Jerzy Janczewski* https://orcid.org/0000-0002-6994-2683

Reverse logistics from the perspective of the circular economy

Apart from providing many advantages to enterprises, reverse logistics also minimises their negative environmental impact, which in the fullness of time translates into advantages for the whole society.
Supply chain management is a linear partnership which uses classic methods of analysis of needs and forecasting. That technique was very effective in the past, and, although it might still be used in some companies, the growing number of requirements from business environments expects more productive and flexible processes and precise planning of all movements, both the traditional and reverse ones. It is not insignificant here that the next wave of logistics is approaching, the so-called consumer logistics, following on from global logistics.
The characteristic feature of economically developed and rich societies is their excessive consumption and the fact that in a very short period of time they are able to use up more resources than nature is able to re-provide. For that reason, the concept of a circular economy is becoming more and more important, as well as the closed loop economy that originates from it, supported by processes and operations of reverse logistics.

Keywords: reverse logistics, circular economy, after-sales logistics, after-use logistics, consumer logistics

Introduction

At each stage of the supply chain returns may occur. Returns forwarded to organisations for recovery and utilisation, returns of faulty products, returns of industrial waste, raw materials for recycling, devices and production equipment, etc. are listed

* PhD, Eng. Jerzy Janczewski – adjunct at the department of the Transport Systems at the Faculty of Computer Science, Management and Transport of the University of Humanities and Economics in Lodz.

as examples. This also refers to returns to producers and secondary market distribution centres of e.g. demonstration products, excess supplies, products after repair, returns from clients, e.g. warranty returns, returns of used products, returns for recycling and others.

A returns management system that is properly organised and well-functioning may make the supply chain more effective. It can also increase a company's profitability and competitiveness. At this point it is important to remember that the reverse movement of goods does not pose a problem and means nothing is wrong and it should not be avoided. It is rather a source of added value and it creates opportunities for business. In Poland chains of supply and companies that participate in them as well as companies from the West can see the correlation between returns management and economic, marketing and ecological effects[1]. Enterprises in the United States have the greatest tradition and experience in the management of returned products.

The aim of this article is to present processes and operations of reverse logistics from the point of view of the circular economy and the progressing revolution in logistics, which results in an increased interest in processes of reverse logistics and consumer logistics, as well as the interest in the involvement of customers themselves in the implementation of the circular economy model. In order to achieve that goal, processes and operations of reverse logistics in the supply chain have been characterised, assumptions of linear economy and reverse economy have been compared and the role of reverse and consumer logistics in implementation of the circular economy has been pointed out.

Reverse logistics in the management of the supply chain

Reverse logistics — refers to all operations related to reverse movements that take place in a supply chain, it can be perceived as management of primary movements in such a chain. By analysing those movements it is clear that at each stage of products' movement in the supply chain, returns occur. For example, the reverse movement of raw materials, half-finished products and products from a raw material supplier through a producer or a distribution unit involves: production waste, damaged materials or materials of poorer quality, materials with short expiry date, surplus stocks or repaired products, unwanted products or products with exhausted work resources.

[1] Those are especially important because of the continuous shrinking of global supplies of natural raw materials and the growing amount of waste. Plastic waste is a classic example, 8 million tons of plastic waste is disposed of in ocean waters on a yearly basis. This situation is particularly visible, among others, in many parts of Asia where developing economies, vast ocean shores and densely populated cities result in pollution of the local seas with waste, including plastic waste (Taylor, 2019).

