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Dear friends,

By providing international platform, 3. International Conference on Quality of Life 2018 will gather experts from industry and academia in order to exchange ideas and present results of ongoing research in a range of topics.

This Conference has a motto "From quality to happiness".

We invite you to participate in this important event.

Sincerely yours,
President of Programme Committee

Prof. dr Slavko Arsovski

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THE POSSIBILITY OF IMPLEMENTING CIRCULAR ECONOMY IN COMPANIES IN THE REPUBLIC OF SERBIA

Abstract: *Principles of circular economy are based on the hypothesis of spending and using resources in the processes of production in a way that results with reduction of negative effects on the environment, but also with creation of additional value and reuse of the product. Because of the importance of circular economy, the aim of this paper is benchmarking the possibilities of its implementation in the Republic of Serbia through monitoring of production process.*
Monitoring of circular economy is showed in the example of the company "MB INTERNACIONAL" that produces cardboard packaging, and it is done by using indicators of circularity MCI.
After applying the methodology in the concrete example, it is concluded that circular economy can be used in the Republic of Serbia, but in order to do so, it is necessary to define proposals and measures for improving the circular economy.
Keywords: *Circular economy, monitoring, material circularity indicators, methodology.*

1. INTRODUCTION

Nowadays, biological balance of the Earth is broken, which has the effect on endangering the environment. That instability is caused by global issues, such as water and air pollution, etc. For that reason it is necessary to develop prevention systems, in a way which could enable prevention of the pollution at the source of their creation.

Interest in maintaining and improving the quality of the environment is growing and has been implemented into sustainable development strategies. According to the Brundtland Commission, sustainable development is the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs [1].

Transition from linear to circular economic model is proven method to improve the quality of the environment is.

Considering that this topic is significant for the improvement of environmental quality, both in the world and in the Republic of Serbia, the aim of this paper is checking the possibilities of implementation of circular economy in the Republic of Serbia on the example of a company.

2. THE TRANSITION FROM A LINEAR TO A CIRCULAR ECONOMY

Economics is defined as a scientific discipline that studies the economic activities of a society that uses scarce resources for the production of goods and services and distributes them among members of society [2]. An important segment of economy is life cycle of the product. Based on the life cycle of the product, all stages, from the extraction of raw materials which are used for the production, all the way to its disposal, are being studied.

Every product which occurs in the process of production, service or other activities, as well as unwanted materials that occur in the process of consumption or materials that are not suitable for further use, are considered under waste [3].

The last stage of life cycle of the product is considered the most critical for the environment, because it includes the activities which are related to waste treatment. However, some products have cyclic movements in the last stage. In other words, waste has the possibility to be transformed and prepared for reuse, by which the significant saving could be achieved.

2.1. Linear economy model

Current production model of the goods is based on the transformation of resources into ready to use products and their disposal, by which life cycle of the product is not ecologically suitable, which can be proved by certain analysis, such as life cycle assessment.

That way of production is called linear economic model which functions by „take – make/use – dispose“ methodology.

That kind of product life cycle was never sustainable, ecologically acceptable and economically cost-effective.

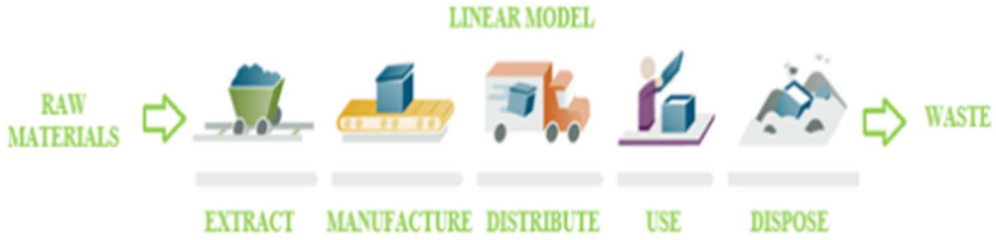

Figure 1 - Product flow in a linear economy [4]

Linear model of production is schematically shown in figure 1. It is consisted of the extraction of resources and their use in the process of production, distribution of products, market placement, use of products by consumers, and finally product disposal in the form of waste.

