

Supplementary Material

The document contains the methodological guidelines to assist companies in the design, development and implementation processes of circular business models.

Supplementary Information 1 – PAPERCHAIN METHODOLOGICAL GUIDELINES (Source: *paperChain EU project*¹)

The document contains the methodological guidelines to assist companies in the design, development and implementation processes of circular business models, covering the required guidance from the beginning towards the complete operationalisation of the CBM. This guideline was preliminary shared with the case studies and after the creative workshops, it was improved taking into account all their valuable inputs.

1. INITIATION PHASE

The creation process of a CBM starts when one or more organisations (hereafter ‘CBM leadership’) identify the need or opportunity for the creation of a CBM.

This **CBM leadership** shall take the lead for the creation of the ‘**CBM ecosystem**’, being the main responsible for the definition of the **CBM’s strategy**, the **involvement of relevant partners** and, eventually, an initial scheme for **transition model** can be envisioned that encompasses the expected performance by all its members.

We will now list below the evaluation of four relevant aspects for creating the basis for launching the circular economy model as the following figure shows:

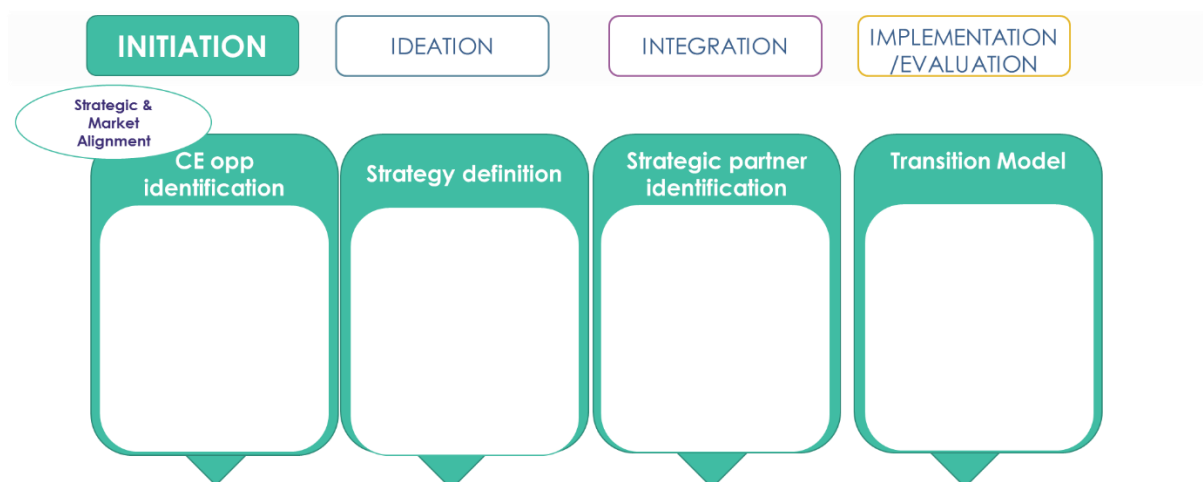


Figure S1: Initiation phase – Key components for setting up a novel Circular Business Model.

¹ [Home - paperChain](#)

1.1. CBM Opportunity identification

When the 'CBM leadership' identifies an opportunity to create a novel circular economy model and to produce innovative and value-added solutions (**waste valorisation-based products**) under a collaborative perspective, it shall assess the possibility of tackling this challenge in a long-term collaborative way. **Two aspects** need to be analysed from a global vision regarding the identification of an opportunity for launching a CBM:

Motivation - CBM leadership

This step is focused on the analysis that the 'CBM leadership' should develop regarding **the motivational factors** of the creation of a circular business model. In order to help the companies involved in a CBM in a **strategic thinking exercise**, the following table questions (with concrete examples) are provided.

Table S1: Key questions for CBM opportunity identification – MOTIVATION.

Key questions	Contents
CBM LEADERSHIP/ FACILITATOR(S)	<ul style="list-style-type: none">• Identify them (name & industrial sector) Or a group of partners?• Does the problem-solving challenge emerge from the waste generator (PPI) or the end-user sectors? From both?• Other:
What is the origin of carrying out CBM in a collaborative way?	<ul style="list-style-type: none">• Impulse by an industrial cluster to exploit a unique or specific resource• Impulse by a large/leading manufacturing company (territory)• Impulse by government incentives• Impulse by previous experiences• Other:
Why are the Circular Case's leadership willing to set up a CBM?	<ul style="list-style-type: none">• Sustainable goals are routed in the strategy of the facilitator's company• The need to diversify, to find new lines of business, etc. from the existing technologies and resources in the organization• Need to reduce the uncertainty around the use of the resources or look for a collaborative supply chain• Sense of maturity, stagnation, regarding products/services/organization• Need to develop relatively quickly a knowledge domain so far not undertaken by the company (e.g. bioeconomy)• The company is feeling great uncertainty and plans to have a large number of open scenarios regarding new product development• Seeking new market niches not covered with a response given from our products and services

- Consider the willingness to learn from collaborative projects of innovation and to extend the practice in the long term.
- Others – please mention details

Technological and organisational substrate (basis)

The second step within CBM opportunity identification is focused on identifying **those factors and forces, embedded in organizations** (e.g. culture, experiences, knowledge, operating routines, etc.) that might represent **higher or lower aptitude to accept new production or new organisational solutions for such a collaborative innovation process that CBM embodies.**

In order to help the companies involved in a CBM in a **strategic thinking exercise**, the following questions (with concrete examples) are provided.

