Reconfigurability and Resilience in manufacturing

Presenter name	Date
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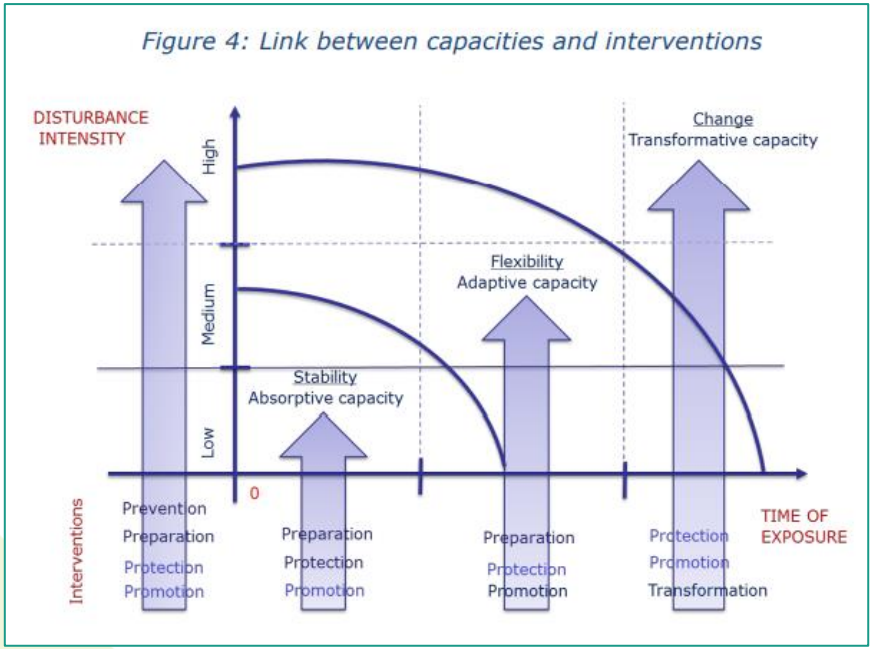
Resilience as a policy goal

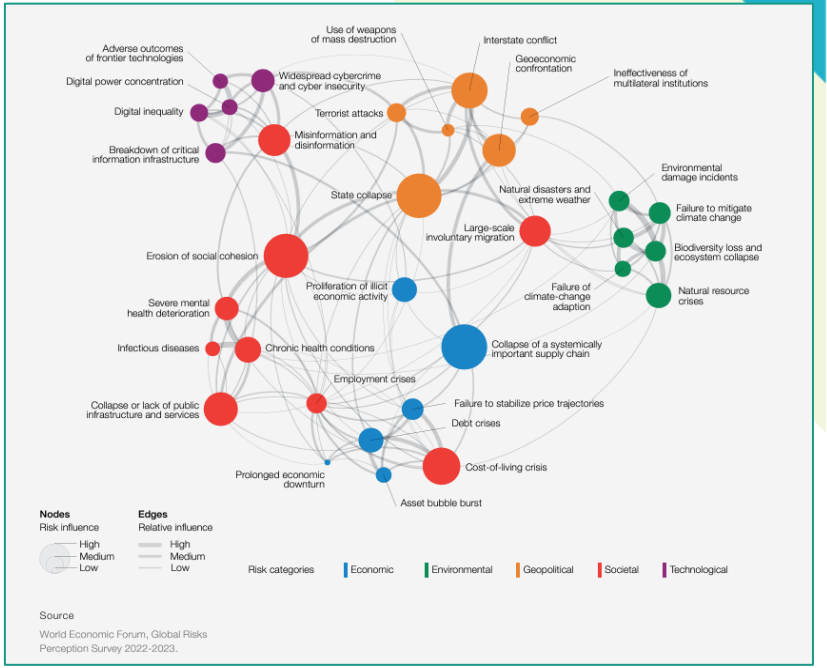


Source: Manca A; Benczur ; Giovannini E. Building a Scientific Narrative Towards a More Resilient EU Society Part 1: a Conceptual Framework . EUR 28548 EN. Luxembourg (Luxembourg): Publications Office of the European Union; 2017. JRC106265

- 'the ability not only to withstand and cope with challenges but also to undergo transitions, in a sustainable, fair, and democratic manner'
- Upgradable and robust manufacturing systems and plants are necessary for flexible, responsive and resilient manufacturing

