Technical Report

ISO/TR 59032

Circular economy — Review of existing value networks

Économie circulaire — Examen des réseaux de valeur existants

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 323, *Circular economy*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 The global economy can be characterized as "linear" as it is mainly based on extraction, production, use and disposal. This linear economy leads to resource depletion, biodiversity losses, waste and pollution causing serious damage to the capacity of the planet to continue to provide for the needs of future generations. Moreover, several planetary boundaries have already been reached or exceeded.

To meet current and future human needs (welfare, housing, nutrition, healthcare, mobility, etc.), there is an increased understanding that a transition towards an economy that is more circular, based on a circular flow of resources, can create and share more value with society and stakeholders, while natural resources are managed and regenerated in a sustainable way, securing the quality and resilience of ecosystems.

Organizations recognize many potential reasons to engage in a circular economy (e.g. delivering more competitive and sustainable solutions; improved relationships with stakeholders; more effective and efficient ways to fulfil voluntary commitments or legal requirements; engaging in climate change mitigation or adaptation; managing resource scarcity risks; increasing resilience in environmental, social and economic systems) while contributing to satisfying human needs.

The ISO 59000 family of standards (see Figure 1) is designed to harmonize the understanding of the circular economy and to support its implementation and measurement.

These standards also support organizations, such as government, industry and non-profit, in contributing to the achievement of the United Nations (UN) Agenda 2030 for Sustainable Development.

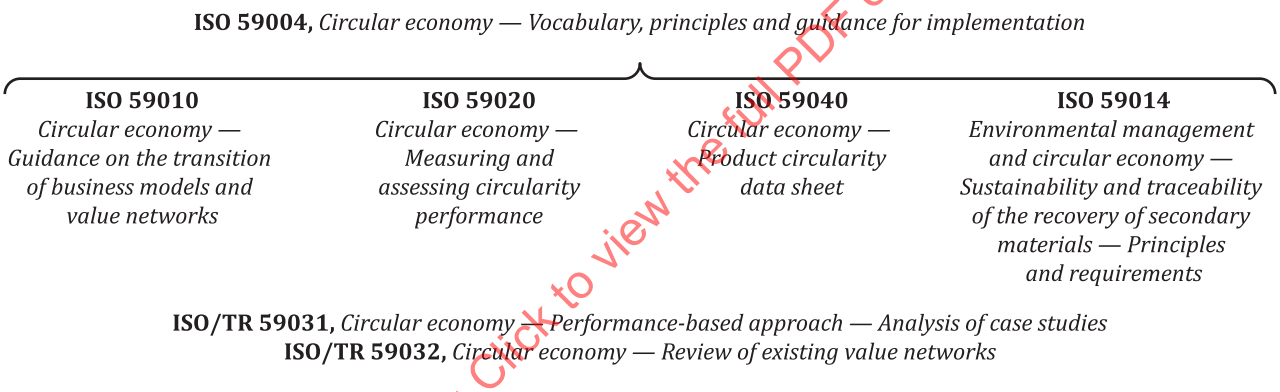


Figure 1 — ISO 59000 family of standards

0.2 ISO 59004, ISO 59010 and ISO 59020 are interconnected, as shown in Figure 2, and support organizations in implementing a transition towards a circular economy.

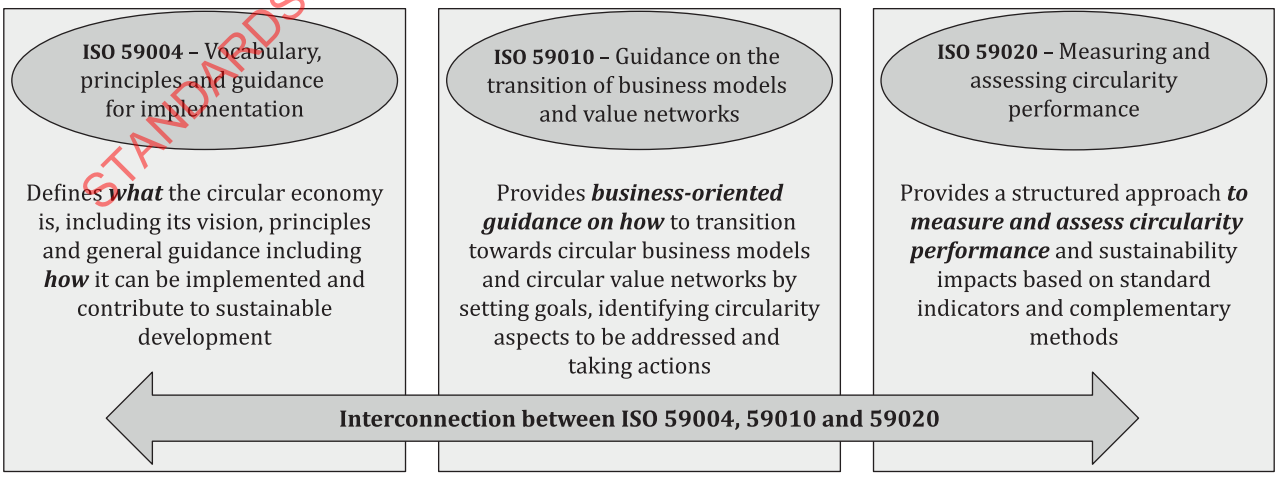


Figure 2 — Relationship between ISO 59004, ISO 59010 and ISO 59020

0.3 ISO 59010 provides guidance on supporting an organization's business model and processes from linear to circular by transforming an organization's business ecosystem into a value network. The contents of this document support the users of ISO 59010 in providing further detail on the development of value networks in a circular economy. In the development of ISO 59010, a survey was conducted to review and analyse the examples of globally existing value networks. This document provides an analysis of the survey results. It reviews examples of value networks to illustrate their characteristics and structures and how they can accelerate a circular economy transition process, and therefore supports ISO 59010.

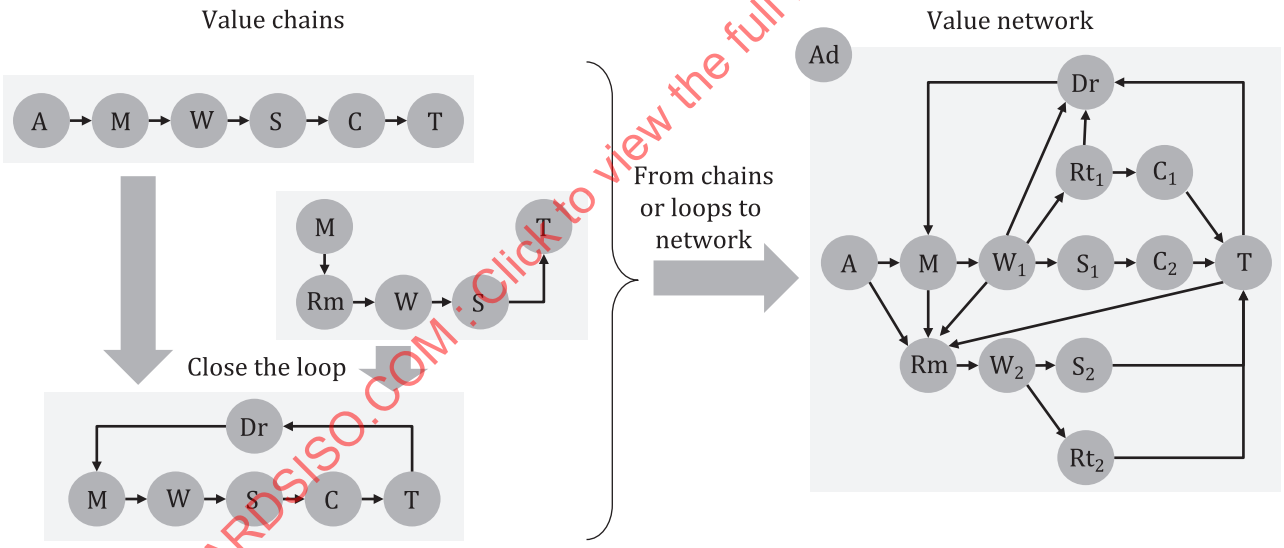
This document investigates suitable examples of value networks to promote circular economy transition. The characteristics and structure of the value networks reflect multiple organization cooperation. The multiple organizations work together to advance their businesses and accelerate their circular economy transition process. A specific organization does not necessarily control the others. This document addresses the methods used to establish and organize a value network to meet the desired requirements.

This document collects and analyses existing relevant cases, examples of the creation of value networks, to demonstrate what is a value network in the context of the circular economy. A general image of the value network discussed in this document is shown in Figure 3.

The objectives of this document are:

— to provide useful information by analysing existing value networks;

— to enhance understanding of the success factors and enablers for creating value networks derived from examples.



