

# STRATEGIC MANAEGMENT AND THE CIRCULAR ECONOMY

## 1. THE CHALLANGES OF THE PRODUCE-USE-DISPOSE MODEL

Between 1900 and 200 the GDP has grown 20 times, meaning that humanity has experienced a steady growth in material wealth. The reasons of the rapid industrialization are given by:

- newer and more efficient technologies of production
- lower labour costs
- economies of scale
- globalization of markets.

This economic expansion has led to:

- mass production goods and services
- material prosperity and higher per capita disposable income
- benefits in healthcare, life expectancy, access to electricity, faster and safer transport.

The industrial model standing at the roots of our current standards of living is a linear system of production, or take-make-waste paradigm, in which natural resources are :

1. extracted,
2. processed to become usable objects,
3. distributed
4. used
5. incinerated or discarded as waste in landfills.

Each of these steps causes a damage to natural ecosystems that get heavily polluted, deprived and irreversibly modified. This is because the linear model does not account for any effective regenerative actions. As a result, after 1950, global economic activities have exacerbated the environmental footprint affecting the Earth structure and functioning on multiple levels like deforestation, biodiversity loss, ocean acidification, CO<sub>2</sub> emmissions. The linear model has reached its tripping point and now at least 4 trends are warning humanity:

1. natural tresholds are being excedeed
2. scarcity of raw materials
3. middle class is growing and so its demand
4. structural inefficiencies of the current economic model are worsening.

## NATURAL TRESHOLDS ARE BEING EXCEDEED

There are 9 key biophysical processes that reulate the stability of the earth system:

1. **climate change** → the safe limit surpassed and worsening, the global average temperature has warmed by 0.85° → extreme weather will be more frequent and will impact businesses:
  - tougher legislative regimes to curb emissions
  - natural disasters will impact primary plants hubs in coastal regions and climate sensitive areas

- damages to intangible assets and shift in customer preferences: carbon intensive companies risk to weakening their image and losing market share.
- 2. **Loss of biosphere integrity** → safe limit surpassed and worsening (rate 100-1000 extinctions per millions species-years. → tourism and agriculture will be the most affected.
- 3. **Changes to biogeochemical flows** → safe limit surpassed and worsening → release of nitrogen and phosphorus into natural environment due to industrial and agricultural fixation → aquatic ecosystems overloaded with chemicals → marine species decreases → impact on fishing → regulatory constraint in sectors like agriculture, power generation, transport...
- 4. **Water** → within limit, but competition for water will intensify in many regions. → impact on industries like food and beverages, pulp and paper, textile...
- 5. **Land use** → safe limit → converting vegetation areas to cropland affects climate and water flows → agricultural companies might face limitations and regulation.
- 6. **Release of novel entities** → high toxicity substances and with long permanency in the environment. The current situation is unknown. → Industries most likely to be affected by regulations and public pressure are agriculture, medicine, electronics
- 7. **Atmospheric aerosol loading** → caused by the burning of tropical forests, coal and oil
- 8. **Ocean acidification** due to CO<sub>2</sub> → within limit but on the brink → carbon emitted in the air and absorbed by waters leads to acidification that would change the marine ecosystem. → Impact on fishery and food industries.
- 9. **Loss of stratospheric Ozone** → within limit and improving → by adopting the Montreal protocol the use of CFC substances (refrigeration, solvents, cleaning products, air conditioning...) are diminished.

## SCARCITY OF RAW MATERIALS

The new century has been marked by rapid and steep increase in price of commodities and high volatility. There are at least 5 causes that contributed to these problems:

1. **monopoly over reserves** → Rare earth elements (REE) are 17 chemical elements sharing comparable properties and located in the same geological deposits (China controls 90% of REE. 3 Companies control 90% of lithium)
2. **political instability**, war and conflicts affecting resource rich countries (Rwanda, DRC)
3. issues associated with **exploration and extraction activities**:
  - increased operational costs and lack of funding
  - difficulties to obtain licenses to operate
  - increased attention from environmental NGO
4. supply chain disruptions due to **labour related issues**:
  - when raw materials and processing plants are located in countries with poor labour conditions and neglected worker's rights.
  - Long and elaborated supply chains makes impossible for the company to have control over the entire chain of suppliers.
5. **projected scarcity** → many key resources will be depleted in a short period of time.

