Interreg Danube Region

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Plan-C

DESIGN THINKING

Moving PLastics and mAchine iNdustry towards Circularity

Plan-C

Shaping the Future of Plastics – Designed for Circularity

From Waste to Value – Together for a Circular Industry.

Introduction

This publication was created within the framework of the **Plan-C project**, which aims to drive the circular transformation of the plastics and machinery industries across the Danube region. The project brings together plastics producers and machine manufacturers in a unique collaboration to co-develop **circular product and machine concepts** designed for reuse, remanufacturing, and long-term value retention.

Plan-C offers more than just a vision for a sustainable future – through **prototypes and innovative business models**, it delivers tangible solutions that demonstrate how waste can be turned into new value.
This publication aims to provide practical guidance for circular transformation, with a special focus on design thinking methodology and creative ideation techniques applicable to the machinery sector. It is intended primarily for those who:

- work in the **plastics or machinery industries**,
- are involved in **development, design, or innovation**,
- are exploring **circular economy business models**,
- or are simply open to new ways of thinking.

The content is closely linked to the Plan-C project's **Transnational Action Plan**, which offers ready-to-implement recommendations and concrete steps for circular product development and sustainable industrial collaboration – contributing to a shared, cross-border future in the Danube region.

How design thinking can be applied to circular transformation

Design thinking is particularly well-suited to circular transformation because it encourages a systems-level view of challenges while focusing on human needs and behaviours. By applying the five phases of design thinking, organizations can creatively address the complexities of implementing circular principles across all life cycle phases of machines. For example, during the **EMPATHIZE** phase, understanding how different stakeholders interact with machines throughout their life cycle reveals where circularity can be improved. The **DEFINE** phase helps narrow the focus to specific circular challenges, such as reducing resource use or improving end-of-life management. Through **IDEATION**, participants generate innovative ideas that challenge linear thinking, such as modular designs or service-based models. In the **PROTOTYPE** and **TEST** phases, these ideas are translated into practical, scalable solutions that can be piloted within organizations. The iterative nature of design thinking ensures that solutions are refined based on real-world feedback, making it an ideal methodology for driving circular innovation in the machine industry.

Techniques to encourage creativity and divergent thinking

Divergent thinking is at the core of the ideation process in design thinking, enabling participants to generate a wide array of ideas without immediately evaluating them. Encouraging creativity and divergent thinking is essential for developing innovative, out-of-the-box solutions, especially in complex contexts like circular transformation in the machine industry.

The key techniques include:

Brainstorming

Brainstorming is one of the most widely used and effective techniques for encouraging creativity. It involves group discussions where participants are encouraged to share as many ideas as possible in a free-flowing manner. To make brainstorming more effective:

- Set a clear focus: Start by framing the challenge in a way that promotes creativity. For instance, ask, “How might we reduce waste in the machine’s production phase?” or “How can we make maintenance more circular?”
- Avoid judgment: During brainstorming, all ideas are valid, regardless of how feasible or practical they may seem at first. This opens the floor to a range of ideas that might not surface in a more formal setting.
- Build on ideas: Participants should be encouraged to listen carefully to others and build on their ideas. This creates a snowball effect, where even small, initial ideas can evolve into innovative solutions.

Mind Mapping

Mind mapping is a visual brainstorming tool that helps participants explore a central idea and branch out into related topics or concepts. It is particularly effective in helping participants see connections between different aspects of the problem.
How to apply it:

- Start with a central question or concept, like “Circular transformation in machine manufacturing.”
- Draw branches for each phase of the machine’s life cycle, such as design, manufacturing, logistics, or end-of-life management.
- As participants contribute ideas related to each phase, continue to add branches and sub-branches, exploring different areas where circular economy principles can be applied. For example, under “manufacturing,” participants might branch out to ideas around material efficiency, renewable energy use, or waste minimization.