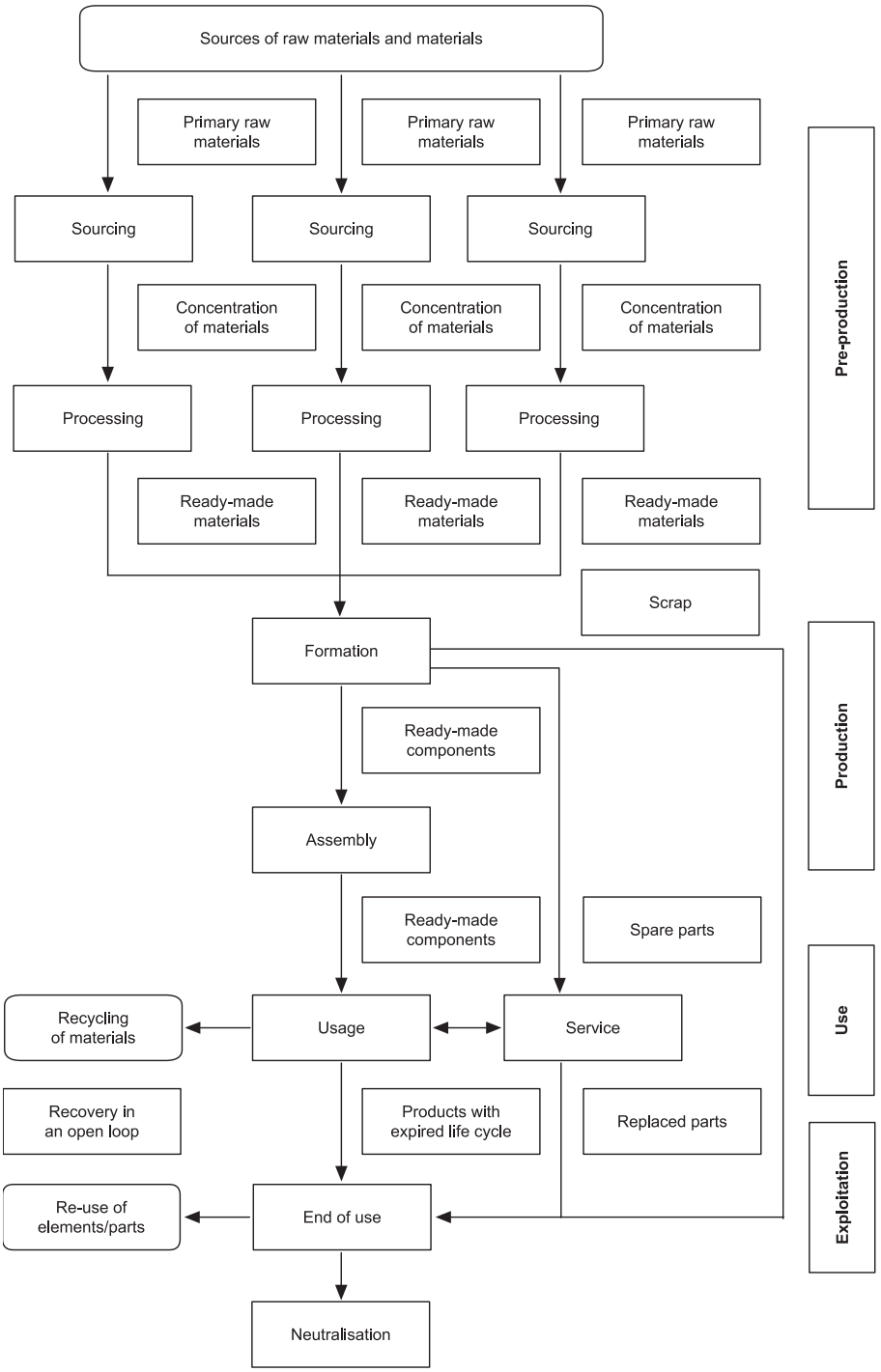

Fig. 1. Open loop of reverse movements

Source: Starostka-Patyk, 2016: 48.