VUCA world

- ***Volatility***
  - Unstable and unpredictable resource cost and/or availability at unpredictable times and durations
  - Expected fluctuations on resources with unknown timing, and magnitude
- ***Uncertainty***
  - Lack of knowledge
  - Unclear impact of change, but cause and effect known
- ***Complexity***
  - Many interconnected parts
  - Complex regulatory/political environments, multiple component parts
- ***Ambiguity***
  - Doubt about the nature of cause and effect
  - Little to no historical information to predict outcome
  - Difficult to forecast or plan for



VUCA for manufacturing

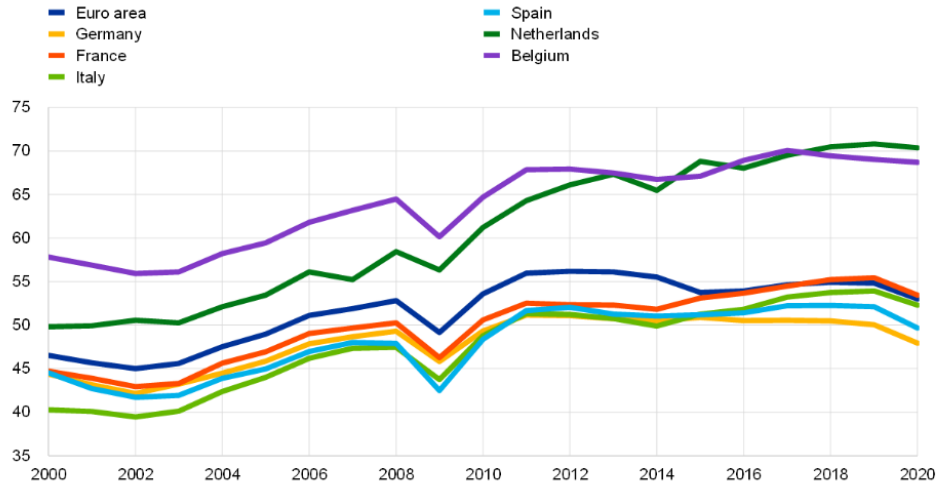
Term VUCA (Volatility, Uncertainty, Complexity, and Ambiguity), translated for manufacturing:

- **Scale up or scale down** in production capacity (e.g. starting with market testing and moving on to full-scale mass production, based on market acceptance);
- **Introduction of new suppliers** (material, semi-product or machinery) in the manufacturing value chain, potentially affecting the final product quality;
- Reconfiguration of production to accommodate **multiple product variants**;
- Reconfiguration of production to address an **unprecedented event** (e.g. societal or political changes, new regulations).

Chart A

Global value chain participation in the largest euro area countries

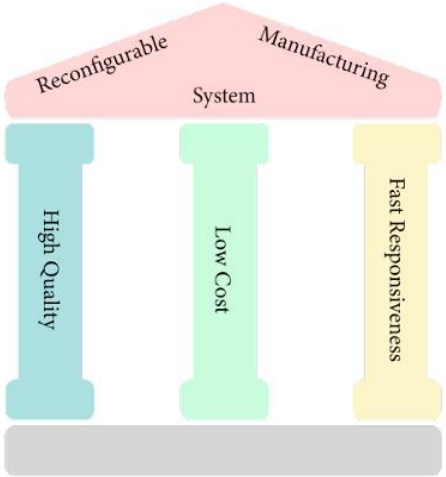
(percentage of gross exports)



Source: ECB staff calculations based on the World Input-Output Database (WIOD, see: www.wiod.org).

Reconfigurability as a Resilience Response

- *Economy* – RMS increase the manufacturing system value for the manufacturer, thereby making the business more profitable.
- *Environment* – Usually refers to reducing carbon footprint and water usage, but the main contribution of RMS is obtained by not scrapping the old transfer lines every few years.
- *Society* – Supplying high-quality products, exactly at the time that consumers need them.*



*Source: Dahmani, A., Benyoucef, L., & Mercantini, J. M. (2022). Toward sustainable reconfigurable manufacturing systems (SRMS): past, present, and future. Procedia Computer Science, 200, 1605-1614

Where does R3GROUP stand on the resilience research?

