

Chapter 7

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NEW TRENDS IN GREEN MANAGEMENT

Abstract: Waste production is one of worldwide biggest problems nowadays. On one side we face to environment contamination and on the other side there is deficiency of sources. A paper compares circular economy model with waste management in the Slovak republic. System of waste management in the Slovak republic is described in the first part of the paper. Than circular economy model is explained. After that output of questionnaire survey is presented. The questionnaire is focused on waste management situation in Slovak industrial companies. Finally situation in the Slovak republic and the circular economy model are compared. Potential of the circular economy model usage in Slovak industrial companies is described in the end of the paper.

Key words: Waste management, Cradle to Cradle, Circular economy, Material

7.1. Cradle to Cradle

We can see that behaviour in field of ecological issues is changing nowadays. Lowering of waste management costs and compliance with law are substitute with proactive approach. The change is represented by prevention, responsible product design or by analyses of product lifecycle (SIPS K., KUPPERS P. 2011).

People are looking for alternative ways of living. It is because of problems with unemployment, increasing of energy and materials prices, population explosion, lack of water and food and climate changes.

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Circular economy could be a solution for many of them (SMITH T. 2012a).

Walter Stahel is one of founders of industrial sustainability. He established “Cradle to Cradle” concept in the end of seventies. Stahel worked on “Close Loop” principle in industrial production. He founded Product-Life Institute in Geneva, Switzerland in 1982. His main goals are to longer product life, remedies and to prevent generation of waste (BLÉRIOT J. 2012).

Cradle to Cradle concept is getting into the minds nowadays. It happens mainly thanks to American architect William McDonough and German chemist professor Michael Braungart They published book Cradle to Cradle: Remaking the Way We Make Things in 2002 (HELLASSITES 2008).

Challenges of Circular Economy by Walter Stahel (PRODUCT-LIFE INSTITUTE 2008a):

- Significant economy difference between repeated reusing of goods and recycling of molecules.
- The smallest loop is the most advantageous one in sustainable corporate strategy.
- It is necessary to make supporting laws and policies. Making loops of material flow is not enough.
- Connection between energy/input sources and job creation in Loop Economy.

Our system works on linear principle. On the other side the Earth works on circular principle for million years. Waste does not exist in nature. Materials are part of loops. Someone’s waste is food for the other one. This systems use safe energy form the Sun (SMITH T. 2012b).

Sources are mined, than products are manufactured, later they start to be boring for us. So we bury or burn them. Sources of planet are depleted on one side and waste pollution is increased. This is not a sustainable way of life (SMITH T. 2012a).

One of goals of cycle economy is to completely eliminate waste. It is possible if designers use Cradle to Cradle principles in their work (SMITH

T. 2012b).

Thinking about sustainability goes forward thanks to Michael Braungart and William McDonough. Linear thinking about material flow “from Cradle to Grave” lead us lower our negative impact on environment. But it does not take into account the cause of waste. It is better to use circular way of thinking in production and consumer behavior. Cradle to Cradle concept is in harmony with this framework (SIPS K., KUPPERS P. 2011).

Five main principles (SMITH T. 2012a):

- Waste became food. Biological and technical materials should bring new value.
- Various systems are resistant systems.
- Energy of system must come from renewable sources.
- Price must be true. We cannot pay to nature with money. We can pay with our care.
- We should focus on systems rather than on their individual elements.

One of main goals of Product-Life Institute is economy of functional services. It means we should not sell goods. We should rather provide services. And prices should count with all real costs. This model is known as “Cradle to Cradle” or “Circular economy”. Other goals are: to longer product life, design of products with long life, corrective actions, waste prevention (PRODUCT-LIFE INSTITUTE 2008b).

Cradle to Cradle is not just concept of waste management. It is radical innovation in business area. Aim is to remove all negative impact of human activity in nature. This include also waste (VEZZOLI C., ORGETEGLI L., CORTESI S. 2011).

Dead bodies of plants and animals are absorbed into soil and recycled. Our way of life could be similar. Circular model takes example from nature (SMITH T. 2012b).