Table S2: Key questions for CBM opportunity identification - TECHNOLOGICAL AND ORGANISATIONAL SUBSTRATE.

Key questions	Contents
Technological & Organisational substrate - Are the technological and organisational features of the CBM leadership (or of the companies involved) encouraging the CBM initiation?	<ul style="list-style-type: none"> • Clear separation of roles and activities within the value chain - suppliers are specialized in specific process steps, whilst final producers focus on the assembly and distribution of products • Existing Industrial Cluster • Existing Technological Platform • Existing Research Infrastructure • Other:
Existing relations amongst the companies – Have formal or informal relations been previously established?	<ul style="list-style-type: none"> • All the companies knew each other because of existing supply relations. • All the companies have supply relations, but also competitive and collaborative ones. • More competition relations emerged - the actors in every context, had already worked together, especially in joint purchasing new market penetration, or R&D activities, but never in the joint management of waste. • Other:
Location factors – Do exist relevant location factors (e.g. industrial cluster) affect the nature and the direction of flows, the degree of cooperation/competition amongst firms, and the presence or absence of key nodes in the network?	<ul style="list-style-type: none"> • The CBM was planned or emerged <u>to exploit a unique or specific resource</u> (e.g. a given raw material) - a certain level of process homogeneity exists at the 'ecosystem' level. • The CBM is born after the establishment of a <u>large/leading manufacturing company</u> in a given territory - several complementary processes and material flows exist, which

Local community – involvement or resistance from local community?

Shall the **companies' values** imply a constraint to the CBM initiation?

- depend on the nature and the complexity of the final productions.
- Backward areas are industrialized because they are promoted by government incentives or tax reliefs for companies, or for the presence of generic factors (low cost of labour and infrastructures) in which no specific industries/ processes or structural relation may be detected
- Other:
- The strength of local community is strong enough in the decision-making process to lead the companies and local government to abandon the project. For instance, the opposition of the population to the management of waste flows in the area.
- The local community represents one of the main stakeholders of the CBM with a considerable engagement in the initiation phase.
- Other:
- The CBM's companies are ready to participate in collaborative networks – they are willing to be transparent
- The companies are aware of the paradigm "information is power" has been replaced by "sharing knowledge is power"
- The companies understand the collective vision as an end in itself, and not just as a mere means
- The companies are used to/are ready to move in more democratic governance environments, meritocratic and horizontal

1.2. Strategy Definition

After identifying the main motivation for the creation of a CBM, the second step is to define the **strategic goals** for creating and implementing a circular economy model of industrial symbiosis. Within this element, we can find different levels of definition concerning the strategic goals. At the company level, the motivations or strategic objectives to enter the CBM are remarkably different than the strategic goals at the system level considering the '**ecosystem**' or **business system** the companies are part of. Therefore, we should now evaluate the **strategic benefits** that the CBM will provide to the companies involved from different perspectives shown in the following table.

Table S3: Key questions for Strategy Definition – STRATEGIC GOALS FOR CREATING A CBM.

Key questions	Examples
In terms of systemic changes that the CBM will represent to the companies, which of these options better fits your aspirations to enter the CBM?	<ul style="list-style-type: none"> • Some of the proposed solutions do not require relevant economic or technological shifts and the organizational dimension of the systems is slightly involved (e.g. the collective management of scraps). • Other solutions mostly impact the managerial and organizational dimensions and marginally modify technologies (e.g. the sharing of obsolete equipment to recycle materials or the development of a local common recycling platform). • Some improvement measures require a series of <u>radical shifts, both in products and process technologies</u> and in the economic dimension of the system (e.g. the end-of-life collection and management of final products).
In terms of the strategic impact that the CBM represents to the companies involved, which of these options better fits your aspirations to enter the CBM?	<ul style="list-style-type: none"> • A CBM focused on the customers' needs, can have positive effects on <u>customer satisfaction</u> and customer loyalty of the companies involved. • A well-performing CBM may have positive effects on the sales products of the companies involved or on entering new markets, new niche markets. • The CBM can have positive impacts on <u>the technological development capacity</u> of the companies. • Social impact: a collective (including public bodies) consciousness about <u>environmental issues as well as the societal benefit</u> of industrial activities resulting from the CBM (including future job and competitiveness) • Manufacturing companies possess <u>potential awareness about the environmental impacts</u> of their industrial activities. • Other(s)
In terms of market impact , what are the main reasons for creating a CBM?	<ul style="list-style-type: none"> • Coping with market turbulence • Increase chances of survival • More chances to compete with larger companies • Prestige, reputation, reference • Access/explore new markets/products (e.g. multidisciplinary sector) • Expand geographical coverage • Increase potential for innovation • Economy of scale • Others...
In terms of collaboration (the 'ecosystem' or business system), which of these	<ul style="list-style-type: none"> • The company gets access to business opportunities out of reach to the individual organisation • The company is facing difficulties in finding the right partners to respond to market opportunities or customer demand

