**QUALITY ASSESSMENT OF DELIVERY IN THE SUPPLY CHAIN OPTIMIZATION (TIMES NEW ROMAN, SIZE 12, DO NOT USE ABBREVIATIONS HERE)**

Marek Grega, Marcin Kurońb\*, Krzysztof Kiećc

a Student of Department of Production Engineering, Logistics and Applied Informatics,   
University of Agriculture in Krakow, Poland, e-mail: …, ORCID … (Times New Roman, 9pkt.)

b Department of Food and Agriculture Production Engineering, University of Rzeszow, Poland, e-mail: e-mail: …, ORCID …

c Faculty of Agrobioengineering and Animal Husbandry, University of Natural Sciences and   
Humanities in Siedlce, Poland, e-mail: e-mail: …, ORCID …

\* Corresponding author: e-mail: [marcin.kuron@gmail.com](mailto:maciej.kuron@gmail.com)

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| ARTICLE INFO |  | ABSTRACT (TNR, 7 pkt) |
| Article history:  Received:  Received in the revised form:  Accepted: |  | The paper discusses supplier evaluation as a tool for controlling the level of service in a production enterprise based on data from the selected production company. The suppliers were assessed and analyzed based on their respective assortment groups and strengths and weaknesses of their activity were indicated. It was found that the supply chain in the analyzed company is largely determined by the type of ordered goods, the place of its production and the method of its distribution to the customer. (TNR, 8 pkt) |
| Keywords:  logistics,  quality,  delivery,  assessment,  supply |  |

Introduction (TNR, 12 pkt.)

One of the key challenges modern logistics faces is the issues related to the management and functioning of the contemporary supply chain (Coyle et. all, 2012). The latest trends and concepts of supply chain management (SCM) relate to creating the possibilities of comprehensive management of all its links and processes. Effective management of the contemporary supply chain requires not only discerning all the processes and links of this chain, but also automating many processes (Witkowski, 2010; Iakovou, 2014). Effective and flexible supply chain management also requires acquiring lots of data in real time. Meeting the expectations towards the contemporary and prospective supply chains, which are related to the permanent reduction of costs and implementation time of logistic activities is more and more difficult, more complicated and requires taking into account more and more data, often variable (Blaik, 2010; Bujak, 2015). One of the key tasks of logistics is the effective management of the enterprise supply chain, including planning, creation, as well as continuous improvement and implementation of functional improvements.

To ensure the smooth procurement process in the enterprise, it is also necessary to create a strong network of suppliers and contractors responsible for delivering the most important assortment. Building a strong partnership based on strategic suppliers makes it easier to build a company's competitive advantage in a given market by improving the quality of the offered procurement services and lowering the prices of the supplied goods. It also allows analyzing, detecting and reducing unnecessary activities and obstacles towards smooth delivery of goods, information and cash, as well as cutting down the time of these flows (Krygier, 2011).

Purpose and scope of work

The aim of the research was to assess the quality of delivery as exemplified by a selected company. The main criterion for selecting suppliers for the evaluation was the number of product lines delivered to the company.

Objective, scope, and method of work

The aim of the research was to assess the quality of delivery as exemplified by a selected company. The main criterion for selecting suppliers for the evaluation was the number of product lines delivered to the company. They were selected from five assortment groups with the largest number of product lines delivered to the selected company. The thus selected criterion for supplier assessment also limits the impact of exceptional situations, both incidental and individual, on the overall picture of suppliers' activities in the course of cooperation with a selected production company. The scope of work covered the deliveries of fifty suppliers from five assortment groups in 2018.

The supplier assessment was based on the results of four selected Key Performance indexes (KPIs) which were adopted as the general benchmark for measuring the quality of services provided by contractors in the delivery of goods. The selected suppliers will be assessed for individual indexes, based on which their overall assessment will be made. The exported results of each assortment group of suppliers have been summarized in a tabular form. Then, the mean scores for individual groups for each of the measured indexes were taken from each collective assessment sheet in order to compare the relationships and assess the characteristics of individual groups. For the assessment, the following indexes were taken into account:

* average delivery time (days),
* timeliness of delivered product lines (%),
* logistical inconsistencies in admitting goods into the warehouse (%),
* quality of deliveries measured by the PPM level index.

