The Circularity Grid

An Introduction

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Circularity Grid | Purpose

- We acknowledge that different types of resources move from one location to another under the influence of ‘hard’ factors, such as technologies and infrastructure, and ‘soft’ factors, such as management practices or culture. Circular systems differ from linear systems, and are generally more complex, and which affects costs, risks, information flow, stakeholder interactions, infrastructure needs, and dependencies.

- These factors and connections, like in any business, need to be managed appropriately. It is important to be aware of these differences, influences and relationships, as circular solutions may need a different approach from how a business or a value chain operates in a linear economy.

- The Circularity Grid offers a framework that helps us examine the complex connections and relationships of circular solutions, so that we could influence them to our advantage. This type of analysis also provides preliminary insights into what enablers are already in place, and what barriers can be expected along the way. On this basis, concrete actions can be outlined and prioritised in combination with the Circularity Grid tool.

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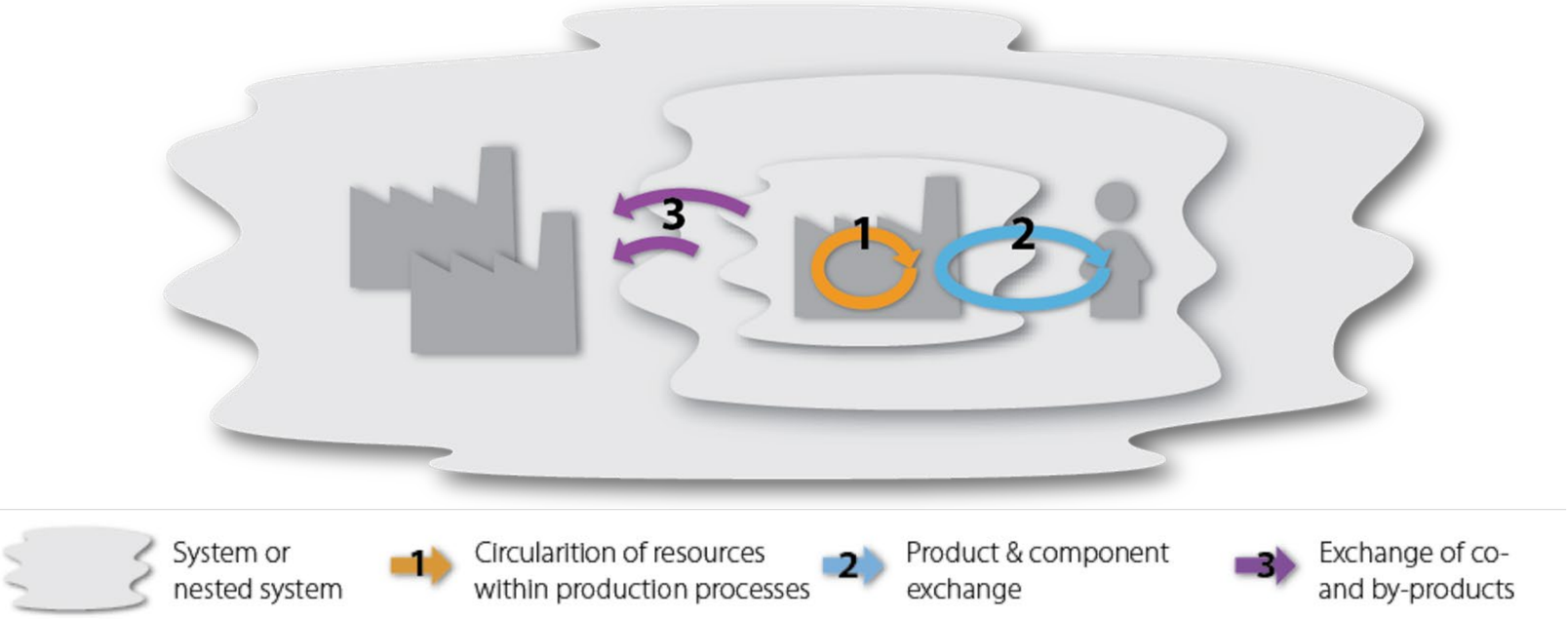
Circularity Grid | Structure

The Circularity Grid borrows from systems thinking methodology - in particular the concepts of *nested systems* and *feedback* or *coupling* - to examine the difference between linear and circular systems more closely.

Nested systems are used to distinguish between different ‘types’ of resource flows: e.g. flows within manufacturing processes, co- and byproduct flows, and part and product flows. Coupling explains how different outcomes are created as different (parts of) systems interact or relate to each other.



Together these three represent the major flows that can be circularised

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Circularity Grid | Structure

In line with this, the three different types of flow that can be distinguished are:

- Material flows generated and reused **within the same production process** (e.g. waste, water, energy);
- Material flows can be **by- and co-products** (e.g. produced in one place and used in another. Multiple production units);
- **Product and component flows in a broader system** (finished goods as well as parts, modules, or other resources).

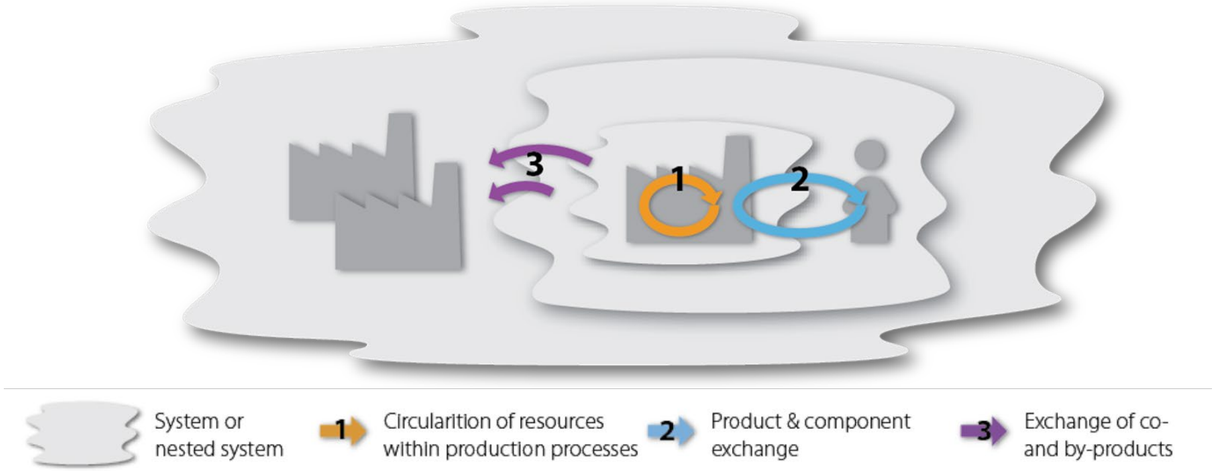
This typology is based on nested systems, or the idea that systems can be part of larger systems, and there are flows connecting all levels. These three describe the main types of flows within our economy, and hence these are the main flows we wish to 'circularise', however the connections are not always clean and recognizable in the real world.

In this image production processes are designated as a subsystem of the product and component system, which in turn is a subsystem of the wider economy within which both sub-systems exchange co- and by-products.

So that's one dimension of the Grid – the types of **flows.**

First dimension: Types of flow

The Grid offers a three part-typology for different types of flows. First of all, this visualization of nested systems highlights production flows and production systems within one company (orange circular arrow). Then, it highlights connections with neighbouring production systems or by-products that are moving into other systems (blue circular arrow). And beyond that, there are interactions with broader systems and pools of resources (purple arrow).



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Circularity Grid | Structure

The second dimension is the type of **coupling.**

Think of coupling as a scale where:

- Tight coupling means a direct and tightly controllable relationship;
- Semi-coupling represents a degree of influence, without complete ownership or control;
- Open coupling relies on much more loosely defined relationships.

To give an example in the area of part and product flows: tight coupling means a company coordinating a circular business model entirely in-house, semi coupling would imply a partnership between multiple companies or the involvement of intermediaries, and open coupling describes a type of relationship where one company performs circular activities without having a direct connection to the producer of the product that is circulated.

Different types of coupling can exist between different parts of a circular solution, especially if multiple circular strategies are involved. Understanding the nature of these interactions, and the strength and potential time delay of their effects (or lack thereof) are key to improving the design of circular systems and for planning the change process.

The three types of flows and coupling create a 3x3 matrix, the Circularity Grid, which uses real-life cases to further illustrate the different levels and archetypes of coupling.

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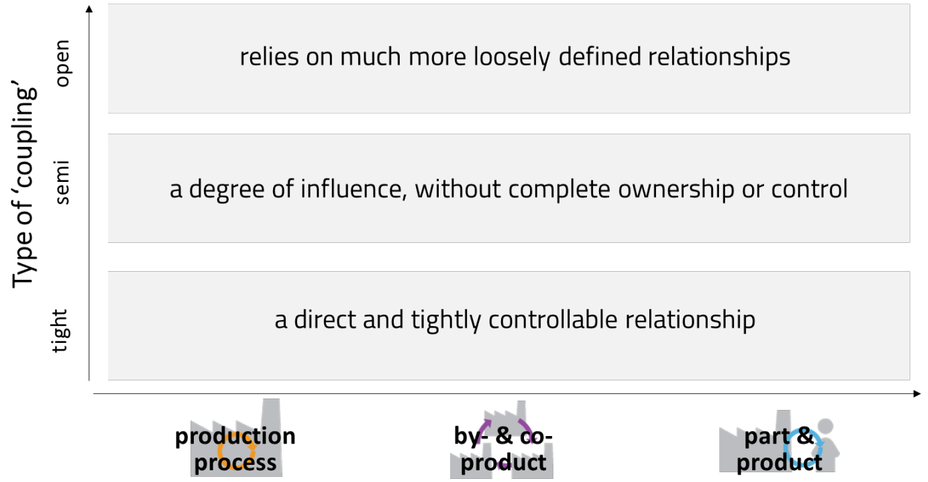
Second dimension: Types of coupling

The next dimension on the grid is the ‘coupling’. Coupling explains how different outcomes are created by the manner in which different (parts of) systems interact or relate to each other. In other words, ‘coupling’ is the term used for ‘feedback’ in supply chain terminology. This can be thought of as the degree or strength of feedback that exists within a system. Each of these flow-types can be governed by tight, semi or open coupling.

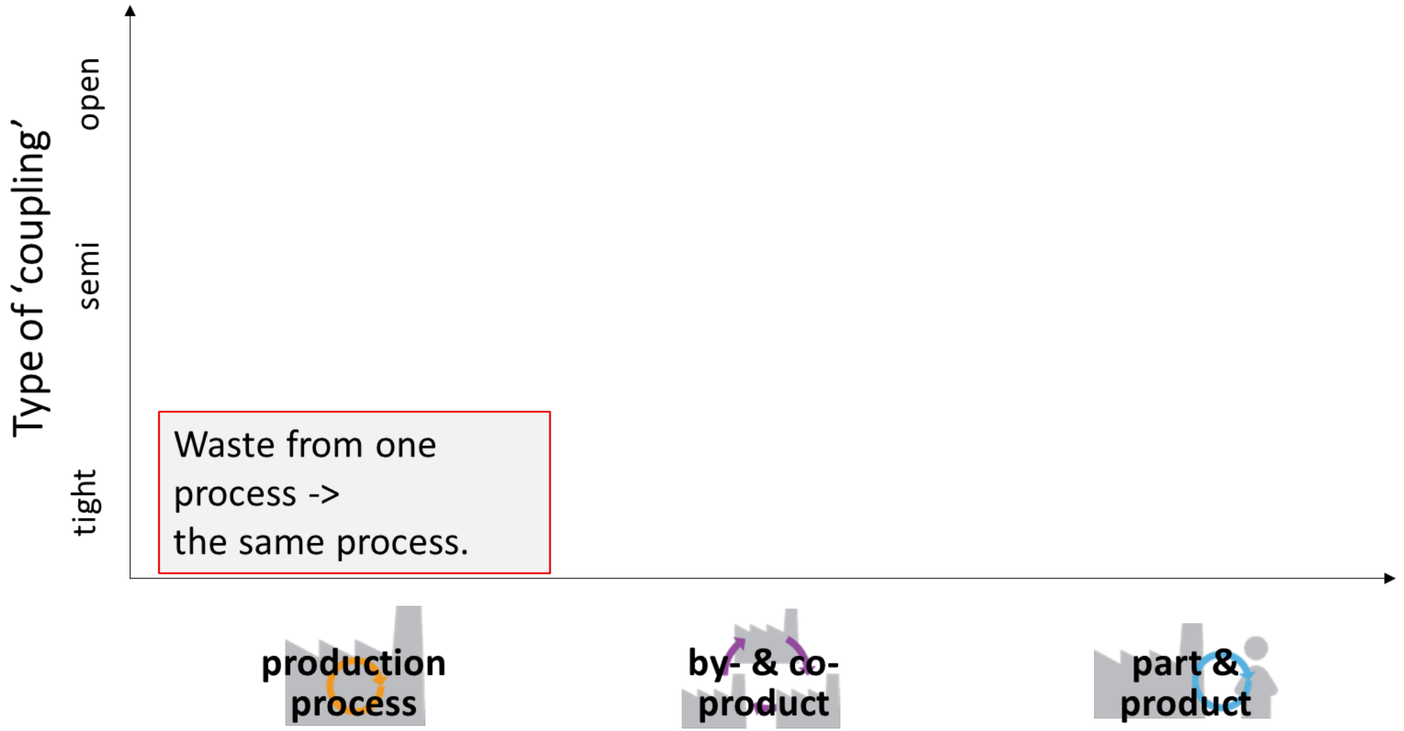


Circularity Grid | Structure

In the first box are the tightly coupled production processes. Here, the output of a process is directly coupled to its input. Waste from a process is directly used as an input to the same process.