Key questions	Examples
options better fits with your expected benefits from operating in the ecosystem that the CBM represents?	<ul style="list-style-type: none"> • There exists a lack of internal knowledge in the company. Only by joining the competencies of several organisations, it is possible to develop and deliver new products or new services with competitive advantages in the market • The company is interested in creating/increasing its reputation in the circular economy (e.g. bioeconomy market) • Collaboration appears as a critical instrument to differentiate organisations' offerings and reduce costs by focusing on the respective core businesses
In terms of organisational factors , what are the expected benefits of operating in a collaborative environment ?	<ul style="list-style-type: none"> • Valuation of materials within a closed-looped system • Natural resource use while reducing pollution or avoiding resource constraints and sustaining economic growth • Approaches to building trust and improving the potential of risk-taking • Learning and training • Sharing costs of branding/marketing

1.3. Strategic Partners Definition

In parallel, the identification and further selection of strategic partners must be based on the predefined strategy of the CBM. The choice of **potential partners** should come firstly from studying among the current partners which **operate in the value chain of the 'CBM leadership'** and, secondly, **from other partners beyond the value chain** that can offer complementary skills, capabilities or services. The following table provides key aspects that the CBM leadership needs to consider when identifying those relevant strategic partners.

Table S4: Key Questions for Strategic Partners Definition.

Key aspects	Contents
Typology of strategic partners in CBM	<ul style="list-style-type: none"> • Business entities (large, medium or SMEs; manufacturing and non-manufacturing companies) and sector • R&D institutions (universities, technological centres, etc.) • Support institutions (legal services, certification bodies) • Public institutions (municipality, regional, national, European) • Collaboration links (associations, etc.), • Coordination links (the CBM Model leadership) • Others:
The <u>potential of a company</u> to operate in a CBM shall be	<ul style="list-style-type: none"> • Its significance and replaceability of the analysed company in the network • Its knowledge, expertise, resources and quality output

assessed based on the following elements:

- Its adaptability to changes or responsiveness
- Its correspondence between cost level and performance
- Ease of communication and collaboration
- Its ability to deliver, compliance with agreements, openness in case of problems
- Its reliability and networking of responsible persons
- Its ability to adapt to changing environments and collaborate with other enterprises
- Other:

1.4. Transition model

The fourth element within the INITIATION phase is the “transition model” which characterises the process to **assess the motivation to change** of the different partners and the **economic feasibility** of the circular models over the existing linear models. This process will result in **several stakeholder mappings** representing the different organisations of the partners in both **linear and circular models**. Additionally, different **scenarios** will also be tested to assess a **preferred option for the implementation** of the circular economy model. This stage is closely linked to the economic dimension in the next IDEATION phase, where the sustainability model should be characterised for the CBM. Such a sustainability model will cover the cost structure and the revenue streams that will make the CBM economically viable.

OUTPUT PHASE 1: Defining ‘CBM global vision’

Once the ‘CBM leadership’ has reflected upon the questions mentioned above, the approach goes beyond the single company strategy level and needs to address the common goals of the partners involved in such a CBM. A **common strategy for the ecosystem** needs to be set up which constitutes the **global vision of the CBM**. The ‘CBM global vision’ might be founded on the definition of **clear collective goals, alternative rule sets** and **leadership**. Therefore, this shared vision of the CBM will be defined collaboratively and a consensus needs to be reached among the members of the ecosystem. For this aim to be achieved, we propose including the **Circular Business Model Innovation** as an iterative process that helps to define the CBM global vision and is updated along the three first stages.

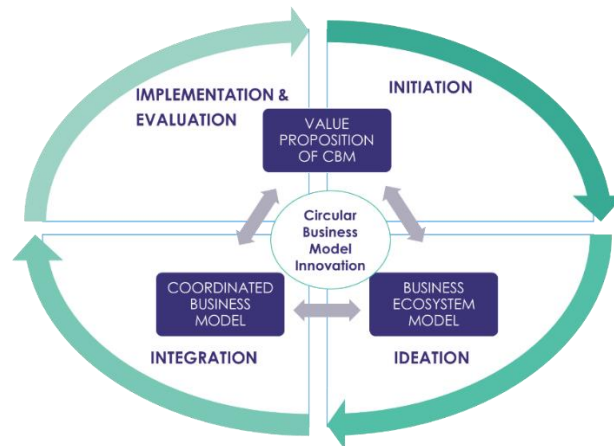


Figure S2: Circular Business Model Innovation – Iterative Approach.

Under this dimension, we are addressing the configuration of the business model that originates the circular economy model chosen from a strategic point of view (**Value Proposition**). We then attempt to provide valuable insights for designing the main elements of the sustainability model (**Business Ecosystem Model**). Since the cooperation among all the stakeholders that form the ecosystem is a key success factor of a CBM, the CBM will be reinforced with the main elements that guarantee the cooperation (**Coordinated Business Model**) and then boost business cases for sustainability that will in turn increase market share of the companies involved in the CBM.