General Information

Call Topic: HORIZON-CL4-2022-TWIN-TRANSITION-01-01 - Rapid reconfigurable production process chains (IA)

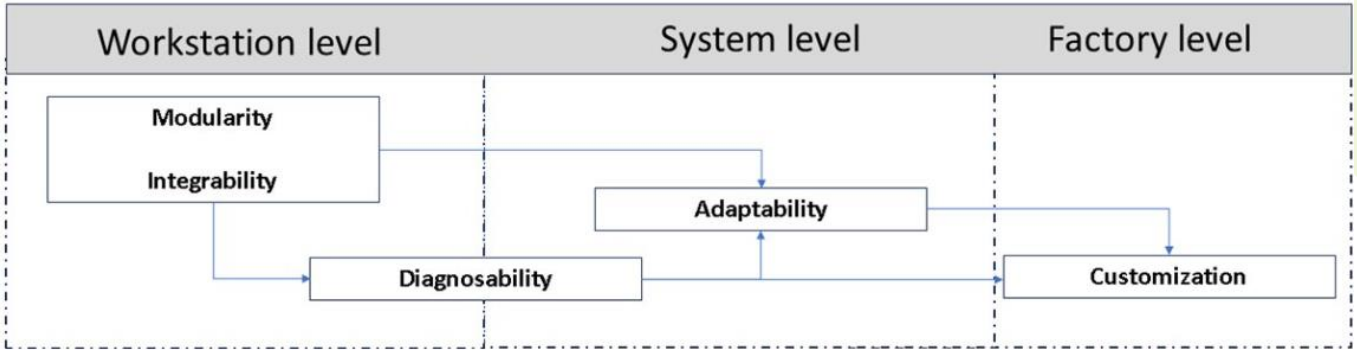
- 25 Partners from 11 countries
- 4 year project
- 5 Pilot Lines
- Ca. 9M€ EU contribution

Objectives

Achieve Resilience through Rapid Reconfigurability:

- Develop tools to foster Rapid Reconfigurability
- Anticipate and capture weak signals from the VUCA environment and trigger reconfiguration
- Assess reconfigurability and resilience of a manufacturing system

Reconfigurability on different levels



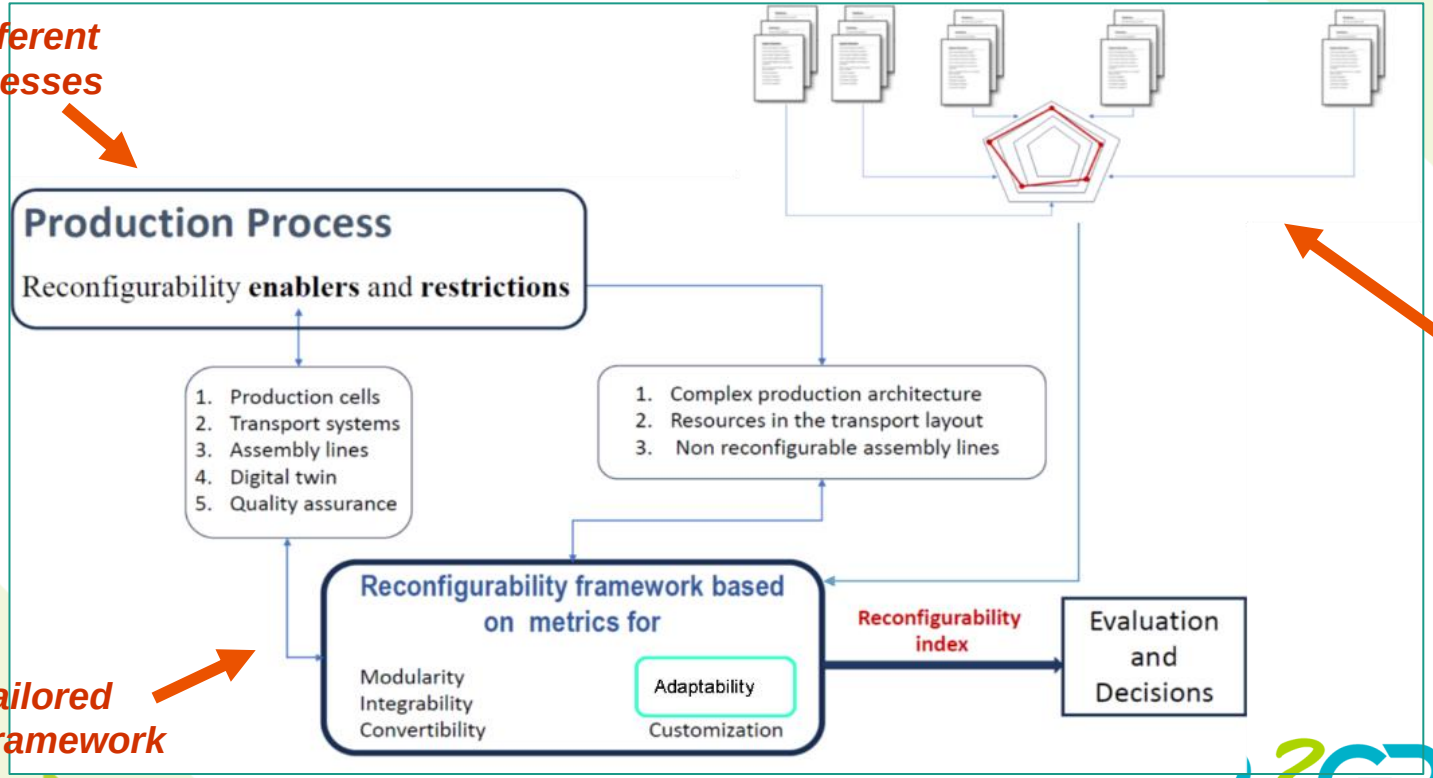
Different levels within a company or organisation when improving resilience through reconfigurability:

