Product Passport through Twinning of Circular Value Chains

Deliverable 5.5

Annual business models and exploitation plans v1

WP5: – Impact Creation, Solutions Scale-up and Exploitation

Editor:	Giulia Carosella
Lead beneficiary:	IDC
Version:	1.0
Status:	Final
Delivery date:	21/12/2023
Dissemination level:	PU (Public)

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101092008

Document Factsheet

Grant Agreement No.	101092008
Project Acronym	Plooto
Project Title	Product Passport through Twinning of Circular Value Chains
Start date	01/01/2023
Duration	36 months

Deliverable Name	D5.5 Annual business model and exploitation plans v1
Related WP	WP5 Impact Creation, Solutions Scale-up and Exploitation
Due Date	31/12/2023

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Approved by	All partners

Document History

Version	Date	Author(s)	Organisation	Description
0.1	22/09/2023	Golboo Pourabdollahian, Giulia Carosella	IDC	ToC is defined
0.2	07/11/2023	Giulia Carosella	IDC	First contents for chapter 4
0.3	17/11/2023	Golboo Pourabdollahian, Giulia Carosella	IDC	Restructuring of the document
0.4	20/11/2023	Golboo Pourabdollahian	IDC	Contents for chapter 2
0.5	23/11/2023	Giulia Carosella	IDC	Contents for chapter 3
0.6	27/11/2023	Golboo Pourabdollahian	IDC	Updates in Chapters 4 and 5
0.7	05/12/2023	Katharina Grimme. Margherita Forcolin	IDC MAG	Added Content
0.8	6/12/2023	Golboo Pourabdollahian, Giulia Carosella	IDC	Final draft ready for internal review
0.9	12/12/2023	Andreas Katsigiannis	KPAD	Peer review
0.10	15/12/2023	Antonis Gonos	ESOFT	Peer review
0.11	20/12/2023	Giulia Carosella	IDC	Addressing comments from internal review
0.12	21/12/2023	Margherita Forcolin	MAG	Quality check
1.0	21/12/2023	Golboo Pourabdollahian, Giulia Carosella	IDC	Final version ready for submission

Executive Summary

The European Union (EU) has been at the forefront of advocating for a circular economy, aiming to reduce waste, promote resource efficiency and create a more sustainable society. With ambitious policies like the European Green Deal and the Circular Economy Action Plan[1], the EU has set targets to achieve a carbon-neutral continent by 2050 and to decouple economic growth from resource use[2] .

Central to this movement is the concept of a circular economy, where products and materials are designed, produced, used, and recycled in a closed-loop system. In the manufacturing sector, which is the industry where Plooto pilots operate, incorporating circular economy principles into production and operations is the top initiative for organizations to advance their sustainability agenda. By reusing, recycling, and remanufacturing components, manufacturers can minimize resources consumption and waste generation. This leads not only to cost savings and lower dependence on raw materials, but also to greater ability to meet customer expectations, increased customer loyalty and improved brand reputation. This concept demands innovative solutions to track and manage products throughout their lifecycle, giving rise to the concept of Digital Product Passports.

DPPs are digital representations that incorporate crucial information about a product, enabling easy access to data regarding its origin, materials used, manufacturing processes, and end-of-life possibilities[3]. Adopting circular economies practices requires the development of innovative value chain business models, where the cooperation of value chain partners enables greater value creation. By establishing advanced monetization strategies, those business models enable organizations to maintain these initiatives in the long run. Through subscription-based models, pay-per-use arrangements, or other innovative monetization mechanisms, manufacturers can not only cover their operational costs but also generate revenues.

Within Plooto's scope, this document provides the initial necessary step to develop a framework for circular value chain business models and definite Plooto exploitation and sustainability plans, including IPR rights and individual and joint exploitation plans of the three pilots in the project. The main findings are summarized in the following:

- From an exploitation perspective, there are opportunities in market considering factors such as EU regulations, scalability and interoperability of DPPs. By exploiting new channels (e.g. marketplaces), new products & services (e.g. data and Plooto's assets and tools) and new pricing models (e.g. subscription and pay per use models) Pilot's partners could achieve sustainable business growth.

[1] https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
[2] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en
[3] https://medium.com/circulatenews/the-power-of-digital-technologies-to-enable-the-circular-economy-5471d097ee7f

- However, there are also challenges that could hinder the exploitation, such as privacy and security concerns of data sharing, standardization issues and required investments especially for SMEs.
- At the current stage, Plooto pilots' core value proposition is centred around the opportunity to respond to ESG challenges and new regulatory requirements, unlock collaboration opportunities and achieve operational improvements. With the progress of the project, we expect pilots to further explore the commercial monetization opportunities; for example, connected with the exploitation of IP assets, which are laid out within this deliverable.

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

Acronym	Description
B2B	Business to Business
B2C	Business to Customer
CAWI	Computer Assisted Web Interviewing
CEAP	Circular economy action plan
CEO	Chief Executive Officer
CFPR	Carbon-fiber reinforced polymers
CSRD	Corporate Sustainability Reporting Directive
DPP	Digital Product Passport
EMEA	Europe, the Middle East and Africa
EPR	Extended Producer Responsibility
ESG	Environmental, Social, and Governance
EU	European Union
FTE	Full-Time Equivalent
GDPR	General Data Protection Regulation
ICT	Information and Communications Technology
NGEU	Next Generation EU
PM	Permanent Magnets
SCDDA	German Supply Chain Due Diligence Act
SME	Small and medium-sized enterprises
WEEE	Waste from Electrical and Electronic Equipment
WP	Work Package

1 Introduction

1.1 Purpose and Scope

This document is the first deliverable of T5.2 related to collaborative business model for circular value chains. The main objective of T5.2 is to develop business models for Plooto pilots, considering the concept of circular economy for digital product passports. Moreover, within the scope of this task, a proper exploitation model will be developed and supported by a preliminary market analysis, to facilitate the commercialisation of project's assets and ensures its sustainability. Task 5.2 will run during the whole lifecycle of the project and is conducted in three phases. In the first phase (M1-M12), a preliminary market analysis is conducted and the business model framework for circular value chains is developed. Moreover, the first mapping of Plooto pilots using the business model framework is made. In addition, the outline of the exploitation plans is identified, including the analysis of opportunities and challenges as well as main assets and exploitation targets. During the second phase (M13-M24), the business model mapping of the pilots will be evolved, and a detailed list of exploitation activities will be developed, based on the mid-term results of the projects, and some parts of the exploitation plan, such as market penetration and joint and individual exploitation plans will be defined. Finally, in the last phase (M25-M36), the final business model mapping and the final exploitation plan will be developed, including financial plan, IPR issues and updated joint and individual exploitation plans. The results of the first phase, summarized in this document, highlights the insights from market analysis, the preliminary mapping of the three Plooto pilots' business models, as well as initial identification of exploitation assets and targets. As the activities evolve during the upcoming months, the updated results will be delivered in D5.6 (M24) and D5.8 (M36).

1.2 Relation with other deliverables

In the first phase, T5.2 has been carried out in close collaboration with WP1, WP2, WP3 and WP4. The main interactions are described below:

- **WP1**: the interface of the financial part of the value chain with the business model structure requires an interaction between T1.1. and T5.2 (business model design). In particular, during the data collection process of T1.1, specific data related to the business model design of the pilots were also collected. The value chain mapping conducted in T1.1, has established the backbone to understand the processes of pilots and design the first mapping of the business model.
- **WP2**: The link between WP2 and T5.2 is strong due to the need to understand the technical services of the project (designed in T2.1), in order to properly define the value proposition in business model, as well as the link with the data spaces which is being investigated in T2.2.
- **WP3**: This WP provides the main input for Plooto exploitation plan. The interaction between T5.2 and WP3 in the next two phases will be tailored to develop different elements of the exploitation plan.

- **WP4**: The interaction with WP4 has been the core of the preliminary mapping of the pilot business models. The mapping has been conducted for each pilot and collecting data and information through different methodologies.

1.3 Structure of the document

The document is structured as follows:

- **Section 2** introduces the methodology that has been developed for running T5.2 in a gradual approach in three phases of market research, business modelling and development of exploitation plan.
- **Section 3** describes the findings and results of the analysis of market landscape for sustainability with considerations of digital product passport.
- **Section 4** describes the progress of activities regarding business modelling. The section introduces the business model framework developed in Plooto project for circular value chains and the methodology of data collection from the three pilots of the project. Additionally, it presents the results of preliminary business model mapping of the three Plooto pilots.
- **Section 5** introduces the preliminary elements of Plooto exploitation plan. It describes an overview of opportunities and challenges in terms of exploitation and commercialization and identifies the initial list of Plooto assets and targets for exploitation.
- **Section 6** summarizes the findings and conclusions of the work done and defines the next steps.

2 Methodology

In order to establish a structured approach to define the Plooto business model and exploitation plan, a methodology is developed to identify the three main dimensions of T5.2 and the main topics to be covered in each dimension. As illustrated in Figure 2.1, the three dimensions of activities are related to 1) market analysis 2) business model 3) exploitation plan. More specifically:

- **Market analysis**: An overview of market research on sustainability will be presented, highlighting the status, trends and outlook of the market.
- **Business model**: Considering the specific characteristics of the circular value chains, a business model framework is needed to address the peculiarities of the concept, taking into account pillars such as data exchange, value chain stakeholders, etc. The business model will be mapped for each Plooto pilot.
- **Exploitation plan**: Based on the assets that will be developed in Plooto, an exploitation plan will be developed to secure the sustainability of the assets.

These three phases are iterative and are going to be evolved during the project lifetime gradually, in a way that by the end of the project, a complete business and exploitation model for Plooto will be delivered.

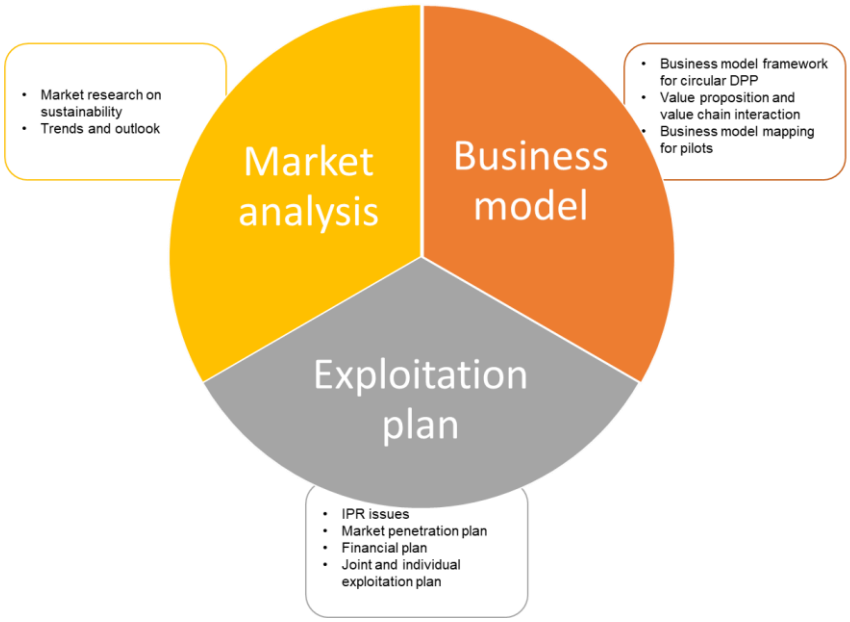


Figure 1: Methodology for Task 5.2

3 Market Landscape and analysis

In recent years, Europe has emerged as a key player in promoting sustainability and circular economy principles, driving innovation and the adoption of digital tools such as Digital Product Passports (DPPs). The convergence of the two aspects of circular economy and DPP presents a burgeoning landscape for transformative change across industries.

3.1 The Sustainability Imperative

European organizations are increasingly recognizing the interrelationships between social, environmental, and economic issues. As a result, a significant number of organizations are implementing elements of corporate and social responsibility in their business strategy.

Figure 2: At which stage of Sustainability strategy planning is your organization?