For the purpose of the assessment, a dedicated scoring key was created for each of the indexes in order to provide a measurable presentation of the level of service of the company's largest suppliers. After the assessment, each of the suppliers was assigned one of the three statuses:

* **Preferred** - the highest possible status, which proves the high quality of the order delivery process in the enterprise.
* **Accepted** - supplier performance continues to be positive, but there is room for improvement to further improve the level of service provided.
* **Provisionally accepted** - the lowest possible status, proving that the supplier is not at the best level in particular areas and requires the introduction of appropriate corrective actions aimed at the fastest and effective improvement of the delivery process.

The overall scoring range is the score sum for each index. Table 1 shows the scoring range for supplier ratings.

Table 1.

Supplier scoring scope

|  |  |
| --- | --- |
| Score threshold | Supplier status |
| > 51 | PREFERRED |
| > 31 | ACCEPTED |
| < 31 | PROVISIONALLY ACCEPTED |

Research results

After collecting the material and compiling the results of the evaluation of selected suppliers, the results were summarized in the form of tables broken down into individual product groups. The tables contain detailed information on the evaluation of each supplier with   
a detailed listing by individual indexes. It also contains collective information for the entire assortment group. Data analysis was performed to determine the current quality level of delivery for the selected criteria. Based on the obtained data and the adopted scores, following an evaluation, the suppliers were awarded appropriate results and status marked with a color.

Green - PREFERRED supplier,

Blue - ACCEPTED supplier,

Red - PROVISIONALLY ACCEPTED supplier.

Tables 2-4 show the results of supplier assessment for the selected product groups:

1. **Electromechanics** - a group of suppliers that produces and supplies cables, harnesses, wires and connectors. Most often these are custom components made in accordance with the design and the required technical specification, but very often these are standard catalog parts sold by distribution networks.
2. **Semiconductors** - electronic components with specific parameters that play a functional role in the finished product: integrated circuits, resistors, capacitors, varistors, transistors, coils, chokes, etc. These components are very rarely manufactured to special order in accordance with the design and required technical specification. The most common are standard catalog components available from distribution networks.
3. **PCB printed circuits** − custom elements made to order in accordance with the design and the required technical specification. They are the basic component for electronic products.

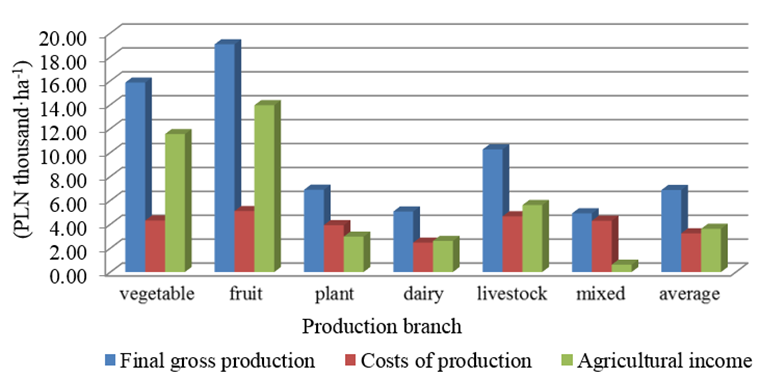
Suppliers from the assortment group **Electromechanics** was assessed at 31 points which is an acceptable score, with some areas for improvement. Of the ten vendors assessed, only one achieved the Preferred status, i.e. Supplier no. 4, who achieved a score of 55 thus exceeding the acceptability threshold in all measured indexes. Five suppliers have achieved the intermediate Accepted status, while four suppliers were awarded the lowest status, Provisionally Accepted. The lowest score was awarded to Supplier no. 10, i.e. only 5 points. The total of delivered product lines in the analyzed year amounted to 13,086. The number of orders in the studied year was relatively large due to the small size of the delivered products and the high minimum quantity of the orders, which is required by the producers. A single finished product often includes several components from a given assortment group. An average delivery time of 32 days is acceptable. The goods come directly from the producers. The production process requires creating no stocks, although most manufacturers still use their customer’s forecasts and production schedules. The timeliness of deliveries is 87.5% and the index score is below the minimum acceptability threshold. Due to the high seasonal workload, the supplier often delayed the previously confirmed delivery dates due to lack of production capacity. The logistic discrepancies at the admission amounted to 3.3%.