Key

A	raw materials acquisition
M	manufacturing
W_1,W_2	wholesaling
S_1,S_2	service
C_1,C_2	consumer
T	collection and take-back
Rm	remanufacturing and reusing
Rt_1, Rt_2	retailing
Dr	disassembling and recycling
Ad	research, association and administration

Figure 3 — General process from value chains to a value network

Circular economy — Review of existing value networks

1 Scope

This document reviews the characteristics and structures of some existing value networks as examples in accelerating a circular economy transition process.

ISO 59010 gives guidance on a critical aspect in transitioning an organization's business model and processes from linear to circular and transforming an organization's business ecosystem into a value network. This document complements ISO 59010 by providing further information on value networks.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
circular economy
economic system that uses a systemic approach to maintain a circular flow of resources, by recovering, retaining or adding to their value, while contributing to sustainable development

Note 1 to entry: Resources can be considered concerning both stocks and flows.

Note 2 to entry: The inflow of virgin resources is kept as low as possible, and the circular flow of resources is kept as closed as possible to minimize waste, losses and releases from the economic system.

[SOURCE: ISO 59004:2024, 3.1.1]

3.2
common infrastructure
systems shared among participants in a *value network* (3.6) for mutual benefit

Note 1 to entry: The system indicates an optimization system, traceability system, information exchange system, branding, equal relationship and internal standardization as a certification system.

3.3
governance
principles, policies and framework by which an *organization* (3.4) is directed and controlled

[SOURCE: ISO 21505:2017, 3.1]

3.4
organization
person or group of people that has its own functions with responsibilities, authorities, and relationships to achieve its objectives

Note 1 to entry: The concept of organization includes, but is not limited to sole-trader, company, corporation, firm, enterprise, authority, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private (e.g. foundation, union, association, agency, municipality, region, country, intergovernmental agencies).

Note 2 to entry: A group of organizations can also be considered as an organization that has, alone or collectively, their own objectives.

[SOURCE: ISO 59004:2024, 3.4.1]

3.5
value chain
set of *organizations* (3.4) that provide a solution that results in value for them

[SOURCE: ISO 59004:2024, 3.5.2]

3.6
value network
network of interlinked *value chains* (3.5) and interested parties

[SOURCE: ISO 59004:2024, 3.5.3]

4 Review of existing value networks

4.1 Method

4.1.1 Survey process

The survey was conducted in accordance with the steps shown in Figure 4. The process of collecting the cases was based on different experts voluntarily accepting an invitation to submit examples. The examples were selected based on the criteria shown in Figure 4.

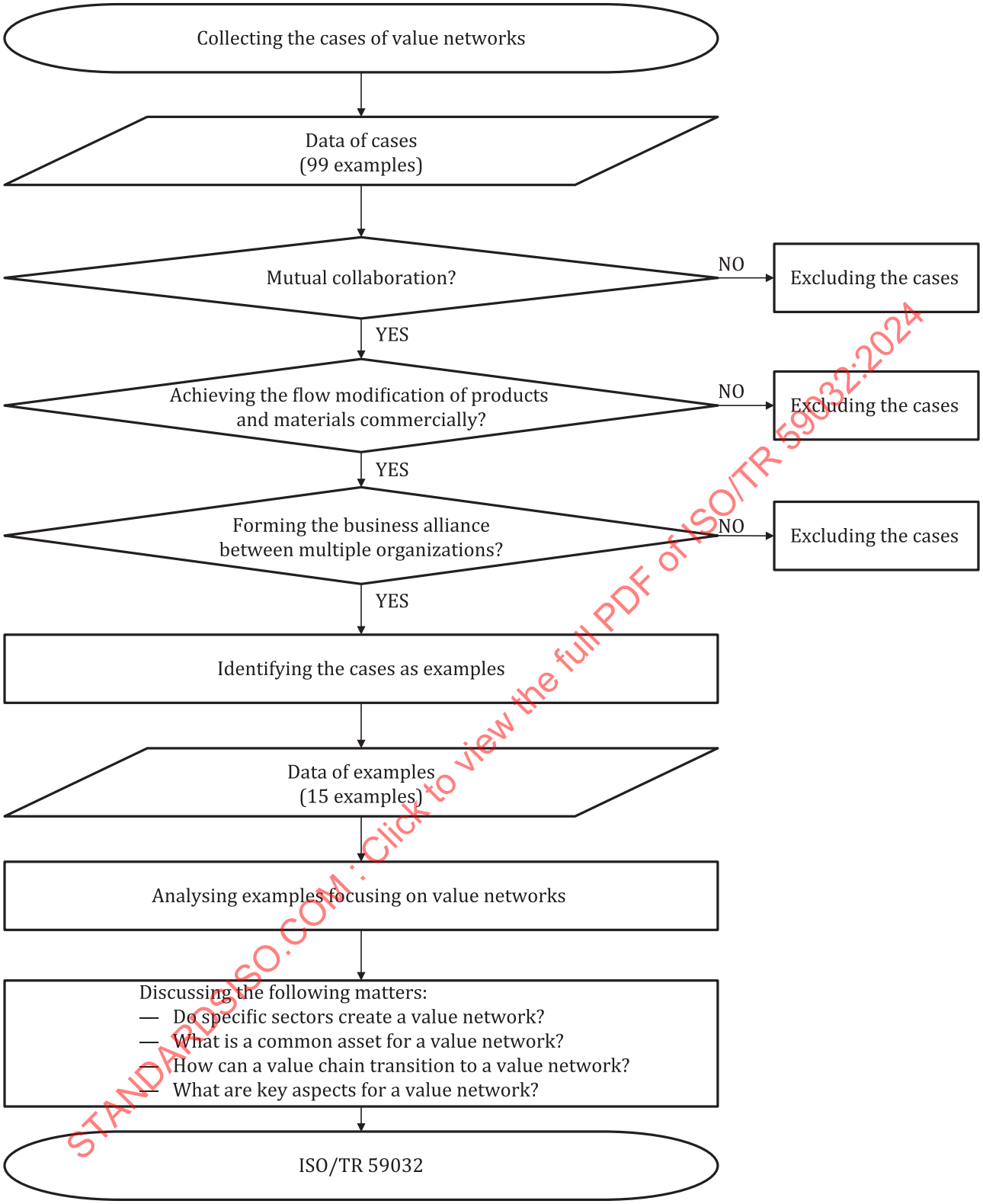


Figure 4 — Survey process

4.1.2 Preparing questionnaires

The survey was conducted by experts on existing value networks in each region, country or organization to collect the following information:

a) type of case;

b) title and basic information;

c) overview of the implementation model;

d) beneficial or detrimental impacts (listing and highlighting critical aspects);

e) relevance to the Sustainable Development Goals (SDGs), including detrimental impacts;

f) key aspects relevant to the circular economy ;

g) implementation methodology;

h) enablers, barriers and concerns;

i) relevant information specific to businesses or individual projects.

4.1.3 Collecting the cases of value networks

The aim was to cover a wide scope of various types of existing value networks. Geographical and sectoral balance was considered when collecting the existing cases of value networks. There were 99 cases collected that fulfilled the questionnaire requirements for further analysis.

The collected cases are geographically diverse across countries or regions (Japan, Europe, the United States, Brazil, China, India, Canada, Mauritius and Singapore). The collected cases cover various sectors, including machinery and equipment, forest and bio-based industries, waste management, textiles, chemicals, food, drink, mining, metals, minerals, cement, construction, transport, furniture, glass and steel.

4.1.4 Selecting the examples

Fifteen examples were selected from the collected value network cases using the following criteria:

a) Does the case have a mutually beneficial collaboration?

b) Does the case achieve the flow modification of products and materials commercially?

c) Does the case form a business alliance between multiple organizations?

The selected examples achieve a scale flow modification of products and materials commercially, and form a business alliance between multiple organizations. The status of the examples covers not only the aspects of the value network but also circular economy implementation and use case (see Figure 5).

