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## Human Resources Responsibilities in Logistic System of Waste Management for Sustainable Growth and Circular Economy

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Magdalena Graczyk-Kucharska<sup>1</sup>

**Abstract:**

**Purpose:** A waste management system requires not only the right decisions, but also the responsibility of people in terms of effective waste management in the enterprise. So far, the literature has laconically addressed the challenges of human resources in the context of waste. Literature lacks collective concepts characterizing the responsibility of people and their actions for efficient organization and waste management in the enterprise. The aim of the article is to systematize the current knowledge in the field of waste management in relation to human resources, their responsibilities, required competences and qualifications.

**Design/Methodology/Approach:** The concept presented in this article is based on a literature review, considering the latest research in this field.

**Findings:** The concept confirms that in each of the company's processes, i.e., delivery, production, distribution and after-sales service, there are activities that can contribute to better organization of work for the circular economy in accordance with the principles of sustainable development.

**Practical Implications:** The concept can be directly implemented in companies as an aspect improving human resource management, division of duties and requirements, the effect of which is to minimize the negative impact on the environment.

**Originality/Value:** The approach presented in the article is an innovative approach that takes into account the responsibility of human resources in the logistic system of waste management and may constitute a contribution to further research in this field.

**Keywords:** Circular Economy, Logistic System of Waste Management, Human Resources.

**JEL Classification:** M51, Q01.

**Paper type:** Commentary/Other.

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<sup>1</sup>Poznan University of Technology, Poznan, <https://orcid.org/0000-0002-4241-8216>,  
e-mail: [magdalena.graczyk-kucharska@put.poznan.pl](mailto:magdalena.graczyk-kucharska@put.poznan.pl);

## **1. Introduction**

The Sustainable Development Goals help to maintain a balance between the three dimensions: economic, social, and environmental (A / RES / 70/1, 2015). More and more often people are placed in the direct center of attention, subordinating activities in the economic sphere to achieving goals related to the level and quality of life of citizens (A/ RES / 70/1, 2015). That is why people, their responsibility, knowledge, skills, and attitudes play a key role in shaping the principles of sustainable development. We know that many waste reduction activities could be organized in parallel while still planning and organizing them (Correia *et al.*, 2018). This also applies to the stage of product design, selection of raw materials and semi-finished products, recovery of valuable materials and components, and internal reuse of waste. Developers of circular products and activities would benefit from systemic thinking (Salmenperä *et al.*, 2021).

In literature and in the strategies of the Member States, the economy is increasingly moving towards a circular economy. This approach may be a response to the widespread culture of consumption, which contributes significantly to the depletion of natural capital and increasing pressure on the climate. Much of the research work of the 21st century relates to waste management in the context of the entire waste management process, from its generation to processing or disposal (Marino *et al.*, 2018). Many entities are most often involved in these processes, including state entities, municipal companies or municipal companies operating in the waste management industry (Bui *et al.*, 2020; Lishan *et al.*, 2021). Publications in this area cover both theoretical and practical aspects (Garcés-Ayerbe *et al.*, 2019; Tsai *et al.*, 2021). There is a lack of analyzes and models in the areas of human involvement and responsibility at the intralogistics and waste management stage within the organization to minimize the negative impact on the environment (Ghisellini *et al.*, 2018). Often, innovations in the field of waste management are undertaken at the process stage, ignoring product and organizational innovations (Gaeta *et al.*, 2021).

The literature indicates barriers affecting the change of the economy from linear to a circular economy (Garcés-Ayerbe *et al.*, 2019). These include, among others, the lack of availability of human resources, lack of environmental education and culture of environmental protection, or lack of knowledge of smart waste management (Zhang *et al.*, 2019). The availability of human resources is related to the competences acquired by employees. To properly perform the duties related to solid waste management (SWM), technical qualifications are primarily required (Marino *et al.*, 2018). To educate the competences required in enterprises and to respond to the competency shortages of human resources, it is necessary to define the scope of duties of persons responsible for waste management in the enterprise.

The aim of the article is to systematize the current theoretical knowledge regarding the responsibility of human resources in the implementation of the circular economy in the enterprise, considering the internal logistic system of waste management in the enterprise. The remainder of the paper is organized as follows. Section 2 reviewed the relevant literature. The next section 3 is the characteristics of the company's logistic waste management system. Section 4 discussed conceptual approach of human resources,

responsibility in relation to the circular economy and waste management in the enterprise. Last section 5 is conclusion of this research.