For example, using waste heat to preheat the inputs for that same process, like a brewery using heat from kettles to preheat water used for the next batch of product.

This has the potential to save on energy and/or material costs, but is likely to require additional equipment, and there could be dangers such as contaminated material contaminating many batches of products, rather than just one.



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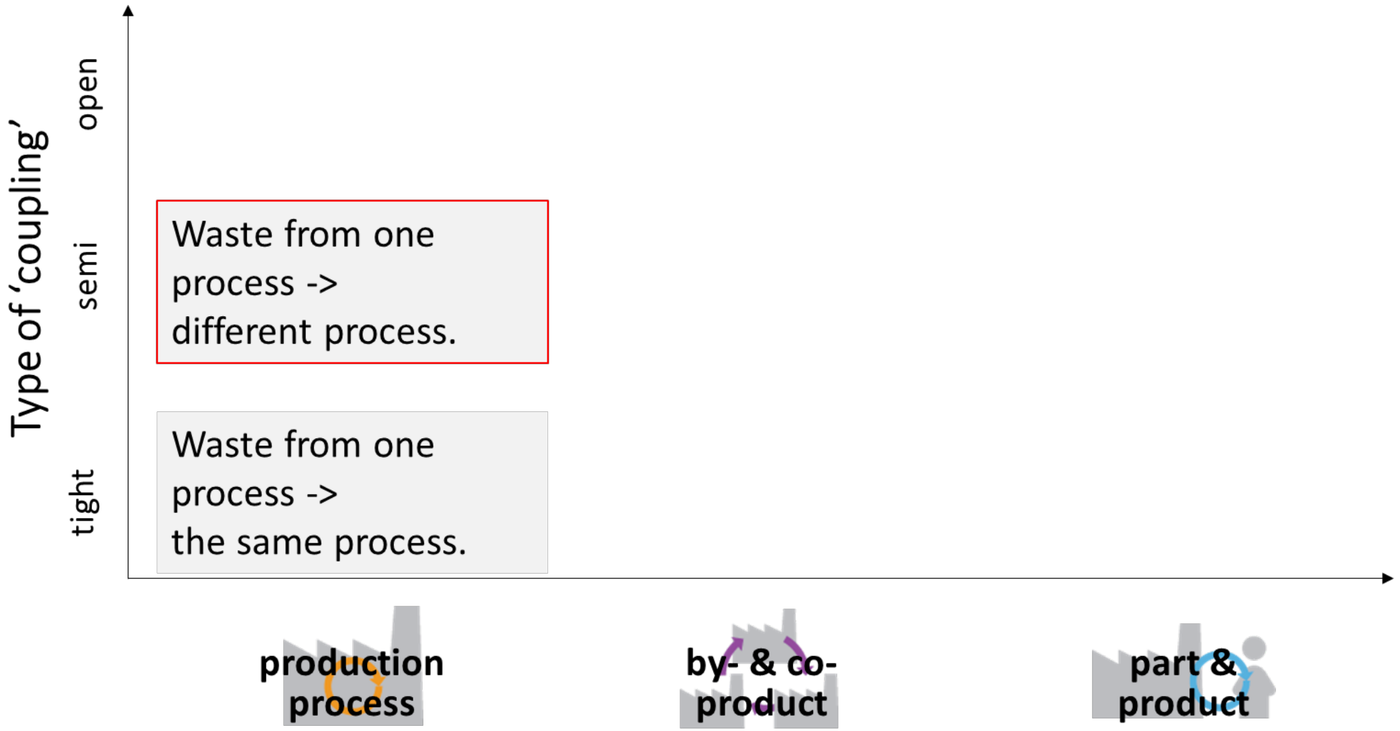
Circularity Grid | Structure

The second box is the semi coupled production process. For instance, the use of waste heat from one process to provide heat to another process. This means that two processes need to be synchronised to run in parallel, where in the examples of tight coupling such planning requirements are minimal.

This can be the case for example in the automotive industry, where the foundry produces parts and provides the heat from the foundry to the next process step, the paint shop, to dry the painted parts. Or, cooling water from one process used to pre-heat another component in a chemical facility.

Similar to tight coupling, semi coupling has the potential to save on energy and/or material costs, and is likely to require further or additional transport within a production facility, which means new or extra equipment is necessary.

The processes are relatively dependent. It is not necessary for them to be part of the same legal or even physical entity, but they should be able to communicate tightly, as they need to know the details of the exchanged resources like e.g. degree of heat, or frequency of output. They also need to orchestrate machine downtimes, etc.



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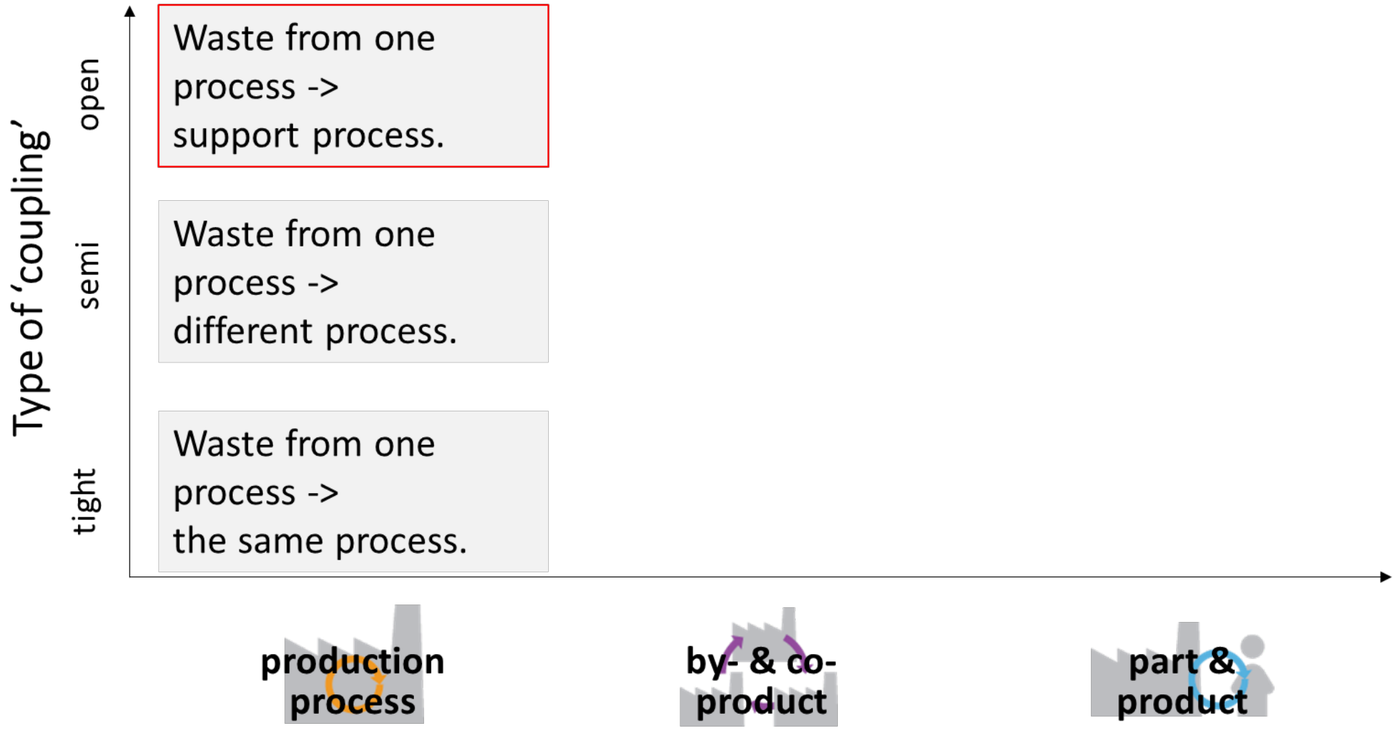
Circularity Grid | Structure

Open coupling in processes, in the third box, refers to examples where no or minimal feedback between linked processes within a facility exist or is necessary.

This means that the waste from a process is used in support processes, such as using waste heat to heat the staff areas of the building in which the process takes place, instead of central heating, or using waste grey-water to rinse or clean spaces and equipment, instead of fresh tap water. Or using the waste heat for district heating.



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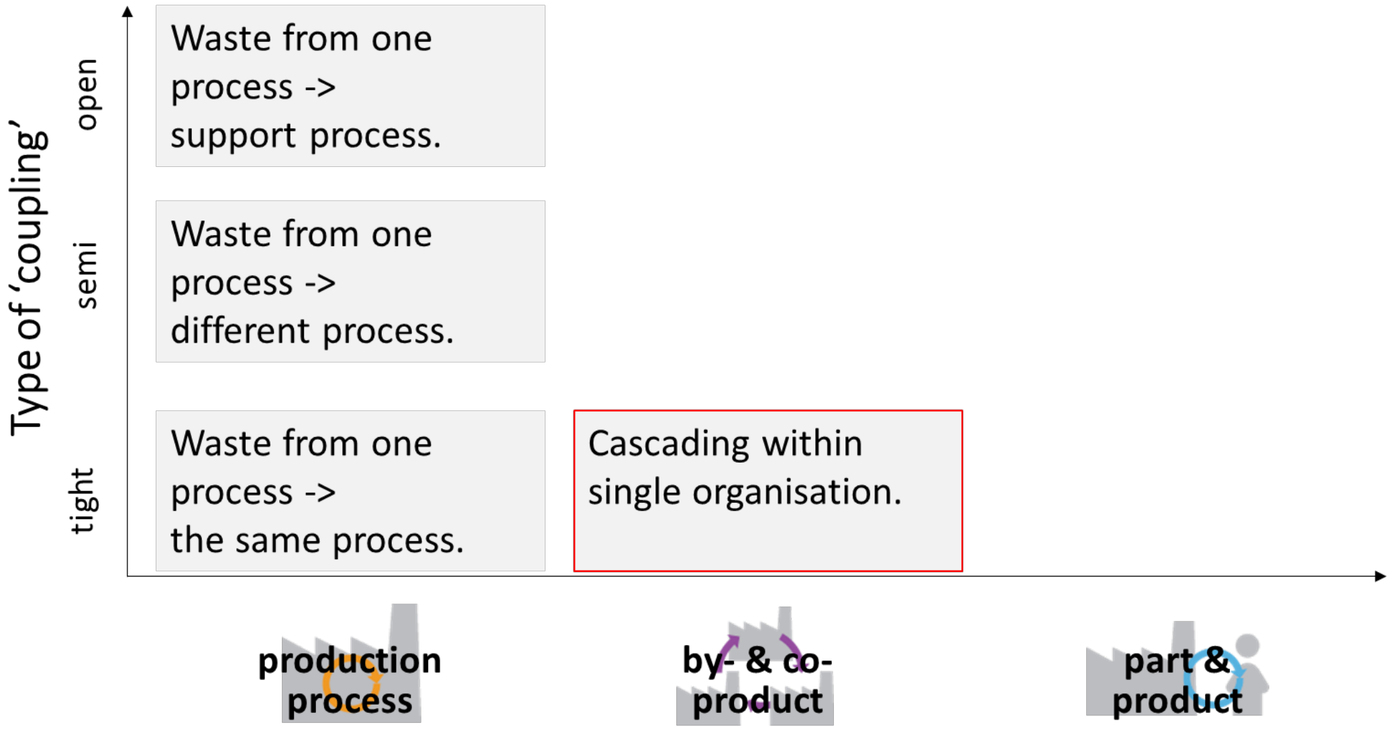
Circularity Grid | Structure

Tight coupling of by- and co-products, in the fourth box, implies the cascaded use of a material, transformation of a resource, such that is no longer suitable for its original purpose, so that a new and different application has to be found. It is possible to not only cascade within one production unit, but multiple ones, within organizational boundaries.

British Sugar operates is an example of where tight coupling of by- and co-products becomes an integral part of how an organisation operates. From the waste streams generated by sugar production a wealth of other sellable products are also created. If they would install a greenhouse, heat it with industrial heat waste, and pump it with food grade CO_2, that would be a tight coupled co- and by-product. The company has a tight grip on the material flows.

In the context of manufacturing facilities this is often referred to as industrial symbiosis.