SCAMPER

SCAMPER is an acronym for a set of creative prompts that help participants explore ideas through different lenses. It encourages them to rethink existing processes or products by using specific actions. SCAMPER stands for:

- **Substitute:** What materials, processes, or components can be replaced with more sustainable or circular alternatives? For example, could steel parts be substituted with recycled or biocomposite materials?
- **Combine:** Can multiple phases or functions be combined to improve circularity? For instance, combining the manufacturing and maintenance phases by designing machines that automatically detect wear and send data for predictive maintenance.
- **Adapt:** How can an existing solution or process be adapted to improve circularity? Can we adapt existing technologies to make machines easier to recycle?
- **Modify:** What can be changed, minimized, or optimized? Could the size or shape of components be modified to use less material and reduce waste?
- **Put to another use:** Can machine components or materials be repurposed after their initial use? For example, can a component at the end of its life cycle be used in a different industry?
- **Eliminate:** What unnecessary elements can be removed to enhance circularity? Could packaging be eliminated or drastically reduced in the logistics phase?
- **Reverse:** What happens if the process or system is reversed? For instance, instead of linear waste management, can waste materials be reincorporated into the production cycle as raw materials?

Brainwriting

Brainwriting is a quieter, more introspective form of brainstorming where participants write down their ideas individually before sharing them with the group. This technique is effective for encouraging contributions from people who may feel less comfortable speaking up in traditional brainstorming sessions. The process typically involves:

- Providing each participant with a sheet of paper or a digital document to write down their ideas related to a specific problem, such as “How can we make machines easier to refurbish and reuse?”
- After a set time (e.g., 5 minutes), participants pass their ideas to the next person, who contributes by analysing, elaborating on or improving the initial concepts.
- The process continues for several rounds until each idea has been iterated upon by multiple participants.

Six Thinking Hats

Developed by Edward de Bono, the **Six Thinking Hats** technique encourages participants to approach a problem from different perspectives by metaphorically "wearing" different colored hats, each representing a distinct way of thinking:

- White Hat: Focus on data, facts, and information. For example, "*What are the known details about the machine life cycle and circular practices?*"
- **Red Hat:** Look at the problem through intuition and emotion. *What are the gut feelings or concerns about current practices that could inspire circular solutions?*
- **Black Hat:** Consider potential challenges and risks. *What obstacles might hinder circular transformation in the machine industry?*
- **Yellow Hat:** Focus on the benefits and opportunities. *What positive outcomes could result from applying circular principles to each life cycle phase?*
- **Green Hat:** Explore creativity and innovation. *What radical or unconventional solutions can we propose for more sustainable machines?*
- **Blue Hat:** Focus on process control. *How can we structure and manage the ideation process to ensure productive outcomes?*

Role-Playing and Empathy Mapping

Role-playing exercises and empathy mapping allow participants to put themselves in the shoes of different stakeholders, fostering creative thinking about their needs and perspectives. In the context of circular transformation, participants could:

- Take on roles such as machine operators, maintenance technicians, material suppliers, or end-of-life managers to explore how circular changes would impact their work.
- Use empathy mapping to delve deeper into stakeholder pain points, behaviors, and needs. For example: what does the operator experience when performing maintenance? What are their goals, frustrations, and concerns related to sustainability?

5 Whys

The 5 Whys technique helps participants identify the root cause of a problem by repeatedly asking "why" until the underlying issue is revealed. In the context of circular transformation, participants could:

- Start with a specific problem, such as excessive waste in the production process, and ask "why" it occurs.
- Continue asking "why" for each subsequent answer to dig deeper into the root cause.
  For example, why is there excessive waste? Why are materials not being reused? Why is there a lack of recycling infrastructure?
- Use the insights gained to develop targeted solutions that address the core issues, leading to more sustainable practices.

Affinity Diagrams

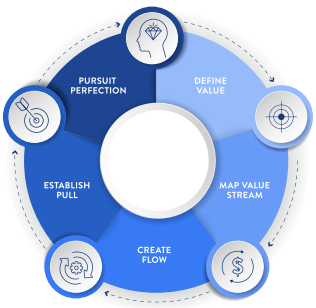
Affinity Diagrams allow participants to organize and categorize ideas, insights, and data into meaningful groups, fostering a deeper understanding of complex issues. In the context of circular transformation, participants could:

- Gather a diverse set of ideas and observations related to sustainability challenges, such as reducing carbon footprint, improving resource efficiency, or enhancing product lifecycle management.
- Group similar ideas together to identify common themes and patterns. For example, cluster ideas related to energy efficiency, waste reduction, and material reuse.
- Use the grouped insights to prioritize key areas for action and develop a cohesive strategy for implementing circular practice.

