LOGISTICS FAILURES IN DISTRIBUTION PROCESS

Milan Andrejić [a*], Milorad Kilibarda [a], Vlado Popović [a]

[a] University of Belgrade, Faculty of Transport and Traffic Engineering, Serbia

Abstract: *The importance of failures identification, monitoring and elimination in logistics is recognized in literature and practice. Failures elimination directly affects the increase of logistics services quality. This further has impact on costs reduction, increasing customer satisfaction, loyalty and finally revenue increasing. In this paper logistics failures in product distribution are identified. Methodological approach for identification and correction of failures in distribution process is proposed in this paper. Failures in warehouse, transport, inventory and other processes are described in more details. Also the main causes are identified. In this paper the failures are analyzed in 13 distribution centers of one trading company that operates in Serbia. The model for distribution centers ranking based on Principal Component Analysis (PCA) is tested. The results show great applicability of the proposed approach.*

Keywords*: failures, distribution, logistics, Principal Component Analysis*

1. INTRODUCTION

In order to survive on the market and achieve profitability, the companies need to meet customer requirements and perform their activities in an efficient way. Quality and efficiency indicators are very important for companies' operations analysis. According Christopher (2002) logistics process becomes more and more complex and with much higher levels of demands, especially when related to achieving a competitive advantage. In that manner, companies need to follow up on services offered to customers. Very important aspect is failure management. The failures are present in each system. Even more the most efficient distribution systems have failures. These failures directly affect complaints. Service recovery may be understood as a set of activities that a company performs to resolve complaints and to change the attitude of unsatisfied customers trying to keep them as loyal customers. Fleury et al. (2000), studying wholesale suppliers and retailers in the Brazilian Industry, found that failure recovery is considered by customers, the fifth most important customer service feature. Thus, it is very important to plan, follow up and evaluate the failure recovery process (key customer services attribute) throughout the supply chain and not only in the final chain stage when there is a contact with the end consumer (Flores and Primo, 2008). Only if systematic effort is made to monitor, mitigate and eliminate failures that effect complaints in distribution process companies can keep customers. There are numerous quality and efficiency indicators in logistics. The ultimate goal of each company is customer satisfaction. Satisfied and loyal customers mean a secure income for the company. On the other side unsatisfied customers and customer's complaints create additional costs. Quality indicators are rarely used for ranking distribution systems (Andrejić et al. 2013). In this paper, more attention is paid on logistics failures in

* m.andrejic@sf.bg.ac.rs

distribution process. The next section describes the methodological approach for failures identification and correction. The third section is devoted to the failure analysis of distribution centers of trading company. In the same section model for ranking distribution centers is proposed. Concluding remarks and future directions are described in the last section.

2. METHODOLOGICAL APPROACH FOR FAILURES IDENTIFICATION AND CORRECTION

Failures in the transport, warehouse and other subsystems represent quality indicators which may be the cause of dissatisfaction and complaints of the customer. In distribution processes and logistics in general there are different types of failures. They are characterized by different parameters: time and place of origin, caused consequences, size, etc. It is very important to identify failures as soon as possible, before they pass on and increase the consequences. It is necessary to correct observed error in the shortest period. This paper proposes new methodological approach for failures identification and correction. The basic steps are:

- **Step 1:** Distribution process decomposition
- **Step 2:** Identification of potential places (systems) of failures appearances
- **Step 3:** Failures identification (according defined systems)
- **Step 4:** Identification of responsibility
- **Step 5:** Failures causes detection
- **Step 6:** Assessment of the consequences
- **Step 7:** Definition of preventive and corrective measures