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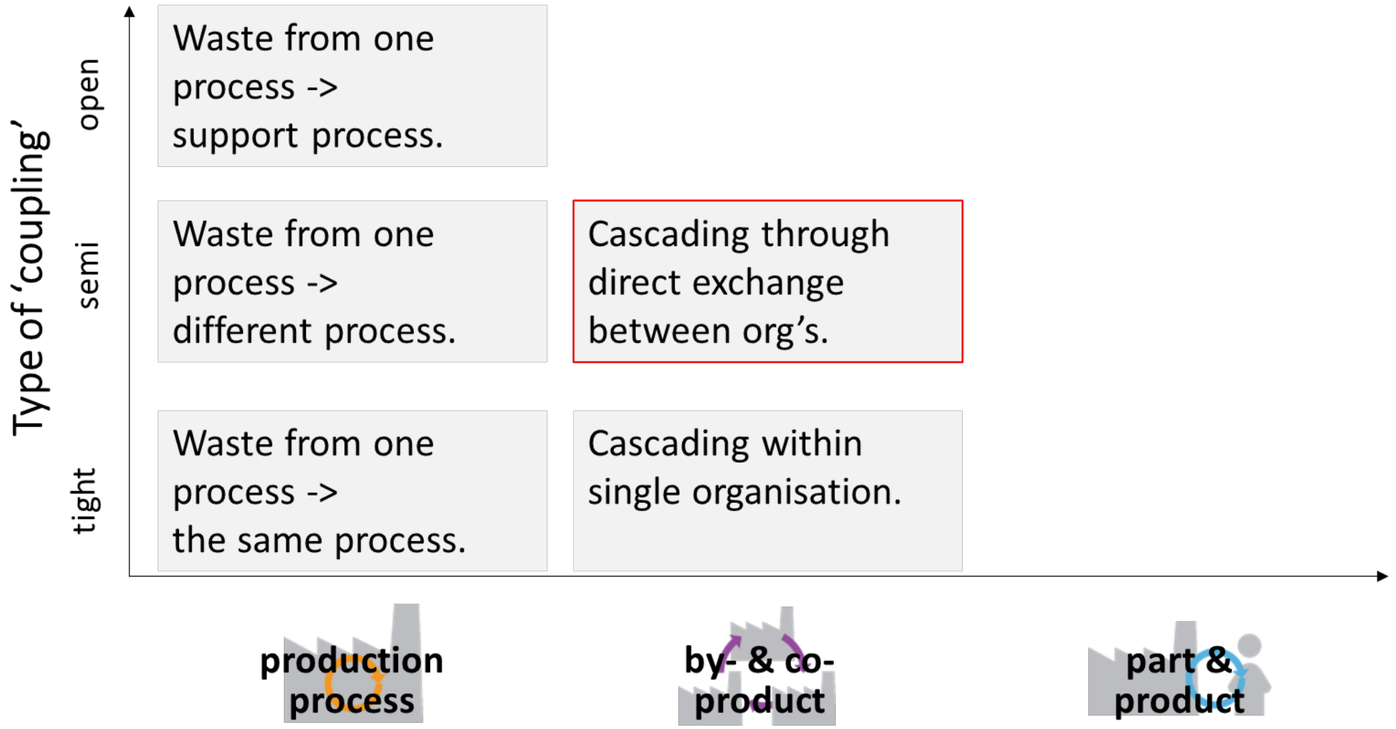
Circularity Grid | Structure

Industrial symbiosis, however, can also take place between organisations, in the fifth box. For instance the well-known example of Danish Kalundborg, where organisations exchange all sorts of material, energy and water flows.

For example, someone is producting paper made from agricultural residue: everything that has a fiber can be used for paper production. The factory has semi-tight contacts with farmers, who provide them with agricultural residue, and the paper manufactury would manufacture paper from it. The factory needs to know what kind of residue they get, because different fibers require differently calibrated machinery.

Waste-to-heat schemes are another example of exchanges where flows are given a subsequent use.

The difference between box 4 and 5, however, lies in the relationship between where the resource is produced and where it is 'circularised': in tight coupling there is direct control over the exchanges within a single organisation, and in semi coupling these exchanges are governed by (contractual) relationships between partners.



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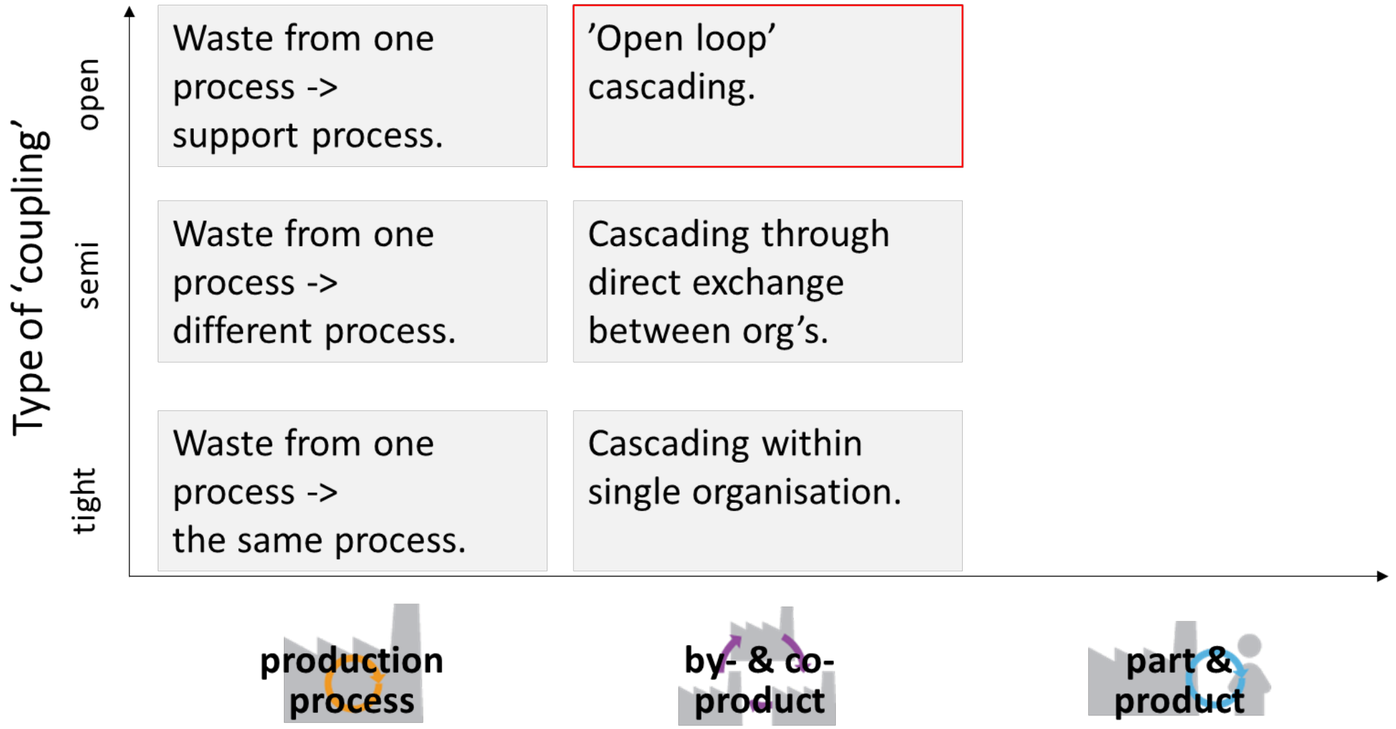
Circularity Grid | Structure

Open loop cascading of by- and co-products, in the sixth box, means the producer does not necessarily know who is receiving their byproduct or waste, it may just get collected by unknown third parties. In contrast to box 4 and 5, open coupling exchanges rely on aggregates and open, therefore unreliable networks.

Terracycle's bottle-cap scheme is an example of this type of coupling in the area of co- and byproduct exchanges. Terracycle asks households, schools, offices - anyone who uses milk bottles and has access to milk bottle caps - to collect them in a box and collects them through post. These are difficult to recycle in a conventional way, so they redirect caps to a specialised processor, preventing premature downcycling, which allows for capturing a higher value from this waste. In this case, only a very loose relationship – or open coupling – exists between the milk bottle cap producer and Terracycle. Open coupling taps into the power of distributed networks to aggregate streams that are otherwise not concentrated enough to process them.



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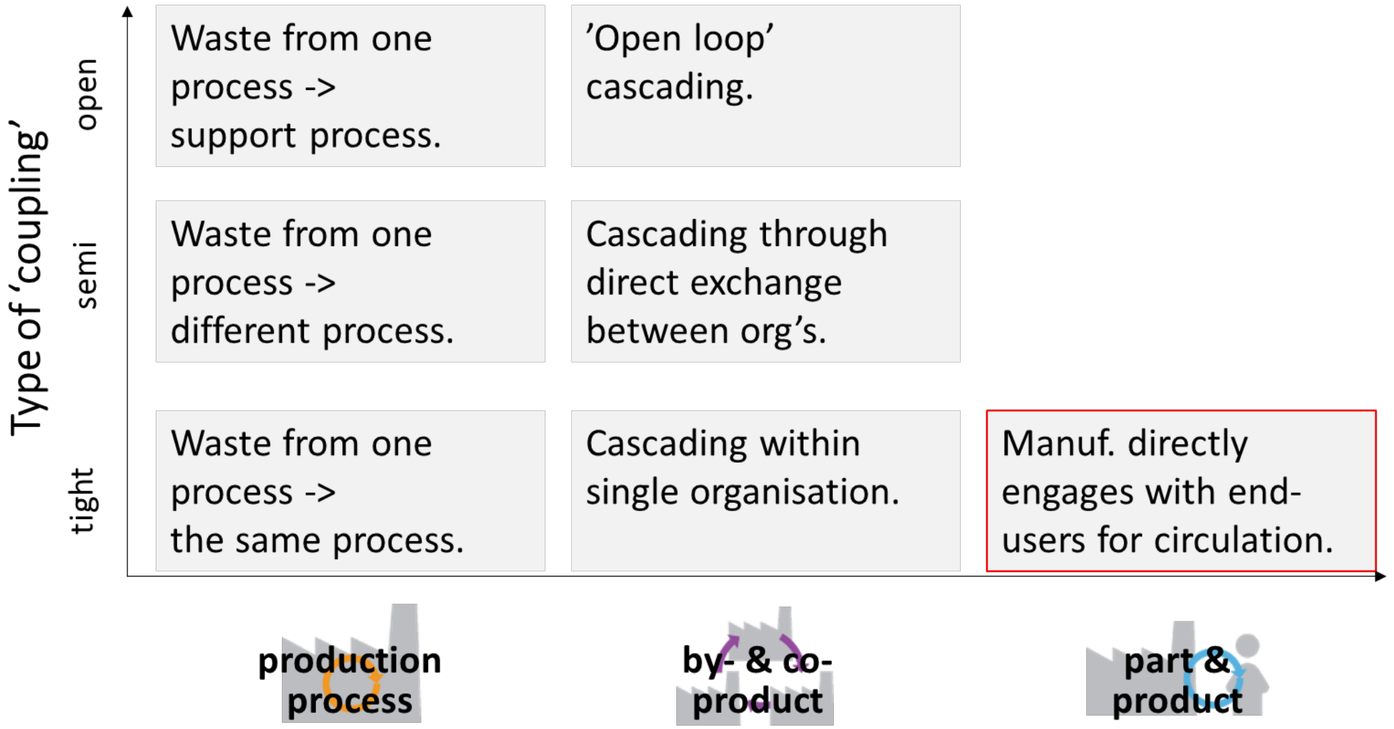
Box 7 describes instances where manufacturers are directly engaging with end-users to recover parts and products. Interface's Re-Entry scheme is an example of this. Through this scheme Interface organises the take-back of its carpets at the end of their life, through buying them back directly from their customers.

This not only ensures continued access to raw materials, but also allows for continued contact with customers. This could result in a renewed sale, or a better understanding of their needs through a tight grip on the resouce flows. Another example is when one offers a product as a service system washing machine with 24/7 repair service to restaurants, and monitors the machines and supports the clients digitally.



