intentional selection technique as well as the possibility of conducting research at the time of business meetings undoubtedly contributed to the high effectiveness and quality of the research.

#### 4. Research results

The observed trends in the economy and politics create premises to conclude that interest – both in the sphere of theory and practice of management – in numerous aspects related to rationalization of costs in production processes will be significantly growing in the second decade of the 21<sup>st</sup> century. Thus, it is necessary to identify actions to determine their optimization. Therefore, in the research implemented by the authors a lot of attention has been devoted to this problem; costs have been referred to selected actions undertaken by contemporary manufacturing companies.

Which actions and to what extent contribute to the rationalization of costs in the spare parts production process?<sup>16</sup> Is there any need to determine their hierarchy?<sup>17</sup> After

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<sup>15</sup> Small and medium entities dominated among the entities selected for the research – 40 enterprises (81.63%).

<sup>16</sup> The experts invited to the research were asked to indicate which actions from the catalog of cost rationalizing actions and to what extent should be taken by the companies represented by them and operating on the market. Replies were provided by means of a 5-point scale, where 1 – low effect of action from the point of view of costs rationalization, and 5 – very high effect.

<sup>17</sup> The conversations and research conducted by the authors allow them to state that, when making the assessment of actions affecting cost optimization in production processes, the majority of the owners or managers rely, first of all, on practical knowledge and experience of other manufacturers. Here, a relatively small interest of practitioners in using scientific methods and tools should be emphasized. A factor determining the possibility to conduct assessment in practice was the propensity of representatives of a given organization to experiment.



all, it is not an easy task to make a full identification of various factors determining costs in the production processes. However, such an attempt has been undertaken in the study. Because of publishing limits, only the proper research results have been discussed in the paper, where the bottom limit of the values range for key actions was the score of 4.00. As a result of the conducted research, a catalog of 26 variables has been classified to this group.

Each production process is defined by material factors, i.e. means of production (machines, devices, instruments, etc.), work objects (semi-finished products, materials, raw materials, energy) and staff factors (contractors for the production tasks). The whole of the input elements to the production process, with the help of which the contractor can transform work objects into the final product (spare part) – in the opinion of the studied companies – significantly determines the costs; their suitable match contributes to their rationalization (average score 4.95; 94.7% of the indications for 5 point score). The application of a worn machine, use of an improper raw material or tool stimulates growth in manufacturing costs. A similar situation occurs in the event that the works are implemented by an employee who cannot perform them correctly.

In the context of rationalizing costs, it is important to develop and implement proprietary non-automated (conventional) machines, tools and methods with regard to processing raw materials, materials or objects as well as a proprietary method of performing the production tasks (average score 4.93; 93.0% of the indications for 5 point score). However, introduction of technical measures and automatic devices (machines) operating on the basis of self-regulation and working without participation of or with limited participation of the man to industrial production is also indicated (average score 4.91; 91.2% of the indications for 5 point score)<sup>18</sup>.

Currently many manufacturers strongly emphasize the need to eliminate wastage [Nogalski 2010, p. 303]. Wastage elimination has become one of the elements determining rationalization of costs in the spare parts production processes (average score 4.86; 86.0% of the indications for 5 point score). It contributes to the accelerated course of production processes, decreased works in progress, shortened transport roads, provides better use of tangible assets, devices and area, simplifies planning, control and control of production processes.

In the spare parts production process, there are technological breaks. At that time, the employee is waiting for completing the work by the given means of production or a machine has already completed the work and there is no person available to handle it. Therefore, it is important to precisely determine how many posts can be operated simultaneously by one employee. It is desirable that they could operate several machines or several posts of one means of production. Multi-post capabilities are a significant factor in order to rationalize costs in production processes (average score

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<sup>18</sup> In the context of the above – as part of cost rationalization in the spare parts production process – special attention is paid to the proper allocation of employees to specific production tasks (average score 4.63; 64.9% of the indications for 5 point score).



