MINES Saint-Étienne

Une école de l'IMT

EMSE_05

Circular Economy and Product-Service System

Elaheh Maleki

Objective

- Objective: To make students familiar with sustainable solution providing

1 Unsustainability & Circular Economy

2 Strategies to reach sustainability

3 Sustainable Product-Service System

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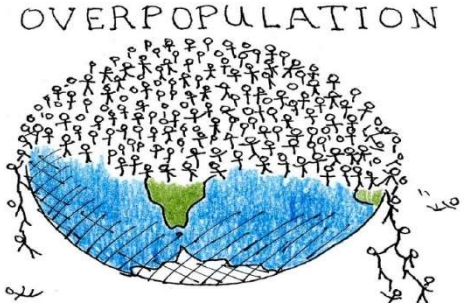
Unsustainability

Critical trends that characterize the unsustainability of the current global situation

1. Overpopulation
2. Resource exploitation and increasing pollution
3. Over-consumption



How to deal with unsustainability?

[Mont, 2000]

Seeing the Bigger Picture

ELLEN MACARTHUR FOUNDATION

DIGIFOF
DIGITAL DESIGN SKILLS FOR FACTORIES OF THE FUTURE

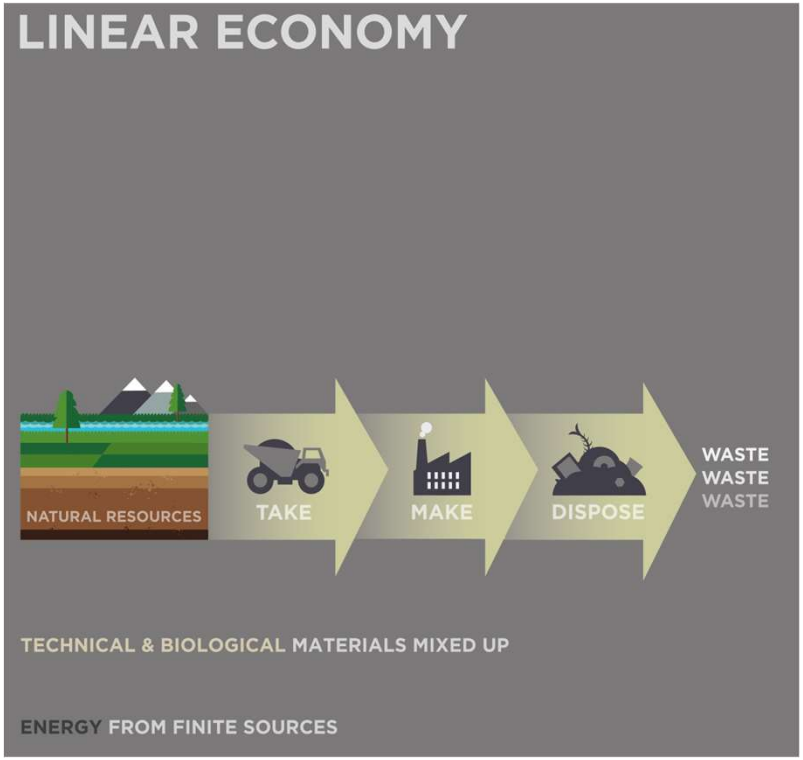
1. The Linear Economy:
   We can't sustain this 'take-make-dispose' model –what's the solution?
2. Recycling?
   What would have to change to make recycling work better?
3. Use Less?
   What would have to change to allow for using less to be ok?
4. Last Longer?
   Could longer lasting products work? How?
5. More Efficient?
   What would we have to change to make efficiency really helpful?
6. Green?
   Although many green products are moving in the right direction, what does the destination look like?
7. Fewer People?
   How can we change things to make our newest members of the human race welcome on our planet?
8. How Do Other Species Live?
   What are the rules [for benign production]?