Methods to guide participants toward innovative, circular solutions

Guiding participants toward innovative, circular solutions requires structured methods that encourage creativity while maintaining a clear focus on circular economy principles. During the ideation process, the facilitator's role is to ensure that participants not only generate a wide range of ideas but also move toward solutions that align with the goals of circularity—reducing resource consumption, minimizing waste, extending product life, and improving recyclability.

Circular Value Mapping

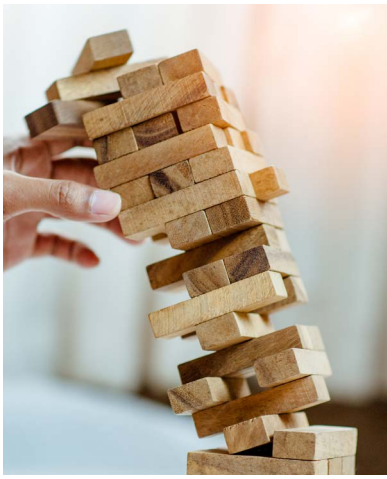


Circular value mapping is a method that helps participants identify value creation opportunities across different stages of a machine's life cycle by highlighting areas for circular interventions. The focus is on uncovering potential for value retention, recirculation, or creation through processes like material reuse, energy efficiency, or product-life extension. In practice, this involves:

- **Identifying key life cycle stages** and mapping out existing linear processes.
- **Pinpointing circular opportunities** at each stage. For example, participants may discover opportunities to recirculate materials through better recycling or reuse practices, or they might identify potential for reducing waste during the production phase by redesigning the manufacturing process.
- Facilitators ask probing questions, such as, "How can we retain more value at the design stage through modularity or product life extension?" or "What circular business models can emerge from shifting to product-as-a-service offerings in the use phase?"

By framing discussions around specific value-creating opportunities, participants are naturally guided toward solutions that maximize resource efficiency and circularity.

Reverse Brainstorming



Reverse brainstorming flips the typical ideation process by asking participants to first identify potential failures or barriers to circularity, then work backward to develop solutions to these problems. This method can be particularly useful when participants struggle to generate innovative ideas directly. In practice:

- Start by asking participants to brainstorm **how things could go wrong** in the machine's life cycle when it comes to circularity. For example, "What would prevent this machine from being easily recycled?" or "What could lead to excessive resource consumption in manufacturing?"
- Once a list of potential failures has been created, guide participants in brainstorming solutions to these problems. For instance, if the challenge is "Materials are difficult to separate at end-of-life," participants might propose a solution such as using standardized, easily disassembled materials.

Reverse brainstorming helps participants approach challenges from a new perspective, uncovering innovative circular solutions by addressing potential barriers head-on.

Value Proposition Canvas

This method can be applied to circular solutions by helping participants focus on how their ideas create both economic and environmental value. In practice, this tool guides participants through a structured process of matching customer (or stakeholder) needs with innovative circular solutions. It includes two main parts:

- **Customer Profile:** Participants define the needs, pains, and gains of machine users or other stakeholders (e.g., recyclers or maintenance technicians). They should explore pain points related to sustainability, such as difficulty recycling machine components or high operational costs due to inefficient resource use.
- **Value Proposition:** Participants then brainstorm how their circular ideas address these needs or alleviate pains. For example, a value proposition might involve developing a modular machine design that reduces downtime and facilitates easier upgrades, thereby meeting customer needs for long-term performance and lower total cost of ownership.

This method is particularly effective for guiding participants to align their circular solutions with real-world business and environmental benefits, ensuring their ideas are both innovative and practical.

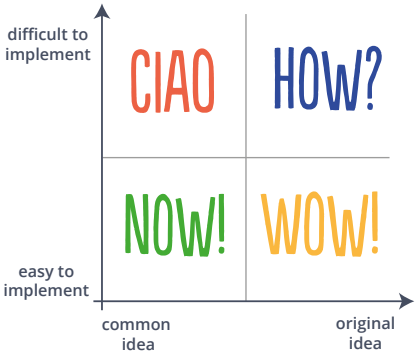
Crazy Eight

Create 8 ideas in 8 minutes without thinking of the technical/financial realizability.