## 2. Theoretical Background

The quality of our environment has a significant impact on our daily lives. For over 30 years, the European Union has been taking steps to minimize its negative impact on the environment. One of the legal acts, sets out basic concepts and principles for waste management in the EU was the Waste Framework Directive (2008/98 / EC), five-step "waste hierarchy", the "producer responsibility" and the "polluter pays principle". Research proves that the overall sustainability of the waste management supply chain should also consider the waste management perspective on the level of sustainability (Geda *et al.*, 2020) and they approach to circular economy.

Circular economy is not only a way of dealing with waste in the form of recycling, as it is often understood within this concept (Ranta *et al.*, 2018). It also refers to the restoration and regeneration of material cycles by always maintaining the value of the materials in the life of the product. The analyzes refer to the environmental impact and effects on the product life cycle and waste streams (Taelman *et al.*, 2018). Except for steel and paper, secondary raw materials still account for only a small part of the production materials used in the EU (A / RES / 70/1, 2015). The effect of these activities is to be a transition from linear economy to closed economic models (Taelman *et al.*, 2018).

As a result, firstly, the amount of generated waste will be reduced, and secondly, its internal reuse will be increased. Converting a waste stream into a value stream can increase the demand risk for waste streams. Therefore, to reduce the social and environmental effects, solutions and innovations should also be sought in other areas, including those related to human resources, process, and organizational innovations.

The results of the studies described in the literature confirm that the only way to eliminate the problems related to waste in the context of sustainable development is to act at source, including by influencing the over-consumption of products, the use of limited resources, or by limiting the use of toxic and non-recyclable materials (Ilic *et al.*, 2018). It is not enough to take 3R actions, reduce, reuse, and recycle (Ghisellini *et al.*, 2018; Huang *et al.*, 2018), but in times of fast process automation, also taking Recycling and Recovery of Waste 4.0 actions. These actions are also called "ReWaste4.0" (Sarc *et al.*, 2019) and are intended to respond to changes in the Industry 4.0 context (Gupta *et al.*, 2021). New activities that should be implemented by enterprises to prevent waste generation is cooperation with suppliers of raw materials and semi-finished products or distributors as part of an integrated supply chain upstream-downstream integration (Laubscher and Marinelli, 2014).

The transition from linear to circular economy affects the transformation of waste into secondary raw materials, which may result in a reduction in the demand for primary raw materials (Fellner *et al.*, 2017). One of the obstacles faced by economic operators wishing to use secondary raw materials is uncertainty about their quality. Due to the lack of EU standards, it is difficult to establish levels of contamination or suitability for high-quality

recycling (e.g., for plastics). It is one of the barriers that can be overcome through organizational and process innovations also through consulting services (Pereira and Vence, 2021).

The circular economy implementation may have many positive aspects in at least several areas. They concern, among others benefits, environmental, economic, social, institutional, technological, and informational, supply chain and organizational category. In order to achieve these benefits, there must be appropriate conditions and circumstances to use the company's potential. To achieve the goal, resources, including human resources, and the required knowledge, skills and attitudes of employees are necessary. The literature indicates a shortage of skills and knowledge in the field of CE among communities, including company employees (Tura *et al.*, 2019). Among the barriers in the implementation of CE, apart from the obvious financial and economic aspects (Garcés-Ayerbe *et al.*, 2019), the lack of system solutions and understanding of CE is also emphasized.

Most often, the approach is limited, and activities focus only on the area of recycling (Kristensen and Mosgaard, 2020). Frequent challenges in companies in the field of CE implementations are the large dispersion of the scope of duties among many employees and the lack of a coordinator in the entire waste management system, starting from the product design stage, through the selection of packaging, monitoring the type and quantity of waste, and taking actions to minimize waste generation and increasing their re-use. Another challenge is also to ensure an efficient flow of information between all employees of the company in the field of waste management, including, collection, transport of waste and minimizing its generation and internal reuse.