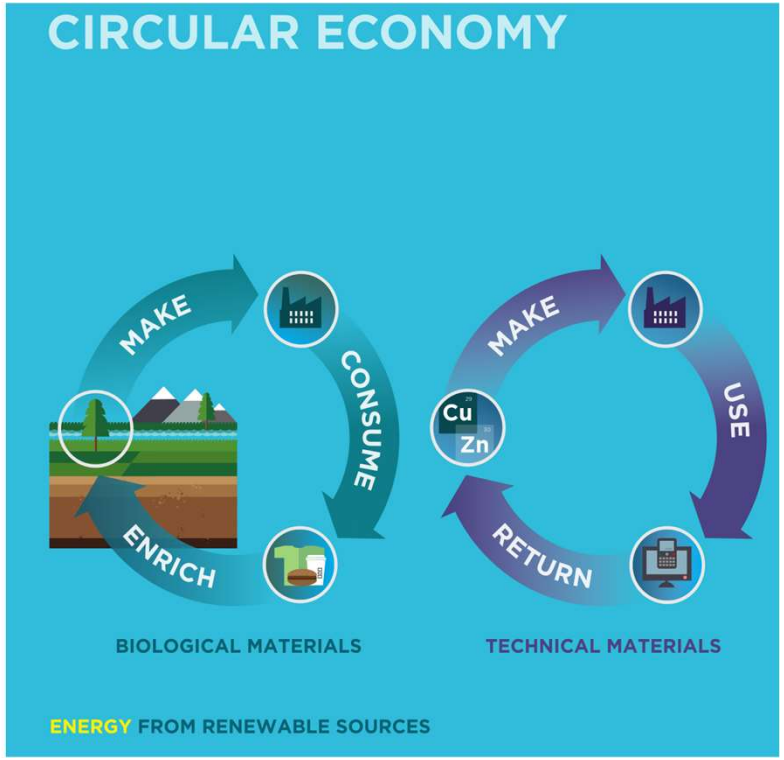
Circular Economy

https://www.youtube.com/watch?v=zCRKvDyyHmI

Circular Economy

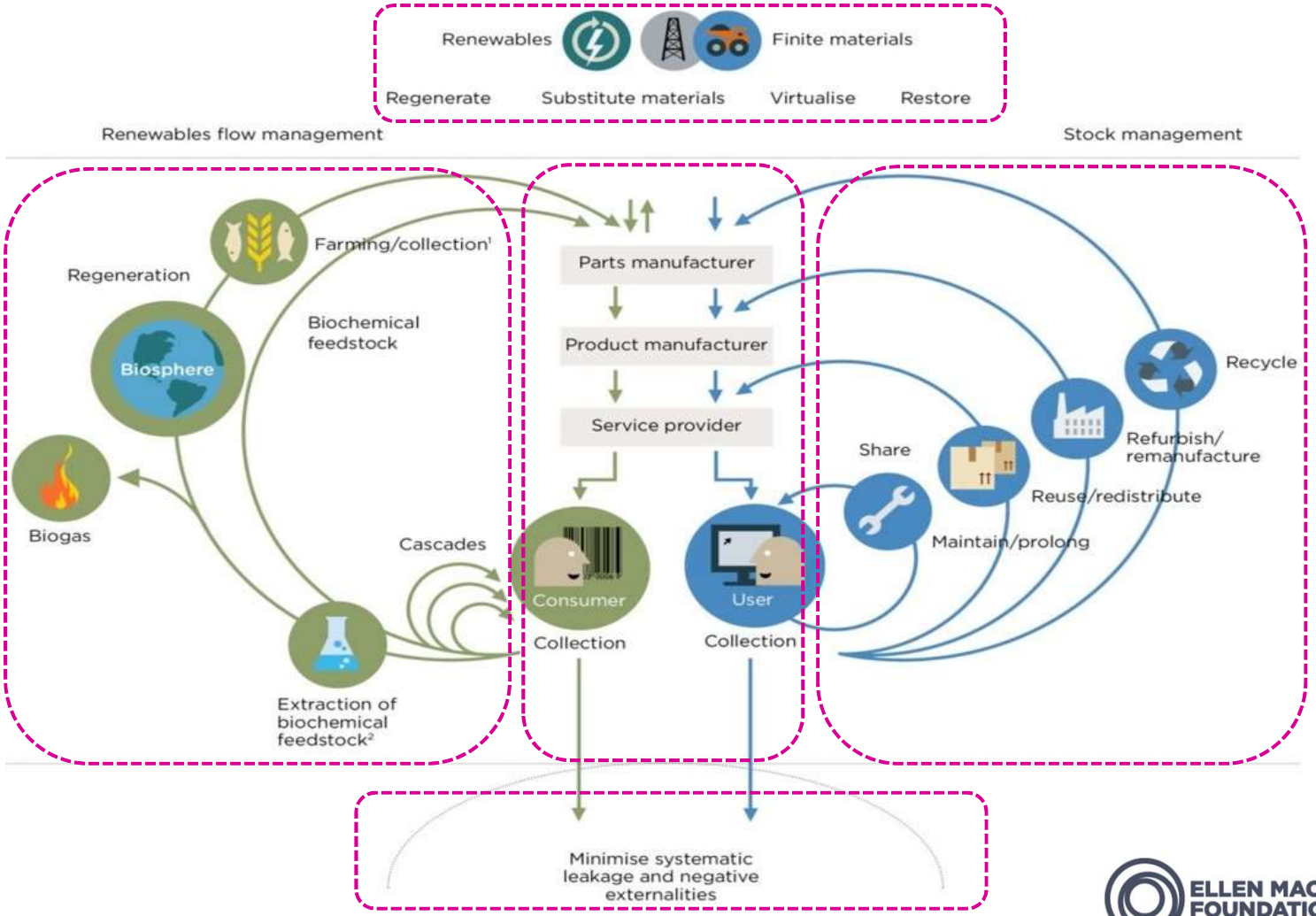
The circular economy offers the opportunity to move away from our "take - make - dispose" model, by ensuring, through careful design and innovative business models, that technical and biological materials continuously flow, safeguarding valuable resources and restoring natural capital.