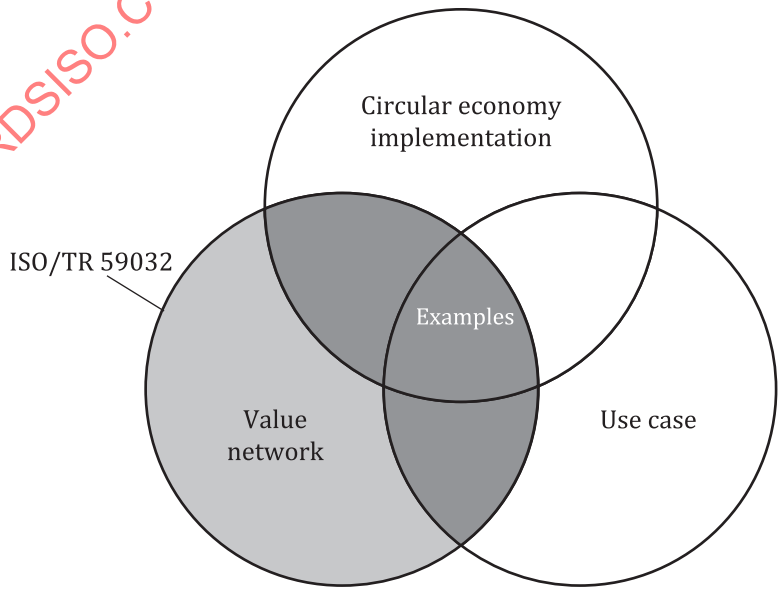


Figure 5 — Status of the examples

4.1.5 Selected examples

The examples shown in Figure 6 and listed in Table 1 were selected as examples of value networks from the 99 worldwide examples collected.

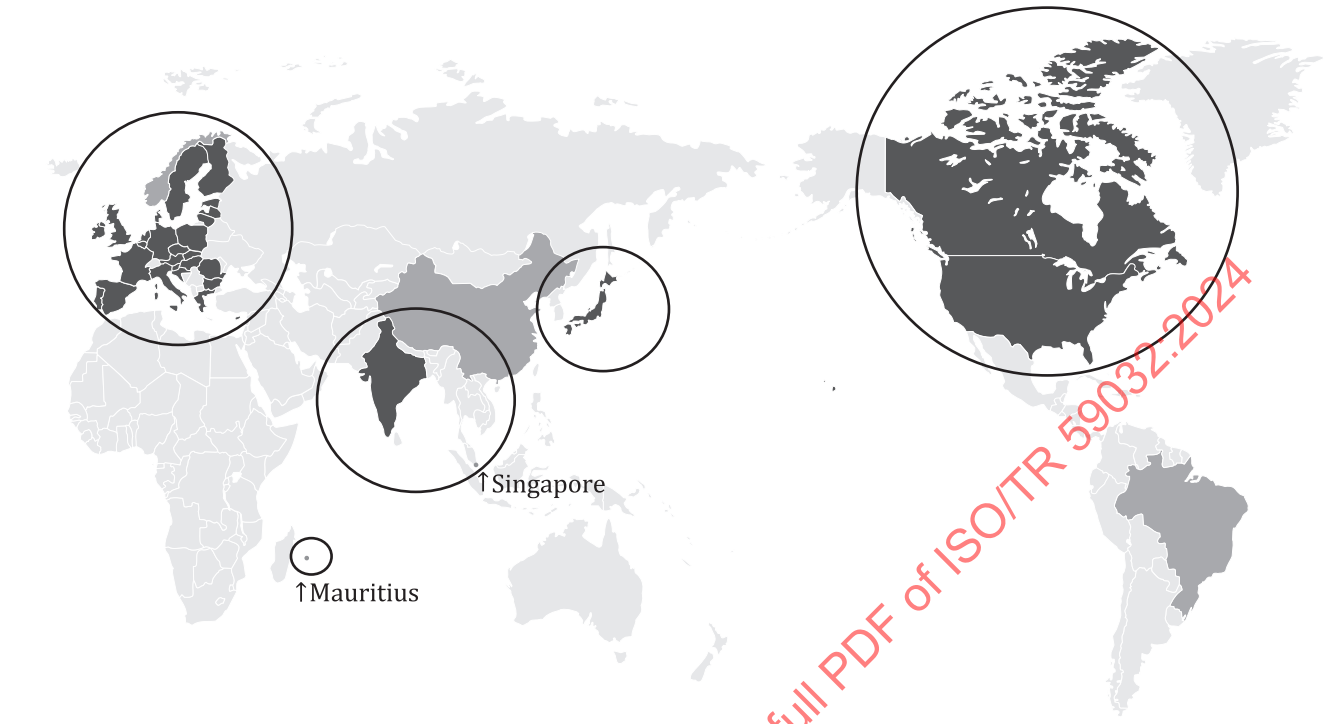


Figure 6 — Geographical distribution of collected and selected examples

Table 1 — Geographical location of collected and selected examples

No.	Title	Geographical location
1	Horizontal closed loop aluminium recycling system of Shinkansen	Japan
2	Improving the income levels of Indian farmers through better access to information	India
3	Case in the USA	USA
4	Effective industrial symbiosis	Denmark
5	CIRCULÈRE – The National Platform for Circular Manufacturing	Ireland
6	Omnicane's "zero waste" industrial ecosystem	Mauritius
7	Eco-town business	Japan
8	Resources complex consortium	Japan
9	Case in Spain	Spain
10	Global case	Global
11	Aluminium recycling in the window and curtain walling industry	Germany
12	Close the Glass Loop – The European Union (EU) ambition to collect increased amounts of glass more effectively	EU

Table 1 *(continued)*

No.	Title	Geographical location
13	Lopyanko – AGRY_GAYA'18 Project for sustainable organic silk	Bulgaria
14	An open-access circular supply chain for fashion	UK
15	Cargo Carousel System	Canada

4.2 Examples

4.2.1 Example 1: Horizontal closed loop aluminium recycling system of Shinkansen (Japan)

This example includes facilitators and participants from various sectors, including information and communication technology (ICT), transport, construction, machinery and equipment, mining, metals and minerals, power and utilities. The construction of a value network is expected to promote the construction of an advanced recycling system consisting of different industries. Key methodologies, including recycling process certification, recycled resources standards and sharing information, can help to create and maintain the value network. Some aspects, including reducing costs and improving the value of resources and resource efficiency, seem to be the key motivations for participation in this value network (see Table 2).

Table 2 — Horizontal closed loop aluminium recycling system of Shinkansen (Japan)

Parameter	Description
Facilitators (designers)	Sectors: — Transportation — Waste management Organizations: — Central Japan Railway Company — Harita Metal Co., Ltd.
Year of implementation	2020
Participating companies	Sectors: — Metal manufacturing — Other transport manufacturing — Machinery — Other (mining, power and utilities) Organizations: — Sankyo Tateyama, Inc. — Nippon Sharyo, Ltd. — Hitachi — Japan Aluminium Association
Geographic location	Asia (Japan)
Relevant matters	Machinery, metals, waste management (recycling), railway
Relevant products/services	Recycled products (aluminium, etc.)
Key aspects (activities)	— Manufacturing Shinkansen materials and parts — Recycling aluminium scrap — Manufacturing and sale of recycled resources — Construction business of recycling systems

Table 2 *(continued)*

Parameter		Description
Impacts	Added/created value aspects	The collaboration has resulted in the construction of an advanced system that reuses the discarded aluminium from the Shinkansen for the Shinkansen (not a cascade recycling but horizontal recycling).
	Social aspects	— Promoting resource recycling — Reducing waste — Reducing environmental impact — Promoting employment — Forming new markets
	Environmental aspects	— Improving resource efficiency — Reducing CO_2 emissions — Reducing environmental impacts
	Economic aspects	— Reducing waste disposal costs — Stable supply of recycled resources — Sustainable recycling
Motivation of participants in the value network		— Cost reduction (collection, waste, recycling cost) — Improving the value of resources — Improving resource efficiency — Development of a circular economy — Improving the recycling technology — Securing secondary resources
Methodology for creating and maintaining the value network		— Recycled resources standard — Recycling process certification — Shinkansen disposal and manufacturing plan — Sharing material information — Certification, standard and traceability system — Japan Aluminium Association as a neutral organization
Common infrastructures		Certification, standard, information
Enablers and barriers		Enablers: — Resource efficiency, traceability and proper disposal of dischargers — A horizontal recycling committee for aluminium vehicles, in which many companies participate in the Japan Aluminium Association — Recycling process certification standard and secondary resource standards for the committee
Source		Based on the Harita Metal website (https://www.harita.co.jp/eng/index.html)

4.2.2 Example 2: Improving the income levels of Indian farmers through better access to information (India)

This example includes facilitators and participants from various sectors, including agriculture, food and drink, ICT and packaging. The construction of a value network is expected to promote reducing the mismatch between supply and demand in a wide range of markets. Key methodologies, including online platforms, win-win structures and fair transactions, can help to create and maintain the value network. Some aspects, including improving income levels and lower procurement costs, seem to be the key motivations for participation in this value network (see Table 3).

