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Will Industry 5.0 herald the revenge of the humans?

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INDUSTRY 1.0

Mechanization, steam power, weaving loom

INDUSTRY 2.0

Mass production, assembly line, electrical energy

INDUSTRY 3.0

Automation, computers and electronics

INDUSTRY 4.0

Cyber Physical Systems, internet of things, networks



1800

1900

1970

2010



Craft



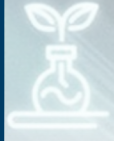
A world in trouble so what about society, sustainability.....?

**The company needs to
lift focus and take
responsibility**

Employees are citizens that have to live with
consequences....Enable them to be the driving force
for change

Technologies ?





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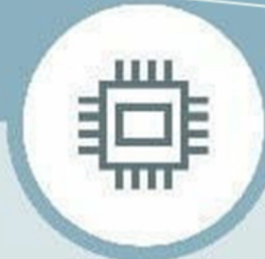
INDUSTRY 4.0

Cyber Physical Systems, internet of things, networks

INDUSTRY 5.0



Craft



1800

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Coming up?

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Industry 5.0

- 3 basic elements



Industry 5.0 focuses on employees as drivers for change, and the successful realization of benefits from technology and domestication. For the company, but also the society in general.

- It is more than just involving people for better technology implementation and fulfilling goals set by the management
- Industry 5.0 is characterized by a sense of purpose that extends beyond the production of things for profit.
- 3 core elements
- 5.0 has a holistic approach seeing these elements in context and building culture, principles, technology and solutions so that these elements are intertwined and create synergies.