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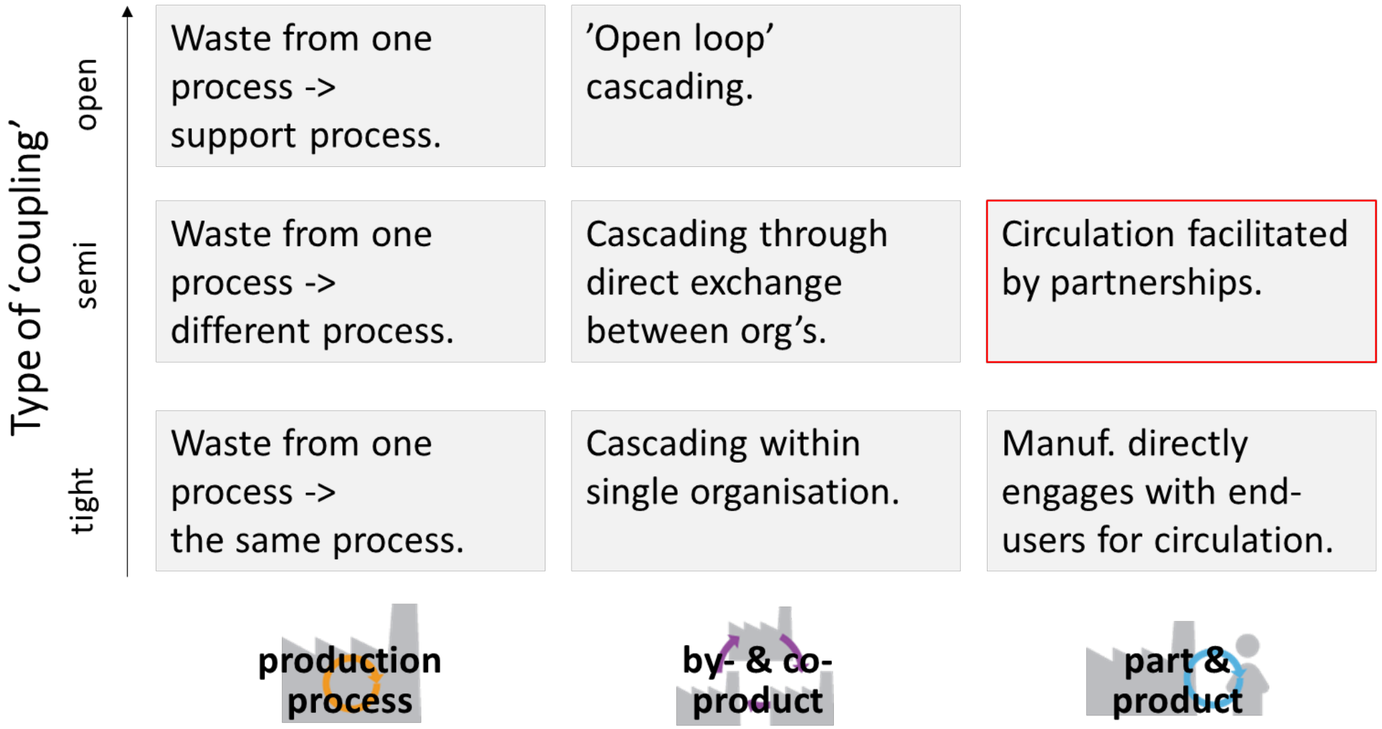
In semi-tight couling, circulation is facilitated by partnerships. For example, beer bottles are often recycled in a systemic way through partnerships (customer brings it back to the supermarket, and the brewery collects it).

Another example is chemical producer Teijin's Eco Circle fibre system, where they partner with apparel producers to organise reverse-retail whereby used clothing made from this material is recovered from consumers who return used product back to retail stores. This means continued access to raw materials for Teijin, but also a new relationship with its customers whereby the customers also become suppliers. It requires partnerships and stable alignment of partner interests to be a long-term solution.

All kinds of sell and buy back schemes are also relevant in this context (e.g. resellable office furniture, that gets bought back by the retailer at the end of life).



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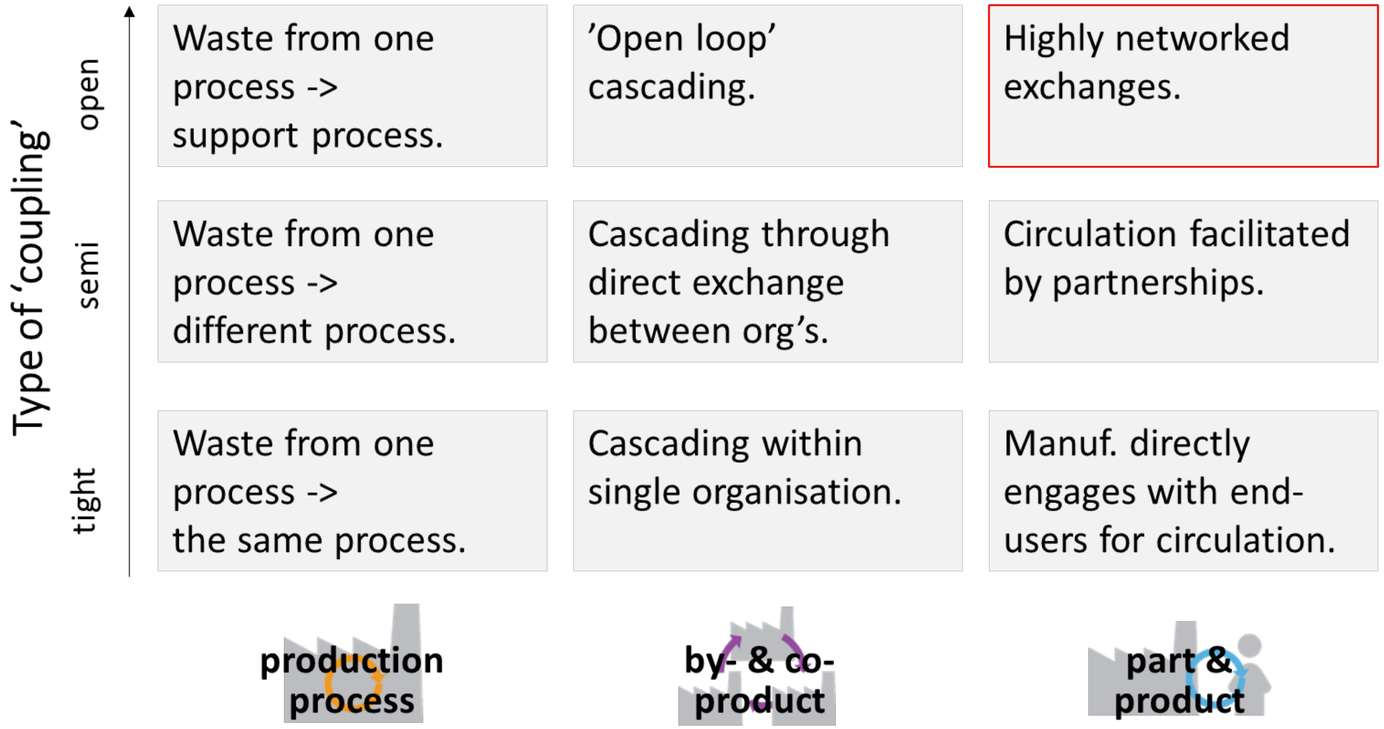
Open coupling in box 9 refers to highly networked exchanges. For example packaging glass is collected in containers, then recycled, and turned into new glass. The actors do not know each other, but there are standards that facilitate the process.

The apparel company Patagonia's products are frequently sold through e-Bay, which in aggregates supply, demand, and redistribution channel for Patagonia products, while Patagonia benefits from an improved reputation for long-lived products. Also, Patagonia customers get a monetary return from reselling. However, no central infrastructure exists for this redistribution mechanism and standardised quality control procedures are absent. Similar to Terracycle's bottlecaps, it is possible to rely on a highly-networked setup even between different industries, such as e-commerce and apparel.



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Circularity Grid | Structure

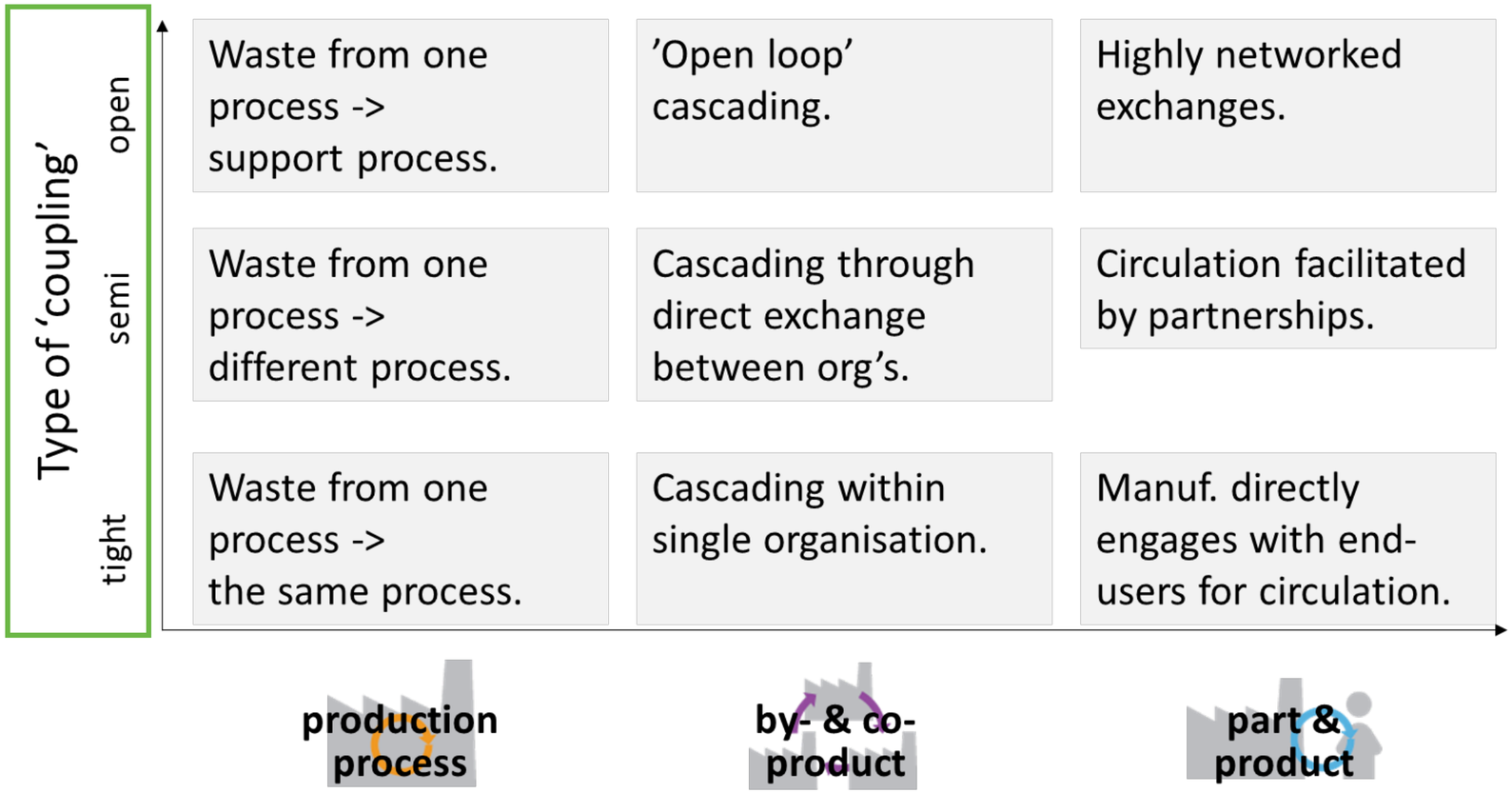
Types of Coupling

The Circularity Grid contains a set of **'archetypes'** or '**ideal examples**'. There can of course be a debate where exactly an example or business case should be placed.

However, the most important thing is to understand the general principle. The Grid is presented as nine discrete boxes - archetypes - but hybrid or 'in between' forms can be found, especially on the **'coupling'** dimension.

Multiple examples within the same box could be placed on different ends of the spectrum a particular box covers.

The Grid is a tool to think through relationships by offering clear and contrasting cases: it is meant for generating insight and learning. Reality is always much messier than the models: but that doesn't mean that the principles are not useful!