Table 3 — Improving income levels of Indian farmers through better access to information (India)

Parameter		Description
Facilitators (designers)		Sectors: — Agriculture (tobacco) — Paper manufacturing — Food manufacturing Organizations: — Private company
Year of implementation		2000
Participating companies		Sectors: — Agriculture — Food manufacturing — Others (ICT and packaging) Organizations: — Private company — Farmer
Geographic location		Asia (West Bengal, India)
Relevant matters		Farmers, online platform, poverty
Relevant products/services		Agricultural products, food
Key aspects (activities)		— Higher profits — Optimizing the use and distribution of time and resources — Securing a long-term food supply
Impacts	Added/created value aspects	Mismatch of supply and demand is reduced in a wide range of markets, which improves the sales for the stakeholders.
	Social aspects	— Ensuring higher profits for farmers — Securing a long-term food supply
	Environmental aspects	— Reducing emissions, water usage and environmental degradation — Optimizing the use and distribution of time and resources
	Economic aspects	— Ensuring higher profits for farmers — Lower procurement (costs) and targeted sales — Optimizing the use and distribution of time and resources

Table 3 *(continued)*

Parameter	Description
Motivation of participants in the value network	— Improving income levels (higher profit) — Lower costs of procurement — Lower targeted sales — Sharing information/knowledge — Securing a long-term food supply
Methodology for creating and maintaining the value network	— Online platform for improving sales/reducing costs (pricing, weather forecasting, knowledge) — Win-win structure (higher profits for farmers, lower procurement and targeted sales) — Four million farmers use the service — Farmers can make decisions on their own — Farmers respect manufacturers that offer fair prices
Common infrastructures	Online platform (information, knowledge)
Enablers and barriers	Enablers: — Lower procurement, optimizing the use and distribution of time and resources through information — Improving income levels, lower costs of procurement, lower targeted sales — Win-win structure (higher profits for farmers, lower procurement and targeted sales) — Developing IT infrastructure
Source	Based on the ITC website (https://www.itcportal.com/businesses/agri-business/e-choupal.aspx), Ellen MacArthur Foundation website(https://www.ellenmacarthurfoundation.org/case-studies/improving-income-levels-of-indian-farmers-through-better-access-to-information)

4.2.3 Example 3: Case in the USA

This example includes facilitators and participants from various sectors, including waste management, food and drink, ITC and packaging. The construction of a value network is expected to promote the use of by-products. Key methodologies, including finding synergies, matching demand and supply, and accessibility for small businesses, can help to create and maintain the value network. Some aspects, including cost reduction, increasing the bottom line and cultivating local circular economies, seem to be the key motivations for participation in this value network (see Table 4).

Table 4 — Case in the USA

Parameter	Description
Facilitators (designers)	Sectors: — Construction — Waste management Organizations: — Non-profit organization — Private company
Year of implementation	2011

Table 4 *(continued)*

Parameter		Description
Participating companies		Sectors: — Agriculture — Food and drink services — Others (ITC and packaging) Organizations: — Small businesses (including farms)
Geographic location		Americas (Chicago, USA)
Relevant matters		Recycled products derived from food waste
Relevant products/services		Closed loop urban system
Key aspects (activities)		— Material reuse — Energy conservation — Compost
Impacts	Added/created value aspects	By sharing outputs as inputs (by sharing related information), the utilization of by-products is facilitated and economic gain is increased. At this time, food supply chains are typically operating in silos.
	Social aspects	— Facilitating collaboration and material flows through the co-location of small food businesses — Creating unique partnerships between profit and non-profit organizations
	Environmental aspects	— Energy conservation — Material reuse — Food waste reduction — Reducing the demand for natural gas
	Economic aspects	— Energy conservation — Material reuse — Food waste reduction
Motivation of participants in the value network		— Cost reduction (waste reduction, reducing the use of natural gas) — Increasing the bottom line — Cultivating local circular economies (development of local economies)
Methodology for creating and maintaining the value network		— The plant is striving to find synergies between each other — Matching demand and supply (organizing farmers' markets, etc.) — Open to every small business — Meeting certain criteria are considered to participate — Information about materials flow is visible
Common infrastructures		Facility and community, information

Table 4 *(continued)*

Parameter	Description
Enablers and barriers	Enablers: — Reducing waste — Reducing the use of natural gas — Reducing costs (reducing waste, reducing the use of natural gas) — Co-location of small food businesses
Source	Based on the Plant Chicago website (https://www.plantchicago.org/), Ellen MacArthur Foundation website(https://www.ellenmacarthurfoundation.org/case-studies/synergistic-food-production-space)

4.2.4 Example 4: Effective industrial symbiosis (Denmark)

This example includes facilitators and participants from various sectors, including chemical manufacturing, power generation, waste management, pharmaceuticals, manufacturing machinery, mining, water supply and public administration. The construction of a value network is expected to promote saving and minimizing waste by sharing and reusing resources. Key methodologies, including full resource utilization, partnership strengthening and sharing the symbiotic mindset, can help to create and maintain the value network. Some aspects, including cost reduction, benefiting both the environment and the economy, local growth and supporting the green transition, seem to be the key motivations for participation in this value network (see Table 5).

Table 5 — Effective industrial symbiosis (Denmark)

Parameter	Description
Facilitators (designers)	Sectors: — Waste management (industrial symbiosis) Organizations: — Non-profit organization
Year of implementation	1972
Participating companies	Sectors: — Chemical — Power generation — Waste management — Pharmaceuticals — Machinery — Mining — Water supply — Public administration Organizations: — Private company — Public institution
Geographic location	Europe (Denmark)
Relevant matters	Saving resources (water, energy, materials)
Relevant products/services	Recycled products (energy, water, gypsum, fly ash, etc.)

Table 5 *(continued)*

Parameter		Description
Key aspects (activities)		— Industrial symbiosis — LCA — Sharing resources — Reusing resources — Closed loop
Impacts	Added/created value aspects	It is possible to share and reuse resources, which saves money as well as minimizes waste.
	Social aspects	—
	Environmental aspects	— Reducing CO_2 emissions — Saving resources (water, energy, materials)
	Economic aspects	— Cost reduction
Motivation of participants in the value network		— Cost reduction (through saving water, energy and materials) — Benefiting both the environment and the economy — Local growth and support for a green transition
Methodology for creating and maintaining the value network		— Full resource utilization — Strengthening the partnership — Sharing the symbiotic mindset — Work based on trust, confidentiality, openness, equality and cooperation — Kalundborg Symbiosis is a private association run by a board — Visible information about materials flow
Common infrastructures		Resources (waste as resources)
Enablers and barriers		Enablers: — Reducing waste, saving resources (water, energy, materials) — Reducing costs (through saving water, energy and materials) — Public-private partnership — Existance of a leading organization
Source		Based on the Kalundborg Symbiosis website (http://www.symbiosis.dk/en/),Ellen MacArthur Foundation website(https://www.ellenmacarthurfoundation.org/case-studies/effective-industrial-symbiosis)

4.2.5 Example 5: CIRCULÉIRE – The National Platform for Circular Manufacturing (Ireland)

This example includes cross-sectoral actors, including pharmaceuticals, chemicals, food, beverages, plastics and machinery manufacturing companies, public administration and professional services. The construction of a value network is expected to promote accelerating the scale-up of circularity. Key methodologies, including innovation opportunities, information/knowledge sharing and funding opportunities, can help to create and maintain the value network. Some aspects, including new revenue models and value creation opportunities, new customer relationships, enhanced customer loyalty and information/knowledge sharing, seem to be the key motivations for participation in this value network (see Table 6).

Table 6 — CIRCULÉIRE – The National Platform for Circular Manufacturing (Ireland)

Parameter		Description
Facilitators (designers)		Sectors: — Professional services Organizations: — CIRCULÉIRE
Year of implementation		2020
Participating companies		Sectors: — Pharmaceuticals — Chemicals — Food — Beverages — Plastics — Machinery — Construction — Professional services — Public administration Organizations: — Irish Manufacturing Research (technology centre/research-performing organization) — Private company — Public institution
Geographic location		Europe (Ireland)
Relevant matters		Greenhouse gas (GHG) emission reduction, waste reduction
Relevant products/services		Products relevant to pharmaceutical and chemical, medical devices, packaging, food and drink, built environment, second-life enablers
Key aspects (activities)		— Design for circularity — Product service systems (PSS) — Reuse and shared use — Remanufacturing, repair and refurbishment — Take-back schemes and reverse logistics — Industrial symbiosis — Recycling
Impacts	Added/created value aspects	Cross-sector collaboration can be fundamental to accelerating the scale-up of circularity.
	Social aspects	—
	Environmental aspects	— Reducing waste and associated GHGs through the implementation of circular strategies
	Economic aspects	— Generating costs savings and new value creation opportunities through new business models