Source: IDC Global Sustainability Readiness Index (Europe n=718, August 2023)

Sustainability is therefore a strategic priority for 96%[4] of European organizations, even though only 43% of them have started implementing relevant practices, as shown in Figure 1.

Several factors are driving these initiatives within board rooms of European organizations. These are shown in Figure 2, and can be grouped in 5 macro areas:

- **Regional and local regulations:** companies must comply with regulations, including for example the EU Corporate Sustainability Reporting Directive (CSRD)[5], which requires companies to report on the impact of corporate activities on the environment and society. According to the IDC European CEO Survey (n=108, February 2023), changing ESG targets

[4] : IDC Global Sustainability Readiness Index (Europe n=718, August 2023)

[5] https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

and regulations is the third most impactful risk that European CEOs see for their organization up to 2025.

- **Access to financial resources,** including investors' capital, which is increasingly focused on 'green' portfolio elements, but also public expenditures that foster the transition to more sustainable business models; for example, among Next Generation EU funds (NGEU)[6] and national recovery packages, 37%[7] of these resources should contribute to environmental sustainability.
- **Business performance improvements** that are directly connected with the deployment of sustainable initiatives, such as cost efficiencies that can be achieved with the reduction or optimization of energy consumption.
- **Expectations from customers, employees and partners that companies need to fulfil**. All these stakeholders are increasingly looking at the impact that companies they engage with have on the environment and society. Additionally, they are increasingly aware of topics such as climate change and circularity of value chains.
- **Creation of business value and competitive differentiation,** by adapting or changing business models towards sustainable products and services. According to IDC Global Sustainability Readiness Index (n=718, August 2023), one-third of the European organizations see the opportunity to create business value through sustainable products or services.

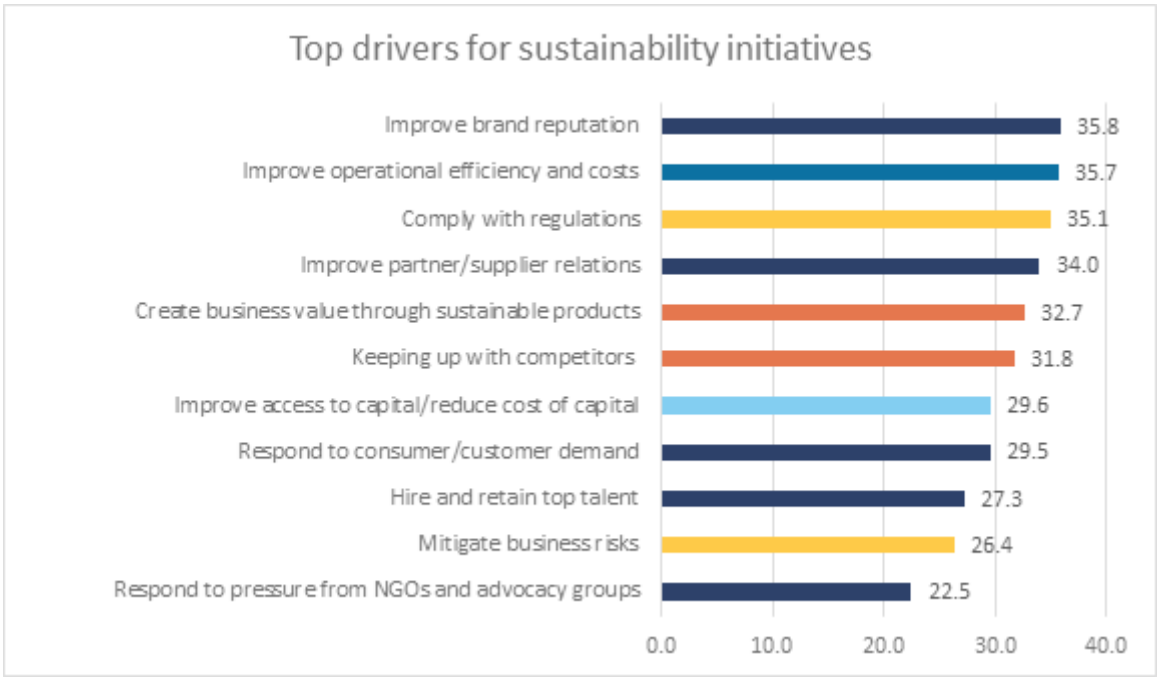


Figure 3: What are the top drivers for your organization's Sustainability-related initiatives?

Source: IDC Global Sustainability Readiness Index (Europe n=718, August 2023)

[6] https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu_en#:~:text=NextGenerationEU%20is%20the%20EU's%20%E2%82%AC,took%20place%20in%20June%202021.

[7] IDC Report "The Digital Impact of Resiliency and Recovery Plans in Europe: An Update on the Four Major European Economies" https://www.idc.com/getdoc.jsp?containerId=US51057823&pageType=PRINTFRIENDLY

Every industry prioritizes different sustainability initiatives, based on the specific industry priorities and challenges, as shown in Figure 3. In the manufacturing sector, which is where Plooto pilots operate, incorporating circular economy principles into production and operations is the top initiative for organizations to deliver on their sustainability agenda. By reusing, recycling, and remanufacturing components manufacturers can minimize resources consumption and waste generation. This leads to cost savings, lower raw material dependence, but also to greater ability to meet customer expectations, increased customer loyalty and improved brand reputation.

European organizations are starting to shift towards more sustainable supply chains. However, there are a lot of challenges to be overcome, both, as a method to achieve the set ESG objectives (given that supply chains typically account for the largest share of CO_2 emissions), but also for improving cost efficiency, risk management and resilience of the business.

Drivers for better understanding and control of the supply chain include regulations (e.g., Germany's SCDDA and the EU's upcoming legislations focused on human rights), the need to address (and reduce) scope 3 emissions, and wider risk management and resilience requirements triggered by the current geopolitical situation (e.g. supply chain shocks from China's zero-COVID policy or the current re-evaluation of dependencies on Chinese products). This results in companies starting to address supply chain resiliency and risk assessments. In some cases, the situation has already led to production site shifts. For example, Apple, Microsoft and Google are diversifying their productions out of China to India or Vietnam (Apple announced that it will invest $1.2 billion[8] in a chip design center in Germany to develop chips for 5G and other wireless technologies). It is possible to anticipate an increase in the number of companies undertaking similar initiatives as a response to geopolitical uncertainties.

Requirements about supply chain transparency involve data collection for ESG reporting, with scope 3 forming a major challenge for most companies, as well as analytics, modelling and forecasting to be able to assess product life cycles. More advanced organizations also encounter challenges in exploring sustainable innovations in areas such as materials sourcing and circularity, which require more fundamental business operations changes.

[8] https://www.apple.com/uk/newsroom/2021/03/apple-to-invest-over-1-billion-euros-in-germany-with-new-munich-campus/

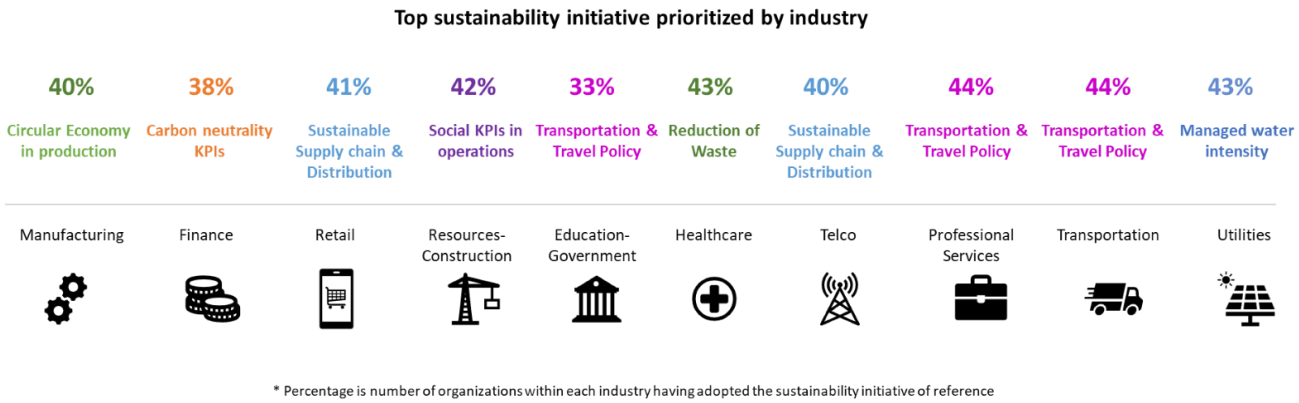


Figure 4: Top Sustainability Initiative prioritized by industry

Source: IDC Global Sustainability Readiness Index (Europe n=718, August 2023)

3.2 Circular Economy and Digital Product Passports in Europe

The European Union (EU) has been at the forefront of promoting a circular economy, aiming to reduce waste, increase resource efficiency, and create a more sustainable society. With ambitious policies like the European Green Deal and the Circular Economy Action Plan[9], the EU has set targets to achieve a carbon-neutral continent by 2050 and to decouple economic growth from resource use[10] .

The key to this movement is the concept of a circular economy, where products and materials are designed, produced, used, and recycled in a closed-loop system. This shift demands innovative solutions to track and manage products throughout their lifecycle, giving rise to the concept of Digital Product Passports.

DPPs are digital representations that incorporate crucial information about a product, enabling easy access to data regarding its origin, materials used, manufacturing processes, and end-of-life possibilities[11]. This passport-like approach allows for transparency, traceability, and efficient management of products across their lifecycle. As a result, all actors, including consumers, will have a better understanding of the materials and products they use and their embodied environmental and social impact.

Currently in Europe, the development and adoption of DPPs are primarily driven by regulations, most notably the EU's CEAP[12]: A key initiative of CEAP is the creation and gradual rollout of DPPs. The EU aims to implement DPPs across three industries by 2026 (apparel, batteries, and consumer electronics) with more to follow.

[9] https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
[10] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en
[11] https://medium.com/circulatenews/the-power-of-digital-technologies-to-enable-the-circular-economy-5471d097ee7f
[12] https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

The EU's shift towards DPP is grounded in the belief that enhanced consumer transparency will exert pressure on manufacturers, prompting them to modify their operations and business models. This, in turn, is expected to lead to a scenario where sustainable products eventually become more cost-effective than their conventional counterparts.

Additional regulations currently planned at EU level involving the 'right to repair' will further drive towards more sustainable/durable products. Some of the key benefits the European Commission expects to achieve include: tracking of raw materials supporting due diligence efforts, enabling manufacturers to create products digital twins, embedding required information, tracking the life cycle of products, enabling new services related to its remanufacturing, reparability, recyclability, enhancing market surveillance and customs authorities, interlinking incentives from policy makers to sustainability performances and allowing citizens to have access to relevant and verified information.

As a result, the market for DPPs in Europe is expected to have significant growth. Several factors contribute to this optimistic outlook:

- **Regulatory Push**: EU regulations, such as the Waste Framework Directive[13] and the Extended Producer Responsibility (EPR) framework[14], require better product traceability and information disclosure. This has motivated industries to invest in DPPs to comply with evolving regulatory standards.
  Further relevant regulations are the following:
  - **France's Right to Repair Index[15]** (January 2021)
    It introduces a Repairability index for 5 categories of electronic goods: Smartphones, laptops, TVs, washing machines, and lawnmowers, across the following categories: Documentation, dissassembly, availability of spare parts, price of spare parts, and product-specific aspects. No sanctions until 2022; sanctions applied from then onwards.
  - **Finland's Climate Strategy for ICT[16]** (March 2021)
    Focuses on longer hardware life and recycling of precious metals as well as on using technology as a tool to enable sustainability.
  - **Spain's "España Circular" Strategy[17]** (2020)
    New Strategy for Circular Economy in Spain until 2030 includes waste and water management objectives across six key sectors (construction, farming, industry, consumer goods, tourism, and textile).
  - **Europe's e-Waste Directive[18]** (WEEE Directive) (2012)

[13] https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en
[14] https://www.oecd.org/environment/extended-producer-responsibility.htm
[15] https://www.halteobsolescence.org/wp-content/uploads/2022/02/Rapport-indice-de-reparabilite.pdf
[16] https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162912/LVM_2021_06.pdf?sequence=1&isAllowed=y
[17] https://circulareconomy.europa.eu/platform/sites/default/files/espana_circular_2030_executive_summary_en.pdf
[18] https://environment.ec.europa.eu/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en

EU rules on treating waste from electrical and electronic equipment, to contribute to sustainable production and consumption.