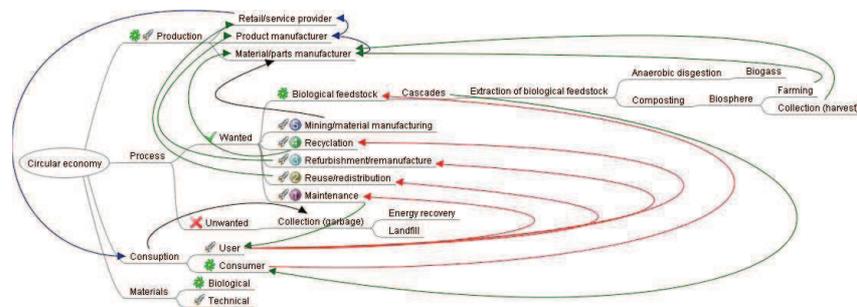
We do not make a chose between economy and ecology prosperity. They can work by each other. Cradle to Cradle shows this to us. We need to build our products, processes, buildings and cities smarter to achieve

this (HELLASSITES 2008).

Cradle to Cradle wants safe and healthy production and maximization of positive impact of human activity. It provides business opportunities in areas: focus on added value and increasing of quality (SIPS K., KUPPERS P. 2011).

Materials are divided into two groups in Circular Economy: group of technical materials and biological materials. After end of product life they can turn back into their cycle (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

We need to disassemble product and separate materials from each other to achieve this. We can use these materials for manufacturing of new product. Name of this issue is design for disassemble. Many designers have made progress in the area. Their products are demountable. Life time of product ends. Biological materials are safely returned back to nature. Technical materials are returned to production in high quality. They are used again and again. We need to change our linear way of living to circular way. Concretely we need to change way we designing, manufacturing, using and throwing away of things (SMITH T. 2012b).



Black line – classical flow, Red line – circular flow from consumption to the system,
Green line – material supply flow Blue line – supplier relationship

Fig. 7.1. Circular economy map.

Source: Ellen MacArthur Foundation circular economy team 2013

Biological materials are materials which enter back into biosphere. Then they produce new biological capital. If product consists of both technical and biological materials it is called hybrid product. If materials are separable, each can be placed to its place (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

So biological materials come back to nature and technical materials come back to system.

The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy (DIRECTIVE ON WASTE 2008):

- (a) prevention;
- (b) preparing for re-use;
- (c) recycling;
- (d) other recovery, e.g. energy recovery; and
- (e) disposal.

Slovak waste management program includes the waste hierarchy as well.

This is not common on market nowadays. It places importance on esthetics and functionality more than on anything else (SMITH T. 2012b).

Cascades from figure 1 mean separation of materials and components after end of life of various value flows (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Extraction of biochemical feedstock is usage of biomass change processes and production of chemical products with small volume and with big value. It includes manufacturing of liquid fuels for production of energy and heat. In “biorafineries” more than one kind of products or energy is made (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

If we wanted to achieve low carbon economy, we should use renewable energy. If we wanted to achieve circular economy principles we would need lots of energy (SMITH T. 2012a).

Anaerobic digestion is a process. In this process microorganisms break up structure of organic materials. Organic materials means food

scraps, fertilizers, and mud. The process works without air. Biogas and solid residue are made this way. The biogas consist primary of methane and carbon dioxide. It is an energy source similar to natural gas. Solid residual can be inserted into soil (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Composting is a biological process. In this process microorganisms (for example bacteria and mushrooms), insects, snails and earthworms break up structure of organic materials and change it into soil. Organic materials are in this case leaves, grass, garden waste and food scraps. Composting is a natural way when biological materials are returned into soil (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Biogas is a kind of biofuel. It arises when biological material is broken up without air (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Our systems rely on fossil fuels. They are centralized. They provide energy concentrated in one place. It is ineffective because of complicated links. Circular Economy prefers power systems powered by the Sun, which are more effective. It means sun energy, wind energy, wave energy and geothermal energy (SMITH T. 2012a).

Soil restoration is a phase of biological cycle. Materials are available for plants and other organisms. This system is refreshed cyclically and it is powered by sun (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Biosphere means complex of all ecosystems of planet. It includes all forms of live and their environments. It is thin surface layer of the Earth with its atmosphere up to 20 kilometers (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Biochemical feed stock represent chemical components in biological form. They can be returned into biosphere (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Farming/collection is a phase when organisms in biosphere are utilized. It can be done by agriculture, hunting or fishing (ELLEN

MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Material/part manufacturer use basic materials, biological or technical, for manufacturing of parts and products from the parts. It includes for example manufacturers of floors from biological materials and manufacturers of engines from technical materials (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Product manufacturer make final products from parts. It is for example baker or car manufacturer (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

We need to change more than products to achieve effective circular economy. We need to design new business models. Goal is to change selling of products into selling of their usage or lifetime (SMITH T. 2012b).