Idea Tower

Choose the most promising idea out of these 8 ideas and encourage your co-workers to further develop that idea.

Feasibility-Impact Matrix or How/Now/Wow/Ciao - Matrix



This is a prioritization tool that helps participants assess the feasibility of their circular ideas alongside their potential impact. This method encourages participants to focus on solutions that are both innovative and practical. In practice, it works like this:

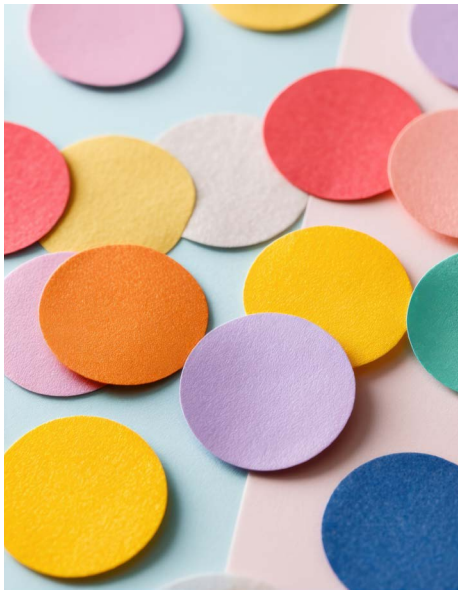
- Draw a 2x2 matrix, with **Feasibility** on the x-axis (low to high) and **Impact** on the y-axis (low to high).
- After brainstorming a range of ideas, participants plot them on the matrix according to how feasible they are to implement and their potential for impact. For example, a solution involving the use of recycled materials may have high impact but low feasibility due to current supply chain limitations.
- Once ideas are plotted, the group can focus on **high-feasibility, high-impact ideas** for immediate action and explore ways to improve feasibility for high-impact, lower-feasibility ideas.

Circular Business Model Canvas

The Circular Business Model Canvas is an adaptation of the traditional Business Model Canvas, specifically tailored for circular economy initiatives. This method guides participants to develop circular solutions that are not only innovative but also commercially viable. In practice:

- Participants use the canvas to map out key components of their circular business model, such as value propositions, key resources, customer relationships, revenue streams, and cost structures.
- Focus areas for circularity are added to each section. For example, under “Key Resources,” participants explore the use of renewable or recycled materials; under “Revenue Streams,” they consider product-as-a-service models.
- By filling in the canvas, participants develop comprehensive circular business models that integrate sustainability with economic viability, ensuring that their solutions are both innovative and implementable in real-world scenarios.

Dot Voting



Dot voting is a simple, yet effective technique used to help participants prioritize circular solutions based on collective input. It ensures that the group converges on the most promising ideas for further development. In practice:

- After brainstorming, facilitators present all the ideas to the group—often using sticky notes or a digital platform.
- Each participant is given a set number of dots (e.g., three to five) and asked to vote for the ideas they believe have the highest potential for circular transformation. Participants can place all their dots on one idea or spread them across several.
- The ideas with the most dots are then selected for further exploration and development.

Dot voting helps move the ideation process from a divergent phase (idea generation) to a convergent phase (idea selection) in a democratic, efficient way, ensuring that participants focus on solutions with the greatest consensus and potential.