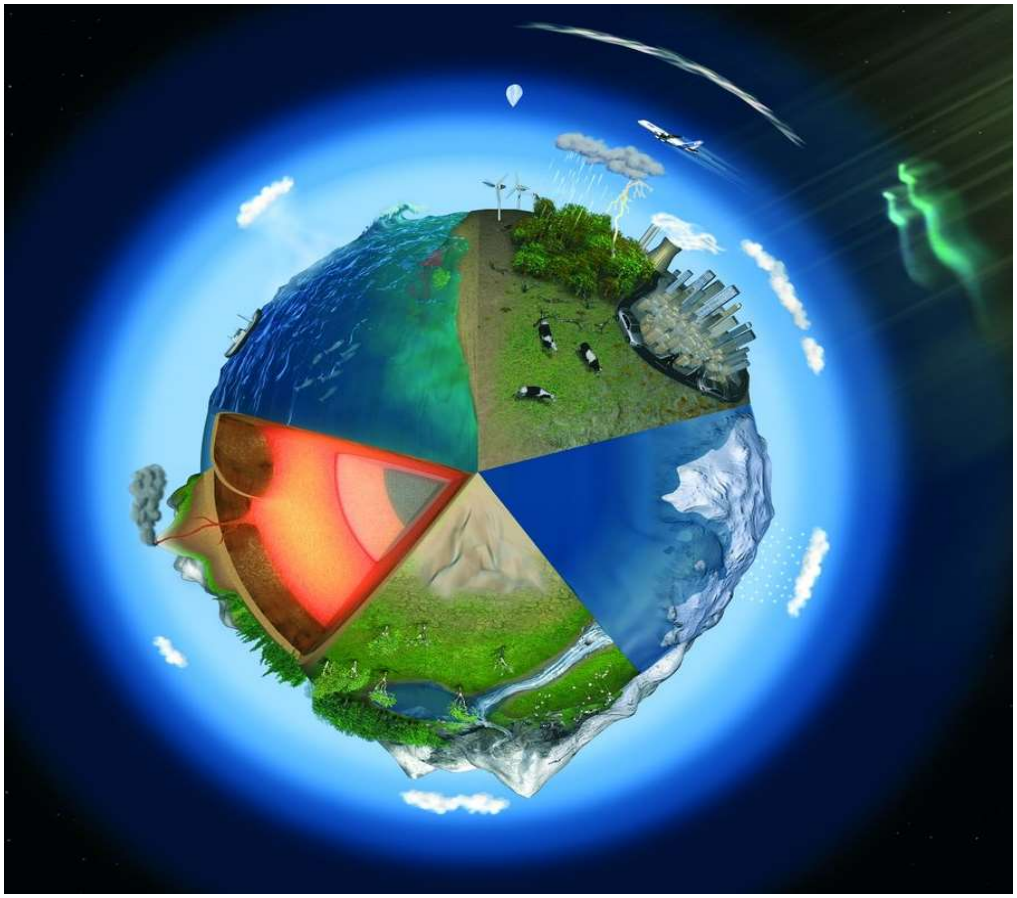


Possible solutions for a Circular Economy

The Ellen MacArthur Foundation was launched in 2010 to accelerate the transition to a Circular Economy.



A new perspective: Rethink everything



https://www.youtube.com/watch?v=Klp7Bjexf3Y&list=PLD2C43638C526D33F&index=9

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Strategies to operationalize the circular approach

DIGIFOF
DIGITAL DESIGN SKILLS FOR FACTORIES OF THE FUTURE

✓ **Product side of reaching sustainability:**

Extending the lifespan of the product [Blomsma and Brennan, 2017] e.g. Reducing requirement for product

✓ **Production side of reaching sustainability:**

Closing the loop of material flow [Blomsma and Brennan, 2017] & replacing the "end-of-life concept with restoration" [Macarthur, 2013] e.g. Reducing the amount of materials in products and services (dematerialisation), Recycling and claiming the product material back

✓ **Consumption side of reaching sustainability:**

"To have a utility instead of ownership" [Mont, 2000] e.g. Eco-efficiency, Increasing efficiency of the product usage phase

"Solution-besed approach" can fulfills these strategies.

[Mont, 2000]

Strategies & examples for moving towards Circular Solution

Depending on your role in company, there are various practices to implement circular solution.

Design

Research, Innovation, Design

Buy

Procurement

Make

Production & Manufacturing

Sell

Sales and Marketing

Dispose

Waste Management

Finance

Investment & Accounting

https://www.ceguide.org/

DESIGN

If you work within the Research, Innovation or Design departments, consider these practices to move your company towards the circular economy.

Regenerative design

Integrated design process

Design for flexibility

Design for the environment (eco-design)

Design for disassembly/deconstruction

Design for recoverability/recyclability

Design for maintainability/reparability

Green chemistry

Cradle to Cradle®

Standardization

Biomimicry

Life cycle thinking

Systems thinking

Lifetime extension & durability

https://www.ceguide.org/

Unsustainability

BUY

If you work within the Procurement department, consider these practices to move your company towards the circular economy.

Critical raw material substitutes

Services (not products)

Bio-based resources

Reclaimed resources

Compostable resources

Renewable resources

Rare earth metal substitutes

Safe chemicals

Recycled resources

Biodegradable resources

Reused/ reusable resources

https://www.ceguide.org/

MAKE

If you work within the Production and Manufacturing departments, consider these practices to move your company towards the circular economy.

Kaizen (continuous improvement)

Resource efficiency

Remanufacturing

Prefabrication

Refurbishing

Six Sigma

Additive manufacturing

Dematerialization

Jidoka (autonomation)

Kanban (just-in-time)

Poka Yoke (error-proofing)

Lean manufacturing

https://www.ceguide.org/

SALE

If you work within the **Sales and Marketing** departments, consider these practices to move your company towards the circular economy.