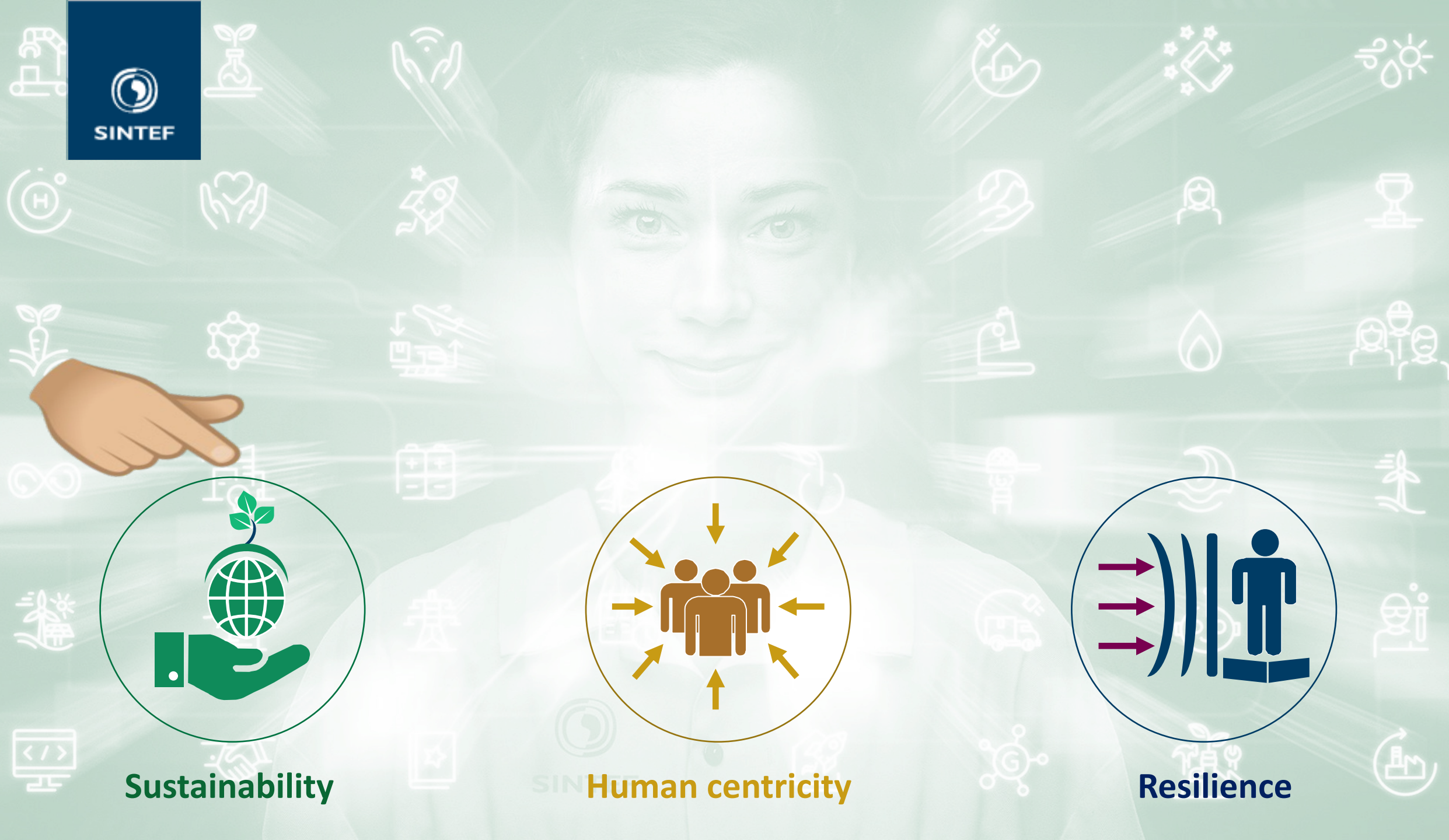
Sustainability



Human centric



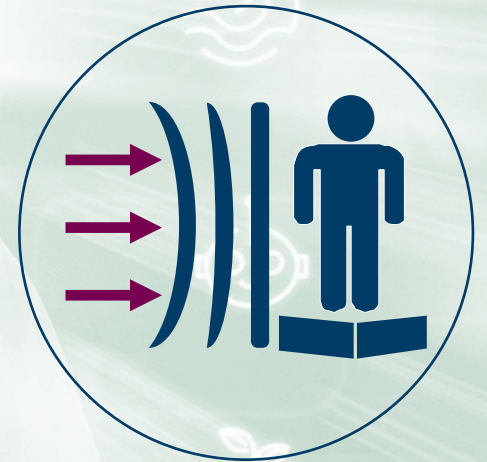
Resilience



Sustainability



SIN Human centricity



Resilience



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Sustainability - drivers for change



The company has to face the challenges (and opportunities) outside the factory. Aiming for positive societal development beyond purely (short-term) business targets (profit).

Drivers:

- The UN's 17 sustainability goals provides guidelines for manufacturing
- EU- Green Deal initiatives is a pull for sustainability
- Increasingly companies are required to report on sustainability, (i.e EU taxonomy regulations)

However, there is a big difference between complying with requirements and assumptions "set by others", and having sustainability and social responsibility as the very driver of the company's operations, strategies and business models





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Sustainability

- local and global perspectives



Sustainable production limit climate change and increase the quality of life for people, and lead to economic growth in the long run.

- This is to a large extent about consequences for people, the workers and families as citizens so the company must contribute positively to the community, but also globally.
- We have to look beyond the company's production, and take responsibility for whole value chains, patterns of use
- Circularity - to use the earth's resources in the best possible way to ensure sustainability and value creation also in the long term. It's about new ways of designing products, reusing materials and making a profit of it.





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Sustainability - enabling technologies



Technology is an important enabler for increased sustainability. This has to a large extent been technologies for more environmentally friendly products and production:

- Automation etc. that provides more efficient resource utilization (e.g. as we find in Industry 4.0)
- Technologies that enable more environmentally friendly products (e.g. separation, production from more environmentally friendly raw materials, etc.)
- Energy saving, waste-, pollution- and emission reduction.. .etc

This is also about technologies for traceability and impact assessment enabling circularity (decision support, LCA/EPD). In I-5.0 employees must be given the tools/technology and opportunity to make decisions related to sustainability





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Sustainability

how to change - twin transition



A twin transition approach recognizes that there is a huge opportunity for technology and data to drive sustainability goals.