This projection put pressure on businesses which soon will need to be looking for alternative solutions.

## RISING MIDDLE CLASS POPULATION

In the last years several countries experienced economic growth: BRIC, MINT and CIVETS. Today humans are already using half of their renewable resources for the future generation, (ecological overshoot) that soon will be no resources left for human use and consumption. The challenge is to decouple economic growth from resource consumption and environmental pollution. The income growth is the primary cause of the levels of material use since the year 2000 and further increases in global material demand are expected.

## STRUCTURAL INEFFICIENCIES OF THE CURRENT ECONOMIC MODEL

The industrial development has been driven by the optimization of sourcing, manufacturing and trade processes with the only aim of increasing sales volumes. Resource depletion and environmental pollution have been viewed as unavoidable consequences of economic growth. The profit maximization led to structural inefficiencies and waste generating practices along the value chain:

1. **over exploitation of resources:** the global demand already exceeds the capacity of natural ecosystems to regenerate their resources and absorb wastes. Some products need to many resources to produce them!
2. **Underutilization of products:** european cars parked for 90+% of their time, 10+ millions empty houses, 60% offices are not used and 42% the average utilization of clinical mobile devices in US hospital.
3. **Short lifespan of asset:** short life cycles to achieve fast replacement (planned obsolescence):
  - preventing repair and unavailability of spare parts
  - programmed failure
  - ad hoc marketing strategies inciting quick replacement
4. **Disposal of assets** reaching their end of life: most of them ended up in landfills or incinerated. The common practice is to ship assets to Africa's poorest countries, where the e-waste is dumped into illegal landfills. Toxic substances are released into the ground.
  - Global recycling rates are still very low due to the inferior performance by some of the highest waste generating nations (US recycles 34%, EU 40%).
  - Lack of a formal waste disposal and recycling structure in developing and densely populated regions.

## 2. AN INTRODUCTION TO THE CIRCULAR ECONOMY

The circular economy (CE) is an alternative industrial model where industrial processes are not seen as the inevitable cause of natural resource exploitation, environmental pollution, and waste generation, but rather as a means to contribute to sustainable development:

- it is restorative by intention

- it relies on renewable energy
- minimizes-track-eliminate use of toxic chemicals
- eliminate waste through careful design.

While the focus is still on making profit, this is achieved by embracing regenerative and closed-loop strategies like switching to bio based materials and green energy sources, modularity and prolonged use, utilization rate maximization, refurbishment, remanufacturing, and components recovery.

The CE is an industrial system that is restorative by intention and design. It's built on 3 key ideas:

1. preserving and enhancing natural capital
2. optimizing resource yields
3. fostering system effectiveness by revealing and designing out negative externalities.

The CE concerns all business processes and human activities and it is strictly connected to the sustainability concept.

Despite being highly innovative, the concept of CE is just the development of other important schools of thought like:

- **cradle to cradle (C2C)** → enables to transform processes to get rid of any externality focusing on 5 actions:
  - I. phase out toxic substances from production processes and switch to environmentally friendly materials
  - II. disassembly/recovery principles
  - III. replace fossil fuel with renewable sources
  - IV. reduce water quality/quantity impacts
  - V. be ethically responsible
- Biomimicry
- Regenerative Design → focuses on devising processes that restore and improve both sources of energy and material used.
- Natural capitalism → involves increasing the productivity of natural resources, shifting to biologically production models, moving to solutions-based business models and reinvesting in natural capital.
- Blue economy → promotes re designing highly polluting industrial processes by: incorporating the value of natural capital into business activities, using cleaner technologies, harnessing the power of cascading systems. At its core it seeks to decouple economic activities from environmental degradation.
- Industrial ecology → seeks to harness the potential synergies between 2 or more value-creating companies so that the by products and waste flows originating from one entity are fed into the other as production inputs and raw materials.
- Permaculture → offers a set of methods and principles to establish sustainable agricultural and social systems.