Digitization and virtualization

Pay-per-service unit

Co-branded services

Sharing platforms

Leasing

https://www.ceguide.org/

DISPOSE

If you work within the Waste Management department, consider these practices to move your company towards the circular economy.

Deconstruction and disassembly

Cascading

Compatibilizers

Feedstock recycling

Recycling

Reverse logistics

Take-back program

Composting

Energy recovery

Industrial symbiosis

Repurposing

Selective extraction

Waste to Energy

Secondary material marketplaces

https://www.ceguide.org/

FINANCE

If you work within the **Finance and Accounting** departments, consider these practices to move your company towards the circular economy.

Integrate circular value in models

Assess ESG risk

Crowdfunding

Prioritize cash flow

Purchase order finance

Natural capital valuation

Assess creditworthiness risk

Incentivize end-of-life returns

Impact loan

Factoring

Green bonds

Assess linear risk

Supply chain financing

Stranded asset management

Integrated client approach

Extend investment time horizon

Emphasize relationship-based financing

https://www.ceguide.org/

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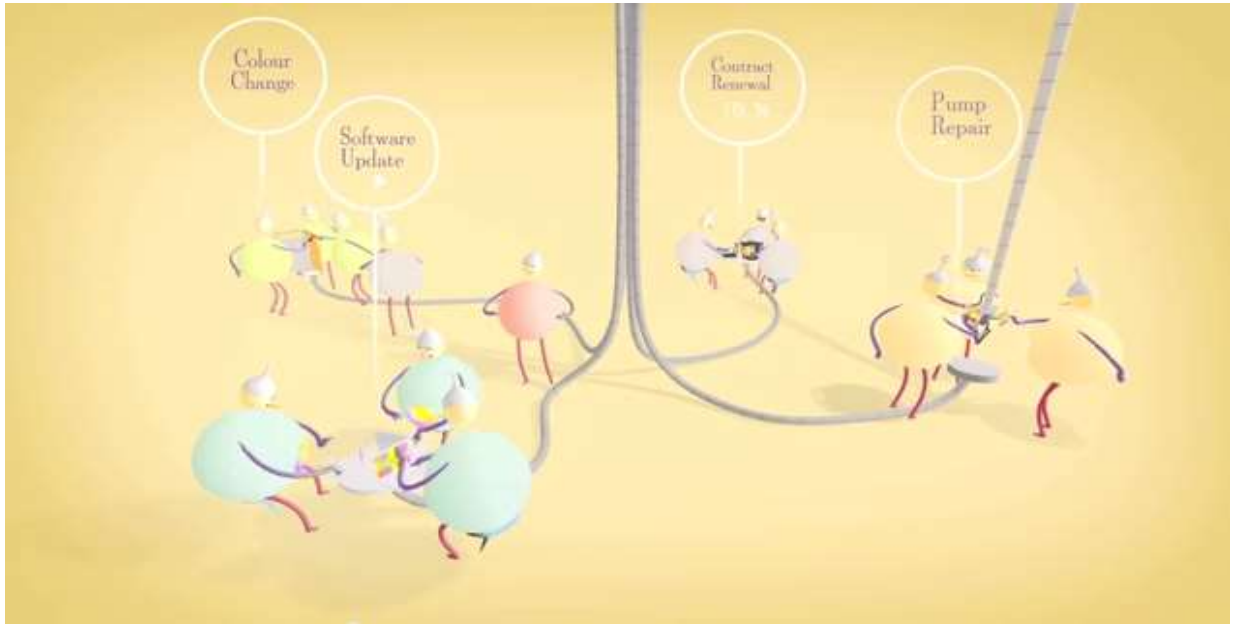
Sustainable Solution-based approach