4.68; 70.5% of the indications for 5 point score). It is important to plan the sequence and parallel organization of the execution of particular elements of operations, as it largely determines the duration of this operation cycle, the efficiency of a given machine. High parameters of a technological operation will be hardly effective, if the course of the operation is not reasonably planned. The above requires proper conditions to be created as well as a favorable organizational culture to be developed. Here, stimulation of employees is important, involving them in the production system improvement process, openness to new ideas and improvements in the method of work, standardization or modifications on production lines (average score 4.58; 57.9% of the indications for 5 point score). As a result, it is possible – in order to significantly rationalize costs in the production process – to synchronize the work of production posts and departments (average score 4.58; 70.2% of the indications for 5 point score).

An indispensable precondition of each employee's activities is the need for continuous learning. Fast information technology, technological and organizational progress makes any acquired professional knowledge quickly become out-of-date. Therefore, it must be supplemented and elevated to a higher level on the current basis. Knowledge acquired as a result of improvement – allowing adjustment to continuous and unpredictable changes – significantly determines the level of costs incurred in the given production process (average score 4.56; 66.757 9% of the indications for 5 point score)<sup>19</sup>.

In order to rationalize costs in the spare parts production process – due to frequent assortment changes – it is important to take actions focused on shortening refitting times (average score 4.56; 57.9% of the indications for 5 point score). They allow to restrict machine downtimes which are treated as wastage in terms of costs. Frequent assortment changes often force part design from scratch, which causes the need to create the executive and assembly documentation. In the context of costs incurred in this respect, according to the respondents, availability of a proprietary design office and a team of designers is important (average score 4.56; 57.9% of the indications for 5 point score).

Businesses which have a diverse assortment in their offer and mostly deal with small series production should implement concepts focused on lead time. Such concept is Quick Response Manufacturing (QRM). Despite the fact that in principle this concept does not attach any greater attention to the rationalization of costs, as a result of better customer service, increased focus on customers and possible faster response to the market needs, the costs and production capacity resources are also reduced. The essence is time in which the production actions are implemented. The company does not concentrate only on the costs of producing the given product. It is important how fast it will be able to produce and deliver it to the customer. A result of QRM application is drastically shortened order lead time. The production process implementation time,

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<sup>19</sup> The ability to share knowledge is also indicated (average score 4.54; 63.2% of the indications for 5 point score)

that is lead time, is shortened. As a result, the company can assign free production capacities to new operations (product diversification). Quick Response Manufacturing concept reduces lead time and, as a consequence, rationalizes costs (average score 4.49; 50.9% of the indications for 5 point score), thereby the business becomes more effective and flexible, hence such a high percentage of the indications<sup>20</sup>.

At the same time, the employees who can decide what they do have a sense of value of their work and are much more efficient. These employees naturally take over responsibility for their development and motivation from the employers<sup>21</sup>. Indeed, it contributes to reduced costs in the implemented production processes (average score 4.44; 49.1% of the indications for 5 point score).

A well-organized working post is the basis for stability and operational efficiency of any production company. It is directly connected with improvement in the company's organizational culture and, what is very important, allows increased stability of the processes implemented in the company. A properly organized working post means that the 5S concept is implemented, which ensures high productivity, quality and work safety as well as creates the grounds for cost optimization. For this reason, following the 5S principle is regarded as a key technique, which should always be applied, in any production environment. It is confirmed by the research results, in which it has been emphasized that the pursuit of rationalized costs in the spare parts production process is a significant premise for implementing the 5S concept principles (average score 4.42; 47.4% of the indications for 5 point score).

Minimizing the risk of unplanned downtimes is a continuous and complicated process. The reasons for downtimes in production plants may result from many factors. Most often these are still errors made by the employees. It is therefore crucial to ensure relevant resources, executive instructions and run a proper security policy. Such procedure is favorable from the point of view of the rationalization of costs of the whole production process implemented in the company (average score 4.42; 47.4% of the indications for 5 point score).

The effectiveness of production processes depends on many factors, among which an efficient communication system between the performers of technological operations and inventory control should be emphasized. Improvement in communication relations and analysis of their effective development becomes more and more significant in management; substantially contributes to reduced costs in the implemented production processes (average score 4.40; 52.6% of the indications for 5 point score).