- Collaboration on the shopfloor or production cells
- Connected logistics, allowing for better planning and anticipation
- Cooperative plants, which can make scaling up or scaling down of a particular production process more smooth
- Cooperative ecosystems, in which all partners in a value chain are calibrated to deal with changes in production lines due to external shocks*

*Source: El-Halwagi, M. M., Sengupta, D., Pistikopoulos, E. N., Sammons, J., Eljack, F., & Kazi, M. K. (2020). Disaster-resilient design of manufacturing facilities through process integration: principal strategies, perspectives, and research challenges. *Frontiers in Sustainability*, *1*, 595961.

How to measure reconfigurability and resilience?

5 different processes



Pilot Profiles for Reconfig

Tailored Framework

Source: R3group consortium

The 5 R3GROUP Pilots

GLN PLAST

Manufacturing of polymer products

Injection molding

GESTAMP

Automotive

Laser-based production equipment

HALCOR

Copper Tubes

Discrete production steps

KATTY FASHION

Womenswear

Garnment manufacturing processes

GORENJE

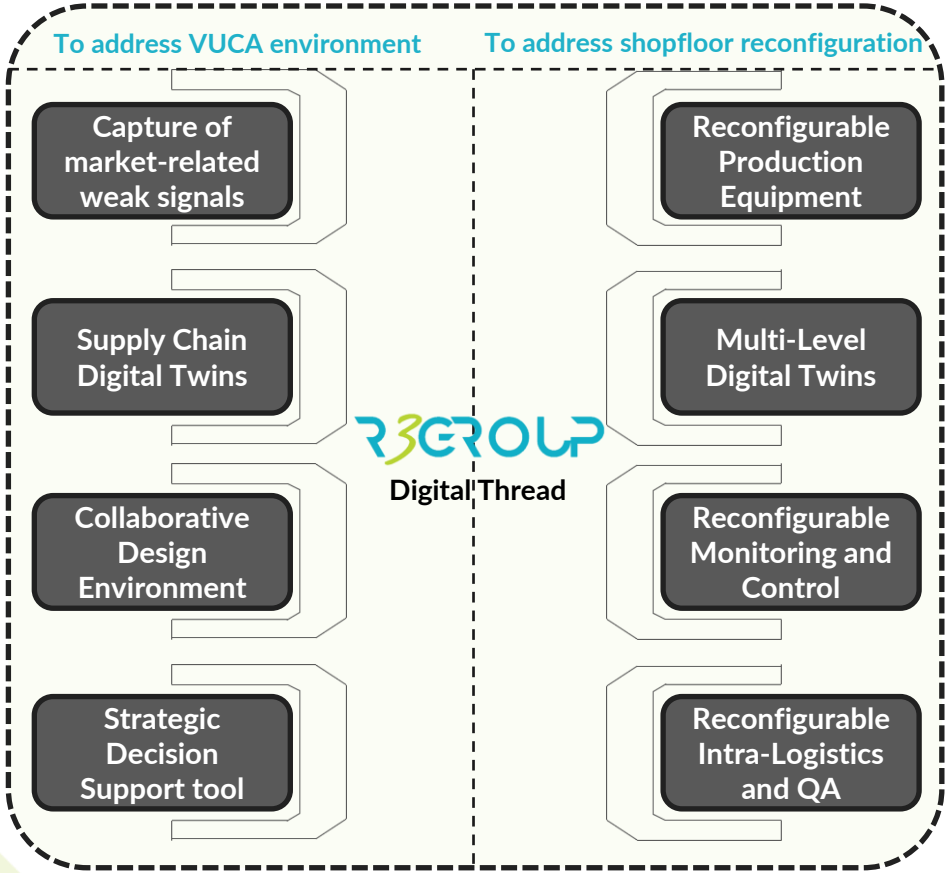
Household appliances

Tooling and stamping

Key Elements

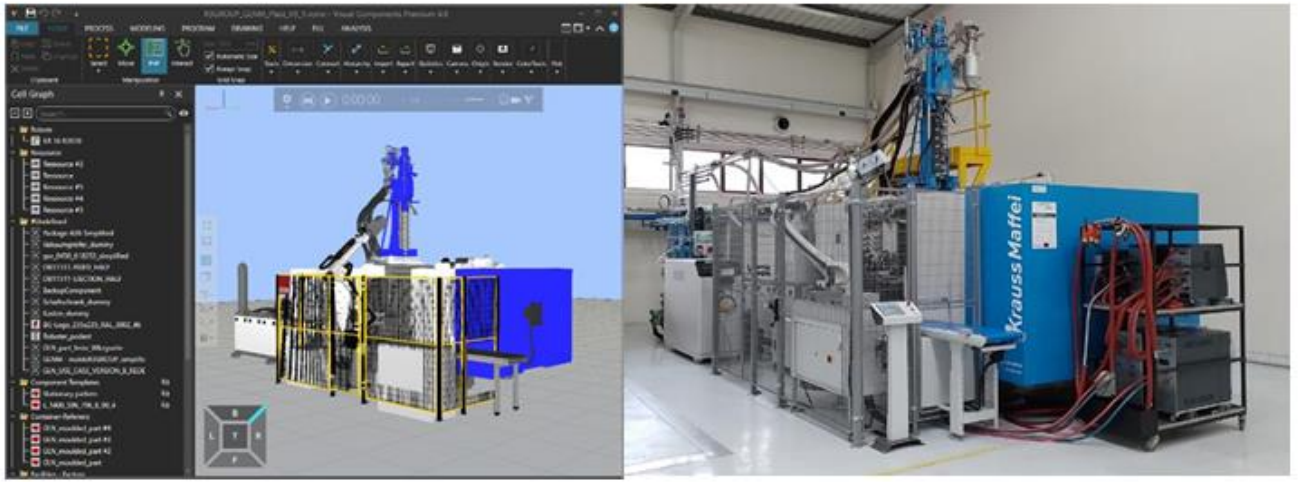
- Diverse sectors
- Different enterprise sizes
- Different digitalization levels
- Different challenges in terms of threats and disturbances from the VUCA environment