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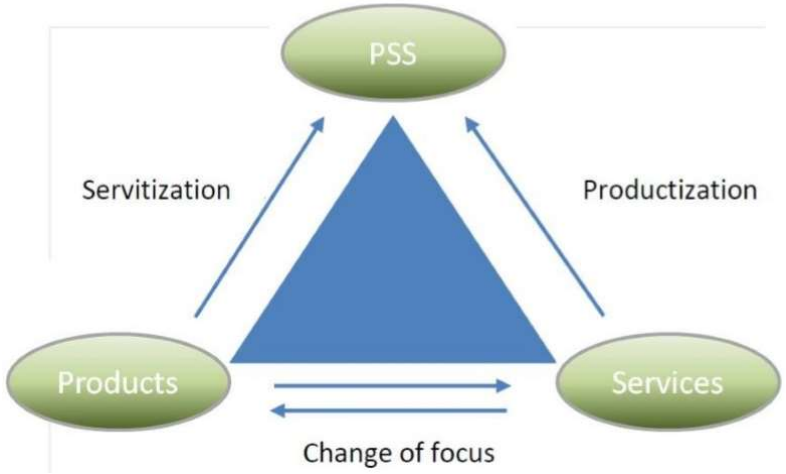
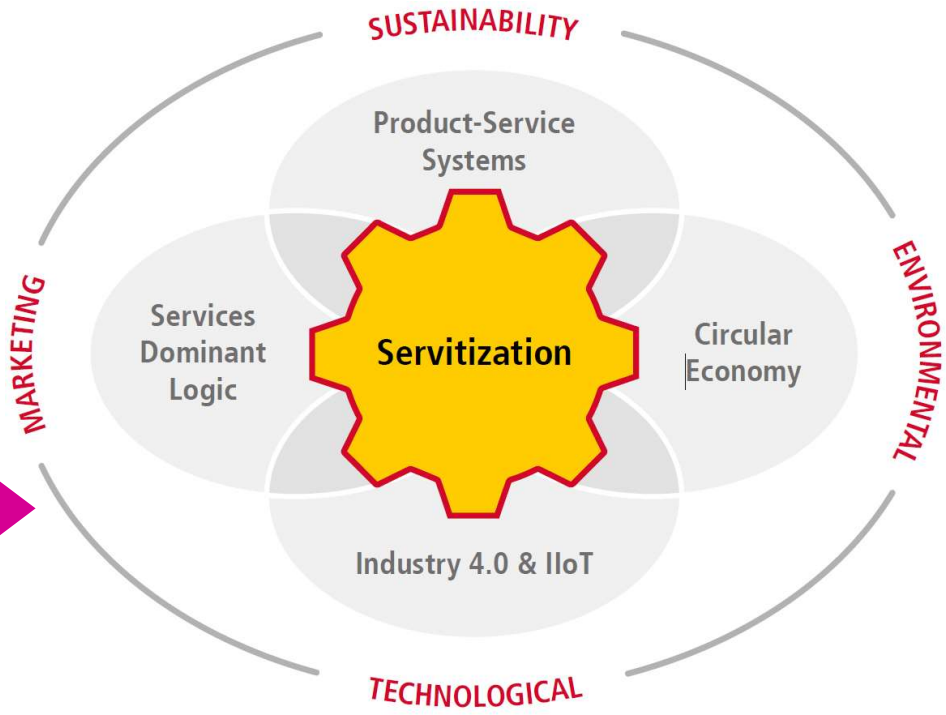
Dematerialization And Service Economy

Product-service systems is a possible answer to sustainability challenges.