Inventory control in the company has two, often contradictory, aspects: economic and logistic. The economic aspect forces minimization of warehousing costs by

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<sup>20</sup> Implementation of Quick Response Manufacturing concept may lead to reduction in the operating costs by 15–20%. QRM is a business strategy aiming at reducing order lead times, appropriate in particular for low-series production (High-Mix Low-Volume) and production designed to the client's order (Custom-Engineered Products). As representatives of companies focused on mass production also participated in the study – apart from the essence of this concept – it was not indicated as a key factor.

<sup>21</sup> It determines control of one's own work to prevent quality errors.

maintaining warehouse inventory at as low a level as possible, which may create a logistic problem to ensure continuity and proper production intensity. Inventory control permitting stock accumulation and non-continuous production results in growing storage costs and lost costs or clients' orders deferred over time. Regardless of the foregoing – the experts subjected to the research – substantially indicate stock reduction in the manufacturing process as a factor optimizing costs in production processes (average score 4.37; 42.1% of the indications for 5 point score).

Currently, an increasing emphasis is put on effective use of the machinery. Often single minutes are at stake which, when collected together, determine superiority over competitors. The essence of measurement is Overall Equipment Effectiveness (OEE) indicator, which determines effective use of machines and devices on the basis of a simple analysis of downtimes, refitting, failures and other factors affecting effectiveness. Improvement in this indicator – in the opinion of the respondents – significantly determines the amount of costs incurred in the given production process – (average score 4.35; 38.6% of the indications for 5 point score).

In complex production processes, the actual flow of products is rarely consistent with the agreed standard. Owing to the complexity of the factors causing changes in the system states, in order to determine the amount of deviations from the agreed standard, it is necessary to monitor the production flow, including the ability – being the essence of continuous improvement – to organize resources, machines according to the sequence of technological operations (average score 4.33; 38.6% of the indications for 5 point score).

A necessary precondition for obtaining products consistent with the specification in the manufacturing process is process stability. A stable process is one in which volatility is a result of random causes, creating minor changes, and not special reasons, resulting in significant changes in parameter values. The task of the producer is, in the first place, to limit the reasons for variability solely to random causes, and then gradually reduce them by improving the processes. Reduction in process parameter deviations – in the opinion of the examined experts – is a significant precondition for rationalization of costs in the parts production processes (average score 4.32; 45.6% of the indications for 5 point score).

It is therefore crucial to ensure maximum effectiveness of machines and devices. This is possible by providing proper maintenance service for machines and devices, implemented within the company by the operators of the production tasks (autonomous maintenance) and qualified operation maintenance personnel (planned maintenance)<sup>22</sup>. Thanks to proper organization of cooperation among operation maintenance and production, it is possible to improve efficiency of even already strongly exploited machinery, and considerably reduce the hazards to continuous production resulting from failures. Therefore, the experts subjected to the research substantially indicate

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<sup>22</sup> This effectiveness is understood as maximum use of the available time of the machine for production of good quality products.

preventive and supervising maintenance as a factor optimizing costs in the parts production processes (average score 4.30; 42.1% of the indications for 5 point score).

A properly prepared technical production preparation process determines the product quality and modernity. In the context of the above, attention should be paid to proper determination of the technological process, selection of input materials as well as machines and instrumentation.

Practice indicates that, when determining properly tight work standards, knowledge of the manufacturing technology is also necessary, in particular in non-standard variations of the technological operations. Mastering the operation time standardization procedure, careful analysis of the content of the operation being standardized and determination of necessary manual and technological activities are not sufficient. Attention also has to be paid to their rational planning and the possibilities for matching the working time of the person and the machine being operated. In the opinion of the surveyed companies, improvement in the value added ratio substantially improves the costs of the machinery parts manufacturing process (average score 4.30; 45.6% of the indications for 5 point score).

Reduction in the unit cost of production of agricultural machine spare parts is possible as a result of mass production. This happens due to work specialization, which contributes better qualitative and quantitative results. Therefore, over a long time, more better quality parts can be produced for a certain amount of outlays, resulting in a decreased cost of producing a single piece of the given part<sup>23</sup>. Work reproducibility contributes to better and better effects. Continuous performance of the same tasks contributes to improvements in the production system. In spite of this fact, the respondents subjected to the research indicate a limited effect of the application of mass production as a factor determining decreased costs in production processes (average score 4.28; 50.9% of the indications for 5 point score). Parts generated in a mass production system are characterized by very large similarity, as they come from the same production series; implying a poor offer of manufactured products.