The implementation of activities in enterprises in the CE area certainly contributes not only to increasing the balance between the economy, the environment and society (Gupta *et al.*, 2021). Positive impact also relates to increasing the awareness of environmental impact, developing competences in the field of environmental protection, and increasing motivation in the implementation of innovative solutions. Modern solutions are aimed at increasing the efficiency of the use of resources, including human resources. In the scientific literature, despite the increasing popularity of the analysis of barriers, tools, and innovations in the field of CE, the area of human resources is still rarely discussed (Jabbour *et al.*, 2019). The role of a human can be attributed to each of the processes carried out in the enterprise (Ghisellini *et al.*, 2018) including the process: delivery, production, distribution, after-sales service.

### **3. Logistic System of Waste Management**

Waste management is still one of the top topics, taking into account the number of publications from the last 40 years (Campitelli *et al.*, 2020). The transition to a more sustainable society requires more sophistication in waste management (Seadon, 2010). It includes waste, containing food, paper, plastics, glass, metals, and textiles, the volume of which diverges according to the practices from singular philosophies, political strategies and legislation, the different economic aspects of each area to form the waste characteristics (Burnley, 2007). Management system is considered as municipal waste, that is a central

element for a good quality of life, a clean environment, and the conservation of natural resources. It is a topic still topical for many developing countries and a huge organizational challenge for the community (Wath *et al.*, 2010). In the context of a systemic approach to waste management, there are also many barriers.

Among them, the most frequently indicated are financial, legislative, organizational barriers at the level of public institutions, educational and human resources, or barriers related to the implementation of solutions (Mmereki, 2018). For improving the performance of waste management in a region or country, it would be so valuable to provide tips and guidance to companies on how to effectively manage waste to minimize the negative impact on the environment at reasonable costs.

The waste management system and the scope of responsibility of human resources do not have to be considered from the point of view of the municipal waste management system (Mmereki, 2018), but also from the level of the company waste management system, here called the logistic waste management system (LSWM). Logistic structures for waste management in an enterprise, being a response to the challenges of sustainable development (Ramos *et al.*, 2014b), allow for the systemization of supply chain processes, including delivery, production, distribution, and after-sales service, and for defining employees' responsibility for activities in the field of circular economy and related legal aspects. For the purposes of the research, the definition of LSWM was adopted, which consists of four subsystems: waste collection, waste shipment, reprocessing and information flow. All four subsystems are interconnected. In each of the subsystems there are processes implemented, the effects of which influence each other between the subsystems. Each of them is also part of the process of delivery, production, distribution, and after-sales service (Figure 1).

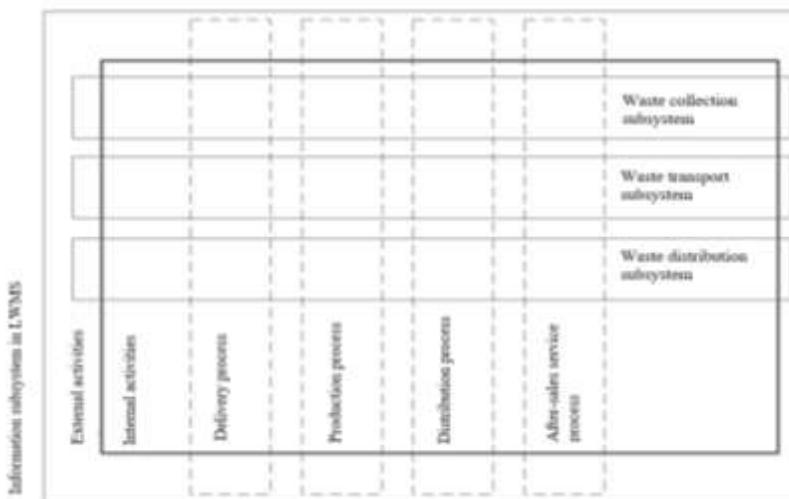
The waste collection subsystem covers activities related to the collection, storage, and handling of waste in the enterprise. Waste collection can be based on outdated technologies with a low level of interoperability offering static processes (Melakessou *et al.*, 2020). The exception is the combination of collection and transport of waste by machines replacing humans in these works. This is done especially with the use of new technologies, sensors, sensors, and data processing technologies (Nowakowski *et al.*, 2020). Collection and storage of waste concerns both the premises of the enterprise and buildings, as well as places of storage outside its walls, e.g., on the square outside the building. It is necessary here to properly secure the waste collection site, especially regarding hazardous waste.