The R3GROUP technologies to foster reconfigurability

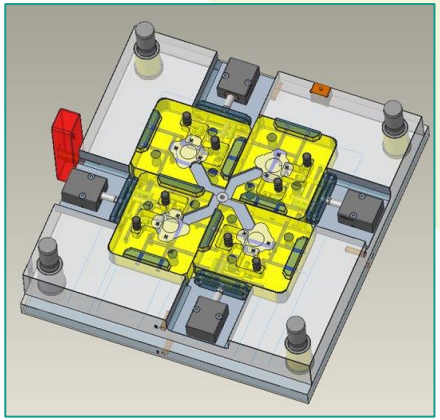


Deep Dive in Injection Moulding Pilot

Digital Twin



Modular Mould



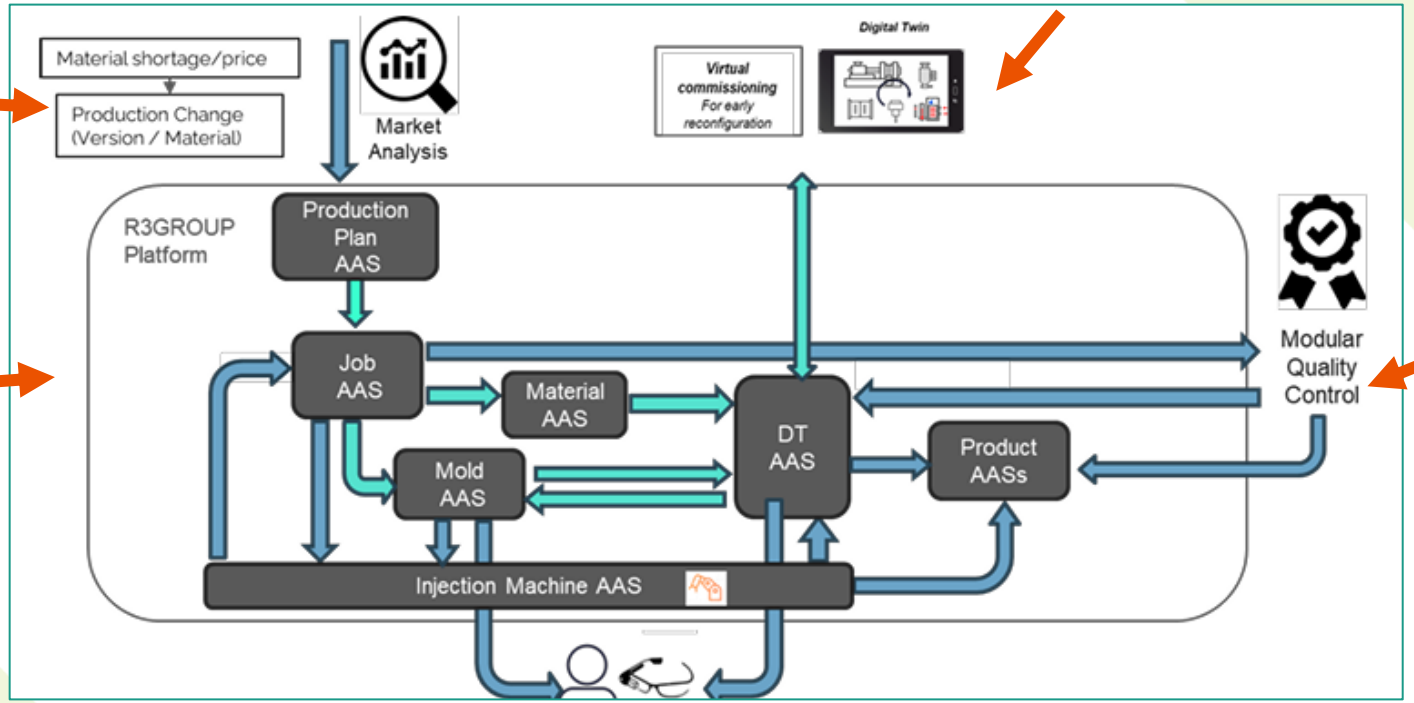
Deep Dive in Injection Moulding Pilot (2)

Digital Twin

VUCA – reconfig trigger

AAS-based platform

Modular quality control



Augmented Machine Configuration assistance

Recommendations for Resilience and Reconfiguration

Policy

- Broadening the JRC indicators on resilience to also include indicators for manufacturing
- Relate RRF funds -evaluation to monitoring of resilience in industry
- Develop a more fine-grained analysis of costs-benefits of different reconfigurability strategies