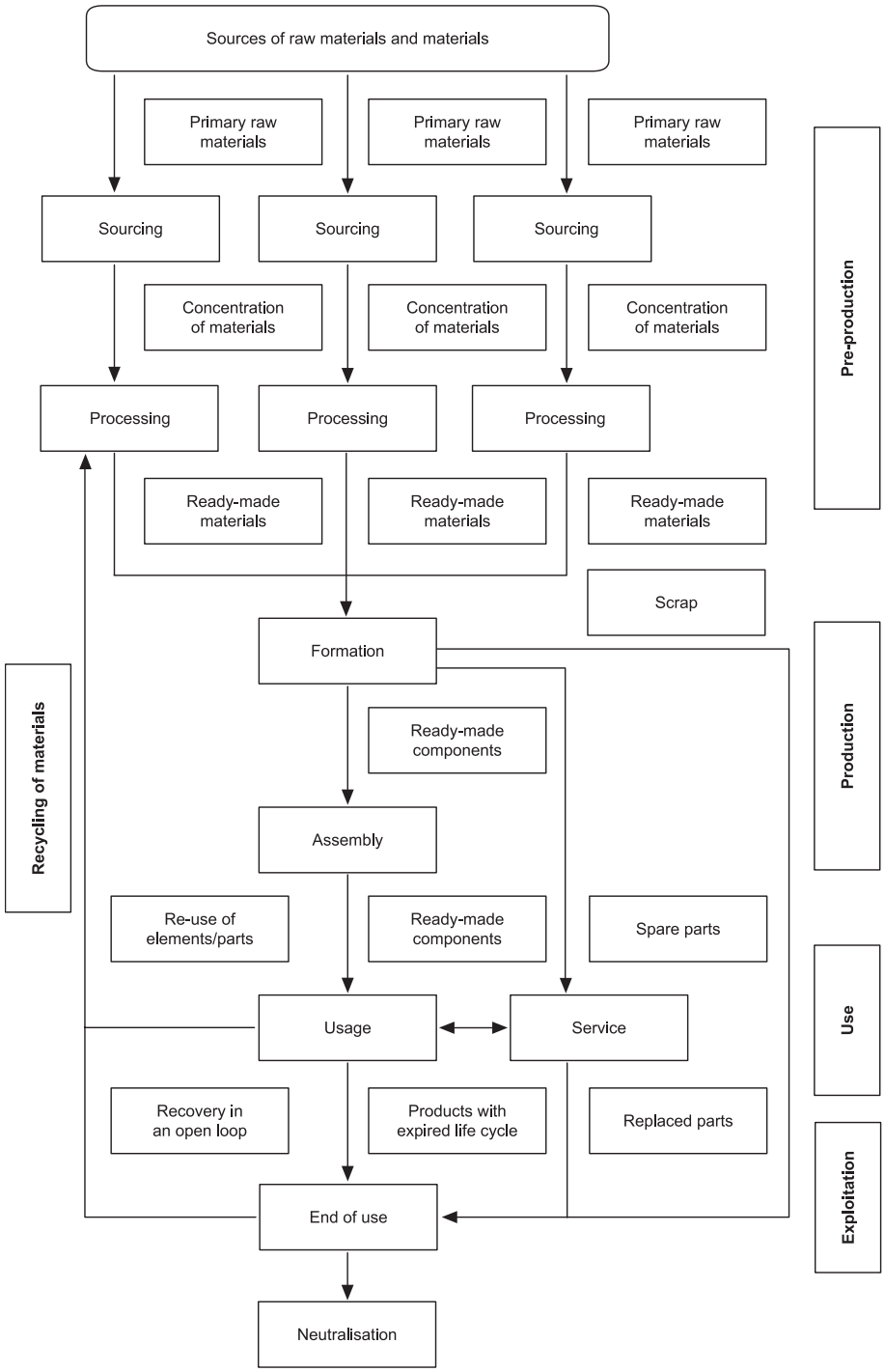

Fig. 2. Closed loop of reverse flows

Source: Starostka-Patyk, 2016: 49.

Reverse logistics does not only focus on the end stage of a product's life, but it also focuses on a broadly perceived management of returns, also including re-use of a product not necessarily in its original form or from its source of origin.

Identification of reverse movements in the logistics of an enterprise or in the supply chain allows us to distinguish two characteristic structures – an open and a closed loop, which result from the course of operations in the sphere of implementation of the concept of reverse logistics. Open loop takes place when the reverse movements are directly transferred to units that deal with processing of returns and management of waste (e.g. recovery organisations) or to landfills, Fig. 1. In an open loop the reverse movements in an enterprise are characterised by a much simpler course than in a closed loop. The content of movements is not re-used and usually it is deposited at landfills or it is forwarded to specialised recovery organisations for recovery of value. Those organisations do it for their own use and that value does not supply the same enterprise or supply chain. Logistic processes related to reverse movements in an open loop refer to gathering of returns and waste, their transport, storage and depositing at landfills (Starostka-Patyk, 2016: 47–48).