The waste shipment subsystem refers to the proper assignment of means of transport and communication routes to transfer waste from the place of its generation to the place of its storage (Ardjmand and Daneshfar, 2020). The method of transporting waste may use modern solutions, e.g., in the field of intelligent containers (Misra *et al.*, 2018) and waste handling based on real-time systems (Folianto *et al.*, 2015; Johansson, 2006). Shipment of waste is also its disposal and a routing problem to achieve two goals, minimizing distance and CO<sub>2</sub> emissions (Ramos *et al.*, 2014a).

On the other hand, the recovery from waste distribution subsystem includes activities related to the minimization of the number of wastes going to the landfill and utilized for re-use, including, waste transfer to suppliers, internal reuse, or recycling (circular economy) (Kabirifar *et al.*, 2020). This also applies to the aspects of ecodesign, i.e., the pro-ecological construction of the product (Ghisellini and Ulgiati, 2020; Whittaker *et al.*, 2019). Achieving higher recycling rates is often hampered by limited administrative capacity, lack of investment in separate collection and recycling infrastructure, and insufficient use of economic instruments (e.g., landfill fees or systems of fees proportional to the amount of waste discarded) (A/RES/70/1, 2015).

The last and fourth subsystem of the LSWM is the information subsystem. It covers the entire LSWM. This subsystem allows the collection, processing, and presentation of data (Pollák and Tkáč, 2019) on waste management in an enterprise, to improve communication between all subsystems and the decision-making process in relation to waste management. It is important for minimizing the key barrier of limited awareness of green trends or scarcity of adequate information (Mittal and Sangwan, 2014). Collecting data, keeping statistics, and processing them into information allows to improve feedback on waste management and linking it with the distribution and consumption process (Singh *et al.*, 2014). A key competence to enable Circular Economy business models is the ability to keep track of products, components, and material data to enable resource optimization. Tracking and tracing assets enables effective return logistics. Information regarding the composition of assets (subcomponents and materials) enables better sorting and (cross-industry) component harvesting. Usage information (wear and tear) of a product or component determines the re-usability and residual value of the asset (Laubscher and Marinelli, 2014).

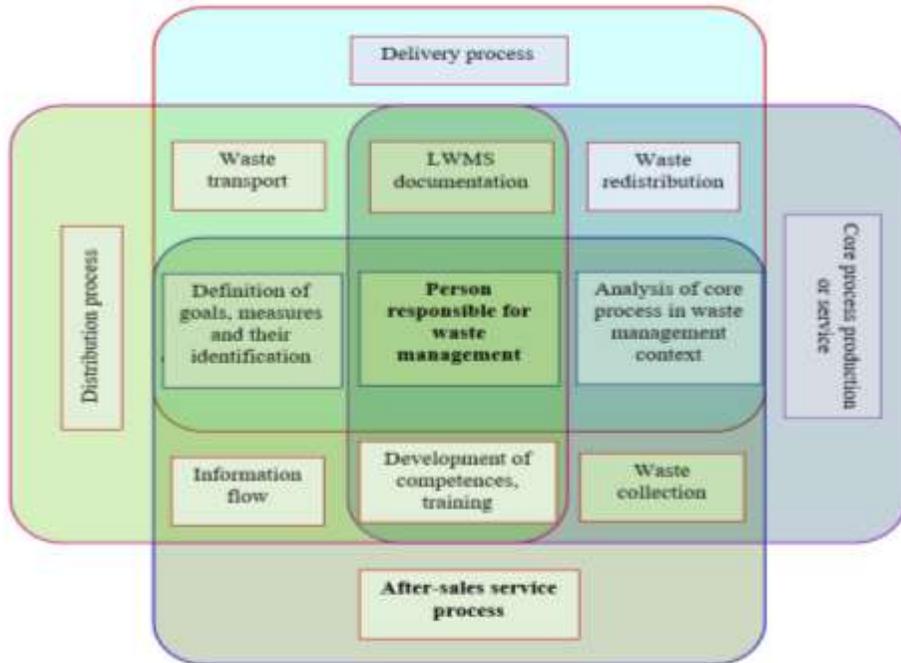
**Figure 1.** Logistics system of waste management



**Source:** Own study.

New technologies can significantly contribute to the information flow in the company in relation to LSWM. This applies to all activities related to the provision of data, their collection, and processing for the purposes of supporting decisions, also in the financial area (Fitriyani, 2019) of the organization in the field of waste management in the enterprise. Organizations need open data to stimulate innovative business (Salmenperä *et al.*, 2021), also in the field of the circular economy.