Under this dimension, the **characterization of the Circular Business Model** of the circular cases will be formed according to the following steps:

- 1) The Innovation Team
- 2) Defining the Value Proposition of the CBM, tools and key activities (INITIATION phase)
- 3) Defining the Business Ecosystem Model, tools and key activities (IDEATION phase)
- 4) Defining the Coordinated Business Model, tools and key activities (INTEGRATION phase)

The first two elements are considered in this phase and the two last ones are covered in the following steps.

Innovation Team

Regarding Circular Business Model Innovation, the first decision must be made on the composition of the innovation team. The following table provides the **challenges** that need to be considered to define the Circular Business Mode. They are included in the form of practical guidance provided to understand how the CE leadership aims to create an Innovation Team.

Table S5: Key questions for Innovation Team definition.

Key aspects	Contents
Has the CE leadership formed an innovation team ?	<ul style="list-style-type: none"> • No, just one company represent the innovation team • The innovation team has been formed just with one member of the companies involved without following any rule to select them • The innovation team has been configured guaranteeing the inclusion of: <ul style="list-style-type: none"> - staff with an innovation profile - risk-takers - external partners - other • Other configuration/idea:
Circular Economy awareness among the members of the innovation team	<ul style="list-style-type: none"> • The CE leadership is required to share knowledge to achieve a common understanding of the CE concept • The CE leadership has required to level of awareness and urgency of opportunities or threats – lack of consciousness of CE field or industrial symbiosis • The CE leadership has required to steer towards “the right network stability” (neither too stable and inert, nor too unstable and too inefficient) • Other:
<ul style="list-style-type: none"> • Balancing: <ol style="list-style-type: none"> 1) NETWORK VALUE (e.g. strategic interests of partners, revenues, intangible benefits, Network openness vs Governance model) 2) CUSTOMER VALUE (e.g. pricing, quality, environmentally efficient) 	<ul style="list-style-type: none"> • It has been rather difficult to find an appropriate balance between network value and customer values • There is a clear primacy of the customer values over the customer ones • There is a clear primacy of the network interests over the customer ones • The CE leadership has found an appropriate fit between the two elements

Defining the Value Proposition of the CBM

This step is crucial to define **how the CBM creates, delivers and captures value**. At this stage, the distinction between the business model of a single company and a Circular Business Model should be emphasized. Among others, we can define the value proposition of the CBM such as supporting manufacturing companies in their sustainability strategy or offering access to new business opportunities related to circular

economy that could not be addressed by CE members individually. The following questions could help to the rationale of the definition required:

- Why are we different from our competitors?
- How do we help the customers accomplish their mission/doing their job better than others?
- Why our product/service is worth being bought?

To represent a first draft of the business model, the Lean canvas was chosen. As presented in the figure below, it is an adaptation of Osterwalder's canvas, but designed for entrepreneurship projects.

Problem Top 3 problems 1	Solution Top 3 features 3 Key Metrics Key activities you measure 6	Unique Value Proposition Single, clear, compelling message that states why you are different and worth buying 2	Unfair Advantage Can't be easily copied or bought 7 Channels Path to customers 4	Customer Segments Target customers 1
Cost Structure Customer Acquisition Costs Distribution Costs Hosting People, etc. 5			Revenue Streams Revenue Model Life Time Value Revenue Gross Margin 5	

Lean Canvas is adapted from The Business Model Canvas (<http://www.businessmodelgeneration.com>) and is licensed under the Creative Commons Attribution-Share Alike 3.0 Un-ported License.

Ash Maurya – Running Lean

Figure S3: Lean Canvas methodology (source: (Maurya, 2010)).

2. IDEATION PHASE

This phase is more related to the creativity and innovativeness of the companies involved in the CBM. We have integrated into this phase six building blocks that group all critical elements as the set of **enablers, success factors and barriers** of a circular economy model of resource recovery. As the following figure shows, these dimensions are technology, economic and financial, environmental, legal, social and KPIs.

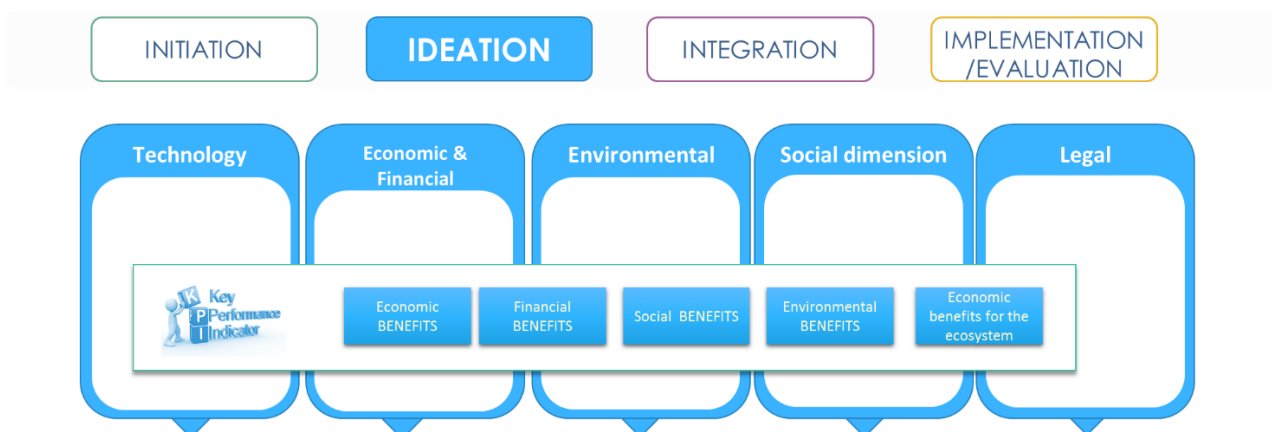


Figure S4: Ideation phase – Designing a novel CBM.