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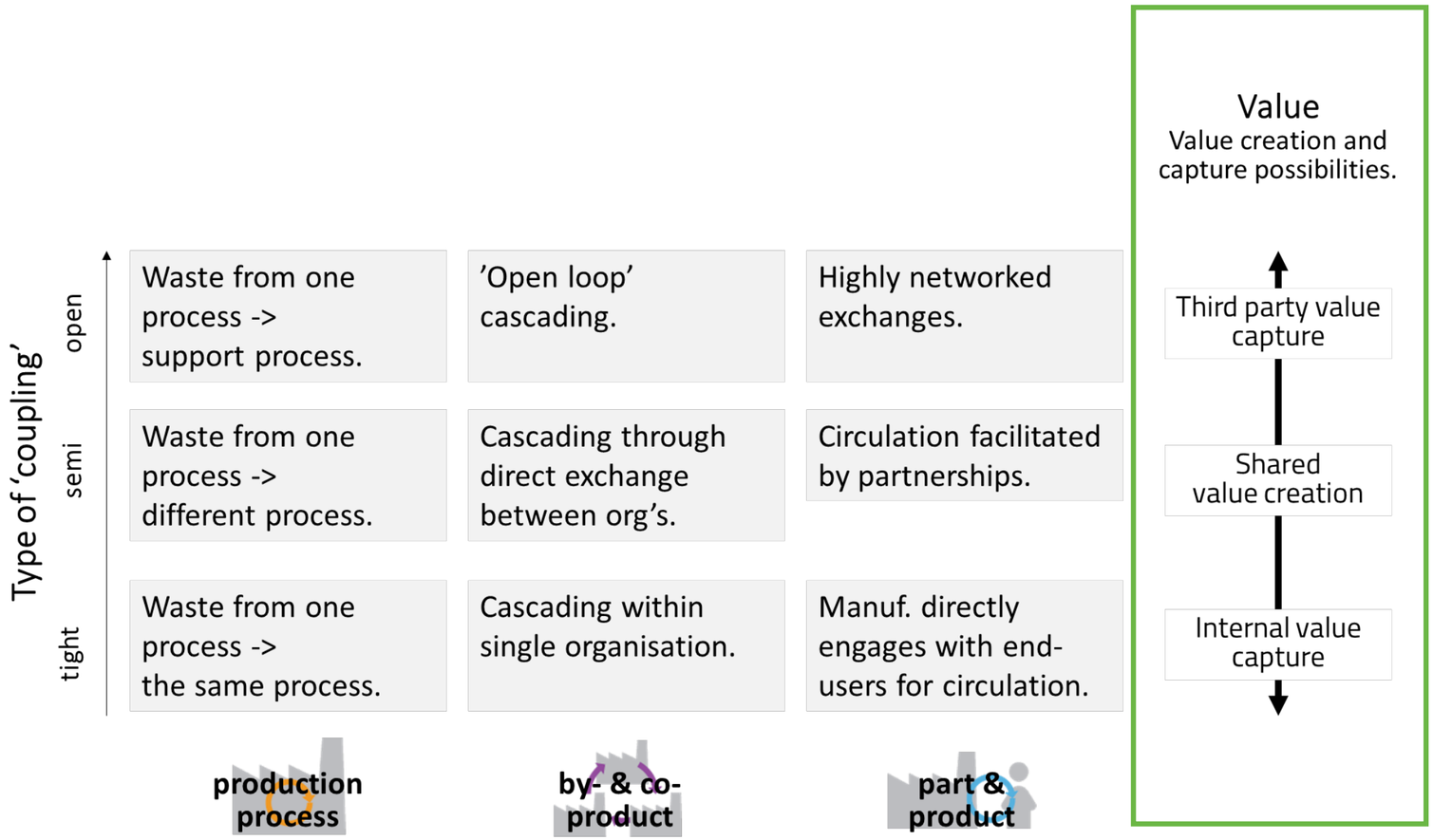
Value Creation

Coupling has a range of implications for businesses and business model architecture. For example, for value creation.

Tight coupling allows a company - a manufacturer - to capture the majority of **the value** it creates.

Shared value creation occurs in the area of **semi-coupling**. This refers to instances where both the company and its partners contribute to the creation of value, and the capture of value from the circular strategy. In co-operation, the added values could be high, but value has to be shared as well. So actors have to think how to set this up properly.

In open coupling, for example, it would be a third party that is able to capture value, like it was discussed with Terracycle collecting bottlecaps without the bottlecap producers benefiting.



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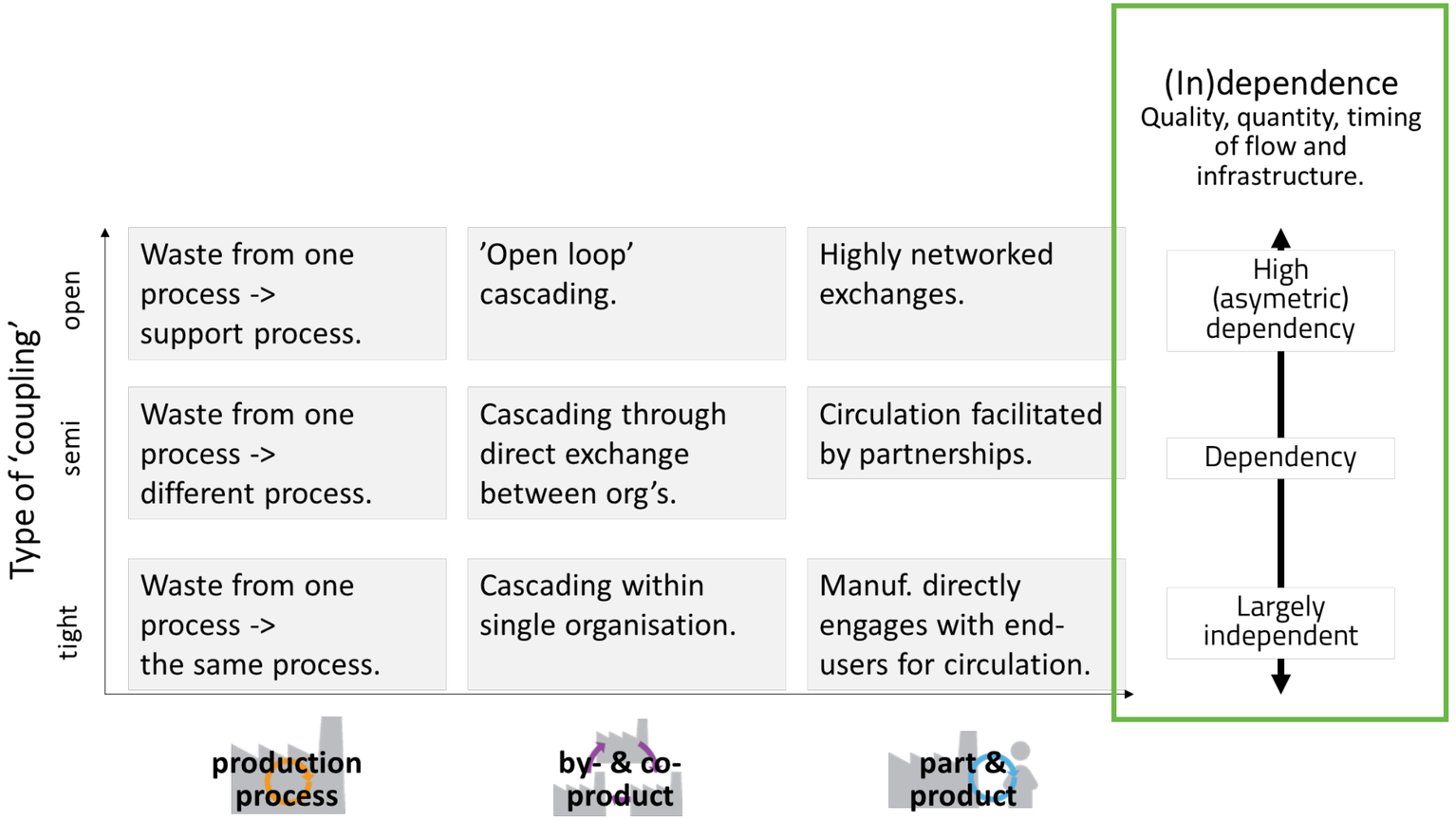
(In)dependence

What does the coupling has to say about **independency and dependency**? In tight coupling, a focal company has tight control over quality, quantity, and the timing of flows and infrastructure. This means independence, it is from their own process, or they have a subcontractor who is controlled directly.

However, in semi-coupling, partners are involved and naturally dependencies exist. This requires careful alignment of processes and responsibilities, either through trust, contracting, the creation of a joint venture or some other means.

In open coupling only a very weak relationship exists between the producer of the resource and the 'circulator company.' In these situations, the 'circulator' is highly dependent on the actions of the producer. For example, the actor who buys the plastic waste on the open market, does not know anything about the plastic that was produced.



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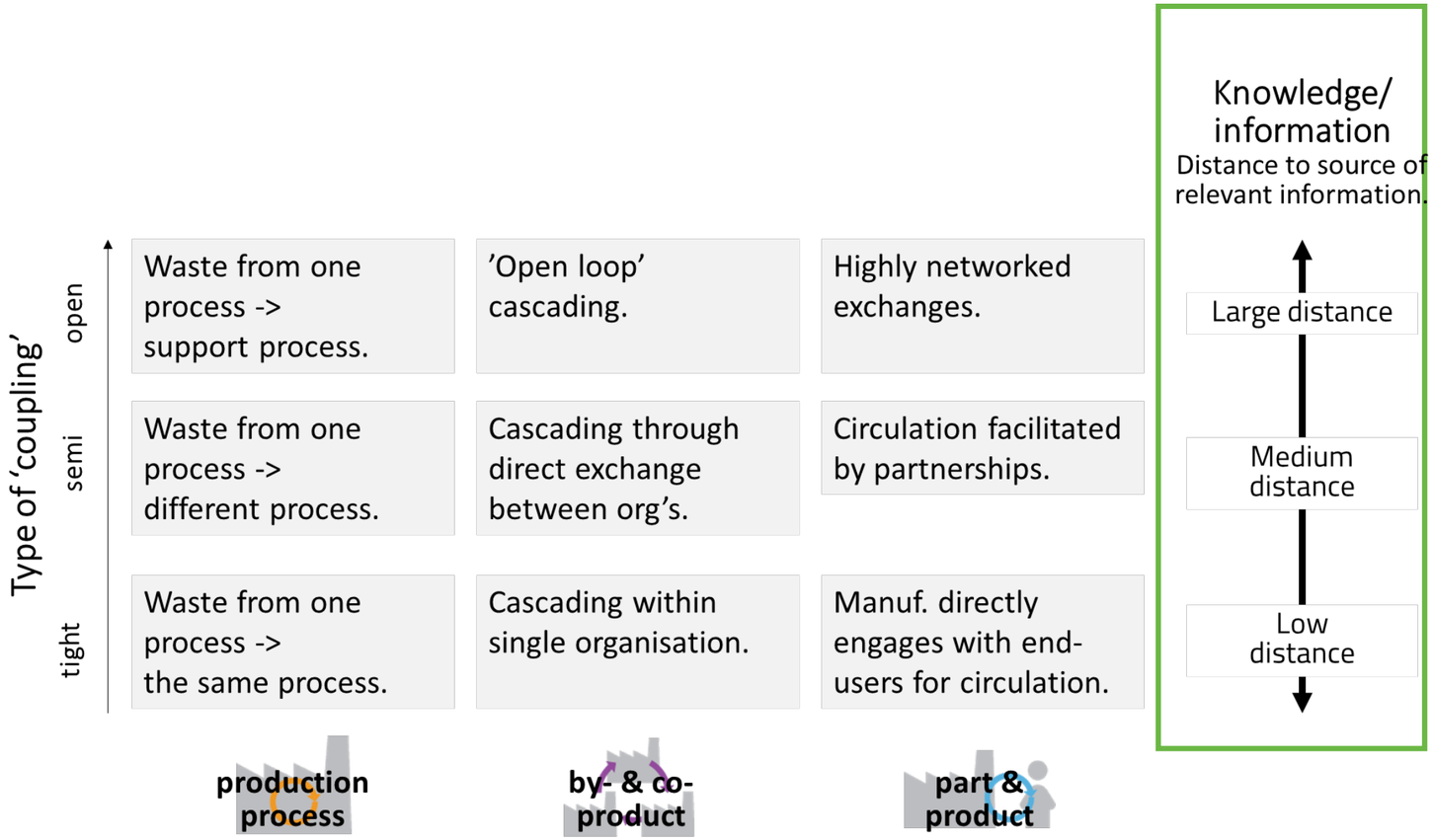
Knowledge

When moving from tight to open coupling the distance to the **source of relevant information** increases from low to high. That means that in tight coupling information is closely available, as colleagues in an organisation can directly communicate.

This cannot naturally be assumed in semi-coupling and prove challenging in open coupling. Actors need tracking and tracing, which may involve, for example, integrated IT systems, blockchain solutions, and material passports.