Various aspects of the full transformation picture



https://www.logistics.dhl/content/dam/dhl/global/core/documents/pdf/glo-core-servitization-white-paper.PDF

Bike Sharing Case

Bike Sharing Case

Paying to OWN the product

Sustainability issues
Competitive market

Shift the focus from selling a product to providing a solution

Paying to USE the product: Bike Sharing Systems

Bike Sharing Case

Product-Service System (PSS)

bicloo Nantes Métropole

Integrated as a system

Bike station

Customized Bike

Smart lock

Mobile Application

Management System

Payment system

GPS

Cloud Server

Industrial Machinery Case: Gear grinding machine

Gear grinding machine

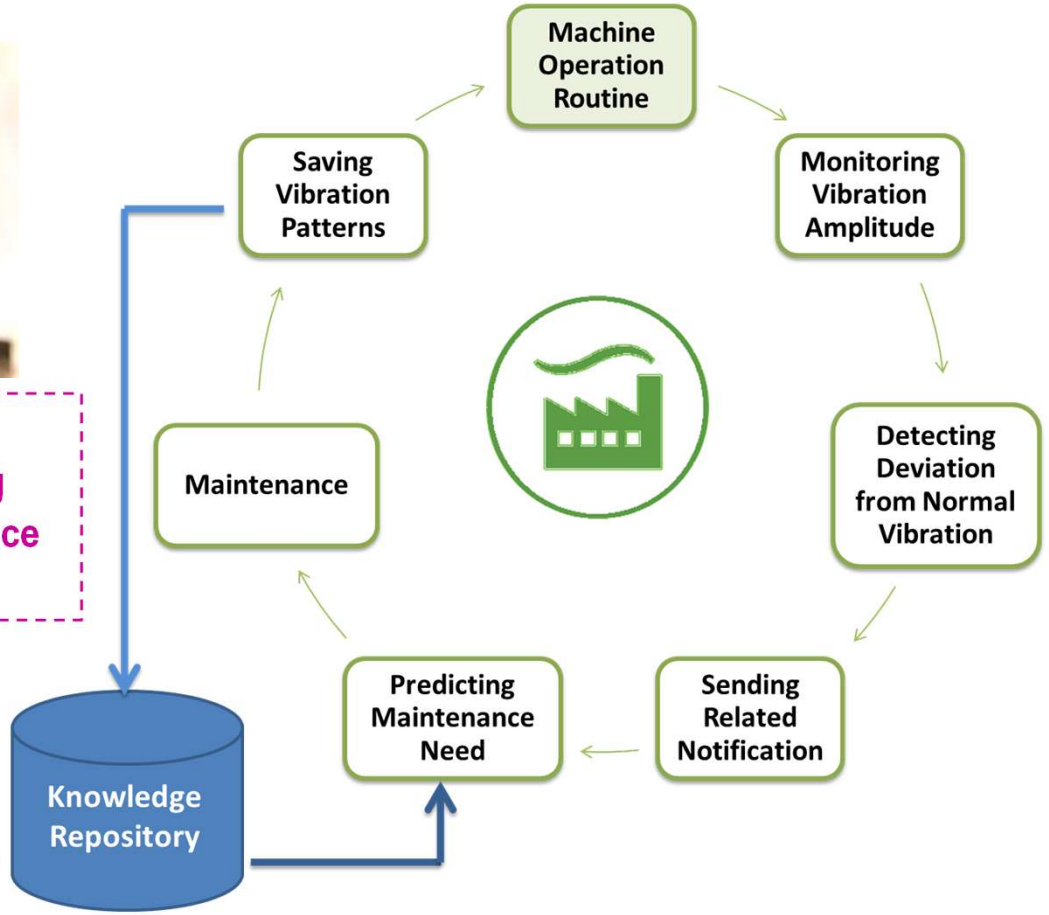
The scenario:
Industrial machine with Health Monitoring Services to increase the machine performance and reduce the waste