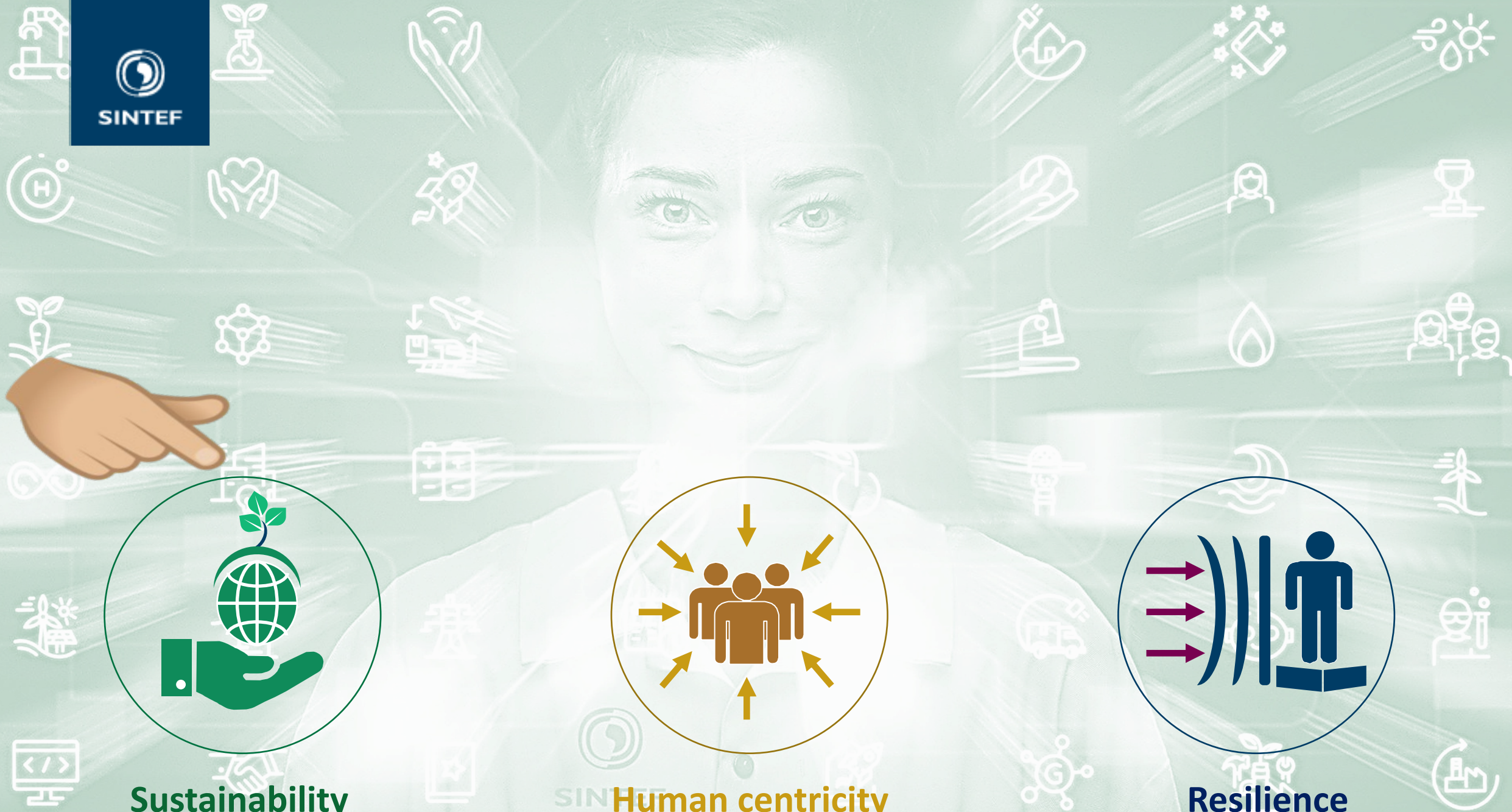
Challenges:

- Lack of resources, knowledge, time and money in cost-intensive process and product changes.
- Dependencies in value chains, and decision-making processes lack an overview of the future and opportunities.
- Often difficult to measure effects on sustainability and societal goals

Success is largely about having sufficient "facts" in good transition processes. Decision support system is a key. Maybe most important you need motivated employees, given the opportunity to take responsibility.



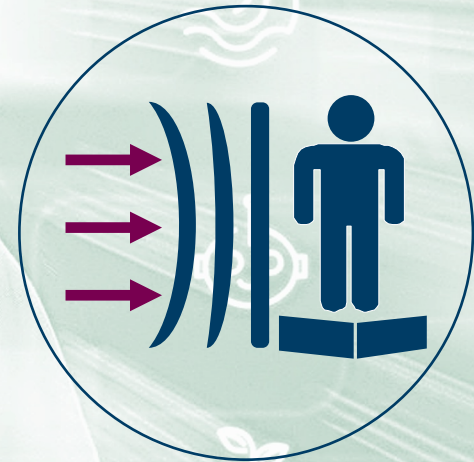
How to operationalize sustainability and make it relevant in the employees' everyday work



Sustainability



SINTEF Human centricity



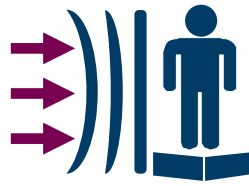
Resilience



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Resilience

– increasingly difficult business environment



As we thought that the end of the pandemic would lead to “good times” and a positive economic development globally.