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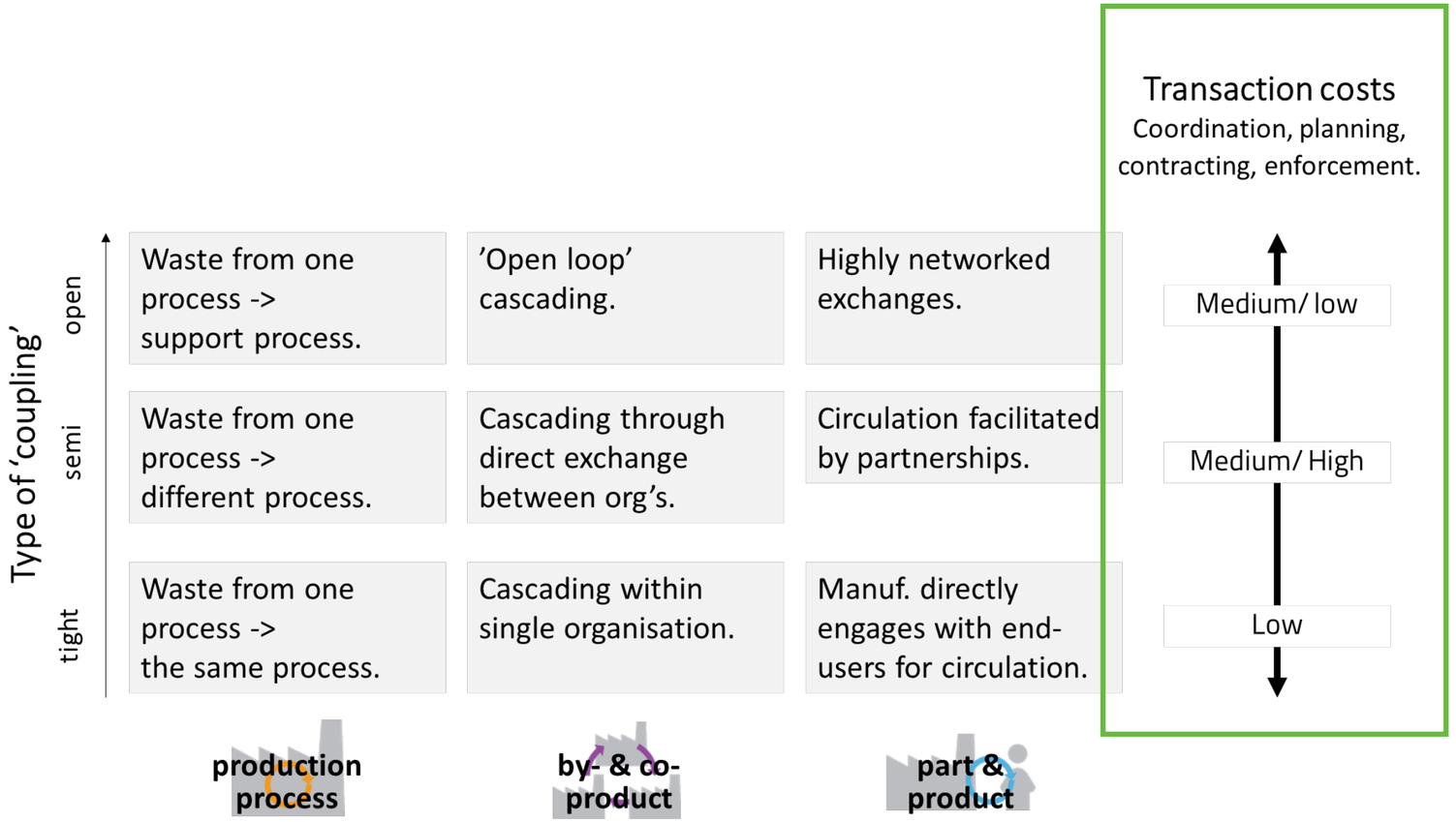
Transaction Costs

In tight coupling **transaction costs**, e.g. costs for coordination, planning, contracting, and enforcement, are generally lower than in semi-coupling, where the companies have to find, select and align with partners, especially to get started, through contracts and new protocols. These costs are lower again for open coupling, as no or only a limited amount of co-ordination between resource producer and circulator takes place (e.g. bottlecaps). But some discussion, forums, or putting messages out there to influence the market and policy might be necessary.



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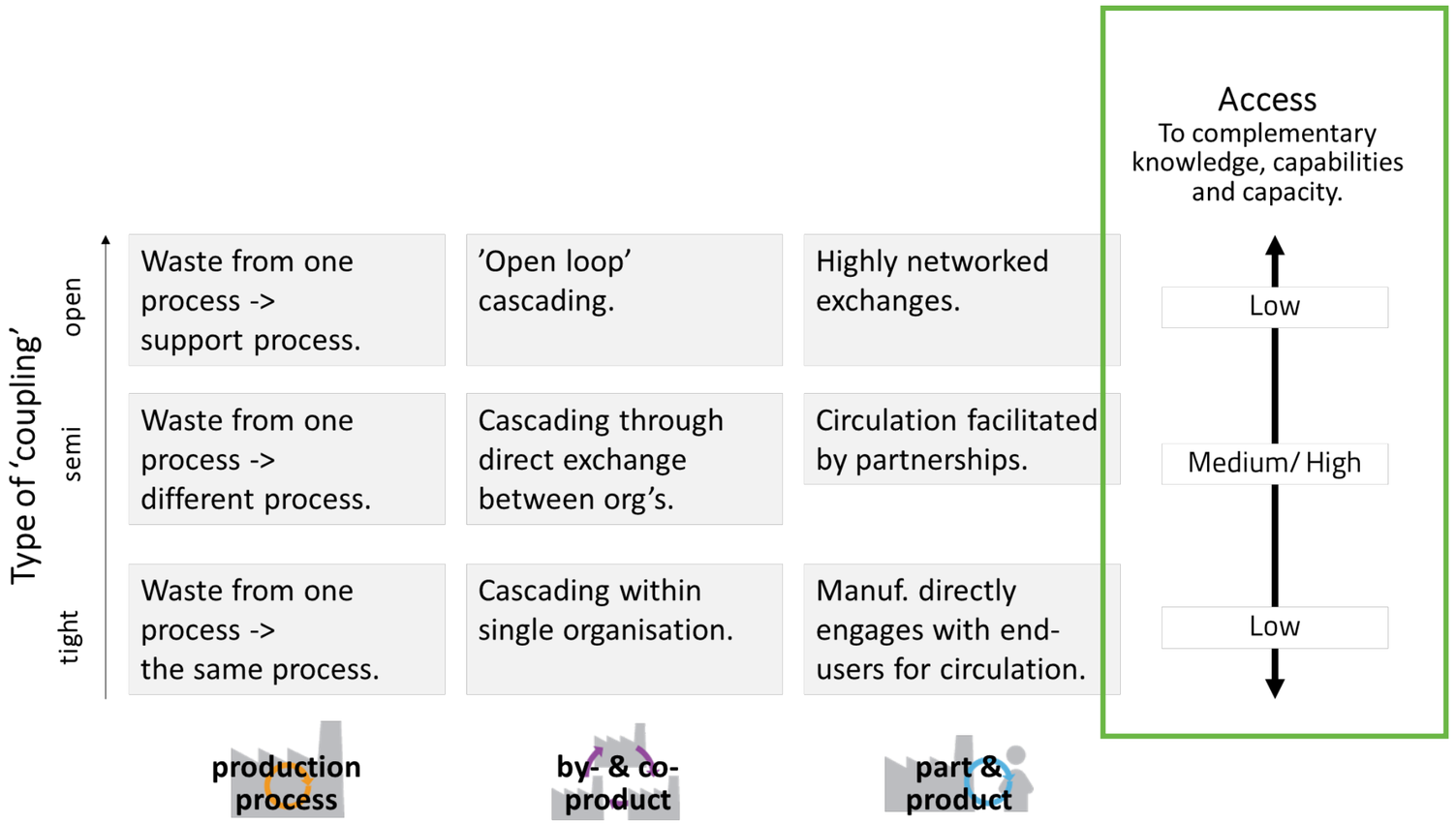
Access

A tightly-coupled system ensures **access** to relevant knowledge, capabilities and capacity through vertical integration. This means that everything needs to be developed and maintained in-house.

Semi-coupling, on the other hand, ensures access to **relevant knowledge, capabilities and capacities** through partnerships and collaboration. In open coupling, due to the weak relationship between producer and circulator, access to relevant knowledge, capabilities and capacity is again low, so it needs to be developed internally.



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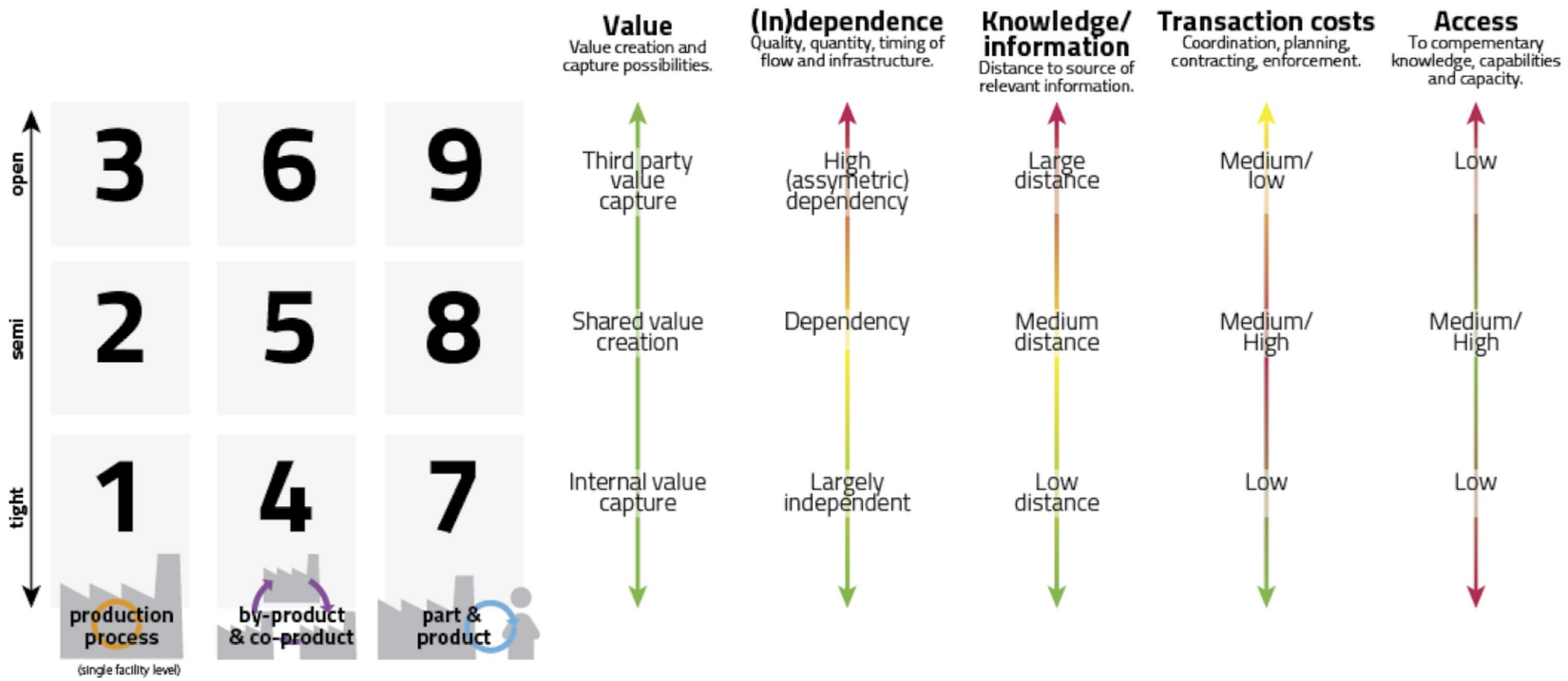
Circularity Grid | Structure

Why use the Circularity Grid?

This approach is about **managing the implications** of the kind of coupling, which helps to understand the dynamics. The Grid also offers a means to start thinking about stakeholder management, collaboration, and, where appropriate, co-design or co-creation.

Who captures the value? What level of dependence is there? Who has access to information in your supply chain? These are all valuable questions to ask at a certain point in the process.



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How the Circularity Grid is used |
Step-by-step process

Identify the type of flow → **Identify** the kind of coupling → **Evaluate** the sub-dimensions → **Iterate**

Identify the type of flow. Differentiate between the three main types of material or resource flows: 1. within production processes, 2. by- and co-products and 3. product and component flows.

Identify the kind of coupling. The coupling can be thought of as the degree or strength of feedback that exists within a system. Flow-types can be 1. tight, 2. semi-tight or 3. open coupling.

Evaluate the implication of the relation regarding sub-dimension like value, (in)dependence, transaction costs, etc.

Question the potential outcomes of the couplings on your business case. Are you satisfied with the way different (parts of) the system interact or relate to each other and the regarding implications that has? Iterate if necessary.