The Ellen MacArthur Foundation has grouped all of these theories under CE principles and practical actions for both the public and private sectors, which are:

- **design out waste** → waste does not exist when the biological and technical components are designed for disassembly and refurbishment within a cycle: biological nutrients are composted; technical nutrients are used again with minimal energy and highest quality;

- **build resilience through diversity** → systems with many connections and scales are more resilient to face external shocks than systems built only for efficiency. Modularity, versatility and adaptivity are fundamental.
- **rely on energy from renewable sources** → to fast track more circular business models
- **think in system means:**
  - understanding how part influence each other and the whole;
  - contextualize elements in their relationships with environment, social and infrastructures
  - combinations of imprecise starting conditions and feedbacks can lead to surprising consequences: outcomes are not necessarily proportional to the input
- **waste is food** → re introduce bio nutrients into the environment with no toxic loops → positive impact on environment. technosphere products cannot re enter the biosphere due to their toxicity but shall be maintained, refurbished and disassembled with the system. From recycling to upcycling (=converting materials into new materials of higher quality and increased functionality)

Why CE has gained exponential interest only in the last few years?

Behind its emergence stands an alignment of global technological, regulatory and social factors that have contributed to make the CE proposition attractive, feasible and lucrative.

**Technological factors** → recent innovations, such as IoT, sensor and mobile technologies, digital sharing platforms, big data, 3d printing, have favoured the establishment of key circular activities concerning the monitoring, collection and re processing of end of life assets. These innovations are helping to:

- reinvent the way they keep track of the levels of consumption, degradation and reusability of the products
- interact with the different actors along the supply chain to support the reverse loop
- engage with costumers beyond the point of sale

**Regulatory factors** → Public institutions have started to adopt policies and implement measures aimed at curbing man made environmental impacts. Regulation and initiatives are informed by principles of circularity that make easier/advantageous implement green solutions for companies (In France manufacturers are required to disclose information about the availability of a product's spare parts. EU in 2015 issued a CE package. Municipality of London offers free of charge support to SME wanting to explore CE business models).

**Social factors** → 2 social trend have contributed to making CE viable and profitable:

- urbanization: 4 billion people live in urbanized areas and by 2030 the number of city dwellers is expected to increase to 5 billion. This is good news for CE advocates, as high urbanization means lower operating costs associated, in fact:
  - asset sharing works best with a large number of users because this makes the sharing process faster and easier.
  - collecting, recycling and treatment of end of use products are easier and more cost effective when large volumes of discarded goods are in a few nearby pickup points
- Growing customer acceptance of alternative business models: people are now familiarizing with servitization and sharing economy, models highly successful in sectors like transportations, housing, chemicals, medical equipment....

Sources of value creation in the circular economy:

- **Power of the inner circle:**

- the tighter the circles are, the larger the savings should be in the embedded costs in terms of material, labor, energy, capital and associated externalities;
- contrasting the linear to the circular setup is the core of the economic value creation
- whenever the costs of collecting, reprocessing and returning the product into the economy is lower than the linear alternative make economic sense.

- **power of circling longer:** keeping products in use longer with more consecutive cycles and spending more time within it.

- **power of cascaded and inbound material/product substitution**

- **power of pure, non toxic or easier to separate inputs and designs:**

- to generate maximum value precedent levers requires a certain purity of material and quality of products and components

- many post consumption material become available as mixtures of materials because of the way materials were selected and combined in a previous single product, and handled without regard for preserving purity and quality.