Table 6 *(continued)*

Parameter	Description
Motivation of participants in the value network	— Accessing new revenue models and value creation opportunities — Creating new customer relationships and enhancing customer loyalty — Sharing information/knowledge — Capacity building — Delivering significant reductions in both CO_2 emissions and waste across their industry members — Increasing resilience to resource price volatility and supply-chain shocks — Taking opportunities for funding — Taking opportunities for innovation
Methodology for creating and maintaining the value network	— Innovation opportunity — Information/knowledge sharing — Funding opportunity — Open to every business (via a website) — Memberships — CIRCULÉIRE is a cross-sectoral industry-led public-private partnership and circular economy innovation network (2020–2022), codesigned by Irish Manufacturing Research (IMR) in collaboration with three Strategic partners: DECC, EPA and EIT Climate-KIC and founding industry members — Open-access knowledge library
Common infrastructures	Information/knowledge
Enablers and barriers	—
Source	Based on the CIRCULÉIRE website (https://circuleire.ie/)

4.2.6 Example 6: Omnicane's "zero waste" industrial ecosystem (Mauritius)

This example includes facilitators and participants from various sectors, including food manufacturing, power generation, waste management and construction (see Figure 7). The construction of a value network is expected to promote enabling the planning and execution of the entire production as an integrated whole. Key methodologies, including optimum resource allocation plans, power purchase agreements for the sale of electricity and equal relationships, can help to create and maintain the value network. Some aspects, including cost reduction, sales improvements, and reinforcing a brand, reputation and loyalty through sustainable business, seem to be the key motivations for participation in this value network (see Table 7).

Table 7 — Omnicane's "zero waste" industrial ecosystem (Mauritius)

Parameter	Description
Facilitators (designers)	Sectors: — Power generation — Food manufacturing Organizations: — Omnicane
Year of implementation	2010
Participating companies	Sectors: — Food manufacturing — Power generation — Waste management — Construction Organizations: — Omnicane milling unit — Omnicane refinery unit — Omnicane thermal energy unit — Omnicane bioethanol distillery unit — Omnicane carbon burn out unit — Constructions/building industry — Electricity industry — Bio-fuel industry
Geographic location	Africa (south of Mauritius)
Relevant matters	Waste management (recycling), integrating energies
Relevant products/services	Sugar cane, recycled products (cement, energy, etc.)
Key aspects (activities)	— Reduce, reuse, recycle — Efficient production — Energy recovery — Resource recovery

Table 7 *(continued)*

Parameter		Description
Impacts	Added/created value aspects	Enabling to plan and execute the entire production as an integrated whole for optimum flexibility, maximum efficiency and, above all, minimal waste, notably by using one operation's by-product as another's raw materials.
	Social aspects	— Attracting, retaining and engaging employees
	Environmental aspects	— Less wastage — More efficient use of resources — Production of renewable energy
	Economic aspects	— Reducing the cost of production-developed new products — Attracting new customers — Reinforcing brand and reputation as an innovative organization — Building loyalty with customers
Motivation of participants in the value network		— Cost reduction — Sales improvement — Reinforcing brand, reputation and loyalty by sustainable business — Ensuring sustainable supply
Methodology for creating and maintaining the value network		— Optimum resource allocation plan — Power purchase agreements for the sale of electricity — Equal relationship seems to be established between each unit (optimum for each unit) — Information is accessible in the same group (company)
Common infrastructures		Land, resource (waste as resources)
Enablers and barriers		Enablers: — Shareholding in the various business operations, legal-framework-making provisions for securing cane supply from planters, power purchase agreements for the sale of electricity — Multi Annual Adaptation Strategy 2006–2015 for sugar sector reform in Africa (in the south of Mauritius) — Omnicane's integrated flexi-factory complex — Equity, loans from financial institutions (commercial banks, European Investment Bank, Agence Française de Development)
Source		Based on the Omnicane website (https://www.omnicane.com/industrial-ecosystem)

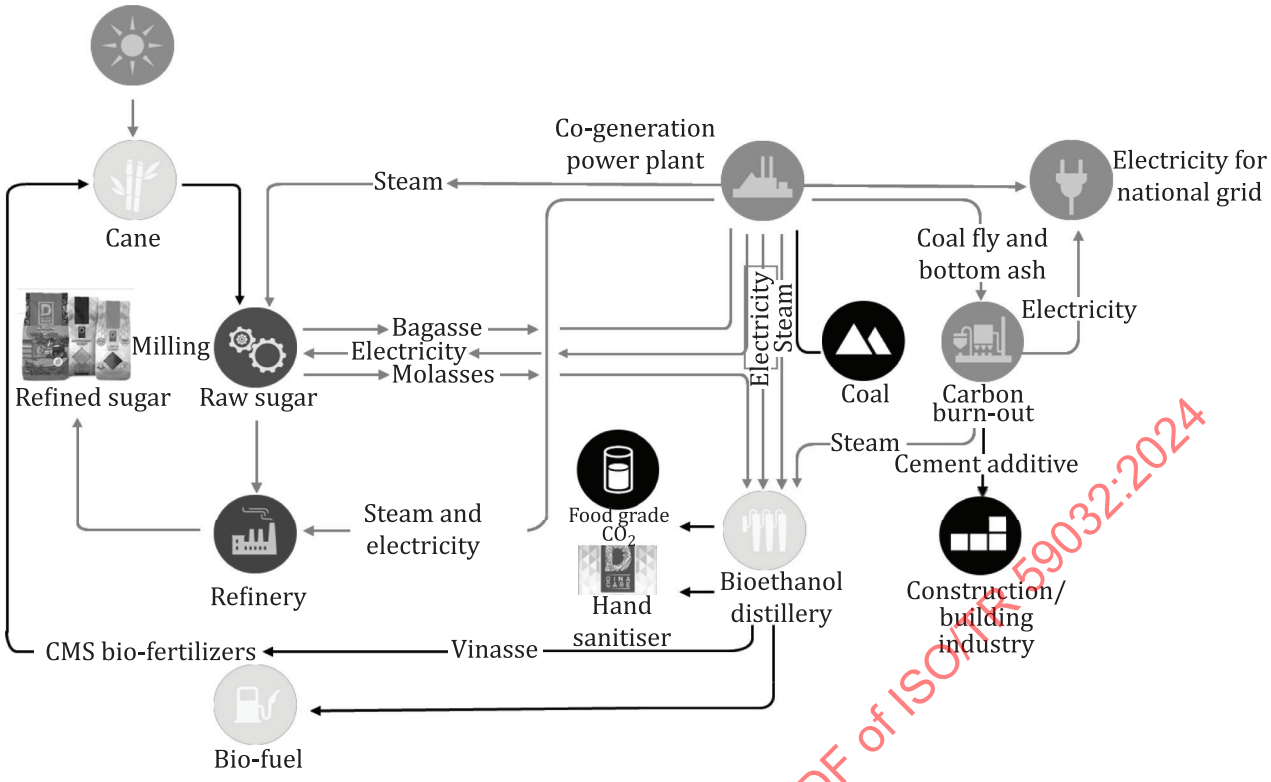


Figure 7 — Omnicane's zero waste industrial ecosystem

4.2.7 Example 7: Eco-town business (Japan)

This example includes actors from various sectors, including manufacturing plastics and metals and their waste management. The construction of a value network is expected to promote utilizing any waste and achieving zero emissions. Key methodologies, including information/knowledge sharing, collaboration among stakeholders (citizens, businesses and government) and technology development support, can help to create and maintain the value network. Some aspects, including environmental policy concepts, basic research, human resource training and establishing bases for industry-academia cooperation, seem to be the key motivations for participation in this value network (see Table 8).