- **Europe's REACH Directive**[19] (Registration, Evaluation, Authorization, and Restriction of Chemicals) (2007)
  Regulates chemical substances used in clothes, cleaning products, furniture, electronic goods, etc.
- **Europe's Green Public Procurement**[20]
  Voluntary instrument with a set of guidelines and criteria for European's Public Authorities on how the purchase of imaging equipment, consumables, print services, datacenters, server rooms and cloud services, among others, can make important contributions to sustainable consumption and production.

- **Consumer Awareness and Demand:** Increasing consumer awareness about sustainability and ethical consumption drives the demand for transparent and eco-friendly products. DPPs facilitate consumers to make informed choices, fostering brand loyalty and market differentiation for companies.
- **Technological Advancements:** Rapid advancements in technologies like blockchain, IoT (Internet of Things), and AI facilitate the creation and management of DPPs. These technologies ensure data integrity, security, and interoperability, making DPP implementation more feasible and effective.
- **Industry Collaboration:** Collaborative efforts between industry stakeholders, including manufacturers, suppliers, retailers, and policymakers, are fostering ecosystems conducive to DPP adoption. Consortia and alliances are forming to establish standards and frameworks for DPP implementation.
- **Investment and Innovation:** Venture capital and government funding are increasingly directed towards startups and initiatives focusing on circular economy solutions, including DPPs. This investment landscape spurs innovation and accelerates the development of scalable DPP solutions.

[19] https://environment.ec.europa.eu/topics/chemicals/reach-regulation_en#:~:text=The%20REACH%20Regulation%20aims%20to,promote%20innovation%20and%20competitiveness
[20] https://green-business.ec.europa.eu/green-public-procurement_en

4 Defining Circular Value Chain Business Models

Despite the strategic opportunities from adopting circularity practices in production and operations, manufacturers encounter several obstacles in evolving into more sustainable businesses. Primary among these challenges is the difficulty in aligning sustainability initiatives with business growth. This is closely followed by a shortage of sustainability expertise and a lack of transparency throughout the value chains. Adopting circular economies practices requires therefore the development of innovative value chain business models, where the cooperation of value chain partners enables greater value creation. By establishing advanced monetization strategies, those business models enable organizations to sustain these initiatives. Through subscription-based models, pay-per-use arrangements, or other innovative monetization mechanisms, manufacturers can not only cover their operational costs but also generate revenues. This financial sustainability is crucial for the continued growth and expansion of sustainable value chains in Europe, further supporting the region's manufacturing sector's digital transformation and competitiveness.

4.1 The Circular Value Chains Business Model Radar Framework

Traditionally, a business model represents how a company creates, delivers, and captures value from its operations and activities. A business model comprises several building blocks that can be visualized in Osterwalder's traditional business model canvas, a strategic management template. The template particularly highlights nine critical components of a business model, from the value proposition to customers and partner relationships to the key resources and activities. However, circular value chain business models are not entirely represented by traditional value chains frameworks. On the contrary, our increasingly interconnected world is leading to the creations of data-driven ecosystem business models, where the shared value is created by sharing and combination of different data and resources among different actors, for the fulfilment of a common goal.

As a result, for the development of the circular value chain business model framework and considering the complexity and the interconnectedness, we started taking into account multiple existing frameworks from literature, and specifically the Business Model Canvas (Osterwalder, Pigneur, 2010[1]), the Service-Dominant Business Model Radar (Turetken, Grefen, 2017[2]) and the St. Gallen Business Model Navigator (Gassmann, Frankenberger, Csik, 2014[3]). These frameworks are reported in 7.1, 7.2, 7.3. The analysis of these frameworks led to the development of a specific framework that captures the peculiarities of the circular value chains, by integrating elements taken from each of the three aforementioned frameworks. More specifically, the partners' roles from the Service-Dominant Business Model Radar (Turetken, Grefen, 2017 [2]), the focus on key resources, benefits and activities from the Business Model Canvas (Osterwalder, Pigneur, 2010 [1]), and the rationalization into the 4 key areas of who, what, how and value from the St. Gallen Business Model Navigator (Gassmann, Frankenberger, Csik, 2014 [3]).

The resulting framework is shown in Figure 5. It consists of:

- **Outer layers** identify:
    - Who: the key partners of the data space and their different roles (orchestrator, data owner, technology provider, customers)
    - Value: the key benefits each single participant get and the resources which they contribute to the data space, including economical, business, organizational and technical resources (e.g. funds, assets, facilities, FTEs)
    - How: the specific activities each partner carries out within the data space.
- **Inner layers** focus on the shared value and resources. These layers include:
    - What: the value proposition, that is the north star, the "why" driving the activities of the data space as well as the benefits that are shared among participants.
    - How: the shared infrastructure and data platform supporting data collection and exchange. The governance model in place, including the governance model, the legal form of the data space, the contracts and IP rights owned.

Figure 5: Circular Value Chain Business Model Radar

4.1.1 Key Attributes & Characteristics

Circular value chains can be defined according to some common attributes that make these types of ecosystems unique. These include:

- **Shared Business Value:** Within circular value chains the relationships between participants, assets, resources and data lead to co-creation of value that is shared among participants. The value generated can be tangible (e.g. new revenue streams, productivity gains) or intangible (e.g. linked to research and development for the industry). Within the value chain, the shared value can only be achieved by co-operations**.**
- **Stakeholders' connection:** all stakeholders are interconnected in terms of processes, activities, resources and value generated. It is important to have defined roles and clear value chain relationships**.**
- **Operating Model,** with multiple stakeholders' processes along the value chain that are interrelated and dependent on one another.
- **Data flows:** data on secondary raw materials and products characteristics play an important role on the value generation process. Data flowing across partners, applications and externally with customers and partners will be enhanced through the Digital Product Passport
- **Shared Resources:** the co-creation of shared business value is connected with the availability and reliance of a set of resources that are shared within the ecosystem. This allows the access to relevant skills, assets and tools for carrying out data space activities.
- **Shared Technology Architecture:** the underlying infrastructure supporting data collection, exchange and usage. This infrastructure should be open, flexible, modular, cloud-driven, and secure.
- **Governance:** This relates to the development of clear policies that enable the responsible use of data, transparency and audit mechanisms for compliance with existing regulations, the sign of proper contracts for IP rights ownership and ethical use of technologies.

	Attribute	Definition	Trait of Mature Data Spaces
1	Shared business value	▪ Value propositions ▪ Participants' benefits	▪ Co-creation and digital revenue generation ▪ Member/participant success ▪ Focus on Purpose beyond financials (e.g. ESG goals)
2	Stakeholders Interconnectedness	▪ Multiplicity of stakeholders ▪ Different roles	▪ Defined roles and engagement
3	Interdependent Operating Model	▪ Processes ▪ Value chains	▪ Interconnected End-to-End ▪ Automated when applicable
4	Data Flows	▪ Between stakeholders & applications ▪ With customers	▪ Real-time, valuable, accessible
5	Shared Resources	▪ Skills, tools & assets	▪ Access to relevant skills, assets & tools ▪ Multiplier effect
6	Shared Technology/Data Architecture	▪ Underlying tech architecture components	▪ Open, flexible, modular, cloud driven, intelligent & trusted platform
7	Governance	▪ Rules and regulations ▪ Contracts and IP rights ▪ Ethics	▪ Ethical sourcing & use of technology ▪ 360-degree trust ▪ Clear participants roles ▪ Data handling, access & usage policies and clear IP rights

Figure 6: Attributes of Data Spaces

4.1.2 Value Proposition

There are different value propositions that Circular Value Chain can pursue. We identified three macro areas of shared objectives that can drive ecosystem activities:

- **Collaboration for Industry & Societal Goals**: this group encompasses non-tangible benefits which are the fundamental objectives of all circular value chains. By design all circular value chain business models have the key objective to respond to ESG (environment, social, governance) requirements, by supporting the reuse, recycle and remanufacture of products to dimmish waste and usage of critical resources. In addition to that, these business models can have the objective to understand and adopt new protocols and regulations (e.g. for the Plooto pilots the development of Digital Product Passport), as well as to foster research within the industry leveraging expertise and data.
- **New revenue generation**: crucial for the long-term availability of the ecosystem is the generation of new revenues from the adoption of circular value chains. This can be achieved through the launch of new products and services codeveloped by the ecosystem, or implementation of new monetization models (e.g. by monetizing the technology or IP rights of the ecosystem), as well as the incubation of new businesses, such as startups, for subsequent market launch.
- **Operations Optimization and Productivity**: among the key benefits companies can gain from circular value chains are the improvement of productivity, the optimization of internal processes and operations and the achievement of efficiencies; for example, by reducing energy consumption. Additional business outcomes in this group include having greater product quality (e.g. by leveraging simulation and digital twin tech), improving predictability of product demand and supply leveraging, real time data along the supply chains, as well as the sharing of costs among ecosystem participants.

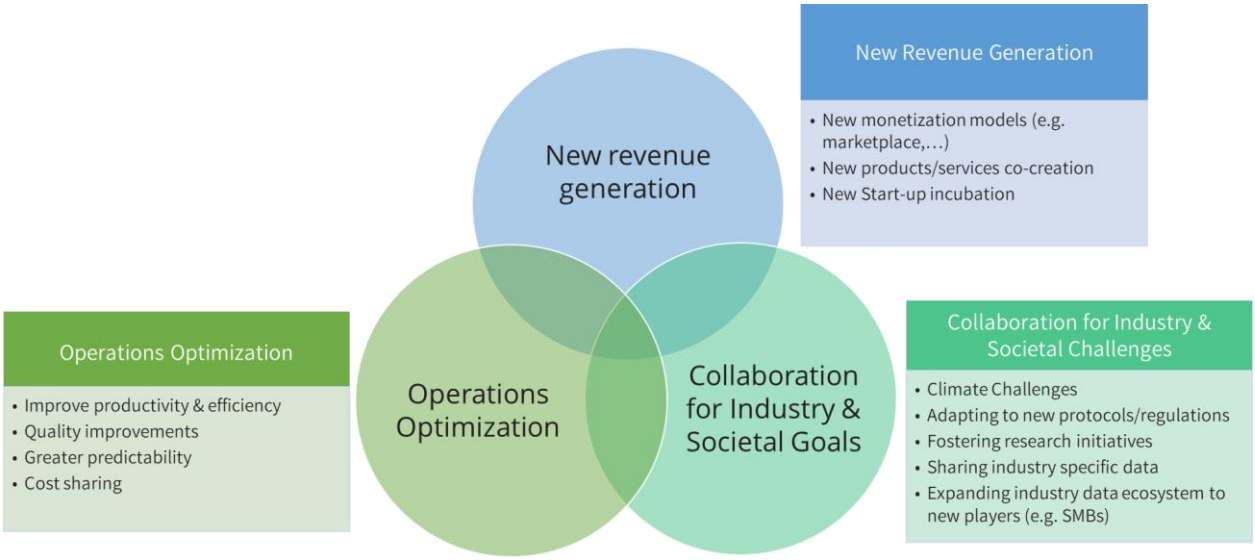


Figure 7: Value Proposition of Manufacturing Data Spaces

New Revenue generation Models

80% of CEOs of Manufacturing organizations in EMEA face pressure to produce financial results from digital business models. In the realm of manufacturing digital ecosystems, circular value chains stand out as particularly significant digital business models. According to the IDC EMEA Digital Executive Sentiment Survey conducted in October 2023, 82% of manufacturing organizations are either utilizing or contemplating the adoption of such models. However, for only 9% of these organizations, participation in digital ecosystems significantly impacts their top line, generating over 10% of their revenues. More thoroughly, Figure 8 presents the IDC's Monetization cube, which shows the ways that circular value chains generate new revenue streams, and the monetization opportunities that circular value chains can pursue.

