DEFECTIVE PRODUCTS MANAGEMENT WITH REVERSE LOGISTICS PROCESSES IN THE FURNITURE PRODUCTION COMPANIES

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Abstract: The paper`s aim is to present the specificity of defective products management in production companies in the furniture industry with the usage of reverse logistics processes. The goal of the article is to highlight the growing importance of development and necessity of introduction the defective products management into production companies' strategy and implementation of the reverse logistics processes in this regard into their practice. The theoretical part introduces the defective products management. It defines the defective products in manufacturing enterprises and presents the methods of their management when occurred. Also, the reverse logistics concept is presented, as its processes state the solution in this regard. The research part is based on the research survey made in 2019 year in the form of a questionnaire. It was addressed to the Polish manufacturing companies in sectors with high potential for the creation of defective products, however for the purpose of this paper only a part covering the furniture industry respondents was chosen. The research sample has been determined based on representative method and calculated as a representative sample, so that the results of the study reflect the situation of all Polish furniture production companies. The research part also covers the development and verification of model of defective products management with reverse logistics processes in production companies. The conclusion highlights the importance of reverse logistics processes as the support for the defective products management.

Introduction

The analysis of the literature of the subject, both international and Polish, identified a certain mismatch in the approach to the subject of reverse logistics. In the international literature, the subject of reverse logistics is posed by waste and defective products, while the Polish literature mentions the reverse logistics concept first in terms of the waste. However, it should be noticed that both the international literature and economic practice have recently pointed to a clear growth in the interest of the dimension of the reverse logistics concept, which is related to defective products management. A defective product is a product that is not waste, however does not meet the quality and/or functional requirements against which it was manufactured, in various stages of its life. The value recovery

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from defective products is an objective for implementation of the reverse logistics processes into management of defective products in manufacturing enterprises.

The studies on reverse logistics of defective products in manufacturing enterprises were inspired by multi-annual and deep analysis of publications related to reverse logistics. This allowed to find a research gap regarding the deficit in connecting the reverse logistics concept with logistics management in the practice of manufacturing enterprises in Polish economic realities, especially in the field of defective products.

This paper creates the first comprehensive study related to reverse logistics in Polish furniture industry. In its theoretical part introduces the concepts of defective products management and reverse logistics. The research part is concentrated on the analysis of defective products management characteristics in Polish production companies of the furniture industry. Also, the development and verification of the model of defective products management with reverse logistics processes in production companies of the furniture industry is presented.

Literature Review

The studies on reverse logistics both in the theoretical and practical field have been performed and explored in the literature of the subject for about 20 years. However, the scientific papers related to those issues, recorded in various databases, published in books or post-conference materials reveal that the approaches to the research carried out in the scope of reverse logistics are characterized with great differentiation and variety (Bajdor, 2017; Moise, 2008). It can be observed especially by analyzing literature reviews, which meticulously explore all English publications on reverse logistics published in a specific time interval. The published literature suggest differentiated directions of reverse logistics studies in their various aspects. The reverse logistics is explored, among others, from the objective and subjective, processual, decision-making, organizational and implementation perspectives. All of those angles are demonstrated both theoretically and practically, and the studies are performed in selected countries, sectors of industry or particular enterprises.

Production enterprises, whose essence is the production of goods offered to customers on the market (Nowakowska-Grunt & Kabus, 2017), basically always have to face the problem of returned products, full value and defective, which supply the flow of logistics in the form of returns (Grondys, 2017; Drljača, 2019).

In practice, manufacturing enterprises have many types of returned defective products that move in reverse flows and must be managed properly (Nitkiewicz, 2013). The main division of defective products specifies the following (Rogers & Tibben-Lembke, 2001): damaged products (failed in use but can be repaired or re-used); outdated products (still represent a certain value); seasonal products (in the next season can be reused); products unsold in the retail (can be used as raw materials or components for re-production or sold on another market); products withdrawn from sales (can be used as raw materials or components for re-

production); products erroneously taken as faulty (after refurbishing can be re-sold on the primary market); product components (still representing a certain value); waste and by-products (must be disposed or used for energy production); packaging (must be returned to the original point or sold to a recovery organization).