Table 2.

Summary of the supplier evaluation results for the Electromechanics group

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| General information  about the suppler | | | | Average  delivery time | | Timeliness of deliveries | | Quality  of deliveries | | Non-compliance receipts | |
| Sup  plier | Score | Supplier  status | No. of delivered  product lines | No. of days | Score | Level | Score | PPM level | Score | Level | Score |
| Supplier 1 | 40 | ACCEPTED | 1839 | 11 | 15 | 77.8% | 0 | 6 | 20 | 4.1% | 5 |
| Supplier 2 | 40 | ACCEPTED | 1598 | 8 | 15 | 98.6% | 15 | 1797 | 0 | 1.0% | 10 |
| Supplier 3 | 40 | ACCEPTED | 1553 | 33 | 5 | 95.1% | 10 | 17 | 20 | 5.9% | 5 |
| Supplier 4 | 55 | PREFERRED | 1548 | 11 | 15 | 99.0% | 15 | 36 | 20 | 2.8% | 5 |
| Supplier 5 | 17 | PROVISIONALLY ACCEPTED | 1308 | 90 | 0 | 93.1% | 5 | 793 | 2 | 0.9% | 10 |
| Supplier 6 | 50 | ACCEPTED | 1293 | 18 | 10 | 97.4% | 15 | 1 | 20 | 2.1% | 5 |
| Supplier 7 | 10 | PROVISIONALLY ACCEPTED | 1137 | 42 | 5 | 89.4% | 0 | 4142 | 0 | 4.8% | 5 |
| Supplier 8 | 15 | PROVISIONALLY ACCEPTED | 1008 | 23 | 10 | 86.1% | 0 | 1245 | 0 | 3.0% | 5 |
| Supplier 9 | 35 | ACCEPTED | 950 | 24 | 10 | 60.3% | 0 | 0 | 20 | 3.8% | 5 |
| Supplier 10 | 5 | ACCEPTED | 852 | 61 | 0 | 78.1% | 0 | 4511 | 0 | 4.3% | 5 |
| Mean | 31 |  | 13086 | 32 |  | 87.5% |  | 1255 |  | 3.3% |  |

The level of the index is at an acceptable level. The number of incidents was small, especially considering the relatively large number of delivered product lines. Average quality of delivery score (PPM) was 1225. The quality of the delivered products exceeds the acceptance threshold. However, on an annual basis it can be considered Acceptable. It is easier for the producer to take care of their own product quality and to introduce improvements and corrective actions.



*Figure 1.* Gross unit final production, production costs and agricultural revenue

In the **Semiconductors** supplier group the average evaluation score was 53 points, which is a very high score in relation to the other assortment groups. Out of the ten assessed suppliers, as many as seven obtained the Preferred status. Two vendors obtained the Accepted status and one Supplier, no. 9, scored under 31 points and was awarded the Temporary Accepted status. The total of the delivered product lines was 27,741. A very large number of delivered product lines results from the huge demand for parts for the production of electronic components. Additionally, a single PCB circuit can even include several hundred semiconductor components. The average delivery time was 12 days. The very short average delivery time is due to the fact that the assortment comes from the distribution network and not directly from the parts manufacturers. Therefore, in this case, the production time is not taken into account. Forecasts are only used for components with limited market availability. Timeliness of deliveries was at 96.2%. The high timeliness of deliveries results mainly from the large stocks of distributors. Hence, there is no major problem with organizing the shipment of the order within a few working days. The logistic discrepancies in the admission were at 2.8%. Logistic incidents were at an acceptable level; it is difficult to avoid minor mistakes, especially with such a high number of delivered product lines. Good and quick contact with representatives allows reacting quickly and solving problems. Average quality of delivery score (PPM) was 14. The quality of delivered products in terms of PPM is very high. The large number of delivered product lines affects the overall PPM level. In case of a complaint, the index level is not high. Quality problems are sporadic, most often functional in nature.

Table 4.