Based on the figure 1, linear economic model is in interdependence with the environment, society, economy and suroundings in every of its stages, and therefore it encounters a large number of limitations [5].

Preventive measures for the improvement of waste management system are defined with the priority schedule, ie waste management hierarchy.

The best option in the waste management system is the prevention of waste generation, which primarily refers to the optimization of resources, or the use of waste material generated in the production process in the re-production process of the same or other kind of product, reuse, then recycling products, sharing products or services among consumers instead of buying, etc. With the time, all of this preventive measures has defined the modern concept of circular economy, which is still evolutionary.

2.2. Circular economy model

According to the circular economic model, life cycle of the product represents the opposite to a linear model, because instead of one direction flow of the materials and energy, in the circular economy there is circular flow.

Circular economy is the approach in the production that transforms the function of resources – waste from the facilities becomes valuable material in other production process, and the products themselves can be repaired, reused or improved instead of being disposed [6].

Figure 2 - Circulation of material in the circular economy [7]

Therefore, the circular economy generates additional value of the product, while it eliminates waste and maximise the use of the product, which is shown in figure 2.

The aim of circular economy is to reduce environmental preassures, ie ecological

footprint associated with the extraction of resources, emission and waste disposal.

The model of circular economy differentiates between two types of cycles:

- biological cycles, in which non-toxic materials are restored into the biosphere while rebuilding natural capital, and
- technical cycles, in which products, components and materials are restored into the market at the highest possible quality and for as long as possible, through repair and maintenance [8].

2. PROBLEM STATEMENT

Adoption of circular economy on macro and micro level brings with it numerous benefits, which can be classified into three basic groups: economic, social and ecological benefits. However, for the further development of the circular economy there are certain barriers, of which the lack of legal regulation in this area is more indicative, as well as the lack of indicators to determine the level of circularity of organizations.

Monitoring or tracking progress towards a circular economy is a challenging and difficult task, because the development of a circular economy is not limited to certain materials, products or sectors. It is considered to be a systemic change that affects the entire economy and includes all products and services in different sectors [9].

Problem that occurs with the lack of tracking and evaluation of circularity, has been figured by the foundation „Ellen MacArthur“, considering that, in 2015 for the first time the foundation has launched and published the project „Circularity indicators“. Project „Circularity indicators“ for its goal has to solve the problem of missing indicators in the field of circular economy and to develop methodology, which should estimates how well the product or the company is performing transformation from linear into circular model of running business.

So the general goal of this paper is to provide an adaptation of the methodology for determining the level of circularity for companies which operate in the Republic of Serbia, as well as defining measures to improve their circular economy model.

3. CIRCULATITY ASSESSMENT IN COMPANIES

A circularity assessment tool is suggested by Foundation Ellen MacArthur as the first step in the transition towards a circular economy.

Based on the publication of “Circularity Indicators”, for determining the levels of circularity of the company, at first it is necessary to determine circularity level of all products which that company is producing.

Circularity level is determined by Material Circularity Indicator – MCI.

3.1 The Material Circularity Indicator for products

Material Circularity Indicator is defined as a basic indicator that shows the extent to which the linear flow of a product is reduced, and to what extent the circular flow of the product has improved (or increased) [10]. This indicator is determined for each product, based on the material from which it was made, and therefore, it is considered that already in the process of product design, the level of circularity can be affected.

The flows of materials which are used during the MCI_P evaluation are shown in figure 3.

For determining MCI_P of the product the following data is necessary:

- mass of materials used in the process of production (mass of raw, recycled and reused materials),
- mass of unrecoverable waste, disposed on the landfield or waste used for generation of energy,
- utility factor that takes into account the length and intensity of product use on the market compared to a competitors’s similar product, and
- the efficiency of recycling processes after the production phase and after the product use phase.

Based on the data collected and analysed, the results of the circularity can be determined.