The main reasons for the development of reverse logistics concept in enterprises are related to the modern conditions in which businesses operate. Characterizing the reverse logistics, it can be stated that it refers to a sequence of activities related to the takeover of products from customers or participants of the business environment in order to recover any value from them, which can then be re-introduced into forward or reverse flows in the secondary form (Lenort & Besta, 2009; Zielińska, Prudzienica, Mukhtar & Mukhtarova, 2016; Ślusarczyk & Kot, 2018).

In the literature thematically related to reverse logistics, it is evident that the use of its processes in business activities brings tangible benefits to diversified profiles and industries as well as entire sectors and branches of the economy. Examples of reverse logistics in specific companies and industries (sectors) are presented in the following studies: Kodak and recovery from the market of construction elements of original final products (Jayaraman & Luo, 2007); Dell and reverse logistics processes on the computer assembly line (Kumar & Craig, 2007); publishing sector and possible, supposed benefits after implementation of reverse logistics (Wu & Cheng, 2006); electronics industry in China and problems related to the implementation of reverse logistics processes (Lau & Wang, 2009); manufacturing industry in China and the issue of development of products with a completed life cycle in reverse logistics flows (Subramanian et al., 2014); food containers and reverse logistics in their recycling and reuse (Jayaraman et al., 2003; Joshi & Bhargava, 2019).

The implementation of reverse logistics processes in various sectors is presented in the works: carpet production (Biehl et al., 2007); retail trade (Bernon et al., 2011); bottling and bottling industry (González-Torre et al., 2004); paper production (Ravi & Shankar, 2006); enterprises packing goods (González-Torre & Adenso-Diaz, 2006); production of mobile phones (Rathore et al., 2011); pharmaceutical industry (Narayana et al., 2014); recycling of batteries and accumulators (Wang et al., 2014).

The theoretical approach to reverse logistics processes in the area of management of defective products reflect only the generalized formula (Sehnem et al., 2019). This generalization is very important because each company organizes and manages reverse logistics and defective products in a different way. Differences occur even within producers operating in the same industry (Rebehy et al., 2019). This is explained mainly by the specificity of defective products, the uncertainty regarding their returns and the lack of direct control over them, as well as the individuality of the enterprises themselves (Al-Aomar & Alshraideh, 2019). And this is the reason of presenting in the paper the furniture industry case. Literature

review resulted in wide theoretical perspective of reverse logistics and defective products management. On this base, the paper content develop the practical perspective on defective products management with reverse logistics support in furniture industry in Poland.

Methodology

Within the research realization, in the first quarter of 2019 a survey was conducted in Polish manufacturing enterprises from sectors with high potential for defective products. These industrial sectors, according to the Polish Classification of Activities, were manufacturers of: 14.13. other outerwear, 14.19 other wearing apparel and accessories, 26.3. and 26.4. telecommunication equipment and consumer electronics, 26.7. and 26.8. optical instruments, photographic equipment and unrecorded magnetic and optical media, 27.2. batteries and accumulators, 27.5. and 27.9. domestic appliances and other electrical equipment, 28.0. machinery and devices, 29.3. spare parts and accessories for motor vehicles, 30.9. transport equipment, 31.0. furniture, 32.2. musical instruments, 32.3. sports goods, 32.4. games and toys. The total size of researched population was 41680 production companies. (Starostka-Patyk, 2017). For this population the research sample covered 302 production companies located in Poland. The sample was designated on the basis of statistical calculations: representative method with fraction estimation (structure ration, percentage) in the simple random sampling scheme was used, as well as stratified sampling with proportional allocation. According to these methods the set sample is a representative sample, therefore the survey results reflect the situation of all Polish manufacturing enterprises (Szajt et al., 2018).

The research included issues related to defective products and the manner of their management in the surveyed enterprises. The survey had a quantitative character and was carried out in the form of a telephone interview (CATI) by an external company specializing in this type of research.