- war in Europe,
- new waves of infection,
- global energy/power crisis,
- extreme weather,
- interest rate increases, price rises, bank collapse...

Unexpected events could also be new market players, the loss of core customers, disruptive technology, etc.

Resilience means being able to resist and, if necessary, change to deal with what is happening in the business environment

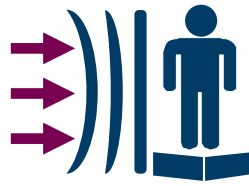




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Resilience

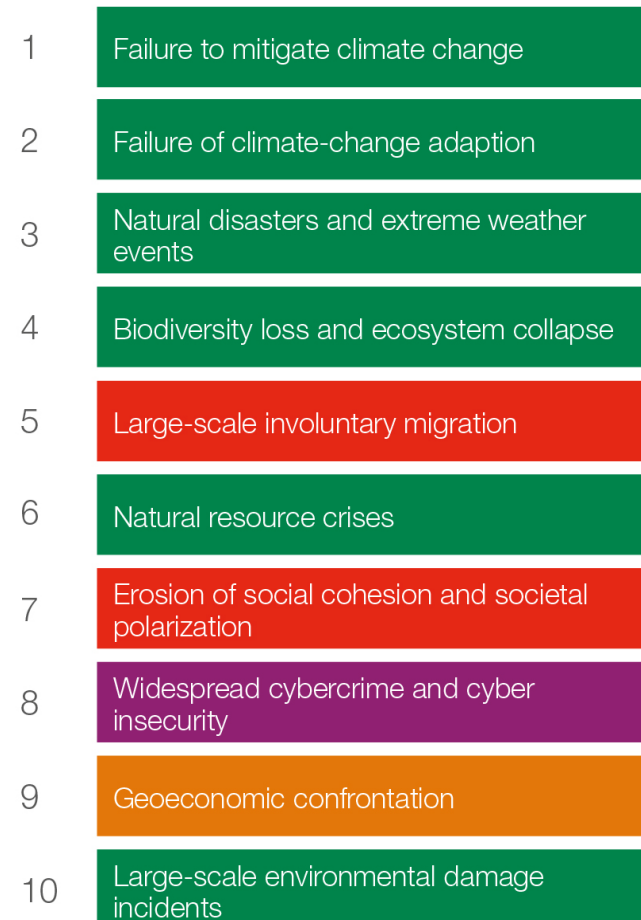
- what do we expect (but expect the unexpected!)



2 years



10 years



World Economic Forum, Global Risks Perception Survey 2022-23

“Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year periode”

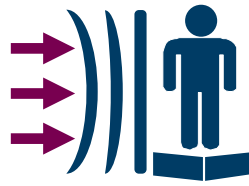




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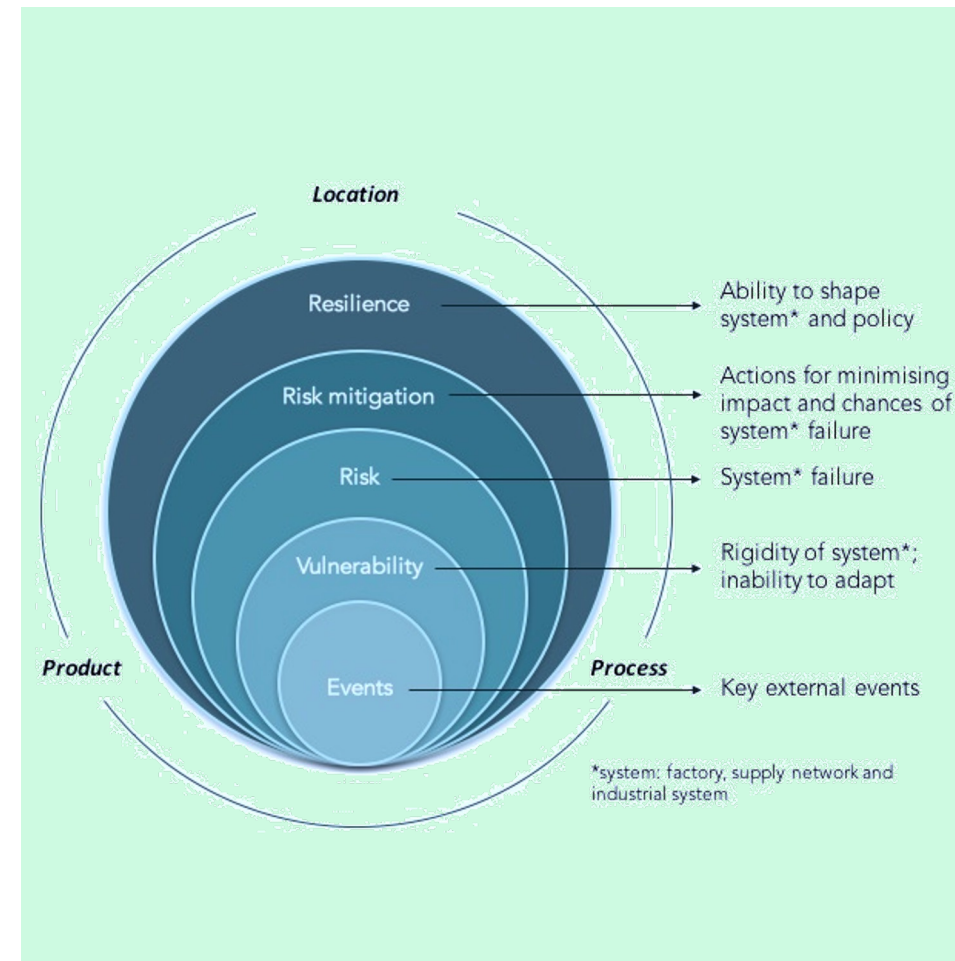
Resilience