Such a situation may cause low competitiveness of the given enterprise on the market [Lisowski, Kozłowski 2007, pp. 30–50]. A highly specialized assembly line focused on a particular product would have to be substantially rebuilt to allow production of a different product, involving the modification cost (low production flexibility). The above relationships and the fact that the research covered, first of all, companies specializing in production of a wide assortment of spare parts (short series production) contributed – in the opinion of the authors – to such perception of the mutual relationships between mass production and manufacturing costs<sup>24</sup>.

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<sup>23</sup> The statement of this fact is the starting point in preparation of the experience effect concept, which says that “total unit product cost decreases by a fixed percent whenever the cumulated output value doubles” [Strategor 1999, p. 79].

<sup>24</sup> Large enterprises focused on mass production accounted only for 12.24% of all those subjected to the study.

The method of organization of the parts production process, in which the production activities are started only in reply to the appearing demand – in the opinion of the examined companies – limits costs to a moderate degree (average score 4.25; 45.6% of the indications for 5 point score). In this kind of production, production posts are characterized by, first of all, work instability, as product manufacturing proceeds individually or with limited reproducibility. However, this reproducibility is irregular, which makes it impossible to effectively forecast new production [Śliwczyński et al. 2013, p. 96]. In the case of such production organization, the consumption of natural resources decreases in the long run, as they are better used, supporting cost reduction. In spite of this – owing to specific conditions of the sector – it is difficult to implement among the manufacturers of agricultural machinery parts<sup>25</sup>.

To a moderate degree – among the cost rationalizing actions in the spare parts production process – the owners and managers subjected to the research distinguished the company's ability to cooperate in production (average score 4.11; 33.3% of the indications for 5 point score) and proprietary means of transport or logistic facilities (average score 4.09; 31.6% of the indications for 5 point score)<sup>26</sup>.

## 5. Summary

Steps should be taken to better and better learn any actions determining cost reduction in the parts production process. The process of its improvement should be designed in this spirit. The study has been developed with this in mind, attempting to reflect activities optimizing costs in the spare parts production process. The study is an attempt to answer the question which of the mentioned actions and to what extent should be taken by Polish production companies operating in the agricultural machines sector?

There is growing activity among owners and managers of companies, manifesting itself in striving for management effectiveness and rationality, which, in the existing external and internal conditions, requires use of properly effective management tools and instruments.

Cost management is an important element of business operations, especially in the age of overwhelming competition. Businesses strive to achieve as high effectiveness as possible in this respect. It is possible owing to the development and popularization of specific methods. It has to be openly said that access to the latest business solutions becomes more and more common and, importantly, cheaper. And this is a very positive

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<sup>25</sup> The problem of material waste minimization in the production process, by correct material cutting, substantially contributing to reduction in production costs, is discussed in their work by B. Nogalski and P. Niewiadomski. More thoroughly: [Nogalski, Niewiadomski 2013].

<sup>26</sup> It has been adopted in the study that production cooperation is present when the enterprise (cooperating contractor) cooperates with another one performing some phases of the production process for them. Therefore, the effect of the cooperation concerned was not studied (cooperating contractor delivers various elements for part manufacturing).

phenomenon, especially in the context of the lean management paradigm. It is time to make use of it. How to do it?

This paper is just one of the guidelines in this respect. The authors present a concept of restricting (minimizing) costs in production processes. An attempt has been made to show practical ways of cost reduction. The intention to the authors was to clearly and understandably present the problem area, therefore the theoretical discussions have been confronted with practice.

Certainly, the problems presented in the study require further, even more thorough, research. The problems raised in particular chapters can be the subject matter of separate studies. In a single short study, there is no way to specify an exhaustive solution to all the problems related to the matters discussed. The research presented in the text should be regarded as guidelines, on which further works will be conducted, in particular bearing in mind the demand for new methods rationalizing costs in the manufacturing processes.

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