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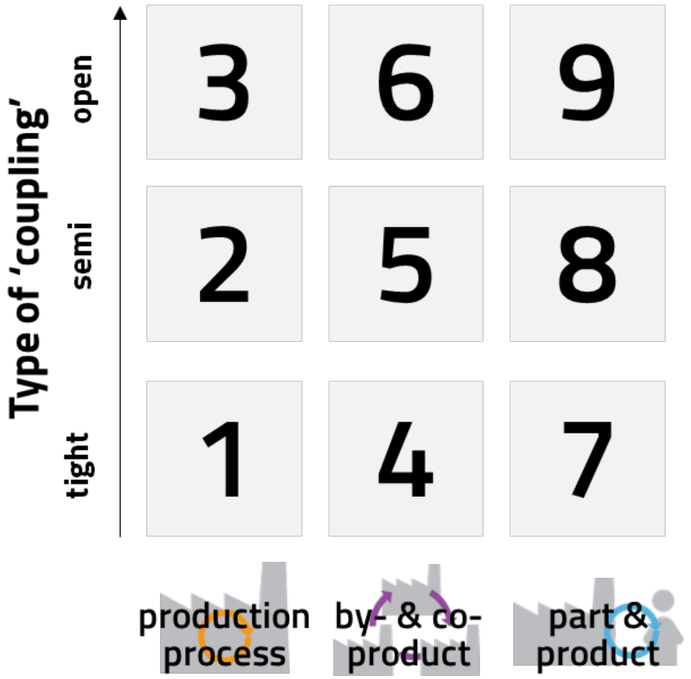
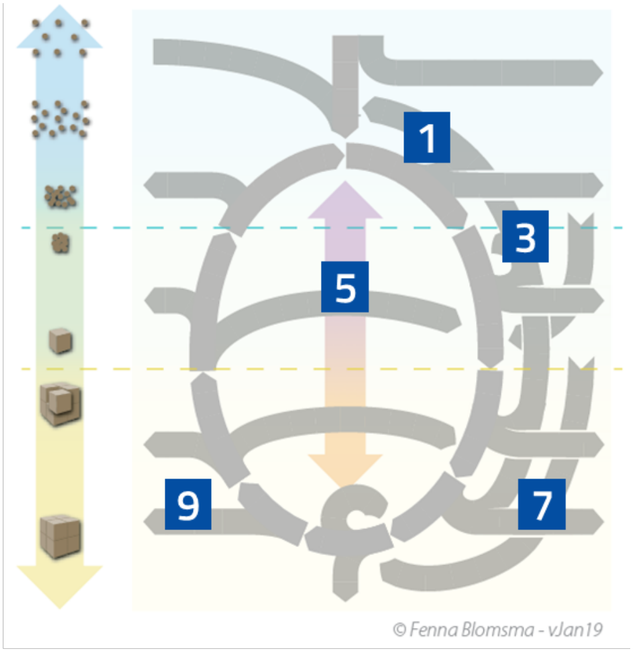
How the Circularity Grid is used |
Step-by-step process

To use the Circularity Grid in practice, we use the numbers of the boxes and place them on the Circularity Compass we produced before. What type and coupling represent the resource flows within the system?

You can work on your existing Circularity Compass and add this new layer of information to it for further analysis, but also extend the arrows outward to connect to other Compasses to understand broader systems dynamics.

Alternatively, you can collect your findings in a SWOT analysis of your product or service as well.





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How the Circularity Grid is used

These case examples might give a small insight into what kind of information or consideration the Circularity Grid is able to provide.

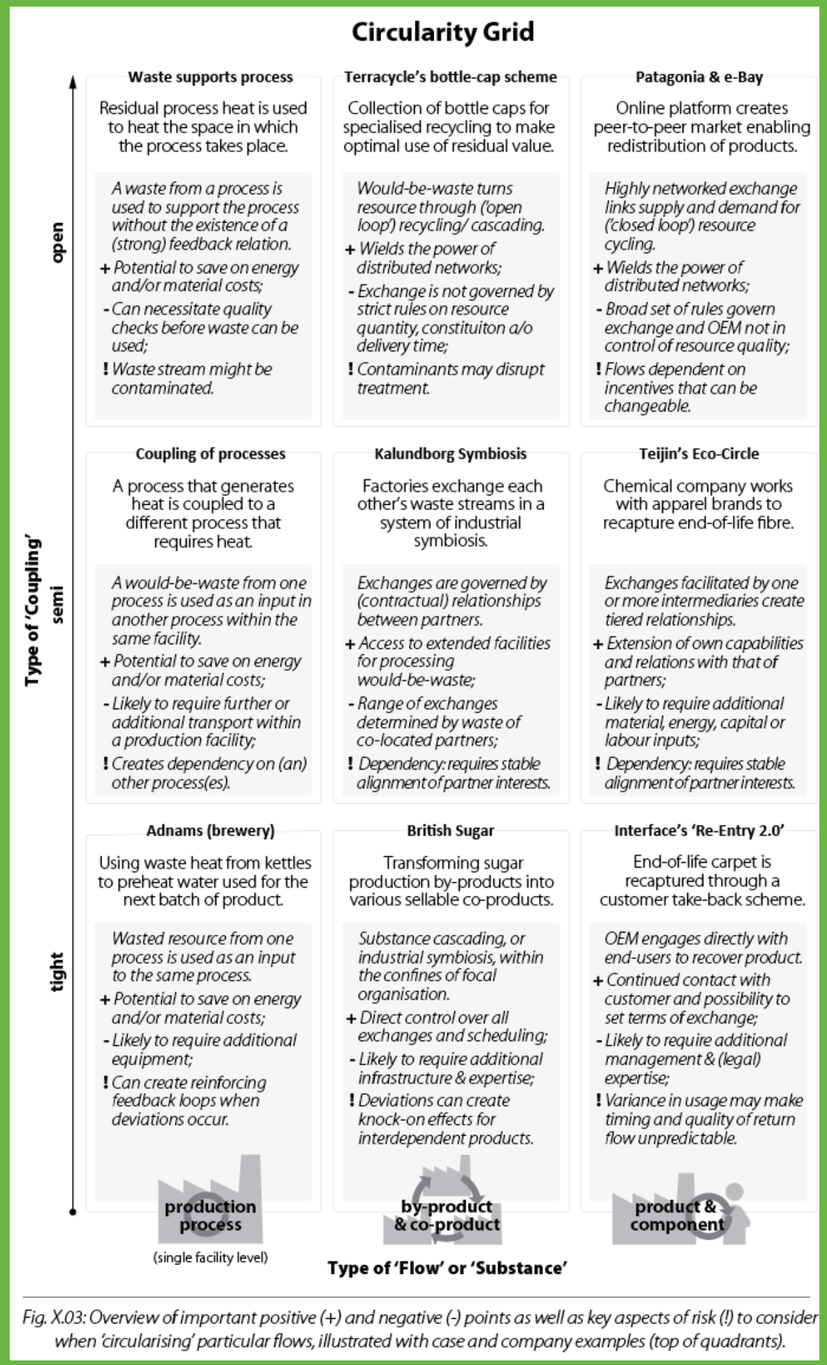

Fig. X.03: Overview of important positive (+) and negative (-) points as well as key aspects of risk (!) to consider when 'circularising' particular flows, illustrated with case and company examples (top of quadrants).

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How to use the tool – case example

Find inspiration on real life case examples how the tools can help to develop circular solutions on the following pages. These include some examples developed by the project team and some developed by training participants during the delivery of Circularity Thinking training courses.

Disclaimer: none of the companies mentioned in any of our case examples made their own use of the Circularity Thinking tools. We applied the tools in hindsight and based on available information of the companies. We only show how the Circularity Thinking tools can be applied on company cases to support the circular innovation process.

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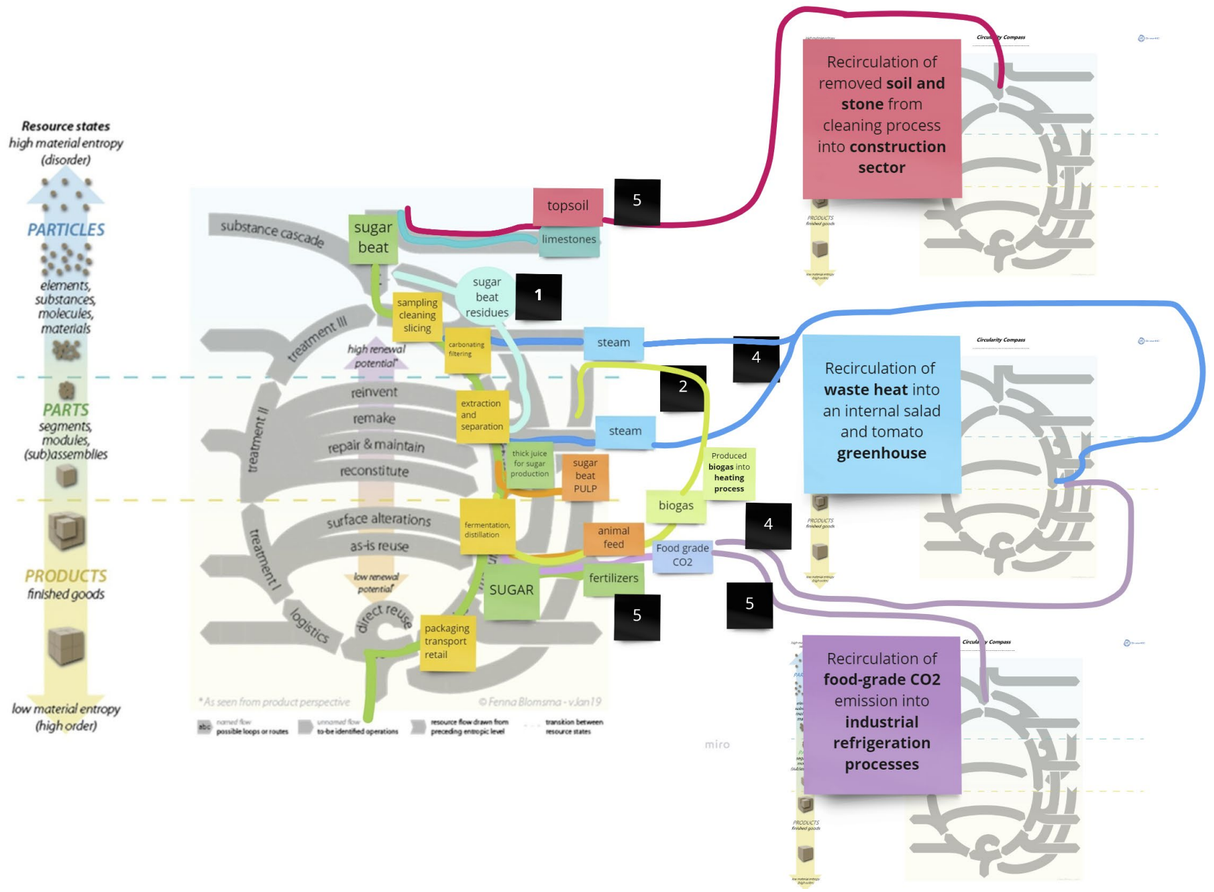
Circularity Grid | Application (on the British Sugar case)

To use the Circularity Grid in practice, we use the numbers of the boxes and place them on the Circularity Compass we produced before. **What type and coupling represent the resource flows within the system?**

You can work on your existing Circularity Compass and add this new layer of information to it for further analysis, but also extend the arrows outward to connect to other Compasses to understand broader systems dynamics.

Alternatively, you can collect your findings in a SWOT analysis of the product or service to facilitate a conversation. If you use the tool for consulting purposes, your client would not need to understand the nine categories, but you can help them navigate the key strategic questions (e.g. value, dependence) with the Grid in mind.



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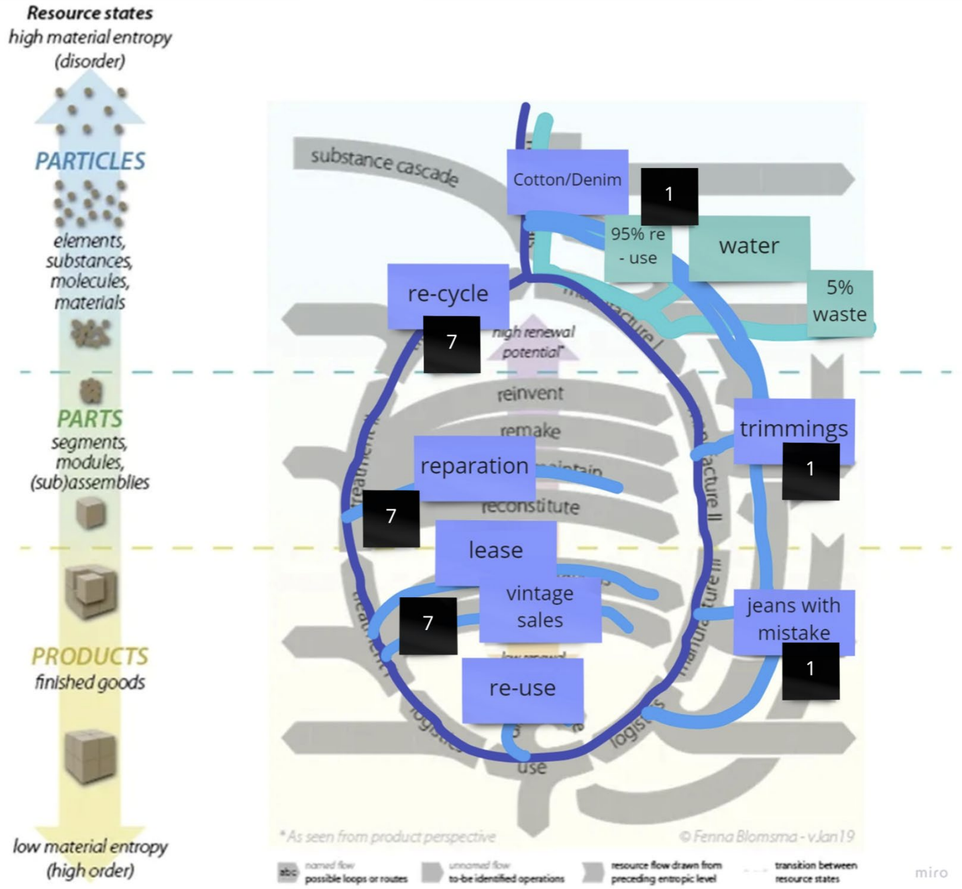
Circularity Grid | Application on the MUD Jeans case

As the tightly-coupled production process (1) indicates, waste from the production process is directly used as an input to the same process, saving on material costs, but requiring additional equipment and quality control.