Distribution process decomposition is shown on figure 1. The first process is product ordering with two basic aspects. The first aspect of product ordering is ordering from suppliers, while the second is customer ordering. All activities in this process relate to information flow. The next process is warehousing. Activities in this process may be divided in two segments. In the first segment are activities of goods receiving, putting away and storage while in the second are activities of order processing and preparing for delivery. Warehousing largely depends on speed of information exchange. Order picking process is the crucial process in warehouses. The following is the process of packaging. This process is realized through merging goods from different segments, forming transport units, goods inspection, as well as the loading goods in vehicles. Packaging is in direct relation with the order processing and distribution (transport). The transport is key processes in the product distribution. This process largely affects customer satisfaction. The process that is related to all mentioned processes is inventory management. The last process is unloading goods in the retail stores. According to the point of origin failures ***potential places of failures appearance*** can be divided into: failures in logistics systems (failures in DC, factory failure, supplier failure, etc.); failures in logistics subsystems (failures in warehouse, failure in transport, failure in inventories, freight forwarding, reverse logistics, IT, etc); failures in logistics process (order processing failure, order picking failure, shipping failure, etc.); failures in logistics activity (labeling mistake, picking failure, transport failure, forklift driver failure, truck driver failure, etc). The next step is ***failures identification***. Warehouses and distribution centers are integral components of supply chains. Processes in warehouses are very labor and cost intensive. In that manner there are different and numerous failures in warehouses. Wang (2002) found five causes of complaints in warehouse: wrong label (18%), later or wrong delivery (45%), damaged cargo (18%), input error (12%) and system error respectively (7%). Transport failures greatly affect delivery process and customer complaints. There are different aspects of transport failures in literature. According Wang (2002) there are five main transport failures. Research shows that wrong calculation (10%), wrong or missed process (7%), input error (7%), delayed shipping (20%) and document error (56%) are responsible for the complaints in freight transport sector. Inventory management has a strong influence on the failures in warehouses and distribution in general.