The survey questionnaire comprised of notions related to defective products and management of their flows through the reverse logistics processes. There were mostly closed and multiple-choice questions, and such that allowed scores to be ascribed to particular items. Other questions were also of a closed character, but with a single answer, considering the percentage values provided as estimations. While beginning the phone interview, each respondent needed to specify whether there are any defective products in the represented enterprises, revealed via returns. Only a positive answer for this question allowed further participation in the research. Therefore, it was possible to examine the whole group of companies, which the representative sample's size was specified for, and it was not necessary to eliminate the surveys out of formal reasons. In its main part, covering the substantial questions, the survey questionnaire's structure allowed acquisition of information about the reverse logistics processes related to management of defective product's flows in the Polish manufacturing companies. The raised

notions were focused on the following thematic areas: (1) defective products (returns) categories, places of their emergence, their quantitative condition and occurrence intensity; (2) return period, duration of the returns processing cycle; (3) politics and motives for returns acceptance, influence of the return on the company's profitability and development of the competitive position; (4) problems related to processing of defective products – implementation of actions in reverse flows management, an analysis of barriers for effective management of returns, systems supporting the reverse logistics processes. The survey questionnaire's results were adopted to illustrate the scale and scope of the reverse logistics processes in management of defective products' flows in the Polish manufacturing enterprises, the premises and motives as well as their manifestations and results.

The respondents of the survey were representatives of enterprises holding managerial positions at the level of the whole enterprise and persons designated by them as responsible for accepting returns and developing the company's strategy and policy in this regard.

In order to characterize the furniture industry in the context of managing defective products, this article presents a selected part of the survey results. For this purpose, the results of the study identified a group of enterprises that are producers of furniture that is 31.0 according to the Polish Classification of Activities. This part of the research covers 39.7% of the total sample, so exactly 120 production enterprises of furniture.

First, to create the overall view of the production enterprises in the furniture industry, the main characteristics of the research sample were made, based on the structure considering sizes of the enterprises, determined against the rate of employment, as well as the structure of answer distribution according to the type of activities undertaken by a given enterprise.

Participants of this part of the research were mainly the representatives of production companies in the furniture industry employing up to 9 persons (micro-sized enterprises) – almost half of the respondents (49.2%). The next two groups in terms of its size were composed of small-sized enterprises – 10 to 49 persons (33.3%) and medium-sized enterprises – 50 to 249 persons (11.7%). The lowest percentage share was taken by big-sized companies that employ more than 250 persons (5.8%).

The respondents were also asked to specify the type of business operations carried out by their enterprise (multiple choice answer). According to the assumption that the target of the survey was posed by the manufacturing enterprises, as many as 100% of the participants considered their business position as a producer. Furthermore, about 15% of enterprises in the furniture industry were determined to be also the wholesaler, 19.2% retailer, and 3.3% transportation and/or other services provider.

On the basis of the respondents' answers from this group it is possible to generalize inferences about the management of defective products in the entire furniture industry. It is also possible to apply for opportunities to shape this industry market

in terms of reverse logistics processes implementation, and by proper decisions in this regard, to become more beneficial and competitive at the furniture market.

Additionally, in order to strengthen the survey results and present the support of defective products management by reverse logistics processes, additional information was obtained through an enterprises examination in the form of direct interviews. They were the second stage of the research – the qualitative one. These interviews were conducted at seven selected furniture manufacturing companies. They were selected with consideration of the research sample and parameters allowing general interference as to this type of economic entities. All of the seven enterprise carry out the manufacturing activities in Poland, the type of their major activity complies with assumption of the furniture production and there are defective products' flows in the area of their activities, as a result of which the enterprises have implemented certain procedures related to the reverse logistics in management of the defective products' flows. Quantitative and qualitative researches allow to create the general view on the investigated area. Also, on its base it was possible to develop and verify the model of defective products management by reverse logistics processes in production companies in the furniture industry.

Results presentation

The survey results on the management of defective products in Polish manufacturing companies in the furniture industry allow for the detailed characteristics on the researched issues. Production companies in the furniture industry implement processes in the field of defective products management into their operational activity, because these enterprises receive the defective products in the form of returns.

Returns of defective products in production companies in the furniture industry can be classified into nine groups according to respondents' indications: damaged products (62%), outdated products (7.5%), seasonal products (6.7%), products unsold in retail (5.8%), products withdrawn from sales (12.5%), products erroneously taken as faulty (16.7%), product components (50%), waste and by-products (82.5%), and packaging (50.8%).

All the above return categories occur in furniture industry enterprises with varying intensity, with the most being numerous waste and by-products (8% of the total yearly production volume), packaging (1%), and product components (1%). Other defective products occur with medium or marginal intensity (in similar proportions).

Returns of defective products for the majority, are sent to production enterprises in the furniture industry in good (36.7%), very good (24.7%) or perfect (6.8%) quality. To a lesser extent, their quality status is described by respondents as satisfactory (17.6%) or poor (9.3%), and in a marginal extent as terrible (4.9%).