We talk about a closed loop when reverse movements forward their content to places which carry out processes of value recovery and then such content in the form of recovered materials is forwarded to an input point of an enterprise, supplying classic movements with secondary materials. In a closed loop the recovered value comes back to the same enterprise, Fig. 2 Closed loop is characterised by recycled content of reverse movements. Those movements lead to entities in which such processes take place, restoring value of products or waste so that they can be re-used, partially or in whole, or in the form of secondary materials and which could supply classic movement at the input of an enterprise.

Reverse movements in a closed loop undergo strict quality controls because on the basis of those controls decisions are made concerning further disposal and designation of the content of movements (Starostka-Patyk, 2016: 49).

Processes and operations of reverse logistics

Reverse logistics that takes place both in a closed and an open loop contains a number of characteristic processes and operations, which also appear in traditional logistics e.g. supply, production or distribution logistics.

The first process in the reverse logistics is the so-called collection, which involves all operations related to collecting and gathering of useless products, waste and packaging, which are usually scattered over a larger area, in places where they are produced.

Another process is sorting, selection and control, which involves separation of collected materials, dividing them into groups which will undergo further procedures. Next, there comes processing related to recovery, which can be of a direct

character or which can take the form of re-production. Processing transforms waste into reusable products and changes them into environmentally friendly products. The last process in the reverse logistics is re-distribution (distribution) related to resale and re-use.

Processes of reverse logistics that take place in different distant locations require storage and transport. Storage takes place before transport, reloading, processing and re-distribution and it is necessary partly in order to collect a certain amount of batch, which will allow optimal use of transport capacity and the owned processing base.

The listed processes express the overall shape of operations that take place in reverse logistics and at the same time they show the complexity of reverse movements (Sadowski, 2010: 68–69).

Two characteristic areas from the processes of reverse logistics can be differentiated in the supply chain. The first area is the area of the internal supply chain in which transformation of the raw material takes place until it takes the form of a product ready for clients. In this area there are returns which are mainly connected with post-production waste, non-compliance with technological and quality regimes or with damage during transport or storage. The second area is the one in which the product is owned and used by clients. This area involves the reverse logistics after sales and reverse logistics after use. In both of those areas there are also movements of packaging. The chosen operations of reverse logistics have been presented in Table 1.

Table 1. Chosen activities of reverse logistics

	Activities of reverse logistics
Products	Return to a supplier Resale Refurbishment, renewal Renovation Repair Cannibalisation, selective disassembly Recycling of a product, material or energy Utilisation
Packaging	Re-circulation Repair Recycling Utilisation

Source: Original publication on the basis of Rogers, Tibben-Lembke, 1998: 10.

Reverse logistics after sales deals with returns from clients that involve: products under warranties, products claimed for different defects and flaws, new, unwanted products and returned products, as well as products with partially exhausted work--efficiency which require service and repair, used products with partially exhausted work-efficiency, unwanted by the initial user. They may be subject to sale on a secondary market and of further use by subsequent users. Sales of second-hand clothes,

furniture, cars and spare parts, etc. are examples of such operations. At times, such products need to be prepared in a special way for them to be sold, sometimes they even need to be fixed. The task of post-sale logistics is to restore the usability to such products (not necessarily to their original condition) and to introduce them back to the distribution chain.

The process of products coming back to sale can be divided into planned and unplanned. Unplanned returns are those that involve new products which were returned by customers for different reasons, among which the most common ones include manufacturing defects or damage, clients refusing products or sale process mistakes e.g. the sale of products that was non-compliant with the agreement. The amount of non-planned returns depends, among other things, on return policies and the type of an enterprise's activity. According to different sources it can range between 2 and as much as 60%, and that number may increase because the following trends appear: buy now, pay later or try before you buy (Balfour, 2019; *Jak zgarnąć pełną pulę w logistyce zwrotnej*, 2011). Many clients, especially online (around 60%) give up on buying again from the same supplier if the returning process is difficult or turns out to be impossible in practice.