Every dimension will be also analysed from the implications that these aspects have in **organisational design characteristics** such as processes, capacities and required tools. As mentioned in the previous phase, under this IDEATION phase we also address the **Circular Business Model Innovation** as an iterative process that helps to define the CBM global vision and is updated along the three first stages. Before addressing the six dimensions of this phase, it is necessary to start defining the **Business Ecosystem Model (BEM)** with its associated tools and key activities. Each “building block” of this model is to be analysed and developed to create a complete picture of the **Business Ecosystem Model (BEM)**.

The following table provides key aspects to evaluate for defining the BEM.

Table S6: Key questions for Business Ecosystem Model definition.

Key aspects	Contents
TRENDS AND BARRIERS	<p>This building block provides a “big picture” of the market of the CBM. It gives information on the current and forecasted situation and potential difficulties that may be encountered by market players.</p> <ul style="list-style-type: none"> • What are the key trends? • What are the main products/services on the market? How is it foreseen to evolve? • What barriers/difficulties market players must face? • How do you expect these barriers going to evolve?
COMPETITORS LANDSCAPE	<ul style="list-style-type: none"> • Who are the competitors (direct and indirect)? Competitors for the value proposition that the Ecosystem provides • What is their competitive advantage? • What customers/market segments do they target?
Key RESOURCES at the ecosystem level	<ul style="list-style-type: none"> • PPI will provide: • End-user will provide • The waste manager will provide • Others:

Key ACTIVITIES at the ecosystem level	<ul style="list-style-type: none"> • New end-users searching process (early adopters)? • Communication activities? Newsletters, Network events, Publications, Marketing communication, Social media following • Legal discussions/legal lobby?? • Marketing activities? • Networking activities (new stakeholders in the circular case) • Encouraging social awareness of Circular Economy?? • Others
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2.1. Technology

This dimension is scarcely addressed in current frameworks for CBMs mainly because this aspect deeply depends on the sectors operating in the circular model. This dimension can include all critical elements related to **technical barriers**, **technological innovation**, **eco-innovation**, **technological path dependency**, etc. that are needed to create new processes or new products.

Table S7: Key questions for IDEATION phase - TECHNOLOGY DIMENSION.

Key questions	Contents
PROCESSES - Please, select which of the following processes are needed in your Circular Case	<ul style="list-style-type: none"> - Waste management: - Waste transportation: - Standardisation process for using/transforming the waste - Industrial scale-up: - Investment planning process adapted to CBM of resource recovery. - Supply chain management (supply of components or other materials): - Supply of waste is limited by the nearness of the waste manager to PPI - Others:
DIVERSITY AND QUALITY OF WASTES	<ul style="list-style-type: none"> - Diverse availability of waste (WPA) and quality of recycling material. - Does there exist a standard for waste? there is no product specification, data sheet, etc. - Level of optimal quality of waste? (Constraint) - Geographical barriers affecting the waste supply process: supply of waste depend on the nearness of the waste manager to PPI? - Others
NEW SKILLS AND KNOWLEDGE TECHNOLOGY DEVELOPMENT	<ul style="list-style-type: none"> - A new regime of operation facilities, medical and health at work? - Others: - Specify technology development: - New equipment investment:

- Availability of special equipment for ash mixing and metering?
- Any recycling infrastructure?
- Digitalisation is needed?
- Others?

2.2. Economic & Finance

Creating a circular economy model shall offer the firm/system relevant economic advantages making the resource recovery-circular economy model a highly attractive business opportunity. However, there still exists the underlying assumption that green initiatives and environmental regulation may impose cost disadvantages on organisations. This dimension can include all critical elements related to **cost structure, revenue streams, transition assessment, return of investments**, etc. that are needed to guarantee economic benefits for the ecosystem, the economic interest of all stakeholders must be preserved and ensured.

A list of costs and revenues of partners of the circular models is drawn to identify Key Performance Indicators that will have an impact on the economic viability of the circular model. A comparison between the current linear models and the circular model considered needs to be conducted. For each partner of the linear models, the drivers and challenges they face are described as well as their main costs and revenues implied by the linear model. Their motivation to change should be precisely analysed to design a circular model that answers all their expectations.

The **definition of effective KPIs from the economic and financial point of view** takes high relevance in supporting managers to evaluate the economic impact of the CBM on the **ecosystem**. Guarantee economic benefits for the ecosystem: avoid misaligned profit-share along the value chain - the economic interest of all stakeholders must be preserved and ensured. The characterisation of the circular cases helped list the key elements of this dimension and new elements were added derived from creative workshops.