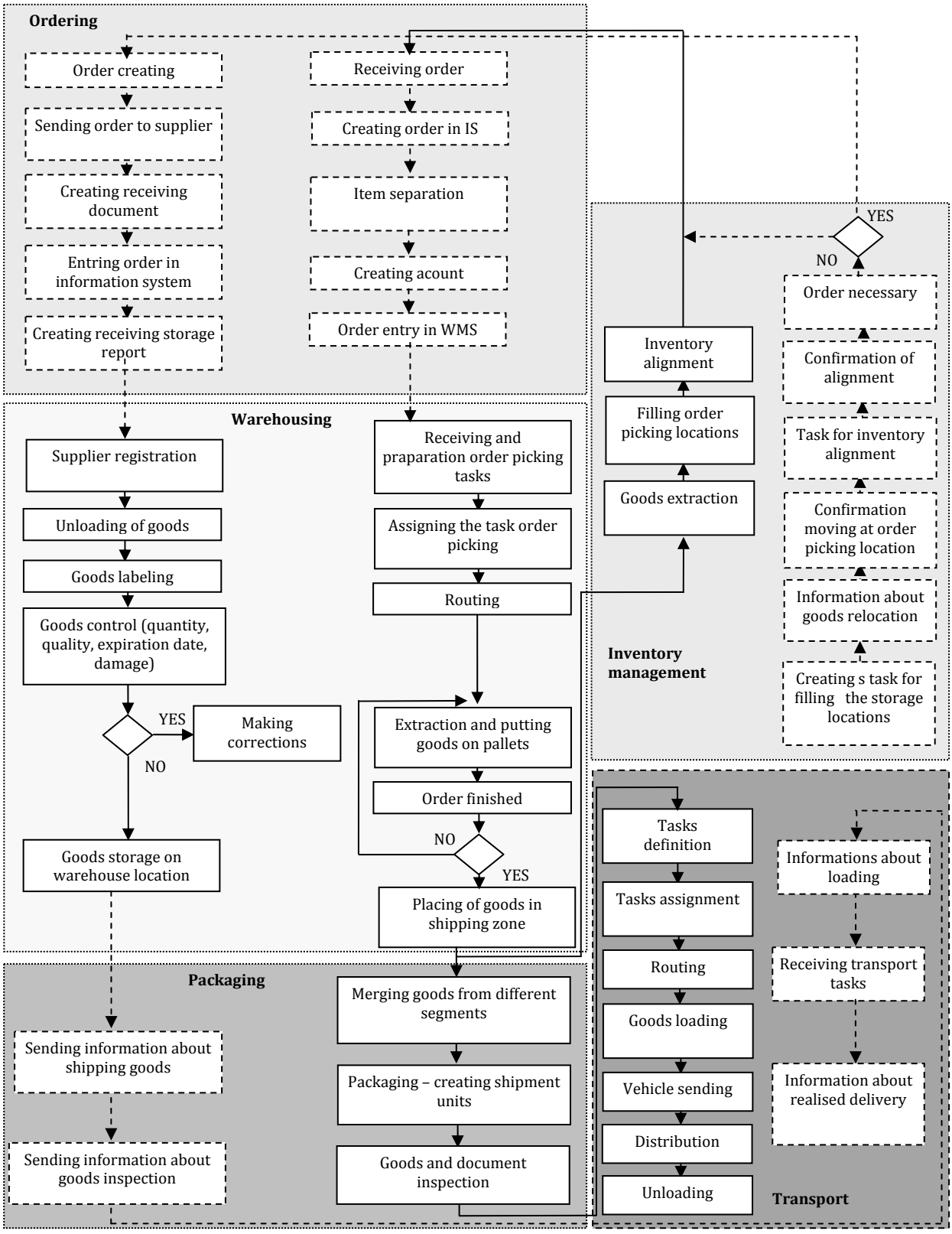

Figure 1. Distribution process decomposition

In that sense there are different causes of complaints in warehouses that relate to inventory maintenance and control: product identification, stock-outs, contaminated products, obsolete merchandise, wrong customer's goods, back orders, percent of demand filled, omission rate, number of incomplete orders, minimum order size, minimum frequency allowed, inventory

backup during promotions, new product, introductions and competitive tests. There are different criteria for identification of failures in order – picking process. According place of identification there are internal (in house) and external (outside) failures. External failures in the most cases cause customer complaints. In the literature there are four basic categories of failures: typing failures (addition, confusion, etc.), failures in amount (shortage, excess, etc.), omission failures and condition failures (damage, lack of packaging, labeling). The failure rate depends of type of order picking system: pick-by-voice (0.08%), voucher (0.35%), labels (0.37%), pick-by-light (0.40%), mobile terminals (0.46%), mob. terminals + labels (0.94%) (Lolling 2002). ***Identification of responsibility and cause*** is the next step in the proposed methodology. Warehouses are responsible for 55% of the total failures in distribution process, while 35% of the failures relates to transport. Together they stand for around 90% of the total failures in distribution logistics. According causes there are four main distribution failures: method caused failures, management caused failures, process caused failures and man caused failures. It is very important to identify the responsibilities of employees for each failure. ***Assessment of the consequences*** is very important step**.** The major causes of customer complaints are failures in logistics subsystems and processes. If failures are detected on time, they will not cause customer complaints. Each failure makes its costs but the failures that cause complaints are more expensive. In the distribution process, not all failures have equal importance. For example, the most damages in warehouse cannot cause customer complaints, because they are detected before delivery. On the other side bad inventory management can cause short expiration date which may results in customer complaints. There are also failures in order picking process like shortage/excess or articles mix-up that cannot be detected in warehouse. They can cause customer complaints. Definition of ***preventive and corrective actions*** is the last step in the proposed methodology. There are problems in the warehousing process when supplier supplies the goods of low quality and short expiration date. One of the basic steps is to define the level of quality and dimensions (specific check lists) of each unit of goods for each supplier. A relative small number of employers in this process limit the level of control. Putting away is very important activity in warehouse. A large number of mistakes are generated in this process. In real systems, order pickers realized this activity. Frequently relocation of order pickers from picking to putting away process greatly affects the occurrence of failures and reducing the level of customer service. They realize this process with insufficient attention. Assignment of smaller number of workers that will realize only putting away process should reduce failures to minimum. Inappropriate organization of space may affects failures. Managers in warehouse often have the goal of minimizing the space for order picking. One of the main aim is to reduce the effort in the order picking process. However, a large number of similar items at very short distances can cause failures. Order picking process is work and labor intensive process. Failures may be reduced if the order pickers strictly follow information system, and do not make decisions alone. Like in the process of order picking process the same situation is in the order processing, packaging and loading. It is very important to assign workers for particular processes. Reducing failures in transport refers to the reduction of losses in money, time, and users that are caused by theft, damage to goods, delays in delivery. Warehouse failures often are transferred in transport process. Failures in transport can be decreased with good organization and process planning. Delivery delays can be overcome by better motivation of drivers and control of the movement of vehicles, as well as good planning routes and predictions of traffic congestion. Theft can be prevented with modern systems for protection of the cargo space. Systems of driver reward and punishment can additionally reduce the number of failures. Failures in inventory management directly affect the write-off of expired goods, which creates significant losses in the observed companies. A failure in the inventory is also the lack of goods required by the user. Failures can be overcome on different ways: inventory monitoring with advances information systems, definition of delivery priority according expiration date, more precise estimation of the expected deliveries of suppliers and expected demands of customers. Video monitoring is one of the basic systems of protection against theft, etc.