Retail/service provider traditionally make connection between manufacturer and consumer. It is for example grocery or car salesman. In circular economy it has wider meaning. Circular economy aims to sell services rather than products. It means for example to sell few washing cycles rather than dish washer. Ownership of the device is not changed (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

User/consumer covers whole process from buy of product to loss of its value for primary user. Usage means to use service of device without damage of the device. On the other hand consumption includes destruction of the product. Circular economy aims to increase number of rental agreement when durable products are used (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Manufacturers and seller would own materials and have responsibility for them all the time. Companies have motivation to develop collecting systems and make durable and repairable products (SMITH T. 2012b).

According to (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013):

- Collection is a process when materials are returned back into one of cycles at the end of product life time. They are not

landfilled or burnt.

- Energy recovery is given for unrecyclable waste. It is transformed into heat, electricity or fuel. Techniques for transformation waste into energy are used
- Landfill is kind of waste disposing. Solid waste is stored on special place on the ground or in the ground.
- Maintenance means to retain good conditions of product without change of user.

Re-use means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived (DIRECTIVE ON WASTE 2008).

Reuse/redistribute means that product can be used the same way and with the same conditions as before. It is just least modified and cleaned (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Circular Economy aims to get important sources into cycle. In nature waste becomes food the same way. So in Circular Economy waste of today becomes source of tomorrow (SMITH T. 2012b).

Refurbishment is change or repairmen of main product components. The components are usually wrong or too worn. It includes also modernization, change of structure or colour (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Recovery means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II sets out a non-exhaustive list of recovery operations (DIRECTIVE ON WASTE 2008).

Remanufacture means removal and recovery of product. It happens on subassembly or component level. Good parts are removed and used again. It includes quality control and improving or change of components (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the

original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations (DIRECTIVE ON WASTE 2008).

Mining/materials manufacturing is making of inputs for technical materials cycle (ELLEN MACARTHUR FOUNDATION CIRCULAR ECONOMY TEAM 2013).

When we talk about sustainable development, we should consider its social and ethical dimension. It includes usage and specification of local sources, responsibility of consumers for sustainable consumption, consumption habits, fair treatment with all stakeholders, strengthening of social solidarity and inclusion of disadvantaged and weaker persons (VEZZOLI C., ORBETEGLI L., CORTESI S., 2011).

Five pillars of sustainable economy and society (PRODUCT-LIFE INSTITUTE 2008b):

- Conservation of nature.
- Lowering of toxicity.
- Creation of resources.
- Social ecology.
- Cultural ecology.

7.2. Waste management in the Slovak republic

There are good legislative conditions for Cradle to Cradle solutions in Slovakia. They are based especially on law number 223/2001 Z. z., notice number 283/2001, waste management program and directive 2008/98/EC. The directive is a basis for all other legislative tools.

Responsibility for waste (material) is borne by holder or manufacturer. In case of municipal waste it is a village (WASTE DISPOSAL ACT 2001).

Waste management in the Slovak republic is still built on cradle to grave system. It means lowering of waste production. There is a challenge to stop a change of material ownership when customer needs

are meet. The responsibility for material should stay in business area and needs should be meet by services, not by products. We really need to change our understanding of product selling into services providing by the product in area of technical materials. It is because business sector is able to manage material flow processes better than private persons and public organizations. Companies dispose advanced material flow management tools, which can be used in minimizing volume of waste effectively.

There is a recycling system based on a recycling found. Manufacturers and importers have to pay a fee into the recycling found. Recycling projects are sourced by money from the recycling found. On one hand manufacturer or importer does have to pay the fee if it will provide recovery of materials after life cycle of a product. On the other hand it can not take finances for the recovery process from the recycling found (WASTE DISPOSAL ACT 2001)

After all there is quite big waste production in Slovakia. It was 10 835 724.56 ton in 2011. And what is more 48.91% of waste volume was disposal (ENVIROPORTÁL 2013). In fact round 5 million tons of material is destroyed in Slovakia per year.