Table S8: Key questions for IDEATION phase – ECONOMIC & FINANCE DIMENSION.

Key questions	Contents
PROCESSES – Please, select which of the following processes are needed in your Circular Case	<ul style="list-style-type: none"> - <u>Economic viability analysis</u> of the new solution: assessment of the economic competitiveness of the solution compared to classic ('linear') solutions available in the market. - <u>Economic viability analysis of the investments</u>: large investment to produce at an industrial scale. - <u>PESTLE analysis</u> – periodical review of the macroeconomic aspects evolution or legal changes - An efficient QUALITY ANALYSIS/QUALITY CONTROL - the valorisation process is not economically uncompetitive concerning standard materials.

**COST
STRUCTURE
AND
REVENUE
STREAMS –
FINANCE -**
Please, select
which of the
following
elements should
be needed in
your Circular
Case

- Long term Environmental Monitoring costs
- WPA warehouses at different strategic locations
- Major up-front investment costs (for the waste manager)
- A considerable amount of cost is involved in on-site machine modifications
- Others:
- For each partner, a list of costs and revenues is realised both for the linear and circular models to carry out a cost-benefit analysis and assess whether the circular model performs better or not than the linear model.
- Enterprises' economic incentives or disincentives to engage in environmentally sustainable development
- More financial and economic incentives at national, regional and local levels could motivate the stakeholders, e.g. missing economic recycling incentives
- Shifting taxes from labour to natural resources and pollution
- Phasing out environmentally harmful subsidies
- The internalisation of environmental costs
- Finance Mechanisms Supporting Circular Economy Approaches – **Sustainable Public Procurement**
- Collaboration between procurement scheme (procurers and suppliers) and business models
- Availability of investment capital (e.g. for new infrastructure)
- Others:

2.3. Legal

The legal dimension relates to the **set of compulsorily laws** and norms for companies operating in the resource recovery circular economy model. One of the main difficulties that companies deal with when designing circular business approaches concerns the fact that the **external legal environment is not necessarily ready to embrace the new concepts**. Strong delays in receiving the corresponding environmental licences or approvals due to the higher complexity of the new solutions could emerge. These delays put strong pressure on the company and threaten the viability of the model.

Table S9: Key questions for IDEATION phase – LEGAL DIMENSION.

Key questions	Contents
LEGAL ASPECTS	<ul style="list-style-type: none"> - Lack of consistent legislation regarding the end-of-life phase of products: the legislation regarding the use of different types of waste is not always clear in the different countries in Europe and may sometimes prevent the implementation of a circular model. - The legal status over the utilisation of waste as a new raw material:

- Legal authorisation required to allow the use or production at an industrial scale:
- Legal barriers can be very different depending on the selected country in UE. In terms of replicability/reproducibility, a specific analysis should be done for each country of interest.
- Others:

2.4. Social

This dimension covers the interaction between the CBM and society in general. Taking into consideration the broadness of this dimension, the focus shall be centred on the **potential impact of the CBM on society** and the constraints and facilitating elements that society provides to the development of the CBM.

Thus, it shall concern how the CBM influences society and/or human needs. The main socio-economic indicators can help to monitor the mentioned influence but other elements shall be considered such as whether and how the firm/system establishes the strategic goals in terms of social benefits as well as sociological and cultural factors (creating jobs, new educational training programs, or awareness and sense of urgency needed to change). The characterisation of the circular cases helped list the key elements of this dimension and new elements were added derived from creative workshops.

Table S10: Key questions for IDEATION phase – SOCIAL DIMENSION.

Key questions	Contents
Encouraging cultural transition towards CE	<p>Propose supporting processes or activities to:</p> <ul style="list-style-type: none"> • <u>To inspire attractiveness as an employer</u> - recruiting and selection, induction and development programs oriented towards circular economy culture. • <u>To gain target stakeholders'</u> (society, government) attention and acceptance - Intense communication efforts: disseminating the positive impact resulting from this innovation, that is, the benefits of the new application (waste reduction) and the obtained results (performance) • <u>To manage resistance (from the local community, sector, etc...)</u> - in the construction sector, initial resistance is expected because that sector has always been very conservative in terms of new materials, methodology and technology implementation.

2.5. Environment

Other measures beyond waste recycling could further reduce greenhouse gas emissions. Within this dimension, the reference framework points out the positive environmental effects concerning the **net reduction in environmental pressure from waste disposal and the production of virgin materials**.

Table S11: Key questions for IDEATION phase – ENVIRONMENTAL DIMENSION.