The cube utilizes three main axes, on which data spaces can act to generate new revenue streams:

- **Monetize through new channels**. For example, through:
    - **Marketplace:** This allows easy access to partners' and 3rd party products and/or services that are made available to external players through this 2-multi sided platform, matching and connecting different parties. A key characteristic of the marketplace is the network effect, which translates to increasing the value of the product and/or service with the number of users.
- **Monetize new assets**. Assets that could be monetized include:
    - **Data:** This includes the monetization of asset data collected (e.g. through IoT devices), and customer related data (e.g. from smart and connected products). For example, in the automotive industry new opportunities are related to the monetization of data used or derived by a vehicle passenger or the driver of that vehicle. This data can be monetized through other ecosystem players (retail, insurance etc.) and used for providing personalized services to the passenger, including fleet management, remote services, roadside and emergency assistance, usage-based insurance and infotainment services.
    - **IP software:** Monetization of IP rights and software solutions or "softwarization". This Includes also APIs as a service (offering business functionalities and capabilities to 3rd party developers). For example, a circular value chain ecosystem has developed a technology platform to collect Digital Product Passport data, it packages that software and then offers it on a subscription basis to other organizations.
    - **Smart products and assets:** This includes the monetization of recycled/remanufactured connected and smart products and assets both B2B and B2C.
- **Monetize in new ways.** This includes the shift from a product-centered strategy to new service-based models, where in addition to physical products or equipment,

manufacturers can sell data-driven services to customers. The "servitization" of physical products can happen through:

- **Pay per use/recurring subscription services:** Here the customer pays to use the product on demand, or on a regular (monthly, annual) basis. For example, one of Europe's leading suppliers of industrial trucks traditionally has been selling upfront or leasing forklifts to logistic players. Nowadays, they added to their traditional model, a new one leveraging IoT modules embedded in forklifts. Data collected were aggregated in a cloud dashboard and used to provide an add-on digital fleet management service paid on a subscription basis.
- **Outcome-based models:** Manufacturers can charge customers based on the outcomes that they achieve through the usage of their products. For example, an industrial valves manufacturer charges its customers based on volume of liquid processed by the valves.

An organization can mix multiple monetization opportunities in a hybrid way, leveraging different revenue models.

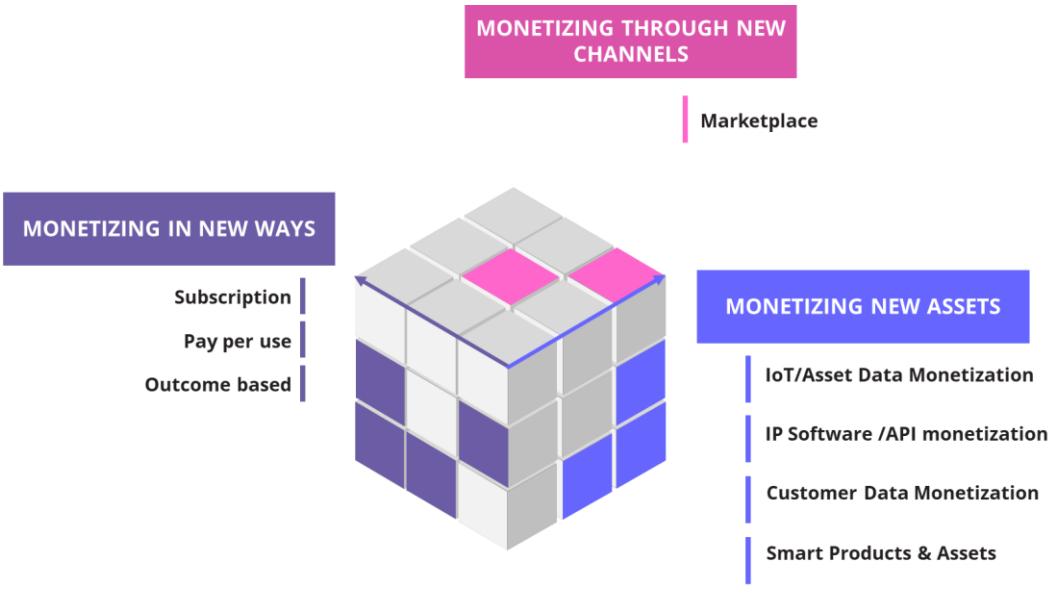


Figure 8: The Monetization Cube

Operations Optimization Models

Circular value chains can also help participants optimize processes and achieve cost efficiencies. By participating in these value chains, companies can achieve:

- **Greater productivity & efficiency.** As an example, the BMW Open Manufacturing Platform, is an open industrial IoT platform to accelerate production and logistics optimization efforts. It allows industrial manufacturers to work together to break down data silos and overcome the challenges of complex, propriety systems that slow down production optimization.

- **Quality improvements**. Leveraging product data, artificial intelligence and digital twin technologies to optimize product life cycle and minimize product defects.
- **Greater predictability** of supply and demand but also on asset performance and maintenance.
- **Improved traceability**, thanks to the sharing and collection of data along the supply chain.
- **Cost sharing**, by minimizing transaction costs for participants to get access to the relevant data and shared resources, or due to automation and greater production efficiencies.

4.2 Sustainable Value Chain Business Models: The importance of data

In the context of circular value chains, data plays a pivotal role in enabling transparency, efficiency, and innovation. At the heart of this role lies the concept of Digital Product Passports (DPPs), which serve as repositories of comprehensive data, encompassing the entire lifecycle of a product. These passports aggregate and encapsulate crucial information regarding a product's origin, materials, manufacturing processes, and potential reuse or recycling opportunities. By integrating DPPs into circular value chains, businesses gain access to comprehensive multifaceted data that facilitates informed decision-making at every stage, fostering a more sustainable and efficient ecosystem.

Data spaces, which serve as secure and interoperable environments for data sharing and collaboration, complement the role of DPPs in circular value chains. These spaces facilitate the seamless exchange of data among various stakeholders, including manufacturers, suppliers, recyclers, and consumers, enabling a more integrated and interconnected circular economy. By leveraging data spaces, the information stored in DPPs can be shared, accessed, and utilized across the value chain, enhancing transparency, traceability, and resource optimization.

The integration of data from DPPs within data spaces unlocks several key advantages in circular value chains. Firstly, it enables real-time visibility and traceability of products, allowing stakeholders to track and monitor the flow of materials, components and products throughout their lifecycle. This visibility aids in identifying inefficiencies, optimizing processes and reducing waste, thereby enhancing resource efficiency within the circular economy. Moreover, the availability of comprehensive data fosters innovation by providing insights into consumer behaviour, market demands, and potential areas for product redesign or material innovation, thus driving the development of more sustainable products and business models.

Additionally, the role of data in circular value chains extends beyond operational efficiencies. It empowers consumers with information about a product's sustainability credentials, enabling informed purchasing decisions aligned with their values. This transparency builds trust and loyalty between businesses and consumers, fostering a culture of responsible consumption. Ultimately, by harnessing the power of data through DPPs and data spaces, circular value chains in Europe can evolve into interconnected and dynamic ecosystems where resource circulation, innovation, and sustainability are harmoniously integrated.

From a business model perspective, leveraging data within circular value chains, particularly through the integration of Digital Product Passports (DPPs) and data spaces, requires a fundamental shift in approach. Companies need to reimagine their business models to capitalize on the opportunities presented by data-driven circularity. As already mentioned, one strategy involves transitioning from traditional linear product-based models towards service-oriented models. Instead of merely selling products, businesses can offer "product-as-a-service" models, where they retain ownership of products and focus on providing ongoing services, maintenance, and upgrades. Data from DPPs can benefit these service offerings by enabling predictive maintenance, personalized services, and optimized product lifecycles, thus ensuring greater product longevity and resource efficiency.

Moreover, adoption of data-driven circularity entails collaborations and partnerships across the value chain. Businesses can explore collaborative business models that emphasize on ecosystem partnerships, allowing for shared access to DPPs and data spaces. Collaborations among manufacturers, suppliers, recyclers, and even competitors can facilitate the exchange of valuable insights and resources, driving innovation and fostering closed-loop systems. Establishing such collaborative models requires not only technological integration, but also a redefinition of value propositions, revenue streams, and risk-sharing mechanisms among stakeholders.

Furthermore, the monetization of data itself can give rise to new business models. Companies can explore opportunities to derive value from the information stored within DPPs by offering data-driven services, analytics, or insights to other stakeholders in the value chain. Monetizing data ethically and transparently, while ensuring data privacy and compliance, can create additional revenue streams and encourage the adoption of DPPs and data sharing. This shift towards data-driven business models not only aligns with circular economy principles but also establishes businesses as pioneers in sustainability, enhancing their competitiveness in the evolving market landscape.

4.3 Business model for Plooto pilots

4.3.1 Methodology for data collection

In order to validate the Circular Value Chains Business Model Radar within the context of Plooto's pilots, primary research was conducted between September and October 2023. The research was conducted with quantitative survey, developed by IDC, and carried out with the CAWI methodology. The questionnaire was designed to investigate all aspects of the framework, from the single partners role to the shared value achieved, with the objective to validate the framework and describe respondents according to the framework. The full questionnaire can be found in section 7.1. The questionnaire was shared and filled out by the three pilots of the Plooto Project. Furthermore, preliminary information on Pilots' value creation, collected through the activities carried out by consortium members in T1.1 for D1.1 "Plooto Methodological Approach and Business Cases Specifications V1", were also taken into account and can be found in section 7.5.

4.3.2 Preliminary Results

4.3.2.1 CASE I: CFRP waste for Drones

This pilot aims to increase the reuse of carbon fibre reinforced polymer (CFRP) composites and avoid their disposal as waste for economic reasons and legislation restrictions. More details on the Pilot, the business case and processes can be found in deliverable 1.1 "Plooto Methodological Approach and Business Cases Specifications V1".

In the current ("as-is") status, CFRP waste for Drones pilot is an example of a circular value chain, with the primary objective of achieving operational efficiencies for the partners. The Business Model Radar information on value proposition, data platform, governance and partners collected through the methodology described in section 4.3.1 is reported in Figure 9.