The obtained values MCI_P are found between two extremes, ie between 0 and 1 [11]. A higher value indicates a higher level of circulation.

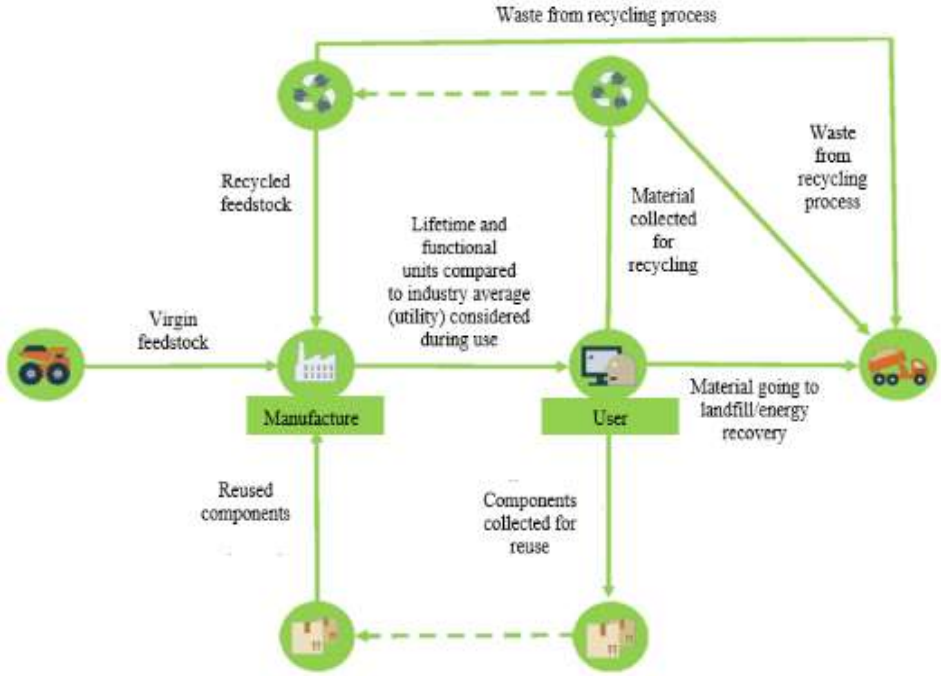

Figure 3 - The material flows used for determining MCI_P ***of a product [10]***

Methodology used for determining material circularity indicators should be based on real information about the product. However, when these information are not available, the data used is data related to representative products in that field of industry.

3.2 Company level indicators

Methodology for determining material circularity indicators at the company level is following general approach, such as determining MCI_P at the level of a product. Therefore MCI_C at the company level is obtained as the average value of worth at the level of a product.

Since companies have wide range of products it is necessary to determine only certain, reference products, to calculate the circularity. For reference products are taken products with the highest demand during the observed period of time.

Except that, it is important to apply DE MINIMIS rule, which allows the omission of certain products from the estimation, in case their share in total mass of products or in total sales, given in domestic currency, is lower then 5 % [10].

As the most important indicator, while determining companies circularity are considered the normalization factors.

4. APPLICATION OF CIRCULAR ECONOMY METHODOLOGY IN SERBIAN COMPANIES

In order to adopt described methodology by companies operating in the Republic of Serbia, it is necessary to adapt methodology appropriately for Serbia legislation policies.

4.1 Case study

The company that has been selected as a representative example for the circularity determination in Serbia is "MB INTERNACIONAL". It is located on the territory of Kragujevac, and its main activity is the production of the packaging made from paper and cardboard, and similar products.

The algorithm of the proposed methodology is realized in the following steps:

Step 1. Inventory list, consisting all the product manufactured in the analyzed period of time has been made. For analyzed company, it

has been concluded that inventory list consist out of 41 products.

Step 2. Related product groups has been formed, based on the similarity of material composition. Company product range is devided in 8 groups, which are: cardboard plates, printed cardboard plates, boxes for rolls and cakes, boxes for cookies, boxes for cakes with an opening, cake pads, pergament paper for muffins and cookies and party program.