↓

1- Relies on Vibration monitoring and predictive maintenance

↓

2- Integrating sensors with machine to acquire data from the machine life stages



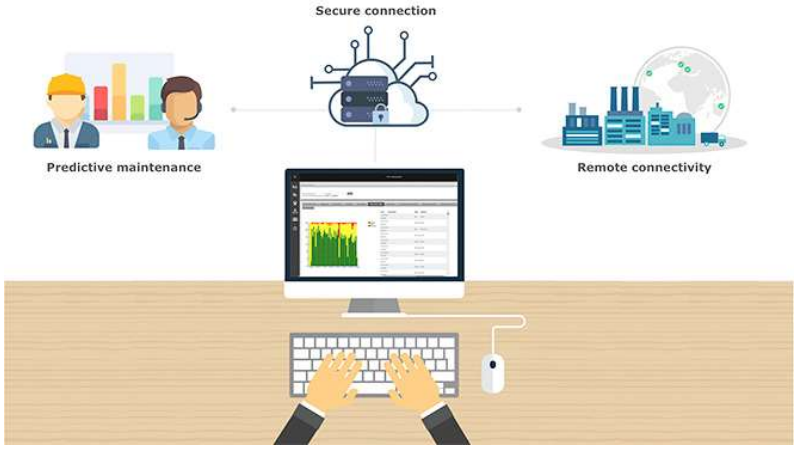
Industrial Machinery Case

Product

Gear grinding Machine

Service

Service Processing: Vibration monitoring (vibration of the machine moving components and condition of the machine)
Embedded System: The vibration sensing system
Software: The HMS software, collaborative platform



Industrial Machinery Case

Enabling Systems

Organizational Capabilities

Human Resources: maintenance engineers

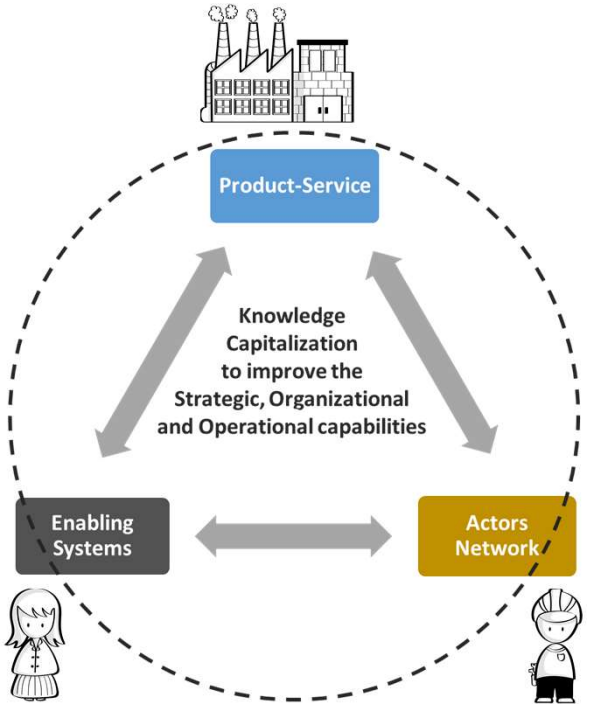
Business processes:
Service delivery, knowledge management

Immaterial Resources: Shared and saved 'know-how' knowledge

Physical infrastructure
Maintenance tools and spare parts

Digital infrastructure
Communication system, Software and cloud

Actors



Actors from production, service and support system interacting with each other and with customers

To go further

- Circular economy: educational resources
https://kumu.io/ellenmacarthurfoundation/educational-resources#ce-general-resources-map/key-for-general-resources-map

- The surprising thing I learned sailing solo around the world | Dame Ellen MacArthur
https://www.youtube.com/watch?v=ooIxHVXgLbc

- The Disruptive Innovation Festival (DIF)
https://www.thinkdif.co/topics

- Case Studies
https://www.ellenmacarthurfoundation.org/case-studies

- A Good Disruption
https://youtu.be/uT66CRYkSM8

- New Plastics Economy
https://vimeo.com/168011130

- Make Fashion Circular
https://www.ellenmacarthurfoundation.org/our-work/activities/make-fashion-circular

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12. Circular Economy: An Introduction (https://courses.edx.org/courses/course-v1:Delftx+CircularX+1T2017/course/)
13. Ellen MacArthur Foundation (https://www.ellenmacarthurfoundation.org/)

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