3. BENCHMARKING LOGISTICS FAILURES IN DISTRIBUTION PROCESS OF TRADING COMPANY

As mentioned before in this part o f the paper failures in 13 distribution centers (DCs) of the one trading company are analyzed. As shown in Table 1 observed company monitors nine indicators that relate to quality: total losses, failures in warehouse, failures in transport, write off expired goods, total value of complaints, number of complaints, complaint articles, approved complaints and not approved complaints. Managers also monitor other indicators like number of employees, number of vehicles, pallet places, demands and turnover. Complaints caused by logistics failures represent multiple losses logistics services providers. The first are costs of failure correction. After that are time losses, and sometimes the material losses if the goods are permanently damaged or lost. Additionally, losses caused by customer's dissatisfaction can appear. The value of complaints in total turnover in average counts about 0.2%, which at first glance does not represent a significant percentage. However, complaints are significant losses for companies. Received complaints are analyzed, checked the causes, time of occurrence, executors, value, etc. Based on all this, a decision on whether the complaint will be approved or not. According values in Table 1 in analyzed distribution centers 60% of complaints are approved. The analysis of the observed sample shows that the number of complaints depends on the type of customers. The distribution centers that supply external customers approved about 77% of total complaints. On the other hand, the distribution centers that supply retail outlets that are owned by the same retail chain only 42% of complaints are approved. This can be explained by the fact that the company focus is on the external clients (easier approve complaints), but also the fact that retailers, as well as members of the same retail chain, frequently (easier) complain. As can be seen monitored DCs have different combinations of input and output variables. The aim of this paper is the ranking of DCs according fourteen variables with special emphasis on failures. There are different approaches for ranking decision making units in the literature. Considering relatively large number of indicators and the relatively small number of decision units in this paper PCA approach for ranking DCs is proposed. PCA approach for ranking DCs has several steps (Petron and Barglia, 2000): *Step 1*: Data normalization and reorientation (failures - negative outputs); *Step 2*: Definition of independent output/input ratio (d_i); *Step 3*: Extracting Principal Components (PCs) for all d_i ; *Step 4*: For each d_i determination of corresponding weight coefficient $w_{i;}$;*Step 5*: Multiplying each coefficient by the value of the corresponding variable d_i for each DC to get the final score; *Step 6*: Final ranking based on the obtained scores. Ranking results of observed set of DCs are shown in Table 2.

Table 1. Descriptive statistics of 13 DCs

Indicator	***Average***	***St. Dev.***
Inputs		
Employees (number)	53,54	31,04
Number of vehicles (number)	8,77	7,06
Pallet places (number)	2974,49	1552,43
Demands (number)	3486,46	2142,25
Outputs		
Turnover (10^6 m.u.)	182,78	107,49
Total losses (10^3 m.u.)	589,63	436,92
Failures in warehouse (10^3 m.u.)	129,16	107,06
Failures in transport (10^3 m.u.)	222,97	197,63
Write off expired goods (10^3 m.u.)	169,57	142,55
Total value of complaints (10^3 m.u.)	360,21	343,04
Number of complaints (number)	169,00	137,30
Comlaint articles (number)	350,38	441,70
Approved complaints (10^3 m.u.)	214,97	205,28
Not approved complaints (10^3 m.u.)	145,26	258,97

Table 2. Ranking scores of 13 DCs

DC	***PCA SCORE***	***Rank***
DC 11	302,01	1
DC 10	180,80	2
DC 5	114,09	3
DC 12	83,31	4
DC 1	16,56	5
DC 3	15,63	6
DC 9	11,51	7
DC 13	10,47	8
DC 6	8,77	9
DC 4	7,04	10
DC 8	4,91	11
DC 2	2,88	12
DC 7	0,95	13

Based on the results it can be concluded that the DC 11 has the best combination of input and output variables. This means that this center with a relatively small number of resources implemented relatively large turnover with a minimum level of failures. In contrast to DC 11, DC 7 has the smallest ranking score, which can be explain with relatively small turnover and large level of failures.

4. CONCLUSION

This paper identified the basic steps for identification and correction of failures in the distribution process. The importance of failure elimination and increasing logistics service quality is equally important for customers and providers. PCA approach for DCs ranking is used in this paper. The analysis of the results confirmed the convenience of its application. There are papers in literature that deals with efficiency in logistics. On the other side, there are also approaches that investigate failures in logistics and supply chains. However, to the best of author knowledge, there is a lack of papers in literature that investigate relationship between efficiency and failures in logistics. In the future research it is necessary to develop new models for measuring and improving quality efficiency. The future models must include new quality indicators, with the special emphasize of failures.

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