- Scale economies and efficiency gains in the reverse cycle can be obtained through improvements in the original design of products and the reverse processes (reduced product damage rates, lower reconditioning scrap (rottami) rates, reduce contamination of materials)

- **power of history/intelligence**

### 3. A CE FRAMEWORK FOR ACTION

The CE is a vast concept that covers a large number of innovative processes and business models touching all stages of the value chain, with no one-size-fits-all solution.

Environmental Management systems EMS is one of the primary tools of organizations to systematically address environmental risks, make sure environmental regulations are met, and strive for a continuous improvement of overall performance through the adoption of dedicated policies, procedures, risk analyses, internal audits...The Plan-Do-Check-Act (PDCA) approach proposed by EMS is suited to welcome circularity at various stages.

**CE GUIDING PRINCIPLES** → The CE can be broken into 4 practical principles that are a response to the environmental socio-economic limits of the linear production system:

1. embrace **green technologies** and focus on a responsible use of **natural inputs**
2. **maximize utilization** rate of assets → asset sharing, servitization
3. **circulate goods**, product components, and materials at the **highest utility** → building capabilities to set up circular flows of materials
4. minimize and gradually **phase out negative externalities**

**CE BUSINESS OBJECTIVES** → how shall a company interpret the CE principles and translate them into practical action?

1. **Regenerate:**

- minimize the environmental impacts of operations
- switching to renewable energy
- sourcing bio based materials
- phasing out toxic production inputs

2. **Share**: focuses on maximizing a product usage through sharing platforms and servitization business models. Repair and re use and find new markets for unsold inventory stocks are fundamental activities
3. **Optimize**: the fine-tuning of an organization environmental performance can occur on multiple levels: supply chain; company operation; product level.
4. **Loop**: means keeping products, components and materials within the production system as long as possible.
5. **Virtualize**: can reduce their environmental footprint while enjoying multiple first-mover advantages (The Independent was the first fully digital Uk newspaper)
6. **Exchange**: means staying at the edge of the technological revolution by replacing outdated materials, machines and devices with superior, environmentally friendly solutions.

**CE AREAS OF INTERVENTION**—> Where a company needs to intervene in order to make the transition possible. Each of these areas is likely to be addressed differently depending on the context.

1. **Innovative product design**: value of today's products is not being properly exploited and customers demand greener solutions that lower the pressure on environment. There are 3 approaches that a firm can pursue:
  - A. **green design**: include different approaches to product design that seek reduction in environmental and health impacts—> replace toxic substances; replace technical inputs with environmentally neutral biological; replace natural inputs or scarce resources applying dematerialization principles (MP3)
  - B. **design for durability**: important for those businesses switching from selling to offering services, as they need to devise goods that can last the longest possible and remain attractive to customers (modular design). Principles:
    - understanding the appropriate product lifetime, how repair and recycling within the overall product life cycle
    - devise parts, components, and connection that are robust by using high quality materials
    - promote maintenance with clear instructions, tools and spare parts, offering low cost repairing services
    - stay ahead of the fashion curve by choosing timeless design and versatility products
  - C. **design for reverse cycles**: advantages of:
    - making product recovery solutions accessible and more efficient: easy to disassemble and re assemble, minimize the number of connection using simple tools;
    - large companies may lack the dynamic capabilities required to re-engineering their business model from linear to circular, but they may benefit from the intervention of external consultants and experts.
1. **Reverse cycles**: actions aimed at collecting its used products and then establish effective post-value channels whereby items get processed according to the new function they will serve. Key circular activities of intervention:
  - A. Repairing —> getting damaged or broken product's components back to a useful state.
  - B. Re-using —> giving a second life to a product, which invariably means finding a second market for it or using it for a different purpose.
  - C. Refurbishing —> returning a product to good working condition by replacing or repairing major components that are defective or close to failure (best for complex goods and machinery).

D. Re-manufacturing → focuses on the disassembly of discarded assets and the revalorization of their functional parts. Reusable components are removed from the used product and assembled into a new one.

E. Recycling → the process of breaking down discarded products into their base materials and convert them into new products.