Step 3. Table that consist out of certain data related to every product from each group has been created, and it contains information such as: name, model of the product, quantity of sold units of the product in the observed period of time, unit price of the product, unit mass, the total mass of sold units in the observed period of time and the total worth of manufactured units.

Representative examples will be shown for the group of products, called *party program*, like it has been shown in the table 1.

Table 1 - Standard accounting information for one group of products

PARTY PROGRAM					
Name of product	**Units sold**	**Unit price (RSD)**	**Unit mass (kg)**	**Total Mass Sold (kg)**	**Total Revenue (RSD)**
Birthday hat 1/6	3,900	44.80	0.075	292.5	174,720
Birthday cup 1/10	3,120	45.00	0.055	171.6	140,400
Party set 3/10	1,890	58.00	0.080	151.2	109,620
Birthday trumpet 1/6	2,400	71.00	0.045	108	170,400
SUM				**723.3**	**595,140**

Step 4. DE MINIMIS rule has been applied. The company has been analyzed for 30 days and during that period, the mass off sold products was 14,317.60 kg, while the total sales, given in domestic currency was 4,896,785.00 RSD.

By the application of DE MINIMIS rule, from the estimation of circularity of a company, group of products *boxes for cookies* has been omitted, because of its share in the mass of products, which is aprox 4.05%, while its share in the total sales aproximates 2.69%.

Step 5. Reference product from each group should be chosen.

As it was mentioned, for the representative group of products, *party program*, as a reference product, a *birthday hat 1/6* has been chosen.

Step 6. For each reference product the table „bill of materials“ has been created, and it includes data about materials and mass of material which goes into the process of production, ie which includes information related to recycled or reused materials, and also informations about predicted share of materials which could be recycled or reused after the stage of product use.

Bill of materials for the group of products *party program* is shown by the table 2.

Table 2 - Bill of materials for Reference Product

Birthday hat 1/6						
Component	**Material**	**Mass (kg)**	**%Recycled feedstock**	**%Reused feedstock**	**%Recycled after use**	**%Reused after use**
Hat	Cardboard	0.0695	97%	0%	100 %	0%
Label	White paper	0.0005	0%	0%	100 %	0%
Deco layer	Color	0.0020	0%	0%	0%	0%
Bag	PE	0.0010	50%	0%	100 %	100%
Contact layer	Glue	0.0020	0%	0%	0%	0%

However, as it is necessary to determine the share of materials used in the production process for a reference product, and not for each of its components separately, statistical technique - the arithmetic mean is used, and table 2 is transformed into table 3.

Step 7. Real lifetime expectancy of the reference product is defined, as well as the average lifetime of a similar competitor's product, and also the real number of functional units and the average number of functional unit of a similar competitor's product.

Table 3 - Bill of materials for Reference Product

Product	Mass (kg)	%Recycled feedstock	%Reused feedstock	%Recycled after use	%Reused after use
Birthday hat 1/6	0.075	29.4%	0%	60%	20%

If it is not possible to insure solid estimation of a lifetime and the numbers of functional units, it is necessary to adopt the fact that these parameters are equal and that their ratio equals 1 [10].

Step 8. Using the mathematical formulas MCI_P is determined for each reference product. The estimation is done by using Microsoft Excel software.

Representative example of MCI_P determination for a *birthday hat* is shown in the figure 4.

Step 9. Normalization factors are defined for every product.

For this case study, for the normalization factor, mass of the product group was taken.

Step 10. Mathematical combining of MCI_P was done at the level of the product, in order to calculate level of circularity of a whole companyMCI_C.

4.2 Results and disscussion

By repeating the above described process for all of the reference products of the company „MB INTERNACIONAL“, the values of all product circularity MCI_P are obtained, and shown in the table 4.

Final result of „MB INTERNACIONAL“ circularity is 0.47.