- In close cooperation with industry develop digital monitoring tools to support risk management models.

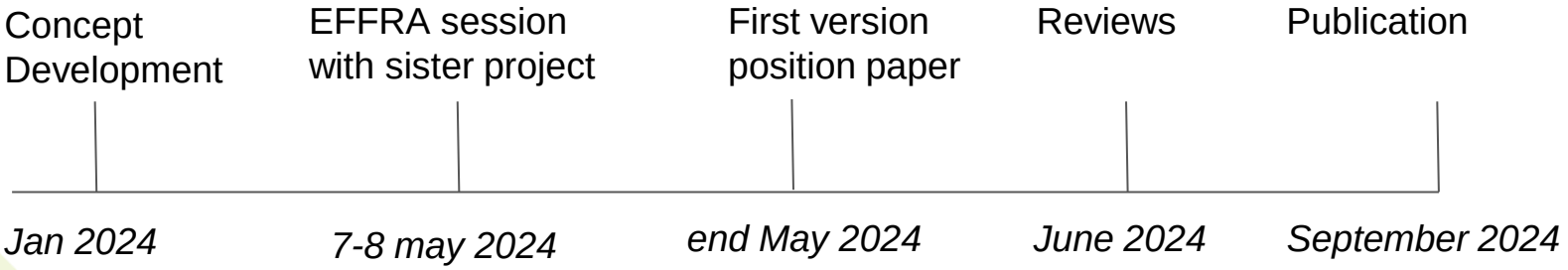
Industry

- Reconfigurability as a new modus operandi to increase resilience
- Improving reconfiguration through digitisation
- From resilience strategies to reconfiguration metrics
- Develop digital thread and have a data strategy
- Think about digital partners or in-house skills development

Position paper in the making

Objectives and Planning

- Better understand the concept of resilience in the context of manufacturing
- Connect elements of resilience to the concept of reconfiguration
- Explore reconfigurability indicators for our project



Thank you

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