In virtual commerce the most typical reasons for returns are: errors related to order picking, packaging and addressing of orders, asymmetry of information i.e. information that is incomplete or misleading, that includes both photos and descriptions, incomplete knowledge of customers about the desired product, practice in which clients order a few items while they intend to pick only one and send back the remaining ones. Non-planned returns of products pose management difficulties to enterprises because the exact numbers of returns cannot be predicted, neither can the date of a return or quality of returned products. Great uncertainty is generated, depending on the type of industry, by the great variety of returned products and the existing trends and fashions. This is the case in the clothes and electronics industry.

The opposite situation is with planned returns which involve a much broader scope of products. Planned returns include: returns of products under warranties, post-warranty return of products, returns of multiple-use packaging – which are also considered desirable returns – returns of new products which participate in promotion campaigns, for example, in chains of large-format shops, returns of demonstration products, e.g. in car sales, returns of used products that took part in a promotional--commercial exchange, i.e. "new product for used one", lease of products when a product returns, e.g. once an agreement expires.

After a product returns to a warehouse, a decision-making problem occurs as of what needs to be done to regain the maximum of its worth with minimum added value involved. There are many options and they depend on the condition of a product and the purpose of the return. In the case of returns that are aimed for repair or service, such products get back to their primary user. In other cases, such products can be re-packaged and sent to another client, or minor repairs or modifications can

be performed and the product can be re-sold for a discounted price on a secondary market. A product can also be forwarded for product, material or energy recycling, or to landfill in the worst scenario.

Reverse logistics deals with products that have been used, that exhausted their work-efficiency, but also with packaging. The latter, though, is not always single-use packaging. Such products can be disassembled and verified so that further decisions can be taken concerning their further use and their being forwarded to an appropriate form of recycling. The most desired form of recycling is product recycling, which allows for another use of the product, such as in the case of auto-mobile services where damaged sub-assemblies are recovered and re-used for car repairs. The least favourable operation is to send such product to landfill (see: Janczewski, 2016: 81–86).

Reverse logistics from the perspective of circular economy

Since the Industrial Revolution a linear model of growth has been prevalent: „take, manufacture, use and throw away", based on the assumption that there is an abundance of resources, that they are available and easily obtainable and that they can be disposed of at a low cost. The linear economy – in a nutshell – means a model in which raw materials are extracted, they are usually used only once and then thrown away. It is becoming more and more apparent that such model of growth should be left behind (*Ku gospodarce o obiegu zamkniętym: program „zero odpadów dla Europy"*, 2014).

The model of circular economy is the opposite of the linear model. It sees a product as one of the elements of a repeatable and reusable cycle (take, manufacture, use, give away), Fig. 3.

The circular economy is an economic system which aims to minimise the losses and exploitation of non-renewable resources. For that reason, this system assumes that individual elements should be designed in a way that allows for disassembly and re-use. The circular economy is also known as a closed economy, a closed loop economy or a "cradle to cradle" model. The *circular economy* is also referred to as closed circulation economy.

The closed loop economy system keeps the added value of products for as long as possible and eliminates waste. It keeps resources within the economy. When the life cycle of a product comes to an end, it can be used again multiple times in a productive way, thus creating new value. Turning to a circular economy requires changes at each stage of the value chain, starting from the design phase, through new business and market models, from new ways of waste modification to new consumer behaviours. It requires a complete systemic change and innovations not only regarding technologies, but also organisations, society, methods of financing and politics. Even within an economy that is largely based on closed circulation there can always be an element of linearity, because there is need for resources that have never been exploited before, moreover, it is necessary to remove residual waste.