Table 4 - Results of M$\boldsymbol{CI_P}$ ***for Reference Products***

Name of product's group	Mass of the group of product [kg]	$\boldsymbol{MCI_P}$
Cardboard plate	3.977,86	0,49
Printed cardboard plate	1.607,09	0,39
Perchment paper for cakes and muffins	455,50	0,32
Pads	3.181,10	0,46
Boxes for rolls and cakes	3.245,00	0,53
Boxes with plastic hole for cakes	547,50	0,39
Party program	723,30	0,44

	Data	Units
METRICS FOR CORE SUSTAINABILITY INDICATORS		
Product total mass (M)	0,08	kg
Product mass from recycled feedstock (Fr)	29,40	%
Product mass from reused components (Fu)	0,00	%
Product sent for recycling at end of life (Cr)	60,00	%
Product sent for reuse at end of life (Cu)	20,00	%
Efficiency of recycling process at end of life (Ec)	40,00	%
Efficiency of recycling process for feedstock (Ef)	55,00	%
Product lifetime **OR** Product use (L or U)	1,00	Years
Industry average lifetime **OR** industry average use (Lav or Uav)	1,00	Years

Material Circularity Indicator (MCI)	0,44

Figure 4 - Excel table which is used for evaluating MCI

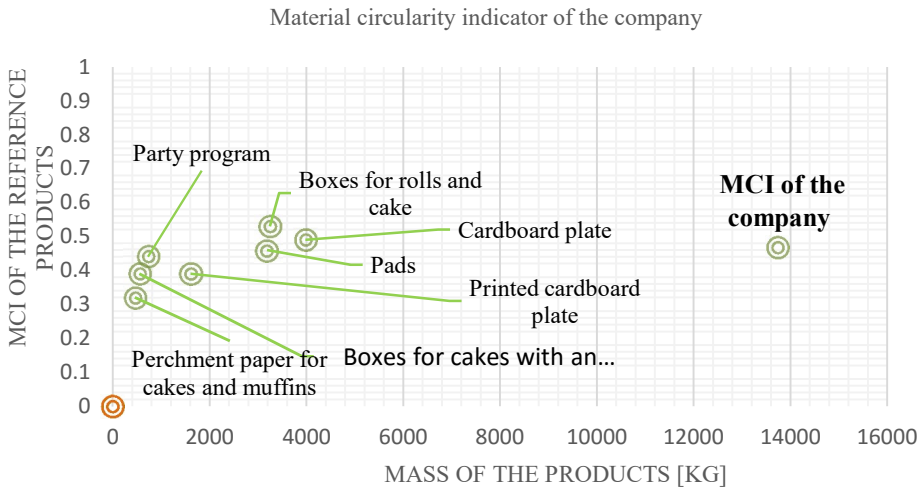

Figure 5 - Results of circularity

Results are shown in the figure 5 and it shows that the company operates using a business model which is in the between of linear and circular model.

Recommendations for the improvement of circularity in the company „MB INTERNACIONAL“ at first are related to re-designing of the products through introduction of eco-design.

Also, the improvement of the company circularity could be obtained by the appliance of high budget activity.

Implementation of circular economy in the company „MB INTERNACIONAL“ is possible, as well as the improvement, although, at first it is necessary to effect on the consumer awareness in order for him to understand the importance and the necessity of such change because the waste is a resource which is necessary to be used in the proper and efficient way.

5. CONCLUSION

Republic of Serbia as the candidate for the membership in the EU is adapting its legislation according to legislation of EU, which implies reduction of waste, its exploitation, reuse, treatment and waste disposal in a way which is safe for the human environment. Application of circular economy measeures, which serves to transform the whole system of waste management, is necessary for the Republic of Serbia. After applying the methodology Ellen MacArthur on the example of a company which operates in Serbia, it is concluded that circular economy is not a novelty for the companies in the Republic of Serbia, although because of the lack of legislation in that field, Serbian social system still doesn't recognize circular economy as a possibility for a future development. Implementation of evolutionary methodology analyzed in this paper, needs to enable the monitoring of progress towards circular economy in companies.

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