Rapid Prototyping

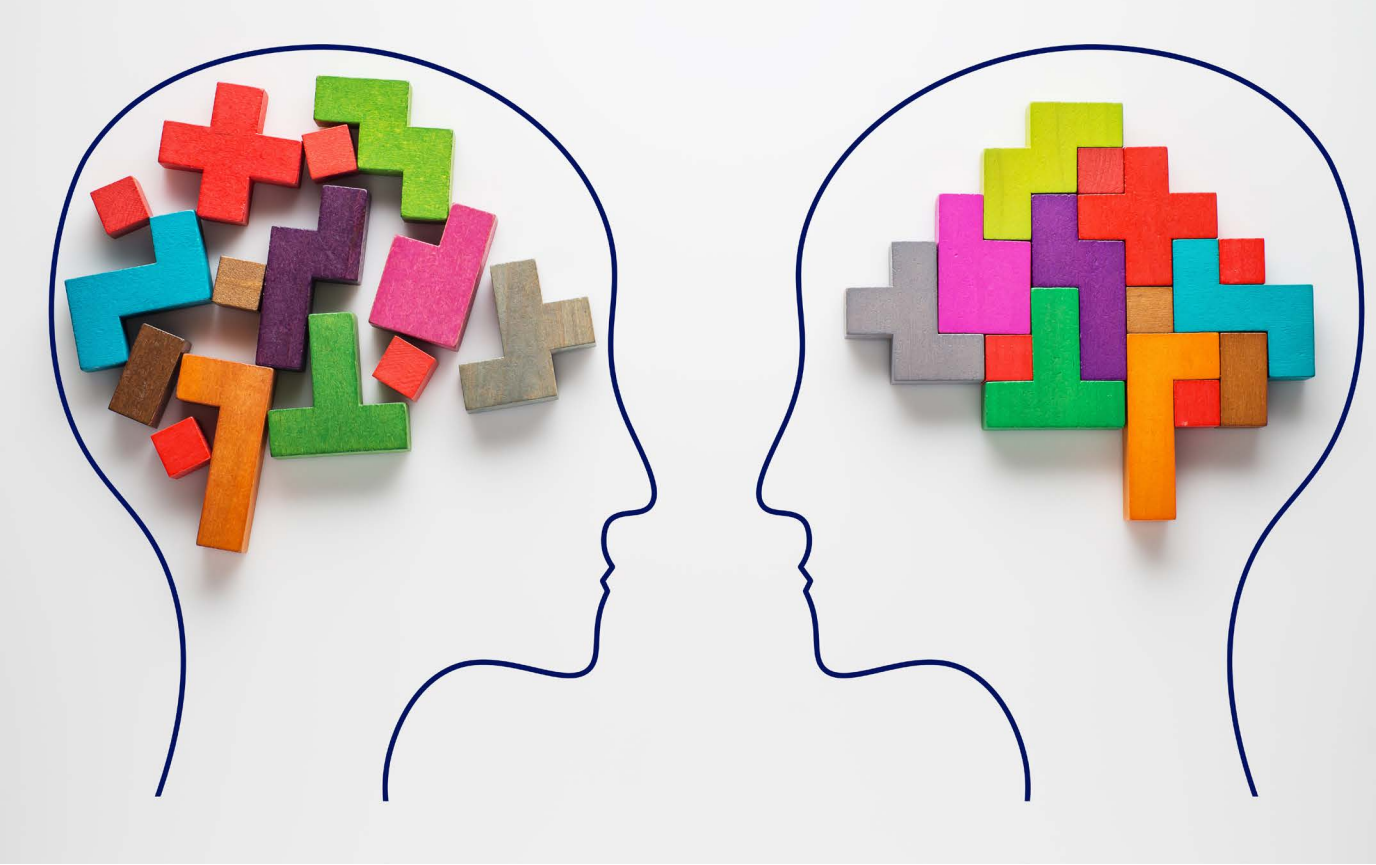
Rapid Prototyping involves quickly creating scaled-down versions of a product or solution to test and iterate on ideas. In the context of circular transformation, participants could:

- Develop quick, low-fidelity prototypes of sustainable products or processes using materials like paper, cardboard, or digital tools.
- Test these prototypes with stakeholders to gather feedback on functionality, usability, and sustainability aspects. For example, how does a new packaging design reduce waste? How easy is it to recycle or reuse the product?
- Use the feedback to refine and improve the prototypes, ensuring that the final solution is both innovative and environmentally friendly.

LEGO® SERIOUS PLAY®

LEGO® SERIOUS PLAY® is a hands-on, minds-on approach that uses Lego bricks to foster creative thinking and problem-solving. In the context of circular transformation, participants can:

- Build models representing different aspects of the circular economy, such as closed-loop systems, resource flows, or sustainable business models.
- Use the models to facilitate discussions and explore various scenarios. For example, how can a product be designed for disassembly and recycling? What are the potential impacts of a circular supply chain on different stakeholders?
- Encourage participants to share their insights and ideas through storytelling, using the Lego models as visual aids to communicate complex concepts and solutions.



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