As manufacturer directly engages with the end-user (7) to offer repair services, recover products that can be repaired and remanufactured (washed, mended, and sold as vintage) or recycled as raw materials. This not only ensures continued access to raw materials and a tight grip on resource flows, but also allows for continued contact with customers, resulting in renewed sales, or a better understanding of their needs.



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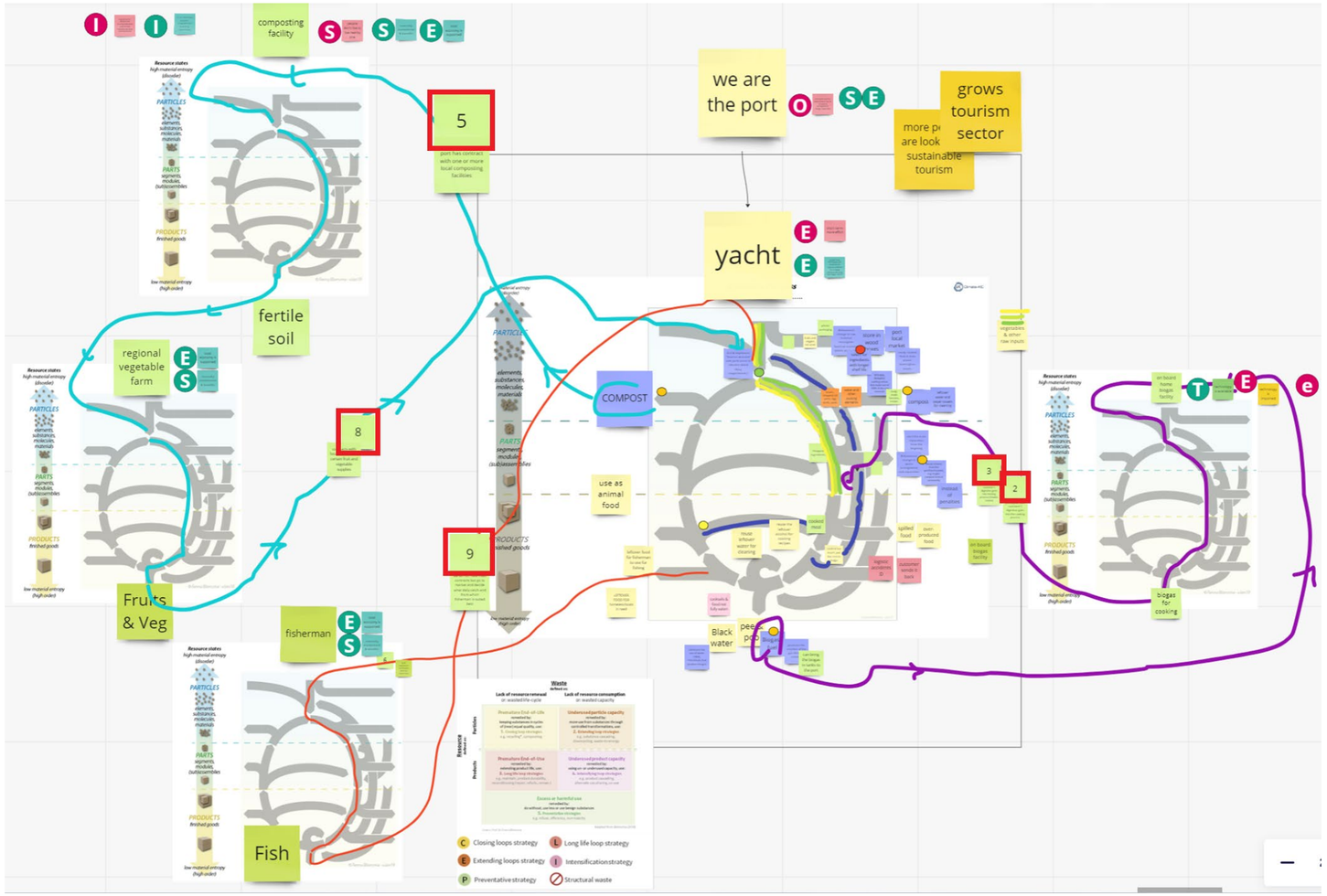
Examples how the Circularity Grid is used | Trainings examples

This example is from a workshop in 2022 shows, how the Circularity Grid was used on the practice case example of organic waste management in a yacht port.

The group identified the type of flow and coupling and then considered the implications they have on the underlying business case.



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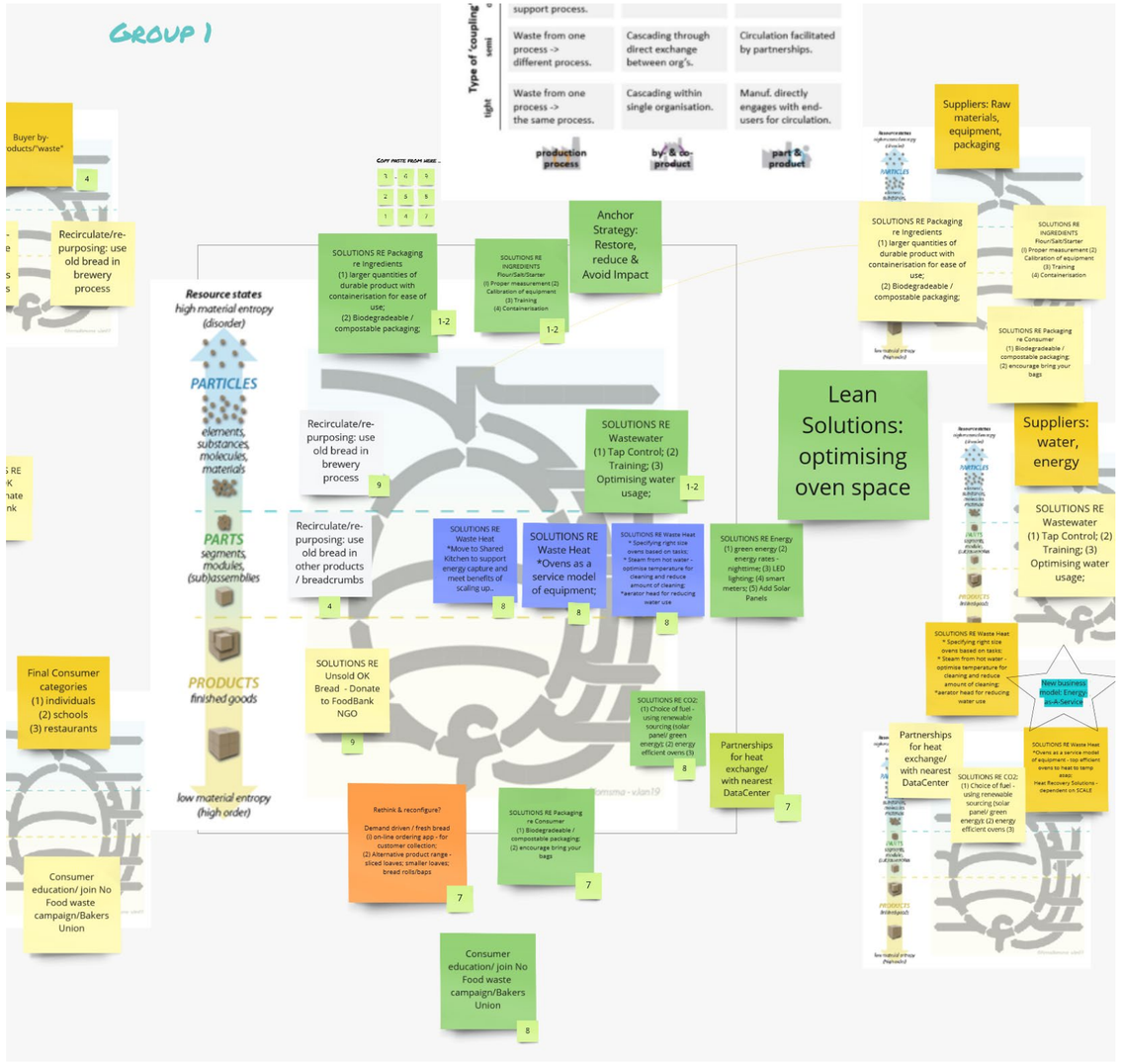
Examples how the Circularity Grid is used | Trainings examples

This other example from a train-the-trainers workshop in 2021 shows the principle of the Circularity Grid used on a bakery (numbers on green sticky notes in the graphic).

The categorisation of the type of coupling is not meant to be academic or as imperative. It is the foundation to understand the kind of relation and feedback loop that is or could be installed for the circular solution in question.

On this grounds, a conversation can take place, if the implications are desired for the business, or if they need to be changed or improved – of even if the underlying chosen circular solution might need to be questioned, as the business implications are undesirable or unrealistic.



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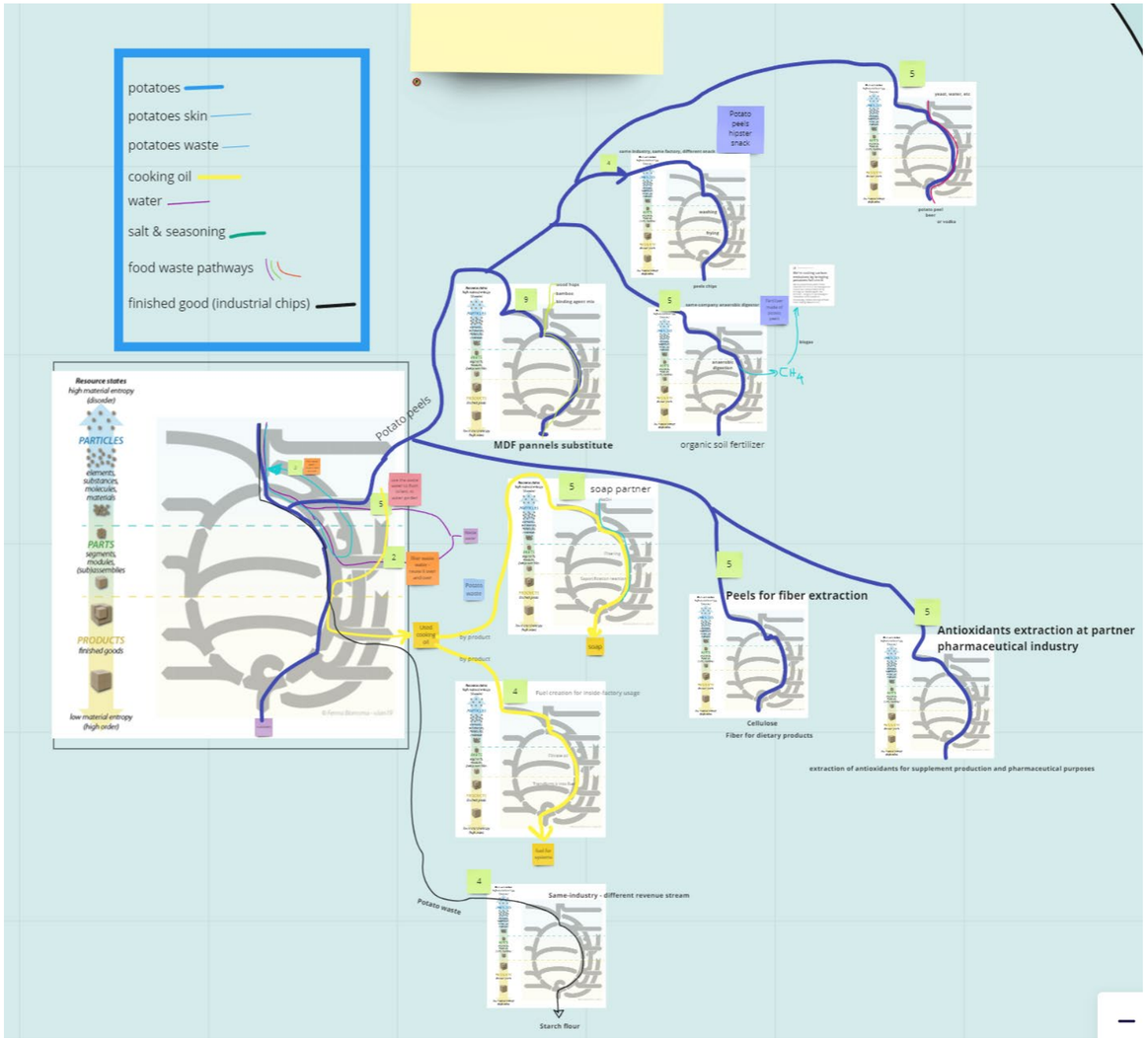
Examples how the Circularity Grid is used | Trainings examples

This example is from a workshop in 2022 shows, how the Circularity Grid was used on the practice case example of management of potato waste in a catering process.

The group identified the type of flow and coupling and then considered the implications they have on the underlying business case.



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www.climate-kic.org | aleksandra.goldys@climate-kic.org