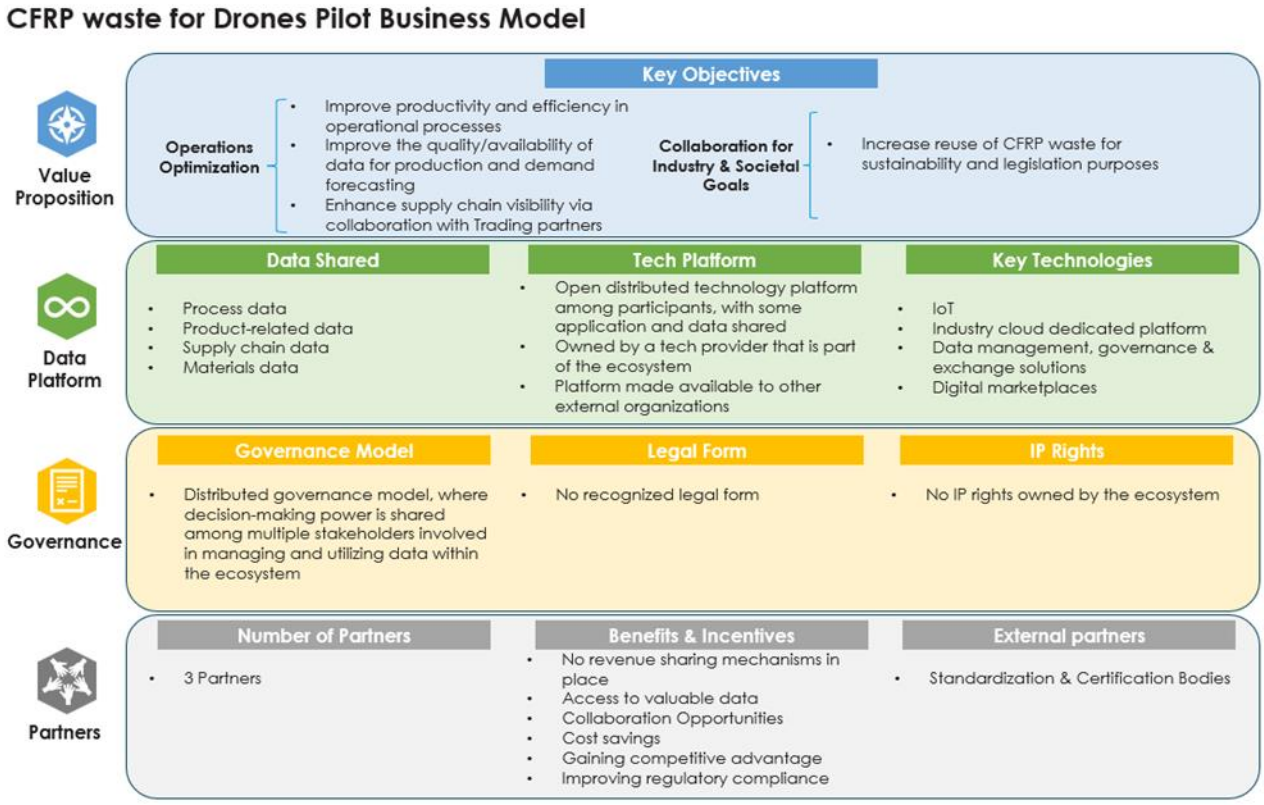


Figure 9: CFRP waste for Drones Pilot Business Model

The ecosystem consists of 4 partners from the manufacturing and professional services industry, involved in different activities of the circular value chain, detailed in Table 1. Each of the stakeholders involved in the pilot's process has different requirements, and clearly information requested varies, depending on the tasks and operations carried out. Overall, the most important information and data that need to be shared across the actors in the full pilot are about the physical properties of the waste, such as thermal and rheological properties (e.g., viscosity as function of the temperature), mechanical properties (e.g., ILSS), and deviation of waste properties from the original material (just to name a few). Manufacturing cost reduction and waste reduction

will be the most critical benefits gained by this pilot. Key metrics to measure pilot's success include, among the others, environmental-related performance, and new skills acquired.

Table 1: CFRP waste for Drones Pilot Partners

Partner	Sub-Industry	Key Role/Activities	Resources	Benefits
HP Composites	Composite Part Producer	CFRP waste provider	Technical and organizational resources	CFRP waste repurposing, reduced disposal cost, new business opportunities
CETMA	Research Center	Technical process manufacturer	Technical resources	New collaborations in composite materials field
CETMA Composites	Parts producer	Produce the drone parts	Technical and organizational resources	New business opportunities
Acceli	Robotic solutions manufacturer	UAV (Unmanned aerial vehicle) manufacturer	Technical and organizational resources	New business opportunities

4.3.2.2 CASE II: WEE for Magnets

This pilot focuses on increasing the reuse of NdFeB and Strontium-ferrite (Sr-ferrite) permanent magnets (PMs) recovered as WEEE from magnet products. The possibility of recovering NdFeB PMs from WEEE brings many competitive advantages, such as a decreased dependency on third countries for the supply of Nd (rare-earth element& critical raw material) to manufacture magnets in Europe, the creation of a competitive secondary raw material source and the valorisation and reduction of the WEEE landfilled. More details on the Pilot the business case and processes can be found in deliverable 1.1 "Plooto Methodological Approach and Business Cases Specifications V1".

In addition to circularity goals, the objectives of the WEEE for Magnets pilot are related to the improvement of the operational processes. The goals are achieved through the design of a fully or semi-automated robotic process to extract magnets from disposed devices and machines, the optimization of the processes to prepare crushed magnets prior to re-enter the production process, and the design of a better process to remove the coating and/or the impurities created by polymers and resins in sintered Sr-ferrite magnets. The pilot at this early stage is working on defining the right governance and technical architecture. The data collected and shared are mostly related to the type of material, the quantity and the origin of the magnets. The data exchange, specifically, relies on different proprietary systems. More details on the current business model can be found in Figure 10**Errore. L'origine riferimento non è stata trovata.**.

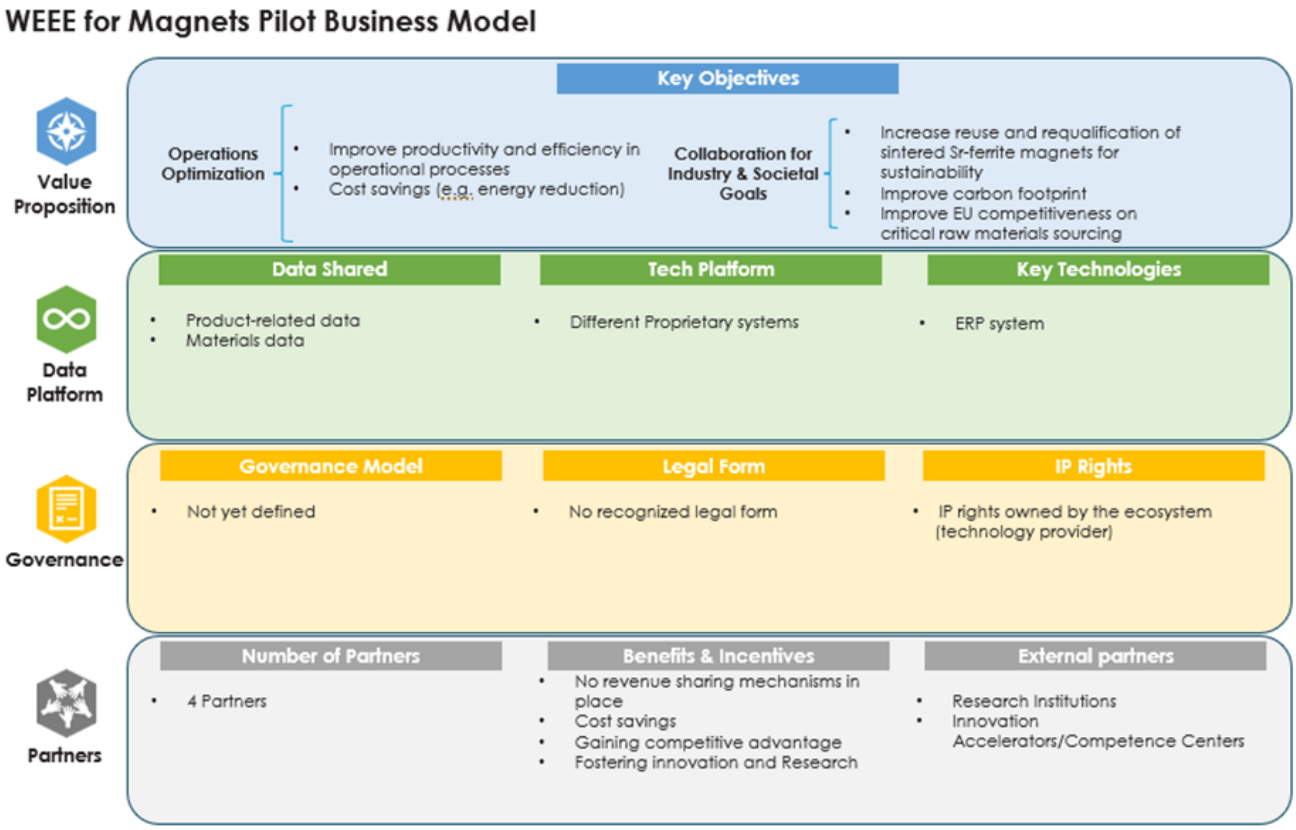


Figure 10: WEEE for Magnets Pilot Business Model

In the WEEE for Magnets pilot, four stakeholders are involved from manufacturing and professional services industries. Full details on partners' roles, activities and benefits can be found in Table 2. The benefits achieved vary: The pilot reduces the environmental impact through the conservation of resources and lower energy consumption. Moreover, it diminishes the dependency on non-EU countries for critical raw materials, potentially leading to import tariff reductions. The added benefits of shortening the supply chain and reducing delivery times further enhance the chances of choice for these types of magnets that are sourced and produced locally – especially when the customer is based in Europe.

Table 2: WEEE for Magnets Pilot Partners

Partner	Sub-Industry	Key Role/Activities	Resources	Benefits
Ferimet	Recycling Center	Recycler, disassembling WEEE	Organizational (FTEs for disassemble engines/motors), secondary raw material	Operational efficiencies with automation, cost savings
Eurecat	Research Organization	Orchestrator. Support industrial pilot partners in the required digitalization. This includes designing a robotic-assisted process for magnets' extraction.	Services, Organizational Resources	Collaboration, replicability of robotic-assisted process offering
IMA	Manufacturer of Magnets	Data owner, manufacturer in charge to produce magnets	Organizational, Technical, Operational (Assets & production)	Certification of their products, higher value for customers, lower costs
IMDEA	Research Organization	Data owner, R&D activities on magnets recycling	Technical, Organizational Resources	Skills & know-how development, collaboration

4.3.2.3 CASE III: Citrus Processing Waste for juice by-products

This pilot focuses on reusing by-products (peels, pulp, wastewater) generated during the production of juice, in the production of animal feed - more precisely cattle feed. More details on the Pilot the business case and processes can be found in deliverable 1.1 "Plooto Methodological Approach and Business Cases Specifications V1".

In addition to circularity goals, the objectives of the Citrus processing waste for juice by-products pilot are also related to the improvement of operational processes. The goals are achieved through the optimization of the process of the by-products, which allows for energy savings and produces certified higher quality cattle feed, compared to feed produced using chemical additives. The pilot is still at early stage when it comes to defining governance for the ecosystem. This is mostly hierarchical with centralized decision making and one partner ASPIS SA owning the underlying technology architecture. The data collection and share are mostly related to the production process and to the properties of the by-products (e.g., humidity, sugar concentration). More details on the current business model can be found in Figure 11**Errore. L'origine riferimento non è stata trovata.**.