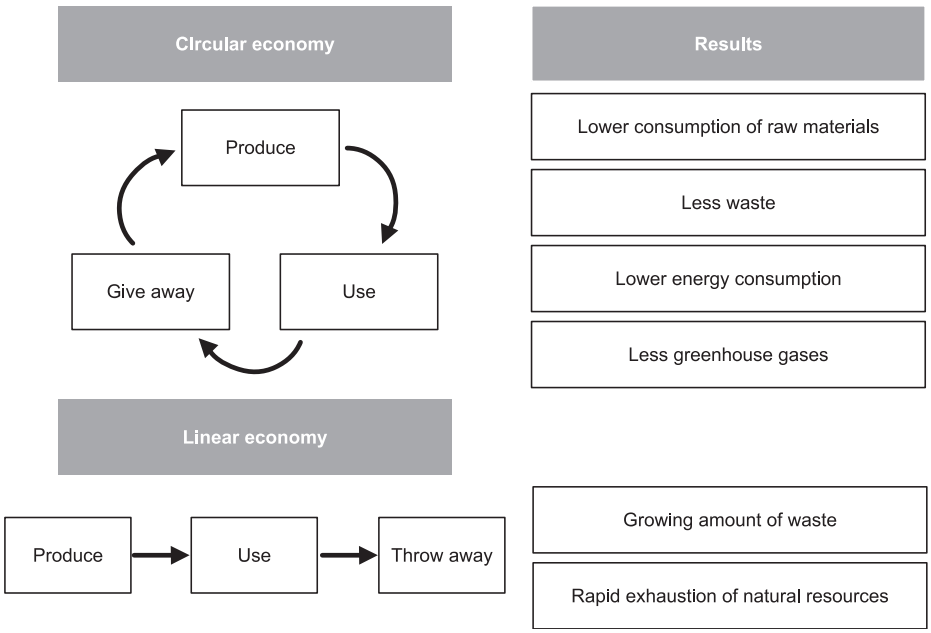

Fig. 3. Circular economy versus linear economy

Source: Original publication.

The assumptions of circular economy involve minimisation of waste from the design stage onwards and, in a standard way, they involve innovations in the whole value chain, not merely solutions for the end of a product's lifecycle. Such approaches are subject to reverse logistics. For example, they can involve (*Ku gospodarce…*, 2014):

- reduction of amount of materials required for execution of a particular service (e.g. reduction of their weight);
- extension of the period of use of products (durability);
- reduction of consumption of energy and materials at different stages of production and use (efficiency);
- reduction of use of materials in products and production processes that are hazardous or difficult to recycle (substitution);
- creation of markets for secondary materials (recycle) (according to norms, public procurements, etc.);
- design of products that are easier to maintain, repair, modernise, modify or recycle (eco-project);
- development of necessary services for consumers in a given area (maintenance/repairs etc.);
- encouraging consumers to reduce waste and to carry out high quality separation and support for those activities;
- encouraging to separate waste and to use collection systems that minimise costs of recycling and reuse;

– making it easier to group activities aimed at preventing side products being turned into waste (industrial symbiosis);
– stimulation of conditions conducive to broader and better consumer choices thanks to services of lease, hiring or co-use which create alternatives to owning things and at the same time securing consumers' interests (when it comes to costs, protection, information, contractual terms, aspects concerning insurance, etc.).

An important starting point is the design of processes for production, products and services. Products can be designed by prolonging the time during which they can be used, by making sure that they can be repaired, modernised, re-designed or finally, recycled – instead of being thrown away. Production processes can be more focused on reusing products and raw materials and on the ability of natural resources to be restored, and innovative business models can lead to creation of new relations between enterprises and consumers, prevent unemployment, but most importantly to minimisation of the effects of linear economy that are negative for the natural environment[2].

Turning into a circular economy, as K. Pikoń suggests, means that the focus of the supply chain is shifted from the raw material-supplies-production centre to distribution centre-consumer-waste management (Pikoń, 2018: 119). The main stress is put on processes of consumer reverse logistics and on engagement of consumers themselves in the implementation of the reverse logistics model. Thanks to modern technologies the role of consumers is changing. They are becoming co-creators of products in the entire value production chain. Consumers' involvement, starting from the designing of functionality of a new product, may take place through so-called crowdsourcing (e.g. via social media) to the stage of personalisation of individual products through their configuration directly at the suppliers. In the end, producers are able to maximise results that come from the potential of owned resources (including production resources) using the effect of *mass customisation*. Internet platforms are a support that allows implementation of such solutions, they gather different groups of stakeholders and they give them access to vast datasets (Nowicka, 2017: 51).