Summary of the supplier evaluation results for the PCB printed circuits group

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| General information  about the suppler | | | | Average  delivery time | | Timeliness  of deliveries | | Quality  of deliveries | | Non-compliance receipts | |
| Supplier | Score | Supplier status | No. of delivered product lines | No. of days | Score | Level | Score | PPM level | Score | Level | Score |
| Supplier 1 | 10 | PROVISIONALLY ACCEPTED | 801 | 45 | 10 | 73.3% | 0 | 1993 | 0 | 6.3% | 0 |
| Supplier 2 | 5 | PROVISIONALLY ACCEPTED | 745 | 77 | 0 | 83.4% | 0 | 24034 | 0 | 3.8% | 5 |
| Supplier 3 | 27 | PROVISIONALLY ACCEPTED | 579 | 28 | 10 | 99.0% | 12 | 11046 | 0 | 2.7% | 5 |
| Supplier 4 | 0 | PROVISIONALLY ACCEPTED | 559 | 47 | 0 | 76.3% | 0 | 13289 | 0 | 6.8% | 0 |
| Supplier 5 | 30 | PROVISIONALLY ACCEPTED | 428 | 36 | 5 | 72.2% | 0 | 16 | 20 | 2.5% | 5 |
| Supplier 6 | 10 | PROVISIONALLY ACCEPTED | 424 | 35 | 5 | 73.4% | 0 | 8227 | 0 | 3.9% | 5 |
| Supplier 7 | 5 | PROVISIONALLY ACCEPTED | 389 | 29 | 5 | 73.8% | 0 | 43791 | 0 | 10.9% | 0 |
| Supplier 8 | 20 | PROVISIONALLY ACCEPTED | 382 | 21 | 10 | 87.7% | 0 | 6182 | 0 | 1.0% | 10 |
| Supplier 9 | 5 | PROVISIONALLY ACCEPTED | 208 | 42 | 5 | 83.2% | 0 | 13982 | 0 | 10.7% | 0 |
| Supplier 10 | 5 | PROVISIONALLY ACCEPTED | 205 | 31 | 5 | 81.5% | 0 | 104S | 0 | 8.9% | 0 |
| Mean | 12 |  | 4720 | 39 |  | 80.4% |  | 12360 |  | 5.70% |  |

The conducted analysis in the **PCB printed circuit** supplier group proved that this is by far the weakest group of suppliers in terms of the assessed indexes. The mean evaluation score was only 12 points. Each of the assessed suppliers from this group achieved a score under 31 points, and thus all PCB suppliers received the status of Temporary Accepted. The assessment result clearly indicates that immediate corrective actions are necessary in this group of suppliers. The average delivery time was 39 days. In the case of this index for importers, the sea route was taken into account, which usually takes 6 to 8 weeks. The timeliness of deliveries is at the level of 80.4%, which is caused by problems with completing orders before the date of shipment. The deliveries are partially sent in subsequent shipments or by dedicated air transport when there is an urgent demand for goods. In some cases, such   
a situation is dictated by the low technological advancement and efficiency of factories.

Conclusions

1. The evaluation of selected suppliers and assortment groups demonstrated that the company's supply chain is largely determined by the type of ordered goods, the place of its manufacturing and the method of its delivery to the customer.
2. The assessment of individual assortment groups has shown that the most difficult group of suppliers in terms of management and quality of deliveries and customer service is the group of PCB suppliers. Each assessed supplier was granted the Provisionally Accepted status. Apart from the group of PCB suppliers, the result of the assessment is acceptable for the company, especially in the full course of the year. However, there are areas for improvement for each group.
3. The highest quality of service and efficiency of the delivery process is ensured by the Semiconductor supplier group. The assessment showed that the level of supply quality for this group is not acceptable to the company. The overall level of service and the low level of quality-related non-compliance of the distributors impact a high score.
4. In order to improve the order processing process in the PCB group, it is first necessary to indicate the weakest areas of the individual suppliers’ activity resulting from the conducted assessment and generating the greatest problems for the customer. Based on the above, the supplier should propose and then implement a number of activities aimed at improving its logistics process. Of course, this should be done in constant contact with the client and require his approval.

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