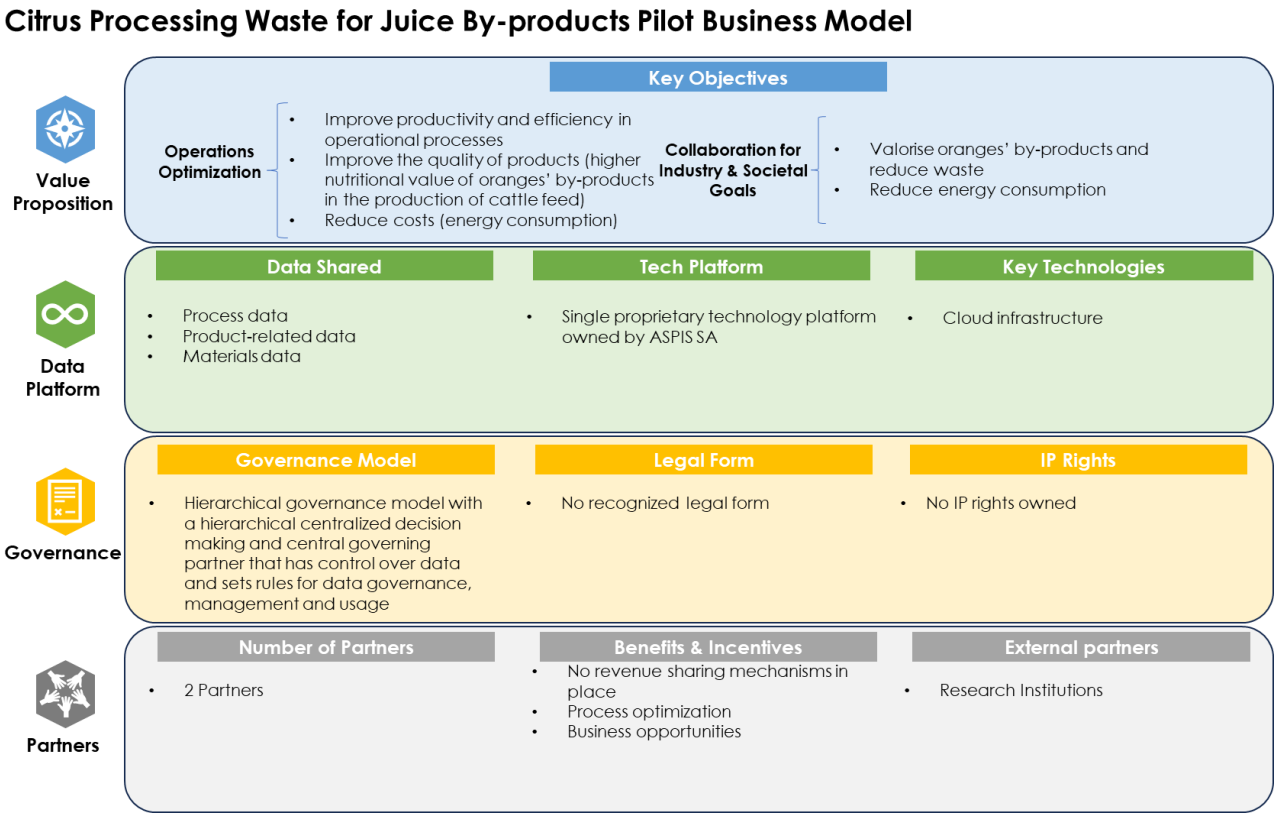


Figure 11: Citrus Processing Waste for Juice by-products Pilot Business Model

The pilot consists of two partners from the manufacturing and professional service industries. Full details on partners' roles, activities and benefits can be found in Table 3. The benefits achieved for ASPIS include enhanced product quality, which will be certified, resulting in greater customer value. Additionally, operational improvements and energy savings contribute to reduced costs. KPAD benefits range from stronger partnerships in the industry to new business opportunities related with the replicability of the acquired know-how. KPIs are related to product quality, energy savings, new skills development and sustainability-related performance.

Table 3: Citrus Processing waste for juice by-products Pilot Partners

Partner	Sub-Industry	Key Role/Activities	Resources	Benefits
ASPIS	Manufacturer	Data owner, Tech Platform owner, Producer of juices and fruit based products	Technical, Organizational, Operations Resources (Assets & production)	Certification of their products, higher value for customers, lower costs
KPAD	Professional Services	Life cycle assessment for waste valorisation, carbon footprint evaluation	Organizational, Technical	Partnerships for scientific research, business opportunities

5 Exploitation plan

Effective exploitation of the Plooto results will be secured through the activity of business modelling and the exploitation plan. This task is divided into three macro activities:

- Design and elaborate an exploitation plan for the Plooto assets and its use cases, including market analysis, business models, and value chains.
- Identify exploitable products and derive business models tailored to their stakeholder needs.
- Prepare the exploitation and sustainability of the results through financial planning, market and intellectual property rights (IPR) assessments.

The approach involves starting early to identify the market, understand the challenges faced by stakeholders within that market, and ensuring alignment between these stakeholders' needs and the tools and services that Plooto offers. Additionally, the task will ensure that the project partners can identify valuable results, understand the IP issues connected them, and exploit them during the project's lifetime.

The following sections explore the context of Plooto and the challenges it may find as it moves forward. This chapter addresses the opportunities and the stakeholders expected to use these potential tools and services. It should be mentioned that according to the methodology described in chapter 2, the focus of the last 12-month activities has been on market analysis and preliminary business modelling of Plooto use-cases. Considering that the main assets of Plooto will be developed in the upcoming months, the exploitation activities will start in the next period, by analysing Plooto assets & services and define the required characteristics for their successful exploitation.

5.1 Context, opportunities and challenges in Plooto exploitation

Plooto provides solutions in a growing market with apparently excellent exploitation potential. The emergence of Digital Product Passports (DPPs) presents a multitude of exploitation opportunities within the circular economy framework in the European market. One of the key exploitable strategies lies in the transparency and traceability capabilities offered by DPPs. These passports serve as comprehensive digital records, encompassing vital data about a product's lifecycle, including sourcing, manufacturing processes, and potential for recycling or refurbishment. Through leveraging this transparency, businesses can not only comply with stringent EU regulations, but also establish trust among consumers, who increasingly prefer sustainable products. Companies can capitalize on this consumer behaviour by strategically showcasing their commitment to circularity through DPPs, thereby gaining a competitive edge in the market.

Another exploitation opportunity lies in the potential for enhanced resource efficiency and waste reduction, facilitated by DPPs. By meticulously tracking a product's journey from inception to end-of-life, businesses can pinpoint inefficiencies in their supply chains and production processes.

This granular insight allows for targeted optimizations, such as reducing material waste, optimizing energy consumption, and streamlining logistics. Consequently, implementing DPPs not only aligns with circular economy principles but also drives cost efficiencies for businesses, enhancing their economic sustainability, while concurrently contributing to the broader environmental goals outlined by the EU.

Furthermore, the scalability and interoperability of DPPs give opportunities for collaboration and innovation across industries. These passports serve as a standardized digital framework that can be adapted and integrated across various sectors, fostering collaboration among stakeholders. From manufacturers to retailers, logistics providers, and even policymakers, the shared use of DPPs encourages information exchange and collaboration, creating ecosystems that promote circular practices. Such collaboration not only fosters innovation in DPP technology, but also facilitates the creation of new business models focused on circularity, enabling the development of novel services and products that align with the circular economy paradigm.

Although Digital Product Passports (DPPs) present promising opportunities for the circular economy in the European market, they also encounter notable challenges that require careful consideration. A notable challenge concerns the standardization and interoperability of DPPs. With multiple industries adopting their versions of DPPs and varying technological infrastructures, achieving a unified standard for these passports becomes complex. The absence of standardized formats and protocols hampers seamless data exchange among stakeholders, impeding the potential for holistic lifecycle tracking and hindering the realization of a universal fully integrated circular economy ecosystem. Harmonizing these disparate systems requires concerted efforts from industry players, policymakers, and standardization bodies to develop universally accepted frameworks and protocols.

Data security and privacy concerns represent another significant challenge in the exploitation of DPPs within circular economy. As DPPs accumulate vast amounts of sensitive information about products, supply chains and consumers, measures ensuring robust cybersecurity and adherence to stringent privacy regulations becomes imperative. The risk of data breaches, unauthorized access or misuse of sensitive information poses a threat not only to individual privacy but also to the integrity and trustworthiness of the entire DPP infrastructure. Striking a balance between data transparency for sustainability purposes and safeguarding confidential information demands meticulous attention to security protocols, encryption methods, and compliance with evolving data protection laws, such as the GDPR in the European Union.

Moreover, the upfront investment and technological readiness required for the widespread implementation of DPPs pose a substantial barrier to their exploitation in the circular economy. Small and medium-sized enterprises (SMEs) may face challenges in adopting DPPs due to limited resources, expertise and technological infrastructure. The initial costs associated with digitizing product information, integrating DPP systems, and training personnel on new technologies can be prohibitive for many businesses. Additionally, disparities in technological readiness among

different regions or industries pose another challenge, limiting the comprehensive adoption of DPPs and impeding the collaborative efforts necessary for a fully integrated circular economy model. Addressing these barriers necessitates financial incentives, capacity-building programs, and support mechanisms to facilitate the inclusive adoption of DPPs across diverse business landscapes within Europe.

Plooto will provide a set of tools and services through a circular and resilient information system that enables waste reduction and end-to-end traceability of second raw materials through interconnected digital services for real-time decision making, monitoring and certification of materials and products. These solutions and services include several aspects such as orchestration services for modelling of supply chain, predictive analytics and AI services, perspective analytics and optimisation services, as well as simulation services and certification tools. The innovative side of Plooto, in terms of integration of services for digital product passport and circular economy, provides a unique added value for its exploitation to the market. However, there are challenges and risks related to integration services, maturity and scalability of assets that need to be considered.

5.2 Plooto exploitation assets

Plooto will deliver several results that tackle the need for efficiency and circularity on various sectors. These results represent the high exploitation potential of the project.
Plooto assets can be grouped into two categories: horizontal technical components and pilot specific artefacts. The table below provides an initial overview of the exploitable assets envisaged so far. In the upcoming months, this list will be evolved and revised based on the progress of projects activities.

Table 4: Summary of Plooto assets for exploitation

#	Exploitation asset	Description	Target customers
Horizontal technical components			
1	CRIS platform	A Digital Twin-based Integrated platform, providing the capacity of modelling, operating and monitoring the customer ecosystem (internal processes, value/supply chain). The platform can be complemented with horizontal services (refer to lines 8, 9, and 10)	Manufacturers in different sectors, from agrifood to electronics.
2	Process modelling tool	The tool allows to model the production process and to assess the impact on varying of selected	Manufacturers in different sectors, from agrifood to electronics.

#	Exploitation asset	Description	Target customers
		parameters (e.g. energy consumption). The model can be used to run simulations (refer to line 8) to get useful insights for optimizing the production.	
3	Balanced scorecard framework and services	Provides a quantitative approach to assess the circularity potentials and impacts. The framework comprises two parts: a) A generic part with criteria for circularity and production/ supply chain performance, in line with existing frameworks (ESG, SCOR, etc.), and b) pilot specific KPIs, tailored to each scenario's particularities.	Manufacturers interested in adopting more sustainable production practices.
4	Governance models	Governance models and sustainability framework for digital circular supply, including guidelines for digital passport design and certification schemes.	Industry
5	IDS connectors	Technical module, compliant with Data Spaces specifications.	IT providers
6	Digital Product Passport Product identity and passport services	Structure and guidelines for the Digital representation of the final product passport. The passport aggregates certified information about the origin of raw material and all processing steps until the production of final products, including % composition of new and recycled materials.	Early adopters of DPP
7	Simulation services	Based on the process models, they estimate how the production line – or some specific part of it – will respond at varying some of the defined parameters.	Manufacturers in different sectors, from agrifood to electronics.

#	Exploitation asset	Description	Target customers
8	Optimization and planning services	They process the information available in CRIS and allow to optimize the production line, based on selected parameters in line with business objectives (e.g. minimize cost, maximise the use of a given resource).	Manufacturers in different sectors, from agrifood to electronics.
9	Analytics services	They allow analysis of the historical data and the information available in CRIS to produce insights to the customer.	Manufacturers in different sectors, from agrifood to electronics & IT
10	Educational modules and lifelong learning programs	Courses on Circularity, Green Deal, Climate Change and Sustainable Development.	Industry Academia General public
Pilot specific results			
11	Collaborative Circular Business models	Showcasing the economic and sustainability benefits of adopting circular practices	Companies Suppliers
12	Practices and guidelines to increase CFPR shelf-life	The CFRP requalification processes allows to identify practices to be adopted to avoid the rapid deterioration of CFRP.	Producers of CFRP components

5.3 Potential users of Plooto assets

Plooto can be specifically tailored for many potential users across industries and domains. Some examples of potential users include:

- **End user companies that generate waste in several sectors:** Plooto can provide the ICT tools for integrating the value chain and tracing the materials, thus will help them to reduce produced waste.
- **Suppliers in different tiers of the value chain:** Plooto can provide the tools that enable tracing secondary raw materials through the value chain and thus will facilitate their real-time decision making, monitoring and certification.
- **Process industry:** Plooto can offer to industrial process engineers reference models for digital circular value chains, ICT tools for DPP certification, and reference procedures and guidelines for waste treatment.

- **ICT application providers:** Plooto can provide concrete tools that facilitate the digitalized waste supply chains. These tools can be used later on by Market ICT players for integration to existing platforms and applications.
- **Producers of CFRP components:** the CFRP guidelines will help adopting practices that will increase the CFRP shelf-life, resulting in economic savings.
- **Manufacturers** of different sectors: Plooto provides an integrated platform to control the production processes, as well as the supply chain, and several tools to assess circularity, sustainability and impact.
- **Early adopters of DPP**: Plooto will help early DPP adopters to understand the DPP concepts, and to be prepared for its adoption (planned for 2027), thus gaining a competitive advantage.