In a traditional model with a supply chain, value is created at subsequent stages of supply, production, distribution and consumption of goods and services. In the circular economy model the supply chain is replaced with a network of relations, and

[2] Such operations are becoming more and more popular and recognisable all over the world. For example, a company called African Foundries, which is a leader on the steel market in Nigeria, uses techniques of circular economy. The company supplies its factories with fossil gas, which is the side-product of oil wells and which would naturally be released to the atmosphere. Procomposto is a Brazilian company which collects and composts food waste, which would normally go to landfill. In Brazil half of the waste that comes from restaurants, supermarkets and residential areas is organic, which means that compost can be used for eco-farming (McIntosh, 2019). East Timor, located in a region where sea waters are flooded with litter, in 2020 is about to become the first country in the world which will process all plastic waste. Currently, East Timor, with as little as 1.3 million citizens, generates around 70 tons of plastic waste every day, most of which is collected from beaches and local cities, and later burned in an open space (see: Taylor, 2019).

value is based on exchange of knowledge, which should be a causative factor for the practical production of goods and services (Pikoń, 2018: 120).

New possibilities to adjust the model of supplies to the individual needs of participants of the supply chain appeared in the 21st century due to the Internet and access to information. Due to the re-configuration of business models, piece production and production of short series became possible. At the same time, the role of co-production and outsourcing has been growing, thanks to which partners can have mutual benefits until they fully exhaust their resources.

New technologies have had an increasing influence on the shaping of supplies, for example, thanks to the Internet of Things (IoT) it is possible to gather data in real time to analyse it in a way that increases the efficiency of a company and by this to overcome barriers of a linear chain of supplies. IoT also enables implementation of solutions that save energy both on the micro and global scale (see: Miller, 2016: 336–337). New technologies, e.g. 3D, support the design of flexible supply chains by modifications of the structure of cooperation between enterprises and making them less dependent on distantly located places of production.

Technologies which use digital technique and IT systems change the way people work, socialise, shop, and the digitalisation changes the global logistics systems into self-service ones, profoundly transforming business models, also including supply chains. In the next few years, the changes in logistics will be dynamic and driven by e-commerce, automation and digitalisation of supply chains. It is difficult at this point not to agree with the opinion of Peter J. Rimmer and Boo Hon Kam, who, by discussing how logistics and digital technologies will impact on each other, are trying to provide a new definition of consumer logistics, claiming that the next (sixth) grand logistics wave is approaching, the so-called individual logistics (see: Rimmer, Kam, 2018).

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Streszczenie

Logistyka zwrotna z perspektywy gospodarki cyrkulacyjnej

Logistyka zwrotna jest w przedsiębiorstwach coraz częściej stosowanym procesem. Nie tylko przyczynia się do poprawy stanu środowiska naturalnego, ale również stanowi dobrą strategię biznesową, umożliwia bowiem odzyskanie wartości ekonomicznej produktów, które zostały zużyte lub wyszły z użycia. Logistyka zwrotna dotyczy działań związanych z przypływami zwrotnymi występującymi w łańcuchu dostaw i może być postrzegana jako zarządzanie tymi przepływami. Logistyka zwrotna nie koncentruje się wyłącznie na końcowym etapie życia produktu, lecz dotyczy również szeroko rozumianej obsługi zwrotów, w tym

ponownego użycia produktu, niekoniecznie w jego pierwotnej postaci i z pierwotnego źródła pochodzenia. Celem artykułu jest analiza procesów i działań logistyki zwrotnej z punktu widzenia gospodarki cyrkulacyjnej i postępującej rewolucji w logistyce, której rezultatem jest zwiększające się zainteresowanie procesami logistyki zwrotnej i logistyki konsumenckiej oraz zaangażowanie samych konsumentów w realizowanie modelu gospodarki obiegu zamkniętego. Aby osiągnąć ten cel, scharakteryzowano procesy i działania logistyki zwrotnej w łańcuchu dostaw, porównano założenia gospodarki linearnej i cyrkulacyjnej oraz wskazano na rolę logistyki zwrotnej i konsumenckiej w realizacji gospodarki obiegu zamkniętego.

Słowa kluczowe: logistyka zwrotna, gospodarka cyrkularna, logistyka po sprzedażowa, logistyka po użytkowaniu, logistyka konsumencka