When implementing reverse cycles it is paramount to establish an effective customer engagement programme for the take-back of used products. Strategies that trigger collaboration from their customers:

- educational activities
- inspiring marketing campaigns
- incentives to customers

**2. Green internal operations:** performances to gradually reduce environmental externalities

- A. Greenhouse gas emissions
- B. water use and pollution

**3. Supplier engagement:** the supply chain is where most opportunities exist to leverage circular solutions and re-invent processes. Acting at the supply chain level can also imply a broader restructuring of both internal operations and relationship with business partners. This could mean:

- A. Growing the company's current role in the supply chain by starting new activities, circular vertical integration
- B. Forging new partnership with suppliers to explore circular solutions

Establishing CE in supply chain could lead to:

- a shift toward a material centric perspective that aims to keep products and components in the production system for as long as possible
- a new star of a network centric model, where multiple player co-operate for the revalorization of assets

**4. Internal alignment:** any company would need to manage the widespread implication this will carry across function such as R&D, product design, procurement, accounting, marketing, sales. Key aspects:

- A. Buy-in from executives and senior stakeholders → early approval from top management is vital to secure the necessary funding as well as internal support.
- B. Getting managers and employees on board
- C. Strong cross departmental alignment → products will be designed to last longer and be shared between users; sales people will need to be instructed on how to manage the transition towards servitization; marketing will be asked to communicate all of these changes to the public.

**5. External collaboration:** can bring multiple benefits. Some categories of partners that CE organizations can approach:

- A. Industry partner associations can act as enablers for sharing best practice and mutual support
- B. NGOs and other non profit organizations might also support businesses in applying circular principles to their operations
- C. Policymakers at all levels can act as catalysts for change by supporting businesses towards circularity
- D. Research centres and universities are partners to engage when a business needs to devise technical solutions for the implementation of circular operations

- E. Specialized Niche Organizations operating in material recycling, waste management, or resource efficiency can be valuable for those businesses that lack the full set of capabilities required to take advantage of a CE strategy.

## 5. BUSINESS MODELS FOR A CE

A business model is the way a company organizes itself to generate value for customers and thus revenues from its operations. Traditional business models aim to increase sales. Circular business models are most likely to be successful and widely adopted to the point of transforming entire industries, thanks to a range of positive characteristics that foster organizations to be agile and adaptive in a more collaborative ecosystem. CE business models need to be:

- carefully tailored (adattati) to the specific set of capabilities and resources of each company;
- operationalized through modern technological advancements;
- directed to the opportunities in the market in which the firm operates.

There are 4 categories of CE business models:

1. **Net-zero innovation** → selling a product/service with net zero or positive impact on the environment. Companies pursuing a business model based on net zero innovation fall under one or more of the following categories:
  - firms producing environmentally friendly materials and products that are sold in B2B (business to business) marketplace
  - businesses specialized in developing **innovative net zero products** for the public
  - companies producing **green inputs and energy** for their own operations
  - companies fostering the adoption of **net zero practices along their supply chains**

**Profit sources by:**

- increasing base of environmentally conscious customers willing to pay a premium price;
- cost effectiveness for producing green solutions, through net zero processes either for self use or to be sold.

**Key areas of intervention:**

- investments in R&D activities to come up with ecologically harmless alternatives in product design or innovative materials
- external collaboration as useful allies at any stages of the process

2. **Servitization** → implies a shift away from the typical transaction based system of product sales and ownership, towards an approach where customers are provided with alternative service based solutions. 2 factors are important:

- development of technological innovations that make servitization easier and cheaper to implement to avoid price war in saturated markets
- for the customer can mean substantial savings in terms of eliminating cost of ownership and maintenance expenses.

3 main categories of Product service systems:

- **Product oriented services** (secondary services like insurance contracts or consultancy)
- **Use oriented services:** the firm retains its ownership, selling instead the right to use the asset for either a certain amount of time or the full life of the product through: product leasing, product renting-sharing, product pooling.
- **Result oriented services:** focuses on the result needed by the client guaranteeing a certain service performance.