6 Conclusions and next steps

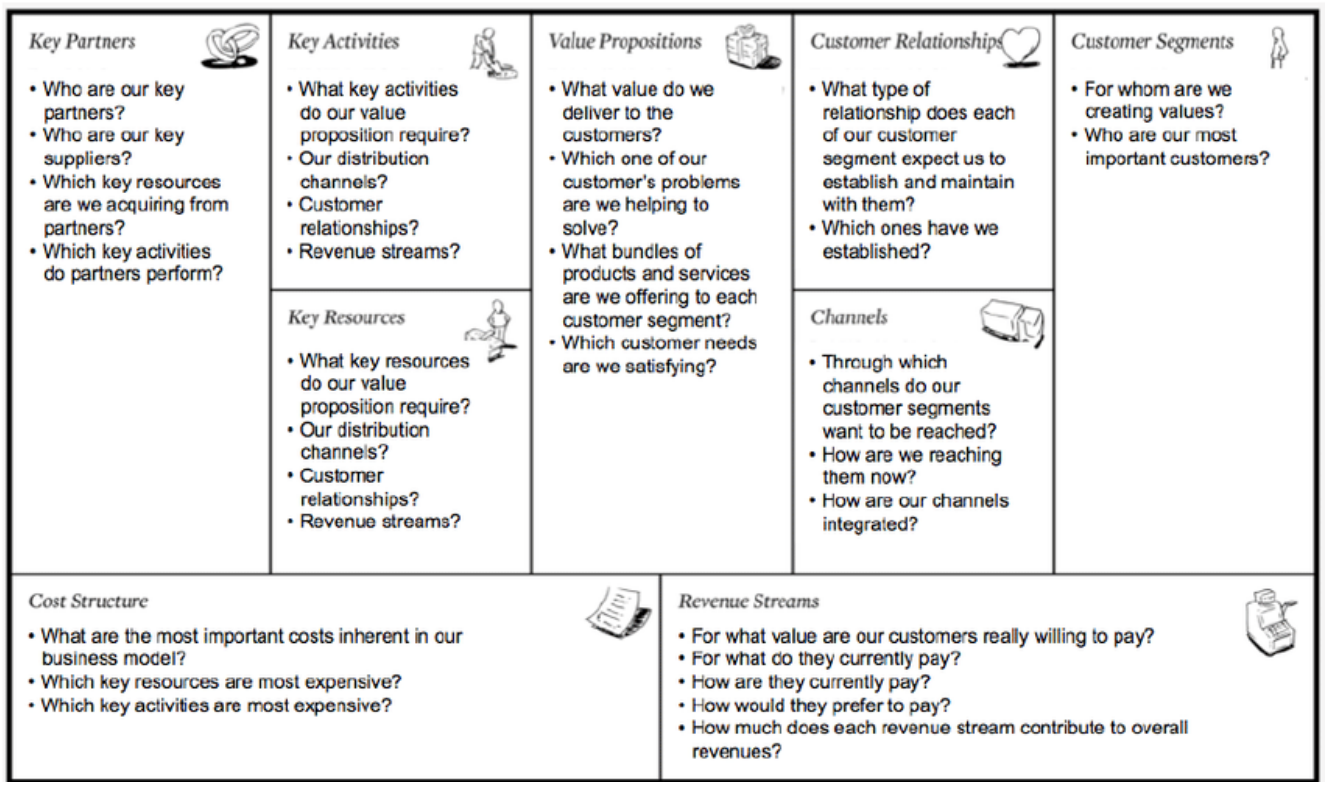
This document provides a report of the activities conducted and the initial findings within the scope of T5.2 of Plooto project. After having assessed market needs and requirements for circular practices in the European manufacturing industry, the activities carried out in the context of T5.2 led to the definition of the Circular Value Chain Business Model Radar framework and related dimensions. The primary research conducted with the Pilots allowed an initial assessment of the Pilots' value chain as-is business model, including value proposition, technology platform, governance model, key partners and activities.

From an exploitation perspective, there are opportunities in markets, considering factors such as EU regulations, scalability and interoperability of DPPs. However, there are also challenges that could hinder the exploitation, such as privacy and security concerns of data sharing, standardization issues and required investments, especially for SMEs. At this phase, the main Plooto assets for exploitation are identified, as well as the main exploitation targets. The next phase of exploitation activities will be conducted in parallel with the development of assets and with the definition of aspects, such as financial planning ad IPR issues. This report laid out also some foundations for defining exploitation and sustainability plans for the pilots, connected with the exploitation of monetization models that will be further investigated in the upcoming period of Plooto project.

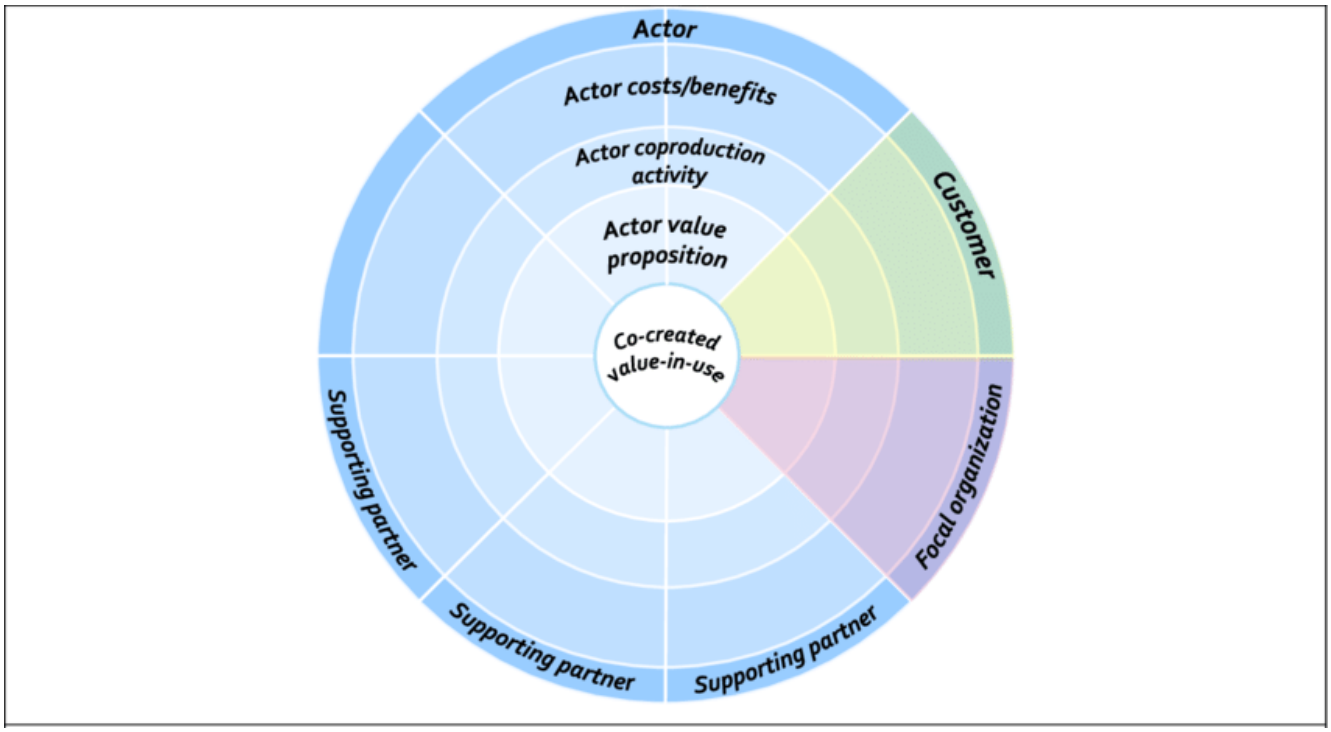
The next report (D5.6) will include the updates of T5.2 progress and results and will be delivered in Dec 2024 (M24).

7 Appendix

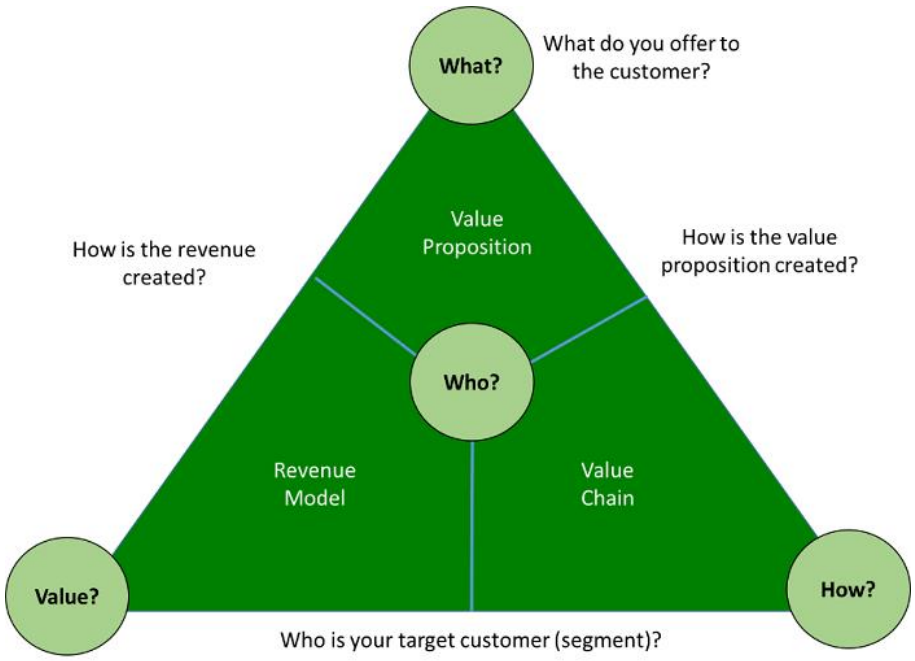
7.1 The Business Model Canvas (Osterwalder, Pigneur, 2010)



7.2 The Service-Dominant Business Model Radar (Turetken, Grefen, 2017)



7.3 St. Gallen Business Model Navigator (Gassmann, Frankenberger, Csik. 2014)



7.4 Questionnaire for Business Model Assessment

Q1. What are the main objectives of your data space and its ecosystem? Select top 3

a. Monetize data generated in operations (i.e. production process, product performance, customers)
b. Create new value propositions based on shared and digital services
c. Evolve product and service innovation processes with collaboration and risk/cost sharing in the ecosystem
d. Increase supply-chain agility
e. Incubate new startups
f. Improve productivity and efficiency in operational processes
g. Improve the quality of products
h. Improve the execution of services on installed products
i. Improve the quality/availability of data for production planning and demand forecasting
j. Enhance supply chain visibility via collaboration with trading partners
k. Increase product traceability throughout the value chain
l. Tackling ESG challenges relevant to the ecosystem (i.e. Scope 3 emissions, circularity, material sourcing, and labour practices)
m. Leverage the ecosystem to better understand and adapt to new protocols and regulations
n. Expand industry data ecosystem
o. Improve collaboration around asset availability and performance
p. Improve asset maintenance through prescriptive and predictive analytics

q. Other

Q2. Which type of data is shared within the data space and its ecosystem? Multiple Response

a. Process data
b. Product-related data
c. Customer data
d. Supply-chain data
e. Asset-related data
f. Other (please specify)

Q3. Does your data space and its ecosystem have the objective of commercializing data, or a digital product/service based on ecosystem data?

a. Yes
b. No

Q4. If Q3=Yes, Which products/services is your data space and its ecosystem providing? Multiple options, Please specify

a. Proprietary Software/APIs (i.e. remote asset monitoring and diagnostics, production analytics, energy management)
b. New digitally-enabled business services (i.e. remanufacturing and recycling, asset service and management, engineering services)
c. Data management, trading, and monetization (i.e. machine and asset performance, demand, capacity, inventory data)
d. Other

Q5. If Q3=Yes, which industries is your ecosystem targeting for commercializing data/digital products or services? Multiple response

Answer Options	Mouse-over Definition
1. Construction	Buildings, industrial facilities, transportation infrastructure, utility projects, etc.
2. Manufacturing — Discrete	Automotive, high tech, IT hardware and telecom equipment vendors, consumer goods, industrial machinery, domestic appliances)
3. Manufacturing — Process	Food, beverages, tobacco, basic metals, plastic, etc.
4. Oil and Gas	Extraction of crude oil & natural gas, oil & petroleum refinery, and service activities incidental to oil & gas extraction and refinery
5. Resource industries	Agriculture, forestry and logging, fishing, mining, and quarrying,
6. Retail trade	Food stores, clothing and footwear, accessories, consumer electronics stores, ecommerce, drug stores, furniture, DIY, gardening, etc.