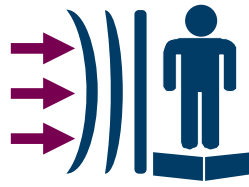
- room for action and flexibility



Resilience= Managing events, uncertainty and risk:

- Contains elements of robustness, adaptability and agility
- Policy, system and solutions that capture events, context, (today's and tomorrow's).
- The ability to define room for action
- Navigate within



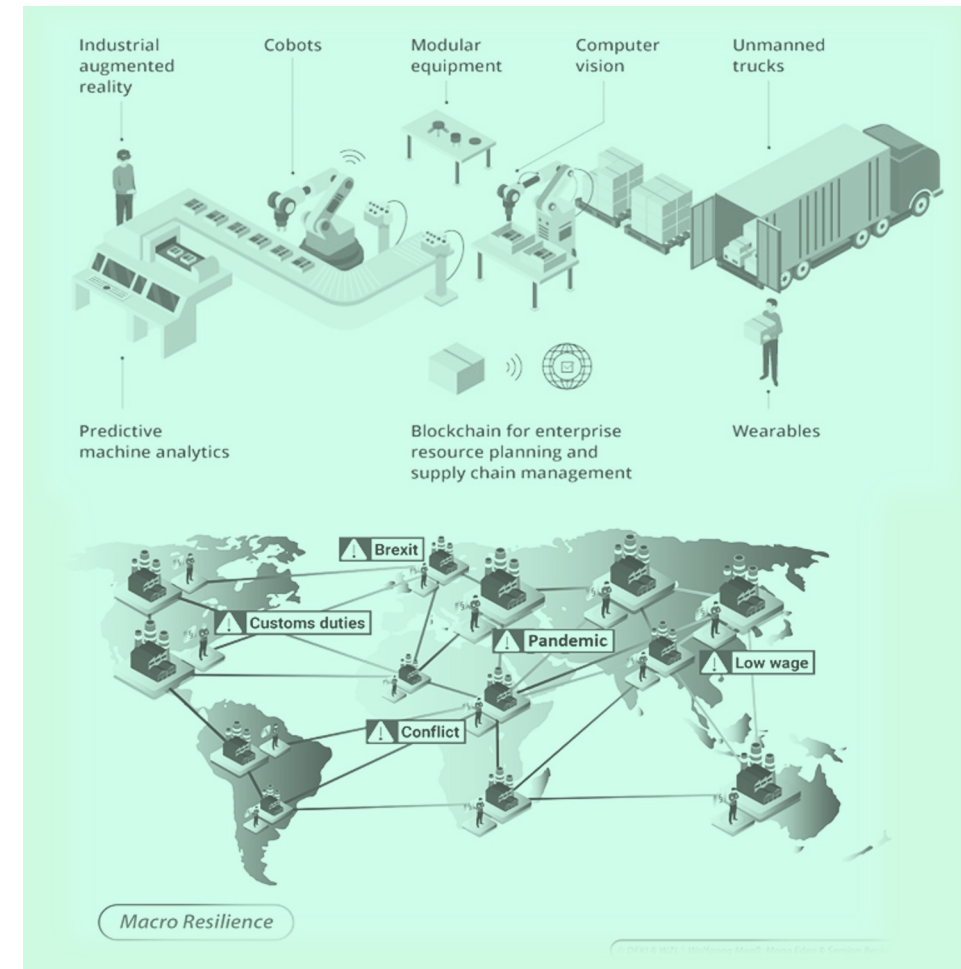


Resilience

- technology for resilience

By digitizing equipment and systems, integrate across the business, it is possible to achieve flexibility and better interaction in production networks