**Profit sources by:**

- smaller but continuous revenue flows
- greater customer loyalty and retention, as the company find itself better aligned with customer expectations, product reliability and durability.

**Key areas of intervention:**

- best suited for expensive products with high production costs and short infrequent usage
- with products that require frequent maintenance operations and do not follow quick changes in style and fashion
- industries like car, elevators, copiers, home appliances, air conditioners, carpet tiles and tyres
- in industries marked by fierce competition and aggressive pricing
- important differences between servitization for B2B (client interested in product reliability, high quality performance) and B2C (business to consumer)
- higher acceptance among younger generations of customers

**Top technologies** that are helping businesses transitioning toward servitization:

- advanced predictive analytics to foresee product failures
- communication technologies to remotely adjust machines and products
- mobile platforms to access data for enterprise resource planning purposes and to interact with customers
- consumption monitoring technologies capable of collecting and assessing large amount of information to create customer specific service offering
- geospatial technologies to track products and users.

### 3. **Product life extension** → is about designing products built to last and to remain economically useful for as long as possible. Key characteristics:

- value proposition is grounded on the values robustness, quality, endurance
- at the core of the value proposition there also reverse cycle aimed at prolonging the life cycle
- it redefines consumption patterns by slowing down disposal and replacement rates, and meeting the real needs of their customers.

**Profit sources by:**

- premium for their durable and high quality products
- providing customers with add-ons upgrades, plus quality repairing and refurbishing services
- enhanced loyalty by customers, who manifest an increased trust in companies that phase out planned product obsolescence and align their interests with those of customers
- gain unique insights into customers preferences, needs and wants as the degree of contact will increase through the ongoing service provided.

**Key areas of intervention:**

- the product's core being suitable for integration into restored versions
- the components of the product asked to be returned having a high market value that does not depreciate much overtime
- the original product being all made in a single factory and not assembled in various successive steps
- both process and product technology not changing too rapidly
- allow easier disassembly and further processing of returned items

- set up efficient reverse cycle channels, beginning with the collection of used products, through the creation of dedicated return points, pickup services and send back programmes
  - if collection of used items can at times be accomplished by leveraging inhouse expertise and facilities, sorting (smistamento), re-processing, and re-marketing are often more complex activities that require partnering up with selected business partners (external collaboration)
  - strategically thinking about the best options for the sorting and further reprocessing of the collected goods
  - strong internal alignment, with closer and more frequent interactions among designers, operation managers, and marketing heads to guarantee all tasks being integrated toward shared circular goals.
4. **Product residual value recovery** → can be implemented when the life extension of products is not feasible through re use, repair, re manufacturing or refurbishing. Recycling is considered the least efficient way of re entering products into the value chain. 3 type of recycling practices:
- **transforming** used products into items of lower quality, without altering the chemical structure of the recycled material
  - **converting** discarded products through chemical or heat processes that break down the structure into core components and than re process them to create a completely new material or item
  - **generating** energy from recycled materials

**Industrial symbiosis** represents the most advanced concept to recover the residual value of products. It is an association between 2 or more industrial facilities or companies, in which the wastes or by products of one become the raw materials for another.

**Profit sources:** usually this model lead to reduced production costs and avoidance of landfill taxes.

**Key areas of intervention:**

- industries where manufacturing heavily relies on REE
- products made of glass, paper and plastic for which recycling processes are now mature and with low costs and intense usage
- food: anaerobic digestion technology makes possible to break down organic substance to produce bio gas and bio fertilizers
- construction and electronics are further industries to have displayed an enormous potential with this business model, particularly when considering urban mining
- set up and adequate reverse cycle channels for the collection of by products /waste
- major strategic decisions need to be made as to whether develop in-house expertise and set up internal facilities, or outsource these activities
- in sector where the collection and treatment of used items are simpler, these activities can be outsourced to reverse logistic experts and specialized recycling organizations.