Table 8 — Eco-town business (Japan)

Parameter	Description
Facilitators (designers)	Sectors: — Public administration Organizations: — Kitakyushu City
Year of implementation	1997
	Sectors: — Plastic manufacturing — Metal manufacturing — Waste management

Table 8 *(continued)*

Parameter		Description
Participating companies		Organizations: — NPR — Nippon Magnetic Dressing — Recycle Tech Japan — Nishi Nippon Auto Recycle — Nishinihon Kaden Recycle Corporation — Japan Recycling Light Technology System — NRS
Geographic location		Asia (Japan)
Relevant matters		Waste management (recycling)
Relevant products/services		Waste management, recycled products (metal, steel, energy, etc.)
Key aspects (activities)		— Polyethylene terephthalate (PET) bottles — Office automation (OA) equipment — Automobiles — Home appliances — Fluorescent tubes — Construction mixed waste — Nonferrous metals — Small home appliances
Impacts	Added/created value aspects	Any waste is utilized as resources in various sectors and zero-emissions are promoted.
	Social aspects	— Improving a city's brand — Employment creation
	Environmental aspects	— Reducing waste — Improving resource efficiency — Reducing CO_2 emissions
	Economic aspects	— Increasing direct investment — Increasing visitors
Motivation of participants in the value network		— Establishment of environmental policy concept — Conducting basic research — Human resource training — Industry-academia cooperation — Implementation of various recycling projects and environmental business — Aiding for small/medium-size enterprises and venture enterprises — Aiding for practical research, incubation of local enterprises

Table 8 *(continued)*

Parameter	Description
Methodology for creating and maintaining the value network	— Information/knowledge sharing — Collaboration among citizens, businesses and government — Support for technology development — Information about businesses is available on the website — Businesses/projects are conducted based on policies
Common infrastructures	Facility and community service system
Enablers and barriers	Enablers: — Support for feasibility studies and technological development — One-stop services for various administrative procedures — Reference case as an advanced local circularity project propagating to other regions — Promotion of the "Kitakyushu local circularity project" as its unique regional policy that integrates "environmental conservation policy" and "industrial promotion" — Collaboration among universities, research organizations, corporations, recyclers, small and medium-sized enterprises (SMEs), venture companies, etc. — Project members involved in the local government
Source	Based on the Kitakyushu Eco Town Centre website (https://www.kitaq-ecotown.com/)

4.2.8 Example 8: Resources complex consortium (Japan)

This example includes facilitators and participants from various sectors, including manufacturing metals, waste management and a think tank. The construction of a value network is expected to promote establishing an advanced recycling model (resource complex consortium) for controlling impurity materials. Key methodologies, including information/knowledge sharing, opportunities for technological development and standardization of secondary resources, can help to create and maintain the value network. Some aspects, including resource efficiency, recovery of valuable resources and waste reduction, seem to be the key motivations for participation in this value network (see Table 9).

Table 9 — Resources complex consortium (Japan)

Parameter	Description
Facilitators (designers)	Sectors: — Manufacturing — Think tank Organizations: — Taiheiyo Cement Corporation — MURC
Year of implementation	2017
	Sectors: — Metal manufacturing — Waste management

Table 9 *(continued)*

Parameter		Description
Participating companies		Organizations: — Tokyo Steel — Mitsui Mining and Smelting — Toho Zinc — Rever Holdings — Harita Metal — Tsuruoka
Geographic location		Asia (Japan)
Relevant matters		Reuse of resources
Relevant products/services		Recycled products (metal, steel, plastic, cement, etc.)
Key aspects (activities)		An advanced recycling model (resource complex consortium) for controlling impurity materials between manufacturers is established and allows each one to sort, separate and use the substances according to preferences for various wastes and by-products generated.
Impacts	Added/created value aspects	Introduction of a safe and innovative technology that recycles 100 % of the residue (carbon mainly) as raw material for cement.
	Social aspects	— Improving the criticality of raw materials, sustaining the recycling system in Japan
	Environmental aspects	— Decreasing landfills
	Economic aspects	— Increasing profits by expanding the market — Sales between material manufacturers
Motivation of participants in the value network		— Improving resource efficiency — Recovery of valuable resources — Reducing waste — Increasing sales — Controlling impurity materials
Methodology for creating and maintaining the value network		— Information/knowledge sharing — Making opportunities for technological development — Constructing a process that enables 100 % resource recycling — Standardization for secondary resources — Traceability system
Common infrastructures		Resources, land, equipment and technology
		Enablers:

Table 9 *(continued)*

Parameter	Description
Enablers and barriers	— Advanced dismantling, sorting and separating — Recycling impurity materials — High quality recycling — Savant landfill costs — Information/knowledge sharing — New standard for controlling impurity materials between material manufacturers Barriers: — Current legal system for waste management in Japan
Source	Based on the ISO TC323 WG2 CE Implementation Survey Results

4.2.9 Example 9: Case in Spain

This example includes participants from various sectors, including waste management, information, public administration, professional services and mining. The construction of a value network is expected to promote supporting decision-making in the areas of life cycle and geographic information system (GIS)-based approaches. Key methodologies, including software platform/information exchange, involving stakeholders at all levels of the value chain and evaluation, can help to create and maintain the value network. Some aspects, including cost reduction, support for environmental compliance and implementation of cleaner production strategies, seem to be the key motivations for participation in this value network (see Table 10).

Table 10 — Case in Spain

Parameter	Description
Facilitators (designers)	Sectors: — Construction and waste management Organizations: — Private company
Year of implementation	2015
Participating companies	Sectors: — Construction and waste management — Professional services — Information — Public administration — Other manufacturing — Waste management — Metal manufacturing — Construction — Mining Organizations: — Private company
Geographic location	Europe (Spain)
Relevant matters	Waste management (recycling)

Table 10 *(continued)*

Parameter		Description
Relevant products/services		New eco-cement, green concrete, innovative ceramic
Key aspects (activities)		— Industrial symbiosis — Closed looped processes — Material recycling — Life cycle approach
Impacts	Added/created value aspects	Supporting decision-making in the areas of life cycle and GIS-based approaches
	Social aspects	— Creating job opportunities and training needs on the circular economy — Raising social behaviour and citizen engagement
	Environmental aspects	— Reducing waste generation — Improving productivity for waste treatment — Improving energy efficiency — GHG savings
	Economic aspects	— Sale of resources and products from waste
Motivation of participants in the value network		— Cost reduction (waste reduction, improving productivity and energy efficiency) — Supporting environmental compliance — Implementation of cleaner production strategies — Realization of cross-sectorial synergies for resource and energy-efficient industry — Conducting demonstrations
Methodology for creating and maintaining the value network		— Software platform/information exchange — Involving stakeholders at all levels of the construction and demolition value chain — Evaluating the material, energy flow, environmental impacts and costs — Replicating pilot schemes at local and regional levels — Demonstrating the application and technical performance of innovative environmental building products — Managing the flow of waste material from different sectors and industries
Common infrastructures		Software (information exchange system), indicators
		Enablers:

Table 10 *(continued)*

Parameter	Description
Enablers and barriers	— Reducing waste by transforming the waste into valuable, acceptable secondary raw materials — Improving the manufacturing process — Clarifying requirements for products — Improving waste management — Reducing the consumption of materials — Reducing energy consumption — Circular economy package — Software platform, resource-intensive industries — SPIRE project
Source	Based on the FISSAC project website (http://fissacproject.eu/en/) and Business Europe website (http://www.circulary.eu/project/accionas-fissac-project/)

4.2.10 Example 10: Global case

This example includes facilitators and participants from various sectors, including manufacturing machinery and waste management. The construction of a value network is expected to promote improving the management of end-of-life aircraft in terms of environmental and sustainable performance. Key methodologies, including taking initiatives through best management practices, establishing a neutral oversight body and establishing appropriate committees, can help to create and maintain the value network. Some aspects, including creating environmental benefits, enabling participation in shaping the future of aircraft end-of-life components, material sustainability, developing best practice standards, and regulatory and media representation, seem to be the key motivations for participation in this value network (see Table 11).

Table 11 — Global case

Parameter	Description
Facilitators (designers)	Sectors: — Public administration Organizations: — Industry association
Year of implementation	2005
Participating companies	Sectors: — Public administration — Machinery — Waste management Organizations: — Industry association — Private company
Geographic location	Global
Relevant matters	Dismantling and recycling aircraft
Relevant products/services	End of-life aircraft management (e.g. dismantling, recycling), recycled/reused products derived from aircraft

Table 11 *(continued)*

Parameter		Description
Key aspects (activities)		— Reuse — Recycling — Reduce the desert degradation or landfill options
Impacts	Added/created value aspects	Improving the management of end-of-life aircraft in terms of environmental and sustainable performance.
	Social aspects	—
	Environmental aspects	— Maintaining the value of products, materials and resources as long as possible while minimizing the generation of waste
	Economic aspects	— Maintaining the value of products, materials and resources as long as possible while minimizing the generation of waste
Motivation of participants in the value network		— Creating environmental benefits — Participating in shaping the future of aircraft end-of-life components and material sustainability and in the development of best practice standards — Accessing regulatory and media representation — Taking opportunities to participate in committee projects — Industry engagement through newsletters and updates — Accessing the eNewsletter, featuring updates from the association's committees, member news and upcoming events listings — Education on the value chain and emerging technologies for disassembly and recycling — Recognition for a commitment to environmental responsibility — Networking and sponsorship opportunities at meetings — Taking the initiative of best management practices
Methodology for creating and maintaining the value network		— Establishing a neutral body — Establishing committees — Striving to include all stakeholders — Offering opportunities for research and development
Common infrastructures		Best management practice guide
Enablers and barriers		Enablers: — Improving the management of aircraft and components — Recommendations concerning best practices for parts management removed from an aircraft, engine or other assets during the disassembly of the assets at the end of its service life (some parts and materials are recovered for recycling) Barriers: — Transport of waste; the complexity of REACH legislation can lead to a fragmented approach at the EU level — Not all end-of-service aircraft owners consider environmental risks
Source		Based on the AFRA website (https://afraassociation.org/) and the Business Europe website (http://www.circulary.eu/project/afra-recycling/

4.2.11 Example 11: Aluminium recycling in the window and curtain walling industry (Germany)

This example includes facilitators and participants from various sectors, including manufacturing metals and waste management. The construction of a value network is expected to promote improving the traceability of recycled aluminium and the quality of secondary aluminium. Key methodologies, including supporting the collection of profiles, enhancing collaboration between all the actors in the value chain, and identifying innovative and creative solutions, can help to create and maintain the value network. Some aspects, including saving primary resources, reducing environmental impacts and improving the traceability of recycled aluminium, seem to be the key motivations for participation in this value network (see Table 12).