Key questions	Contents
PROCESSES	<ul style="list-style-type: none"> • Risks management/LCA analysis: there could be some potential risks which need to be studied in detail and analysed • A best practice document needs to be developed by the Waste manager for the logistics. <p>Others</p> <p><i>There could be some potential risks which need to be studied in detail and analysed.:</i></p> <ul style="list-style-type: none"> (i) <i>contamination of soil by rainwater after getting mixed with the chlorides present in the new product,</i> (ii) <i>the dry particle of the new material being very light in weight can float in the air during transportation or handling and settle down over the plants and crops, which would later have a detrimental effect on them.</i>

Key Performance Indicators of the CBM

Key questions	Contents
KPIs from a Technical perspective	List all KPIs (of the Ecosystem):
KPIs from an Economic & Financial perspective	<p>List all KPIs (of the Ecosystem):</p> <ul style="list-style-type: none"> • Cost reduction • Energy savings, • Reduction of material flows or cleaner production • Increase company's benefits • Reputation and brand value • % increase in sales • Others:
KPIs from a Social Perspective	<p>List all KPIs (of the Ecosystem):</p> <ul style="list-style-type: none"> • Job creation, e.g. in the transport and processing of raw materials. • If the circular model reaches the industrial scale, the CBM may create numerous jobs. • Others:
KPIs from an Environmental perspective	<ul style="list-style-type: none"> • Tons of landfills avoided per year • Reduction of CO2 emission for the whole value chain • % reduction of carbon footprint

- Others:

3. INTEGRATION PHASE

The third phase of the creation of a Circular Economy Model is related to the intensive collaboration of the companies involved in the CBM throughout the system.

The **CE leadership** shall take the lead for managing the collaboration of the members of the 'CE ecosystem', being the main responsible for guaranteeing **information exchange** and **agreements** about responsibilities, liabilities, sharing profits, goals, knowledge and ownership. Therefore, the key challenges in this phase are rooted on defining the **governance model** of the 'CE ecosystem'.

We will now list below the evaluation of the relevant aspects for creating the basis for launching the circular economy model as the following figure shows:

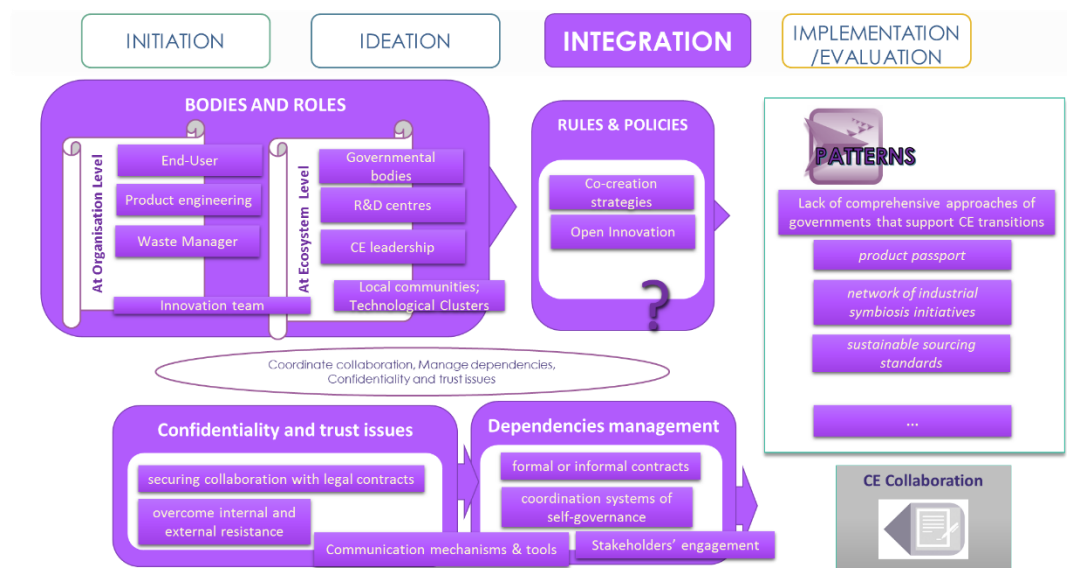


Figure S5: Integration phase – CE collaboration scheme.

3.1. Bodies and Roles

In your opinion, the Governance structure of the “CBM ecosystem” will comprise the following bodies?

Bodies	Yes	No
Collaboration Board (Consists of one person from each partner that participates in the project. The Board will decide on all matters regarding the CBM)		

CE leadership (The collaboration Board will assign or elect one person who will be responsible for the management of the Platform)		
External Advisory board (various providers of technology, ICT, marketing and legal services, governmental entities which will advise on the relevance of CBM's plans)		

Most of the partners involved in the CBM have specific roles assigned within the CBM ecosystem as the following figure shows.

However, do you think any other specific roles should be added to the CBM ecosystem?

- Yes ☐
- No ☐

- If Yes, in your opinion, which roles each partner should have?
Please suggest the name of companies and response for your company only

Partners	Roles				
	Product Sellers	Consultancy/ Training Providers	R&D Services Providers	Equipment Providers	Materials/ components Providers

3.2. Rules and Policies

When referring to the governance rules and policies it is aimed to provide the CBM ecosystem creation with the basic elements which define the behavioural dimension of the ecosystem. In the following table, the main elements to be considered in this stage are gathered.

CBM ecosystem activities	Policies and rules
CE management – technology development	Assessment criteria for the selection of technology relevant to the CBM
	Evaluation criteria for technology providers
CE management- Performance management	Definition of performance management strategy
	Collection of KPI measurement data and evaluation of the CBM's performance
CE management- Membership management	CBM ecosystem entrance policy: definition of the criteria to assess the appropriateness and relevance of organisation to enter the CBM.