Defective products can be also divided into three main categories of returns: production, distribution, and market, regarding the place of their entry into the

enterprise. In manufacturing enterprises in the furniture industry, most often and most frequently there are production returns (9.2%), distribution returns, which constitute a maximum of 7% of the total annual production in enterprises, and market returns, which are numerous, but their percentage does not exceed 4% of the total annual production in enterprises.

The period of defective products return in manufacturing enterprises in the furniture industry is relatively short (usually from 1 week to 1 month - 47.5%, up to 1 week - 31.7% and from 1 to 3 months - 10%). Periods of return from 3 to 18 months are rare (11% in total); and periods longer than 18 months never take place. The duration of the defective products returns processing cycle in production enterprises in the furniture industry is also relatively short (from 2 days to a week - 42%, from 1 to 2 weeks - 17%, from 2 weeks to 1 month - 14%, from 1 to 2 days - 10% and less than 1 day - 9%). Returns processing cycles lasting from 1 to 2 months, and more than 6 months, never take place.

Production enterprises in the furniture industry, in the area of defective products management undertake the following activities on their own: returns acceptance (68.3 %%), charity donations (22.5%), repackage and sales as new (29.2%), sales in the same form as the product was accepted (30.8%), remanufacture (72.5%), production from recovered components and raw materials (23.3%) sales (42.5%), recovery of components (19.2%), recycling (50.8%), and scrapping (4.2%).

The majority of manufacturing enterprises in the furniture industry implements activities related to management of defective products by themselves. Outsourcing of these activities to external companies is negligible (5.5%).

The manufacturing enterprises in the furniture industry have a policy in the field of accepting returns of defective products that is liberal (72%), so it is characterized by principles oriented towards openness towards the customers, enabling them to easily advertise and return products in justified cases. In the last 5 years it has not been subject to any changes.

Production companies in the furniture industry accept returns of defective products for at least one of seven motives: improvement in customer service quality (93.3%), getting rid of unnecessary products from the market (62.5%), compliance with legal and environmental requirements (91.7), recovery of components and materials (66.7%), development of an environmentally friendly company reputation (92.5%), prevention of displacement of new products by products from the secondary market (75.8%), and reduction in the loss of value on unsold or defective products (82.5%).

Among the elements of defective products management related to the construction of a competitive position, manufacturing companies in the furniture industry are distinguished by: costs reduction (90.8%), price (95.8%), quality (97.5%), returns policy (84.2%), delivery time (97.5%) and diversity of products (95%). All these elements are of great importance for companies and constitute an important strategic element for their operations.

Production enterprises in the furniture industry face the following barriers to effective management of defective products (listed by importance): company's policy, lack of significance, lack of financial resources, lack of adequate organizational solutions, legal circumstances, incompetent personnel, aspects of competitiveness, and lack of attention from the managerial staff.

Conducting activities in the field of defective products management in manufacturing enterprises in the furniture industry has a positive reflection in achieving the goals of these enterprises (78.3%), which means that they are not an obstacle and may even be helpful in achieving goals.

Defective products in manufacturing enterprises in the furniture industry in most cases do not contribute to the reduced profitability of the company (55.8%), or reduce it slightly (42.5%).

From a general summary of the results of a survey conducted in manufacturing enterprises in the furniture industry in Poland, it appears that these enterprises actively implement management of defective products, although the scope of this management in individual enterprises is diverse.

Based on the characteristics of defective products management, reverse logistics processes, specificity of defective products, literature and survey research, and analysis of business practices, it was possible to construct a model of defective products management with reverse logistics processes in production companies.

The procedure of model development had three stages (Starostka-Patyk 2017):

1. Development of the basic model of defective products management with reverse logistics processes.
2. Detailing the basic model of defective products management with reverse logistics processes by: a) defining the limitations for defective products flows (inputs / outputs); b) defining the processes of reverse logistics in defective products management, and individual operations carried out as a part of these decisions and processes; c) designing a block diagram for decisions and processes of reverse logistics in defective products management; d) reviewing the design of the model and introducing improvements.
3. Verification of the model of defective products management with reverse logistics processes in production companies and adopting it to the business reality.