7. Transport — freight transport and logistics	Logistics and supporting services, courier & postal services, etc.
8. Transport — passenger transport	Water, air, rail, and other land transport
9. Utilities	Gas, electricity, water, sanitation services, etc.
10. Wholesale distribution	Distribution and import & export
11. Other	All others not listed

Q6. If Q3=Yes Are you providing data/products as a service?

a. Yes, through subscriptions
b. Yer, through pay per use
c. Yes, based on demand models
d. Yes, based on the achievement of certain outcomes (cost saved, revenue generated)

Q7. How many partners are involved in the dataspace and its ecosystem?

a. 1-5 partners
b. 6-10 partners
c. More than 10 partners

Q8. In the table below please define for each partner, the industry, the role the partner has in the data space and its ecosystem, the specific benefits gained, and resources put at stake (add one row for each partner)

Industry	Key Role/Activities in the ecosystem (e.g. Orchestrator, data owner, asset manufacturer, …)	Resources invested/ shared in the ecosystem (business, technical and organizational resources, for example asset, funds, IP rights, technology platform, FTEs, and so on)	Benefits gained by each participant

Q9. How would describe the governance model of the data space and its ecosystem? Select one

a. Hierarchical governance model with a hierarchical centralized decision making and central governing partner that has control over data and sets rules for data governance, management and usage
b. Distributed governance model, where decision-making power is shared among multiple stakeholders involved in managing and utilizing data within the ecosystem

c. Other, please specify

Q10. Does the data space and its ecosystem has a formally recognized legal form?

a. Yes (please specify)
b. No

Q11. Does the data space and its ecosystem own IP (intellectual property) rights over the products and services it provides?

a. Yes
b. No

Q12. If Q11=yes, who among the partners owns the IP right(s)? Multiple response

a. The technology provider
b. The orchestrator
c. The data owner
d. Another manufacturing partner of the ecosystem
e. Another partner of the ecosystem
f. Other

Q13. If existing, what is the revenue sharing mechanism across partners? Select one

a. Revenues are equally shared among partners
b. The partner who orchestrates that data space takes a larger share of revenues
c. The partner who provides the technology platform takes a larger share of revenues
d. Other, please specify

Q14. Who are the external partners and institutions you are collaborating with as part of your data space and its ecosystem's activities? Select all that apply

a. Regulators
b. Academia
c. Research Institutions
d. Innovation Accelerators/Competence Centers
e. Trade Associations
f. Standardization & Certification Bodies
g. Others

Q15. How would you describe the data platform model of your dataspace and its ecosystem? Select one

a. Open distributed technology platform among participants, with some application and data shared
b. Single proprietary ecosystem technology platform
c. Other (please specify)

Q16. Please explain response in Q14

Q17. Who owns the technology platform? Select one

a. A third-party external to the ecosystem
b. Tech provider that is part of the ecosystem
c. Another participant from the ecosystem
d. Other (please specify)

Q18. Is the technology platform commercialized/made available to other organizations external to the ecosystem/other ecosystems?

a. Yes
b. No

Q19. What are the key technologies to enable ecosystem operating business model? Multiple choice

a. IoT
b. Connectivity and networking platform
c. Cloud infrastructure
d. Industry cloud dedicated platform
e. Ecosystem orchestration and management platforms (EOP)
f. Data management, governance, and exchange solutions
g. Application development
h. Data privacy, protection, and loss prevention solutions
i. Billing, contracts, transactions, and intellectual property tracking platforms
j. Digital marketplaces
k. Shared or open APIs
l. Other

Q20. How mature on a scale from 1=basic to 5=advanced is your data space and its ecosystem's governance model?

This includes contracts, IP rights, data handling, access & usage policies definition, ethical use of technologies.

Rate from 1 to 5

Q21. What are the key metrics you use to measure your data space and its ecosystem's success? Multiple Selection

a. Amount and strategic relevance of data exchanged
b. Digital revenue generated
c. Number of products or services launched
d. New skills and learnings in place
e. Environmental/sustainability-related performance
f. Value generated for customers
g. Number of new partners acquired
h. Level of digital maturity reached
i. Creation of new/alternative business models
j. Other, please specify

Q22. For metrics selected in Q21. What annual percentage change in the past 12 months did your ecosystem experience in the past 12 months? Insert %

Q23. What are the incentives for companies to participate in your data space and its ecosystem? Multiple response

a. Access to valuable data
b. Collaboration opportunities
c. Cost savings
d. Gaining competitive advantage
e. Fostering innovation and research
f. Improving data quality

g. Improving regulatory compliance
h. Other, please specify

Q24. What are the key challenges you are expecting for your data space and its ecosystem? Multiple response

a. Difficulties in exchanging data
b. Lack of skills
c. Lack of tools
d. Data protection concerns
e. Unclear contracts design
f. Unclear return on investment
g. Lack of clarity around participants' roles
h. Other, please specify

7.5 Pilots Value Cration Information from D1.1 Plooto Methodological Approach and Business Cases Specifications V1

KPIs

- Reduction of WEEE landfilled
- Increase the usage of Sr-ferrite crushed pellets in magnets production
- Improve the quantity of leftovers and disregarded magnets entered into the transformation process
- Increase the usage of SRM (bonded NdFeb, Sr-Ferrite) in PM magnet pellets' production
- Increase the number of types of validated materials

Benefits

- Reduce environmental impact
- Reduce dependency of non-EU countries for critical raw materials
- Import tariff reduction
- Shortening of the supply chain and reduction of delivery time

Stakeholders and Objectives

- Ferimet will be able to change the current manual process and increase the number of magnets extracted per day
- IMDEA will be able to study better and more standardized requalification processes improving the throughput
- IMA will be able to increase the production of magnets produced with secondary raw materials thanks to more precise information
- Eurecat will support Ferimet in improving magnets extractions processes.
- Final customers sourcing regionally magnets produced with secondary raw materials

To-Be Scenario

The objective of this pilot is to refine the overall process with minor adjustments. The biggest changes that this pilot seeks are related to Ferimet's operations. With the support of Eurecat, the company expects to deploy an automated and robotic process to dismantle magnets from motors and engines. The second most impacted company is IMDEA, that within Plooto expects to understand how to better process the limited number of magnets (1 kg of magnets per week) and eventually scale this up, and to study a requalification process for the coating removal and requalification form impurities for sintered Sr-ferrite magnets. In addition, the company is expecting to be using self-develop methods for processing the materials, such as flash milling to process sintered Sr-ferrite magnets and casting-based polymerization of the materials to prepare the bonded magnets. IMA is the company that expects the simplest intervention, with the optimization proprietary production processes. Looking at the broader impact scenario, IMA and IMDEA expects to improve their carbon footprint and saving costs (across multiple dimensions, e.g., optimization, energy reduction).

Pilot's Business Model

- **Value proposition**: developing a process that allow the provisioning of magnets from secondary raw material with the same quality of magnets produces with net new raw material
- **Commercial/ business model**: Creating an optimized manufacturing process that can be licensed via fees. IMA to keep producing and selling magnets but potentially at a higher markup as using secondary raw materials.
- **Current and future customers final applications:**
  Current: Electronic application (e.g., electric motors and generators, MRI machines, magnetic sensors)
  Future: As IMA already targets multiple customers across multiple countires and industries, there is no need for further expansions

IP Rights

- **IP rights and owner(s)**: Potentially the development of robotic extraction process of magnets from engines (to be confirmed)
- **Beneficiary(ies)**: Ferimet and Eurecat (to be confirmed)

KPIs

- Increase production of animal feed components
- Higher molasses quality
- Reduce COD of CPWW
- Lower volume of CPWW that goes to biological treatment
- Increase revenue from animal feed production
- Improve energy savings
- Improve cost savings

Benefits

- Wastes valorisation
- Energy saving in the production process
- High nutritional value of the final product
- Process optimisation and monitor to prevent alteration in the final product

Stakeholders and Objectives

- ASPIS in optimizing the process, will be able to gain energy savings, and a certification, via the product passport, of the quality and relevance of the production.
- KPAD will perform the life cycle assessment for the waste valorisation line and will support in the evaluation of the carbon footprint of the line
- Organizations in the cattle feed industry to buy locally sourced and produced, natural and higher nutritional value materials.

To-Be Scenario

The primary objective of this pilot is to refine the transformation process of by-products to produce cattle feed. More in details, ASPIS aims at optimizing the separation and evaporation stages of the production to allow a larger production of molasses and CWP. The optimization, despite being the primary objective is not the only one. ASPIS desire to further study and provide evidence of the higher quality and better nutritional value of CPW and molasses from oranges' by-products compared to other SRMs or components entering the cattle feed industry.

Pilot's Business Model

- **Value proposition**: providing fully natural component to cattle feed industries with higher nutritional value and overall product quality
- **Commercial/ business model**: selling to current customers and extending to new customers new geographies.
- **Current and future customers final applications:**
  - *Current*: Cattle feed production
  - *Future*: Potentially to expand to pet feed industry

IP Rights

- **IP rights and owner(s)**: to be determined
- **Beneficiary(ies)**: NA

KPIs

- Increase prepreg shelf life
- Increase the value of uncured prepreg scrap
- Reduce of prepreg disposal (reduction of the quantity of prepreg disposal in HPC)
- Create new jobs in partner facilities related to exploiting uncured prepreg scraps
- Reduce of the existing unused CFRP waste
- Reduce of the amount of unused CFRP waste in the production of composite materials (%)
- Reuse material to produce components for drones (% of material reused)

Benefits

- Manufacturing cost reduction and waste reduction
- Reduction of tons of prepreg that go to landfills every year and turnover deriving from new products made with this secondary raw material and from the sale of the secondary raw material itself
- The expired prepreg will be not disposed with the related costs, but it can be used to produce structural components instead of fresh material at a lower cost
- Enable of potential disposal of unused prepreg

Stakeholders and Objectives

- HPC will be able to effectively valorise scraps and expired prepreg rolls
- CETMA will study a process to valorise HPC's waste
- CC will produce and sell drones parts with a new and optima valorisation process for carbon fibre waste
- ACCELI will sell drones with components made of secondary raw carbon fibre with at a better price/quality relationship
- Consumers buying drones produced with secondary raw carbon fibre

To-Be Scenario

The objective of this pilot is to design a new process to effectively reuse the carbon fibre waste that HPC is producing within its day-to-day business activities. Therefore, the to-be scenario is the design of an optimised requalification procedure for both expired prepreg rolls and uncured scraps, that ensures the ability to process the material in an optimal way. CC, to put in practice this process, needs insights around the exact process window (namely, the right time, temperature and pressure range) to which the expired rolls or the uncured scraps can be processed in an optimal way.

Pilot's Business Model

- **Value proposition**: providing drones purchasers with financially and environmentally sustainable products, derived from the use of waste composite material
- **Commercial/ business model**: To be determined
- **Current and future customers final applications:**
  - *Current*: creation of drones for drone's enthusiasts
  - *Future*: broader UAVs manufacturing industry, other types of industries that could replace current material with secondary raw carbon fibre (with characteristics compatible with the performance of the secondary raw material), any consumer design products producers.

IP Rights

- IP Rights and owner(s): to be determined. Potential usage of new process developed by HPC in another project (LIFE CIRCE) and potentially to patent the new process waste from production of carbon fibre products and prepreg rolls (to be determined)
- Beneficiary(ies): HPC for the proceed developed in "LIFE CIRCE".

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