Table 12 — Aluminium recycling in the window and curtain walling industry (Germany)

Parameter		Description
Facilitators (designers)		Sectors: — Public administration Organizations: — Industry association
Year of implementation		—
Participating companies		Sectors: — Metal manufacturing — Waste management Organizations: — Private company
Geographic location		Europe (Germany)
Relevant matters		Recycling
Relevant products/services		Profiles, aluminium products
Key aspects (activities)		— Recycling
Impacts	Added/created value aspects	Improving the traceability of recycled aluminium and quality of secondary aluminium.
	Social aspects	—
	Environmental aspects	— Recycling aluminium profiles into new aluminium profiles — CO_2 emissions savings
	Economic aspects	— Energy saving
Motivation of participants in the value network		— Conserving primary resources — Reducing environmental impacts — Improving the traceability of recycled aluminium — Improving the quality of secondary aluminium
Methodology for creating and maintaining the value network		— Supporting the collection of profiles — Traceability system — Enhancing the collaboration between all actors in the value chain — Identification of innovative and creative solutions enhancing the collaboration between all actors in the value chain — Establishing a neutral body
Common infrastructures		Traceability system

Table 12 *(continued)*

Parameter	Description
Enablers and barriers	Enablers: — Ensuring traceability — Information for traceability Barriers: — Evolution of the legislative framework, both at the national and European level, can have a positive or negative effect on the future of the scheme — Increased complexity of institutional management
Source	Based on the Business Europe website (http://www.circulary.eu/project/a-u-f/

4.2.12 Example 12: Close the Glass Loop – The EU ambition to collect increased amounts of glass more effectively

This example includes participants from various sectors, including waste management and manufacturing. The construction of a value network is expected to promote the complete recycling of collected glass packaging. Key methodologies, including promoting selective collection, optimizing and developing sorting and treating systems, and exchanging knowledge and best practice, can help to create and maintain the value network. The participants can help to create and maintain an important value network. Some aspects, including cost reduction, contributing to the transition to a circular economy and solving climate change, seem to be the key motivations for participation in this value network (see Table 13).

Table 13 — Close the Glass Loop – The EU ambition to collect increased amounts of glass more effectively

Parameter		Description
Facilitators (designers)		Sectors: — Glass manufacturing Organizations: — European Container Glass Federation – FEVE
Year of implementation		1977.
Participating companies		Sectors: — Glass manufacturing — Waste management Organizations: — Industry association — Private company
Geographic location		EU
Relevant matters		Recycling
Relevant products/services		Glass (containers)
Key aspects (activities)		— Close the Glass Loop — Collection — Recycling — Energy reduction
	Added/created value aspects	Promoting the complete recycling of collected glass packaging.
	Social aspects	—

Table 13 *(continued)*

Parameter		Description
Impacts	Environmental aspects	— Reducing the use of virgin raw materials — Energy saving — Reduction in GHG emissions — Avoiding creating waste
	Economic aspects	— Improving the performance of the circular economy business model — Achieving sustainable growth opportunities in the circular economy
Motivation of participants in the value network		— Cost reduction (energy reduction, waste reduction, reducing the use of virgin materials) — Contributing to the transition to a circular economy and solving climate change
Methodology for creating and maintaining the value network		— Promoting selective collection — Optimizing and developing sorting and treating systems — Exchanging knowledge and best practice — Circularity and innovation — Coordination of national platforms — Communication and awareness-raising — Joining FEVE as a neutral body
Common infrastructures		Traceability system
Enablers and barriers		Enablers: — Reducing energy — Reducing waste — Reducing the use of virgin materials (use of secondary raw materials) — Increasing quality and quantity of available recycled glasses — Reducing costs (energy reduction, waste reduction, reducing the use of virgin materials) — Leadership by glass producers Barriers: — Ensuring all stakeholders along the value chain appreciate the added value of initiatives and agree to support and collaborate — Promoting the selective collection of glass packaging to increase the quantity and quality of untreated glass cullet — Optimizing and developing sorting and treatment systems to increase yields, even from poor collection systems, and generating more furnace-ready glass cullet — Exchange of knowledge and best practices in collection, sorting and treatment systems between countries
Source		Based on the FEVE website (https://feve.org/), Business Europe website (http://www.circulary.eu/project/glass-loop/

4.2.13 Example 13: Lopyanko – AGRY_GAYA'18 Project for sustainable organic silk (Bulgaria)

This example includes participants from a range of sectors, including textile manufacturing, professional services, financial services, chemical manufacturing and waste management. The construction of a value network is expected to promote the use of waste products from primary production as high-quality secondary raw materials. Key methodologies, including designing processes and offering opportunities for research and development, can help to create and maintain the value network. Some aspects, including procurement of high-performance organic materials and cost reduction, seem to be the key motivations for participation in this value network (see Table 14).

Table 14 — Lopyanko – AGRY_GAYA'18 Project for sustainable organic silk (Bulgaria)

Parameter		Description
Facilitators (designers)		Sectors: — Textile manufacturing Organizations: — Bio Company Lopyanko Ltd.
Year of implementation		—
Participating companies		Sectors: — Public administration — Textile manufacturing — Professional services — Chemical manufacturing — Financial services — Waste management Organizations: — Private company
Geographic location		Europe (Bulgaria)
Relevant matters		Remanufacturing
Relevant products/services		Bio-based products, organic silk (highly renewable resource)
Key aspects (activities)		— Bio-based products — Remanufacturing of waste materials into high-quality proteins — Industrial symbiosis
Impacts	Added/created value aspects	Further utilization of waste products from primary production as high-quality secondary raw materials is promoted.
	Social aspects	— Providing the nutrients needed by the human body, such as vitamins, minerals, fibre, fatty acids and amino acids, that are lacking or cannot be obtained in sufficient quantities when consuming food
	Environmental aspects	— Providing high-quality and sustainable proteins
	Economic aspects	— Producing high-quality proteins from waste materials
Motivation of participants in the value network		— Procurement of high-performance organic material — Cost reduction (waste reduction, Reducing the use of virgin materials) — Taking opportunities for research and development with partners

Table 14 *(continued)*

Parameter	Description
Methodology for creating and maintaining the value network	— Designing processes — Offering opportunities for research and development — Cross-industry collaboration is considered
Common infrastructures	Knowledge (information)
Enablers and barriers	Enablers: — Reducing waste — Reducing the use of virgin materials (use of secondary raw materials) — Procuring high-performance organic material — Reducing costs Barriers: — Lack of EU regulations for the silkworm protein powder to be permitted as an officially permitted food — Certification procedures for off-the-shelf products with many restrictions are also a challenge — Difficulties in obtaining investors and funding — Lack of experienced workers in the areas
Source	Based on the Business Europe website (http://www.circulary.eu/project/lopyanko-agry-gaya-18/

4.2.14 Example 14: An open-access circular supply chain for fashion (UK)

This example includes facilitators and participants from various sectors, including textile manufacturing, ICT and wholesalers. The construction of a value network is expected to promote scaling the circular supply chain. Key methodologies, including matching demand and supply, creating a software platform and opening up its availability, can help to create and maintain the value network. Some aspects, including cost reduction, increasing profits and on-demand production, seem to be the key motivations for participation in this value network (see Table 15).