**Figure 2.** The main responsibility of the person responsible for waste management



*Source:* Own study.

Figure 2 shows that the overall activities and improvements implemented in the enterprise depend on the decision-making and organization of work in the enterprise and refer to all processes in the company, including the process, delivery, production / service, distribution and after-sales service. The key action is always to appoint a person, their responsibility in the field of waste management and the goals that should be achieved. The organization of activities should relate to waste shipment, waste recovery distribution, waste collection and information flow in accordance with the characteristics further presented in Table 1. It should be based on a solid analysis of data existing in the enterprise. Analyzes should be carried out in the first place in relation to the key area, which is the production or service process, and then to other processes.

Based on the internal audit and waste analysis throughout the supply chain, indicators should be defined and periodically analyzed. The developed documentation should logically relate to the entire Logistic Waste Management System, with particular emphasis on:

- raising employees' awareness of waste management,
- determining the key competences of each employee related to ecology and minimizing the negative impact on the environment,
- appointing periodic trainings,
- ensuring the flow of information between employees.

#### **4. The Concept of Human Resources Management Responsibilities for Circular Economy**

Table 1 presents the scope of management activities that should be undertaken in the enterprise, monitored, and performed as part of work at a specific workplace. These activities were characterized based on the literature review indicated in the bibliography of the article, which in the table was divided into two categories. In the first of them, dedicated activities were defined, which were assigned to the key processes of the company as part of the supply chain, i.e., the process of delivery, production, distribution and after-sales service (Dey *et al.*, 2011; Rezaee, 2018). In turn, the last column refers to activities that permeate through various processes and it is difficult to match them only with one of them. These activities concern, inter alia, information flow, preparation of documentation, markings, quality assurance of the work performed, or collection and use of data for the purposes of waste management in the enterprise.

***Table 1. Responsibility of the manager and all employees on CE in the enterprise***

<b>Process</b>	<b>The scope of activities of the management in the scope of a specific process</b>	<b>The scope of activities of the management in relation to the processes of supply, production, distribution and after-sales service</b>
Delivery	<ul style="list-style-type: none"> <li>• Negotiating contracts with suppliers in the field of ecological packaging of raw materials, semi-finished products and materials</li> <li>• Minimizing the number of packaging waste, including by reducing double packaging in which raw materials, semi-finished products and materials are delivered</li> <li>• Consulting activities that influence the generation and minimization of waste in the delivery process</li> <li>• Providing appropriate storage conditions for secondary packaging</li> </ul>	<ul style="list-style-type: none"> <li>• Determining the scope of the company's internal documentation in the field of waste management at employees' workstations</li> <li>• Providing appropriate markings for waste, waste containers, waste transport routes, waste storage places</li> <li>• Selection of appropriate means of transport and waste handling</li> <li>• Development of a method of shipment and disposal of waste</li> <li>• Negotiations and selection of waste collectors</li> <li>• Searching for entities for the reuse of external waste</li> <li>• Undertaking activities to prevent waste generation</li> <li>• Taking steps to reuse internal waste</li> </ul>
Production	<ul style="list-style-type: none"> <li>• Taking actions to ensure the pro-ecological design of the product: selection of raw materials and materials, the method of connecting and</li> </ul>	<ul style="list-style-type: none"> <li>• Ensuring the proper flow of information between all employees of the organization in the field of waste management in the enterprise</li> <li>• Ensuring the proper flow of information between the company and external entities involved in CE</li> </ul>