We try to prevent contamination of environment from landfills by modern technologies. But materials are mixed and a volume of waste increase from year to year. The situation is not sustainable.

7.3. Conclusions on waste management in Slovak industrial enterprises

To analyse the waste management in Slovak industrial enterprises we have prepared a questionnaire survey. The questionnaire consisted of twelve questions and was focused on adherence of Cradle to Cradle and circular economy principles. Questions were divided into the following areas: material health, waste management, CO₂ emissions, greenhouse gasses emissions, quality of waste water and social responsibility. Fifty companies with their products participated on the survey.

As a basis Cradle to Cradle principles are not widespread in Slovak industrial enterprises whereas only 22% stated that have a basic knowledge.

Waste management is an integral part of the product design in 80% of the companies from the sample.

Still 40% of the products are made of inseparable materials where for the application of the Cradle to Cradle principles the requirement is 100% separability of the materials.

In our sample one third of industrial production consisted of hazardous materials, which are in Cradle to Cradle principles strictly prohibited.

All in all less than 35% products satisfy required Cradle to Cradle principles. Further 52% of products are made of recycled materials and 56% of bio-degradable materials.

Bibliography

1. WASTE DISPOSAL ACT 2001 Z. z. 223/2001 o odpadoch a o zmene a doplnení niektorých zákonov. viewed 19 April 2013 <<http://www.zakonypreludi.sk/zz/2001-223>>
2. BLÉRIOT, J. 2012. *Chapter I - „Good rather than less bad“: the circular approach*. Ellen Macarthur Foundation. viewed 19 April 2013 <<http://www.ellenmacarthurfoundation.org/circular-economy/circular-economy/good-rather-than-less-bad-the-circular-approach>>
3. DIRECTIVE 98/2008 EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives. Official Journal of the European Union. viewed 19 April 2013
<http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:en:PDF>>
4. Ellen MacArthur Foundation circular economy team. 2013. *Interactive system diagram*. Ellen Macarthur Foundation. viewed 19 April 2013 <<http://www.ellenmacarthurfoundation.org/circular-economy/circular-economy/interactive-system-diagram>>

5. Enviroportál. 2013. *Produkcia odpadů a nakladanie s odpadom v SR*. Enviroportál. viewed 19 April 2013 <<http://cms.enviroportal.sk/odpady/verejne-informacie.php>>
6. HellasSites. 2008. *Cradle to Cradle: Introducing the concept*. Money Conferences. viewed 19 April 2013 <http://www.moneyconferences.com/OLD/eng/synedrio1_b.asp>
7. Product-Life Institute. 2008a. *Cradle to Cradle*. Product-Life Institute. Geneva. viewed 19 April 2013 <<http://www.product-life.org/en/cradle-to-cradle>>
8. Product-Life Institute. 2008b. *Welcome to The Product-Life Institute*. Product-Life Institute. Geneva. viewed 19 April 2013 <<http://www.product-life.org/en/node>>
9. SIPS, K., KUPPERS, P. 2011. *A Journey from Cradle to Cradle. C2C Network Initiatives Guide*. Gruppo Stampa GB. viewed 19 April 2013 <http://www.c2cn.eu/sites/default/files/C2C_InitiativesGuide_2011.pdf>
10. SMITH, T. 2012a. *Circular economy #1: Why pollution, resource depletion and climate change tell us it's time to ditch our linear vision of growth*. RTCC – Responding to Climate Change. viewed 19 April 2013 <<http://www.rtcc.org/linear-to-the-circular-the-principles-of-a-new-economy/>>
11. SMITH, T. 2012b. *Circular Economy #2: How can we redesign our production cycle to remove waste and create new resources?* RTCC – Responding to Climate Change. viewed 19 April 2013 <<http://www.rtcc.org/circular-economy-2-how-can-we-redesign-our-production-cycle-to-remove-waste-and-create-new-resources/>>
12. VEZZOLI, C., ORBETEGLI, L., CORTESI, S. 2011. *C2C Network Perspective Study: Industry*. Milan. INDACO. viewed 19 April 2013 http://www.c2cn.eu/sites/default/files/C2C_PS_industryC2C.pdf