Table 15 — An open-access circular supply chain for fashion (UK)

Parameter	Description
Facilitators (designers)	Sectors: — ICT — Wholesale Organizations: — Teemill
Year of implementation	2018
Participating companies	Sectors: — Textile manufacturing Other (ICT) organizations: — Private company
Geographic location	Europe (United Kingdom)
Relevant matters	Clothing recycling, waste management, organic farming, product design, renewable inputs, recyclable packaging (paper)
Relevant products/services	Textiles

Table 15 *(continued)*

Parameter		Description
Key aspects (activities)		— Reuse — Recycling — Industrial symbiosis
Impacts	Added/created value aspects	Scaling up the circular supply chain.
	Social aspects	— Distributed, diverse and inclusive accessibility (free-to-use and open source)
	Environmental aspects	— Increasing material utilization — Reducing chemical and water inputs and emissions
	Economic aspects	— Increasing material utilization — Reducing chemical and water inputs and emissions — Sharing the benefits with customers and other businesses
Motivation of participants in the value network		— Cost reduction (reducing surplus production, efficient production, reducing chemical and water inputs and emissions) — Increasing profits — On-demand production — Technology development
Methodology for creating and maintaining the value network		— Matching demand and supply — Software platform — Opening up access to the platform — Designing for take-back and recycling
Common infrastructures		— Circular supply chain platform (cloud) — E-commerce platform and digital integrations
Enablers and barriers		Enablers: — Efficient production — Reducing surplus production — Production that meets customer needs — On-demand production
Source		Based on the Teemill website (https://teemill.com/), Ellen MacArthur Foundation website (https://www.ellenmacarthurfoundation.org/case-studies/an-open-access-circular-supply-chain-for-fashion

4.2.15 Example 15: Cargo Carousel System (Canada)

This example includes facilitators and participants from various sectors, including transportation, ICT and professional services. The construction of a value network is expected to promote maximizing space utilization throughout the supply and return chains. Key methodologies, including maximizing space utilization across the supply and return chain, and creating a platform that combines cutting-edge technology and distributed ledger technology (as shown by the example in Figure 8), can help to create and maintain the value network. Some aspects, including cost reduction, carbon credits and promoting corporate social responsibility, seem to be the key motivations for participation in this value network (see Table 16).

Table 16 — Cargo Carousel System (Canada)

Parameter		Description
Facilitators (designers)		Sectors: — ICT — Professional services Organizations: — Circular Supply Chains Inc.
Year of implementation		2022
Participating companies		Sectors: — Transportation Organizations: — Circular Supply Chains Inc. – A sustainable business model for the supply chain and reverse logistics industries being combined into a single system based on circularity
Geographic location		Americas (Calgary, Canada)
Relevant matters		System development, supply chains
Relevant products/services		Transportation system (service)
Key aspects (activities)		— Reduce, refurbish, reuse, recycle — Efficient production — Efficient supply chains — Efficient reverse chains — Reducing single-use packaging
Impacts	Added/created value aspects	Maximizing space utilization throughout the supply and return chains, in the warehouse, trailer/container, retail store and last-mile delivery.
	Social aspects	— Reducing forced labour in supply chains using the internet — Diversifying revenue streams to create more jobs
	Environmental aspects	— Cost reductions in storage and transport — Reducing single-use packaging
	Economic aspects	— Increasing efficiencies — Additional carbon offsets — Reducing labour costs
Motivation of participants in the value network		— Cost reduction — Creating carbon credits — Promoting corporate social responsibility — Improving economics
Methodology for creating and maintaining the value network		— Maximizing space utilization across the supply and return chain — Creating a platform that combines cutting-edge technology — Distributed ledger technology — Robotics, radio frequency identification (RFID), ICT, artificial intelligence (AI), Cloud/Edge
Common infrastructures		The cubic “modules” or “pods”, proprietary system

Table 16 *(continued)*

Parameter	Description
Enablers and barriers	Enablers: — Reducing costs — System versatility (reverse logistics benefits and applicability to any supply chain) — A system that can be remotely controlled from anywhere in the world
Source	Based on the Circular Supply Chains website (https://circularsupplychains.com/

CURRENT PICTURE				DIAGNOSIS	FUTURE PICTURE	
FUNCTION / RULE	Who does?	Who pays?	Inadequate, mismatch, absent		Who will do?	Who will pay?
Core function						
- authenticate worker identity	cooperative	cooperative	mismatch	qualify for bank acct.	non-profit implementer	worker
- workers learn new packaging	cooperative	cooperative	absent	gender equality	non-profit implementer	non-profit implementer
- workers learn new loading	cooperative	cooperative	absent	gender equality	non-profit implementer	non-profit implementer
- retailer uses CCS			absent	lower landed cost	retailer	retailer/shipping co.
Supporting functions						
- worker to wear bracelet			absent	authenticate for bank	worker	non-profit/worker
- CCS replaces ISO container	shipping company	cooperative	mismatch	greater efficiency	shipping company	retailer
- implementer tracks/logs supply chain			absent	continuous monitoring	non-profit implementer	retailer
- delivery is digitally signed for			absent	intiate direct payment	retailer	N/A
- electronic payment to worker			absent	transact direct payment	non-profit implementer	bank/worker
Rules (formal/informal)						
- bracelet must be worn			absent	authenticate for bank	worker	N/A
- Grameen Banking Methodology			absent	qualify for micro loan	bank	bank/worker

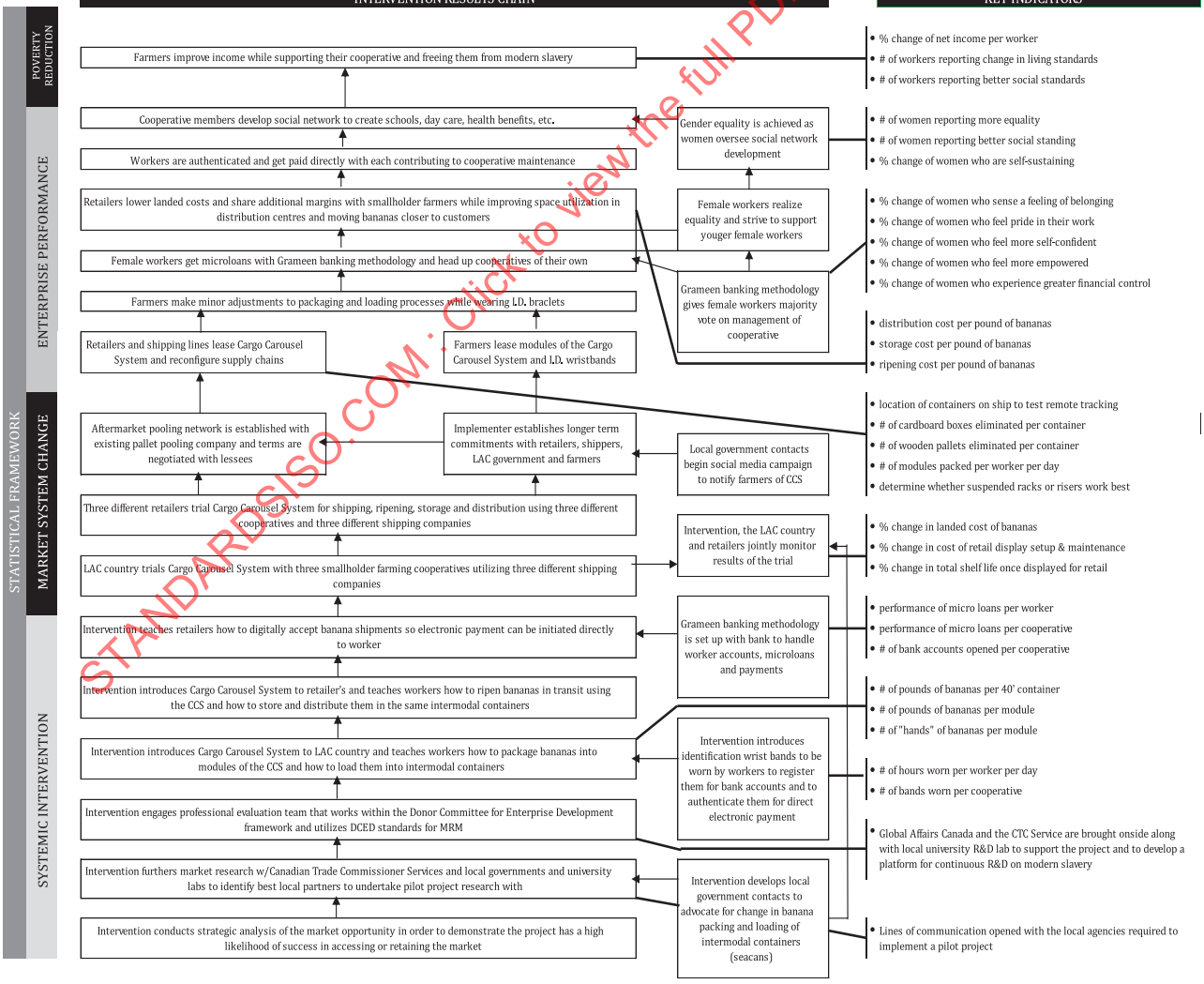


Figure 8 — Pilot project intervention in the banana value chain to verify circular economics