The general model of defective products management with reverse logistics processes, in the course of the conducted research, was verified in seven selected Polish manufacturing enterprises in the furniture industry. They were selected taking into account the structure of the research sample and parameters allowing for generalized inference regarding these types of business entities. All seven surveyed enterprises carry out production activities in Poland, the classification of their business profile is consistent with the assumptions of the research being carried out, and in the area of their functioning there are defective products which result in the implementation of reverse logistics processes in defective products management. On the base of these companies investigation the general model has

been verified and adapted to the needs of manufacturing enterprises in the furniture industry.

The first information about the request made by the customer/participant of the business environment to be allowed to return the defective product is obtained by the manufacturing enterprises in the furniture industry via the customer service center. The contact is established by the customer/participant of the business environment via a telephone (or in rare cases via e-mail). All requests for product returns are recorded by the customer service center's employees and directed to the gatekeeping process (Belu, Paraschiv & Popa, 2016).

Employees of the enterprises follow the conduct procedures stipulated in the internal policy of the enterprise, determining the principles for accepting the product returns. The customer service center's employee also carry out the gatekeeping process.

Next, an authorization of a product is necessary, as it is crucial to ensure compliance of the returned product's brand with the manufacturer's brand because of the fact that in case in the furniture and furniture accessories the products are not marked in such a clear and visible manner as some other products from different industries. Hence, the gatekeeping process covers verification of a given return. If it is negative, meaning that the product is not compliant with product specification adopted in the manufacturer, the enterprise does not accept the return. In turn, if the verification is

positive, the returned product is supplied to the reverse flow and subjected to another reverse logistics process, i.e. collecting and gathering of returns.

The process of collecting and gathering the returns in the analyzed enterprises begins from collecting the returns. The collected products are gathered afterwards. Manufacturers in the furniture industry usually collect and gather the defective products returns on their own. The reason for this is that they usually hold a well-developed chain of manufacturer stores, so the customers can hand deliver the returned products to such a store, i.e. directly to the manufacturer, where they undergo the controlling and sorting process.

In next process of the reverse logistics, the defective products' flows are controlled and sorted. This process starts with the return verification. This verification is based on identification of whether the previously acquired information is correct, and it allows to specify an accurate qualitative and quantitative condition of the returned products. In the case of the enterprises in the furniture industry, the controlling and sorting process has quite a simple course, as verification of returns consists only in determination of qualitative and quantitative parameters of the returned defective products. Thus, after the verification process, the returns are subjected to controlling and sorting actions to determine the option for their further processing, and are afterwards handed to the final disposal process.

A significant issue from the perspective of reverse logistics in the scope of customer service is compensation of losses that the customer suffered because of the defective product. The compensation awarding procedure in enterprises in the

furniture industry take place in the gatekeeping process, after verification and acceptance of the return. This is usually the customer who makes the decision on whether they are willing to get compensation as a refund or a new product.

The last process of the reverse logistics is final disposal. Returns of defective products in the final disposal process are first inspected. The inspection is intended to eliminate any erroneous decisions made towards a given refund during previous processes, and second, verification of the returned product in terms of the possibility to employ a selected option for final disposal and to specify whether this selected option is most advantageous and allows maximization of the value restoration from this return. The manufacturing enterprise in the furniture industry, regarding characteristics of the returned defective products, recovers the value from them through adopting the recycling process, hence obtaining secondary raw materials. Some of the returns are also suitable for charity donation. The remaining returns are ascribed with a waste status during the final disposal process and are delivered to the landfill.

In the case of analyzed enterprises in the furniture industry, the returns that are subjected to the final disposal option undergo re-inspection when a decision is made on whether it is necessary to employ an additional value recovery option in their case. If the decision is positive, then the returns go back to the inspection point and then are transferred to another final disposal option. If the decision is negative, the reverse logistics processes are completed by supplying the forward or reverse flows with the value recovered during the final disposal process. Regarding specificity of the product and the performed value recovery from the product return, the manufacturing enterprises supply flows of their own or of other participants of the business environment. Usually the enterprises in the furniture industry that acquire only the secondary raw materials supply their own production process with them.