CBM ecosystem activities	Policies and rules
	CBM ecosystem membership protocol and agreement: definition of the activities and agreements - cooperation agreement.
	Confidentiality agreements
	Conflict resolution policy
New product ideation – replication	Strategy to search for business opportunities
	Idea assessment criteria
	Co-creation strategies
IPR management	IPR policy: definition of rules for members' IPR protection and determination of ownership.

3.3. CBM patterns

Patterns' perspective shall cover all the standards (for example the upcoming eco-design directive) accounting for social and environmental impacts, and business for Circular Economy (such as International regulation on waste and recycling). The CBM ecosystem needs specific support for Business Intelligence with activities devoted to the searching **process of standards** that could favour the CBM. For instance, high quality standards should be set and collection points should be made responsible for the quality of the collected materials. The feasibility of the CBM ecosystem would be related to the areas in the table below.

CBM Patterns	New patterns
Legislation and policy	Lack of comprehensive approaches of governments that support CE transitions
	At the European level? At the regional level? At the local level?
Product	Tax system - taxing non-renewable resources
	Product passport
	network of industrial symbiosis initiatives or sustainable sourcing standards
Financial incentives	Economic incentives to facilitate CE transitions - tax benefits for "circular products" and tax rate for recovery activities such as maintenance, repair, renovation, recycling of products

4. IMPLEMENTATION PHASE

This phase shall address the **operational structure** of the constituting elements of a circular economy model, namely, the processes, activities, and skills that will constitute the **organisational readiness** of the members of the CE ecosystem. The following figure

shows the key elements to be defined in this phase. It will help define the **global management system**

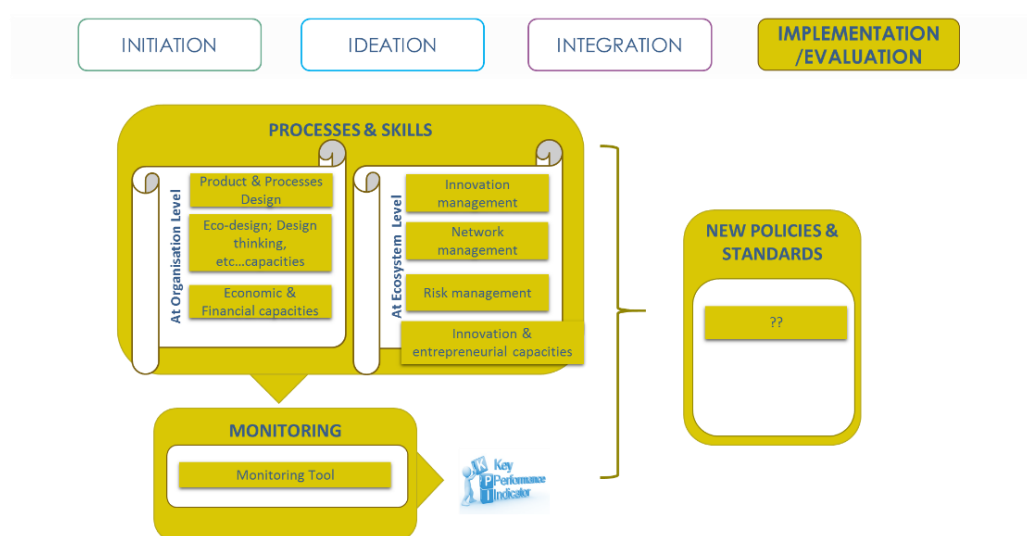


Figure S6: Implementation phase – Adequacy and Benefits.

Some relevant processes have been envisioned and they should be adapted to the characteristics of the circular cases. The key challenge in this phase is to anticipate which elements at the organisational level should be redefined or created. Although new elements could arise along the project, we have compiled previous findings from the literature review and the characterisation of the circular cases in the following table.

Table S12: Cross-cutting issues for defining the support scheme (adequacy and benefits).

	PROCESS	SKILL	ACTIVITIES	STRATEGY	CULTURE
Recruiting and selection, induction and development programmes oriented towards circular economy culture.	X	X			X
Cultural Attributes of a Sustainable Business Model					X
Innovation management process	X			X	
Proactive strategic management - Address many business case drivers strongly and continuously, with the effect of regular creation of business cases for sustainability	X			X	
Risk management in terms of sustainability; Risks Reduction: The reduction of technical, political, societal and market risks	X				
KPIs – selection of the appropriate KPIs and monitoring tool	X	X	X	X	
Capabilities for developing and disseminating knowledge		X			

Capacity for innovation and support for entrepreneurial activities		X		X	
Transition Management - Translate the application of existing strategies, methods and practical experiences of transition management to the transition to a CE			X	X	
Collaboration & formal agreements (stakeholders) - Tools for finding the right partners and organizing collaboration and cooperative arrangements	X		X	X	
Avoid or control the Geographic dispersion of stakeholders	X				
Driving competitive advantage through stakeholder engagement			X	X	
Building customer loyalty				X	