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	disconnecting, the possibility of reuse, the toxicity of materials	<ul style="list-style-type: none"> <li>• Participation in the negotiation of financial contributions paid by producers under extended producer responsibility schemes, based on the costs associated with the disposal of products</li> <li>• Coordination of work with regard to eco-management, audits (EMAS) and supervision over the verification of environmental technologies (ETV)</li> <li>• Responsibility for documentation related to waste management in the enterprise</li> <li>• Providing information on the environmental performance of the product and its impact throughout its life cycle</li> <li>• Defining the ecological policy of internal and external communication as well as the organizational culture of the company</li> <li>• Taking actions aimed at extending the product life cycle, including by reusing and guaranteed repairable</li> <li>• Ensuring the appropriate quality of secondary raw materials, including by identifying quality criteria for reusability</li> <li>• Collection and processing of data for the purposes of making waste management decisions</li> <li>• Analysis and the possibility of using new technologies, including Data Science, for the purposes of CE</li> <li>• Providing opportunities for the development of employee competencies for the efficient implementation and maintenance of CE in the enterprise</li> <li>• Defining and ensuring an eco-friendly recruitment and hiring process</li> </ul>
Distribution	<ul style="list-style-type: none"> <li>• Monitoring and taking actions in the field of rational and effective use of raw materials, semi-finished products and materials</li> <li>• By-product management</li> <li>• Consulting activities influencing the generation and minimization of waste in the production process</li> <li>• Ensuring correct labeling of the product</li> <li>• Selection of packaging for the final product</li> <li>• Minimizing the number of packaging waste, including by reducing double packaging in which end products are distributed</li> <li>• Consulting activities that influence the generation and minimization of waste in the distribution process</li> </ul>	
After-sales service	<ul style="list-style-type: none"> <li>• Consulting activities influencing the generation and minimization of waste in the after-sales service process</li> </ul>	

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*Source: Own study.*

Within the framework of EU-referenced documents relating to CE, particular attention is paid to better product design. Amirreza Mahpour confirms this with the results of the research, identifying the barrier of the lack of producer-based responsibility system in production of construction materials (Mahpour, 2018). These activities are indicated both in the area of pro-ecological construction design and financial contribution to the disposal of used products. Product eco-design requirements apply to the design and labeling of products to facilitate the safe dismantling, reuse, and recycling of electronic displays. The financial aspects relate to the differentiation in the level of financial contributions paid by producers under extended producer responsibility schemes and in relation to the costs associated with the disposal of products. Such actions should motivate companies to produce products that are easier to recycle or reuse.

In the context of ensuring the quality of secondary raw materials, a systemic approach to waste management activities, including the use of the EU Eco-Management and Audit

Scheme (EMAS) 8 and the pilot program on environmental technology verification (ETV), is important. They can be a response to the creation of procedures and documentation confirming the quality of secondary raw materials, as well as supporting process and organizational innovations in the enterprise in the field of waste management.

Another important one from the point of view of managing and predicting changes in the amount of generated waste and the possibility of dealing with it is data analysis (Chen *et al.*, 2018). Due to the continuous processes of digitization and automation, the amount of data is constantly growing. People's ability to use new ways to use data to optimize production processes, also contributing to minimizing waste and the negative impact on the environment, will continue to grow. Moving to a circular economy also requires a skilled workforce with specific and sometimes new skills, employment opportunities and social dialogue (Barca, 2019). Adequate education and training systems will need to be ensured if the right qualifications are to be developed at all levels.

## **5. Conclusion**

The article presents the current knowledge relating to waste management and human resources. Based on legal aspects, including Waste Framework Directive (2008/98 / EC), Closing the loop - An EU action plan for the Circular Economy (2015), as well as current research in the field of circular economy and research related to waste management (Lishan *et al.*, 2021, Gupta *et al.*, 2021, Pereira and Vence, 2021, Tsai *et al.*, 2021; Salvador *et al.*, 2020), the Logistics Waste Management System is characterized, and the scope of the management's responsibilities for efficient waste management in the enterprise is further indicated. The concept considers the impact of the transition of the economy from linear to circular economy, the aspect of sustainable development and efforts to minimize the negative impact on the environment.

The developed concept may be the basis for further practical work in the field of responsibility of human resources on the quantity and quality of generated waste. It is also a direct response to the human resources barriers described in the literature in the context of a systemic approach to waste management (Mmereki, 2018, Garcés-Ayerbe *et al.*, 2019).

The scope of the responsibility of people in the concept is included primarily in relation to production companies, however, aspects related to the construction of products in the case of service companies may be omitted. The results published in this article are related to the article entitled a conceptual model of human resource management for the efficient management of a circular economy in a company, where the results of research are presented and a practical approach to human resource management, circular economy, sustainable development, and a logistic waste management system are described.

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