Results Discussion

The results of model processes differ according to the results of survey questionnaire. But the verification of the model was made only on the sample of 7 enterprises, while the survey questionnaire covered 120 enterprises. What is more, other production companies in the furniture industry which were not interviewed might have yet different procedures. It is worth to notice here that verification and adaptation of the model of defective products management with reverse logistics processes in production companies in the furniture industry allow to show the similarities and differences within the course of these activities realization. This analysis is solely of an illustrative and diagnostic character as regarding the differences, as mentioned even between enterprises operating in the same industry, so it cannot pose any comparative material. Thus, the presented material in this part of the article should be rather perceived as a form of case study analysis.

Conclusions

The production enterprises in the furniture industry, as entities that are especially prone and sensitive to changes in the economy, have recently developed the concept of reverse logistics, the processes of which provide significant support to defective products management. The research performed proved that the defective products management in the manufacturing enterprises in the furniture industry is employed through the implementation and utilization of the reverse logistic processes which allows the management of the returned products effectively. It must be noticed here, that the paper presents only the results for furniture industry and this is their limitation as other types of industry might be totally different regarding the analyzed issues. So practical recommendation is that each company before the implementation of the model terms should verify own defective products management policy and adapt the model to own needs. Future studies on discussed topic should also take into account the significance of decision-making processes in this regard and analyze them in details to create the full picture of organization the reverse logistics processes of defective products management in furniture companies. The presented research proved that the reverse logistics processes can improve operations regarding the defective products management of the manufacturing enterprises in the furniture industry.

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ZARZĄDZANIE PRODUKTAMI WADLIWYMI W PROCESACH LOGISTYKI ZWROTNEJ W FIRMACH PRODUKCYJNYCH MEBLI

Streszczenie: Celem artykułu jest przedstawienie specyfiki zarządzania produktami niepełnowartościowymi w firmach produkcyjnych z branży meblarskiej z wykorzystaniem procesów logistki zwrotnej. Jest nim również podkreślenie rosnącego znaczenia rozwoju i konieczności wprowadzania zarządzania produktami niepełnowartościowymi do strategii firm produkcyjnych i wdrażania procesów logistyki zwrotnej w tym zakresie do ich praktyki gospodarczej. Część teoretyczna przedstawia zarządzanie produktami niepełnowartościowymi. Definiuje je w przedsiębiorstwach produkcyjnych i przedstawia metody zarządzania nimi. Przedstawiono tu także koncepcję logistyki zwrotnej, ponieważ jej procesy stanowią istotne rozwiązanie w tym zakresie. Część badawcza oparta jest na analizie efektów badania ankietowego przeprowadzonego w 2019 roku. Badanie to było adresowane do polskich firm produkcyjnych operujących w sektorach o wysokim potencjale powstawania produktów niepełnowartościowych, jednak na potrzeby tego artykułu wybrano tylko część obejmującą respondentów z branży meblarskiej. Próba badawcza została ustalona na podstawie metody reprezentatywnej i obliczona jako próba reprezentatywna, tak aby wyniki badania odzwierciedlały sytuację wszystkich polskich firm produkujących meble. Część badawcza obejmuje również weryfikację modelu zarządzania produktami niepełnowartościowymi z wykorzystaniem procesów logistyki zwrotnej w firmach produkcyjnych. W konkluzji podkreślono znaczenie procesów logistyki zwrotnej jako wsparcia dla zarządzania produktami niepełnowartościowymi.

Słowa kluczowe: wadliwe produkty, zarządzanie, logistyka zwrotna, przemysł meblowy

家具生产企业中带有逆向物流过程的缺陷产品管理

摘要：本文的目的是通过反向物流流程介绍家具行业生产公司中不良产品管理的特殊性。本文的目的是强调开发的日益重要的意义，以及将有缺陷的产品管理引入生产公司的战略并在其实践中实施逆向物流流程的必要性。理论部分介绍了不良产品的管理。它定义了制造企业中的有缺陷的产品，并给出了发生时的管理方法。此外，提出了反向物流概念，因为其流程说明了这方面的解决方案。研究部分基于2019年度以问卷形式进行的研究调查。它针对的是具有高潜力产生缺陷产品的行业的波兰制造公司，但是出于本文的目的，只选择了一部分涵盖家具行业的受访者。研究样本已根据代表性方法确定并计算为代表性样本，因此研究结果反映了波兰所有家具生产公司的状况。研究部分还涉及开发公司中具有逆向物流流程的不良产品管理模型的开发和验证。结论强调了逆向物流流程作为支持不良产品管理的重要性。

关键词：次品，管理，逆向物流，家具业