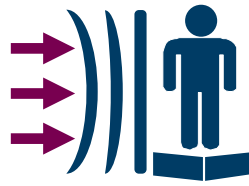
- “Radar” for capturing events: Edge solutions, Cyber security..
- Smart machines and Smart factories integrate production and logistics processes between different companies to optimize material flow, to detect potential errors and to respond flexibly and quickly to events, to customer needs and market changes
- Additive Manufacturing
- Customized production. Technology for Integrated production provide tailored products and adapt to market changes
- Simulation and tech. for training –serious games





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Resilience -more than technology

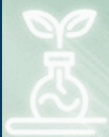


Technology making us more vulnerable? Complex Integrated technologies exposing us to bugs and errors? Cyber security?

- **Modularisation/outourcing/networks:** Developing production solutions and products that are more flexible - "reconfigurable". More easily adapted to changes in market, supply conditions...
- **Decentralization and «Local sourcing»:** In supply disruptions and lack of raw materials, can we find alternatives (locally)?
- **Integration versus flexibility:** Supply chain integration might give a greater degree of trust, cooperation, to deal with crises, etc. However, flexible and loose links provide opportunities to "switch" actors (suppliers, markets)
- **People:** Mindset, ability- and motivation to change, mobility among people, management and organizational solutions etc. that provide flexibility. It is also about skills/reskill, education



How to operationalize resilience and make it relevant in the employees' everyday work



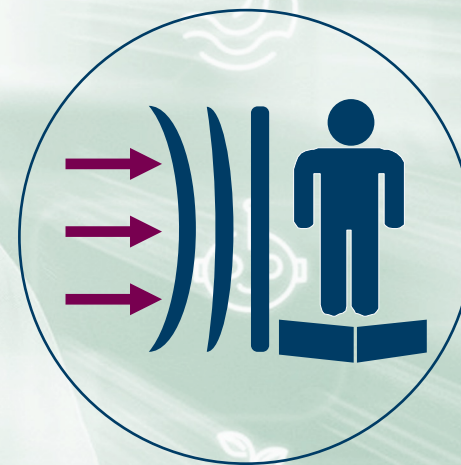
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Sustainability



Human centricity



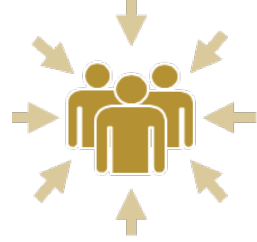
Resilience





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Human centrality - in the factory and as citizen



In Industry 5.0 people are put at the center and in charge of technology and innovation processes. Not only to provide better business processes and working conditions, but also to recognize employees as citizens, stakeholders and resource for sustainability and contribution to positive societal development

- Secure employees' basic rights, i.e. working conditions, autonomy, human dignity and privacy, HSE, env
- Responsibility and qualification of the employees
- Encourage diversity and critical thinking
- Collective social processes and structures,
- Also focus on people/customers etc. in the value chain
- Technology, tools, arenas, processes, organization and conditions that enable employees to be drivers in Industry 5.0

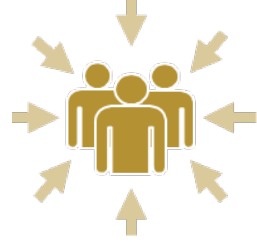




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Human centrality

- how? Categories of participation



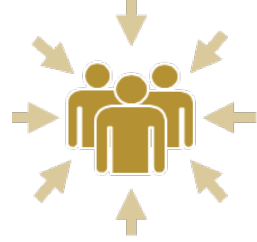
| | SOCIOTECHNICAL PARTICIPATION Involvement in the organization's operations | POLITICAL PARTICIPATION involvement in high-level goal setting and long-term planning |
|---------------------------------|---|--|
| DIRECT PARTICIPATION | <ul style="list-style-type: none">• Individuals and teams who plan, execute and report work• Teams discussing how to improve and further develop the work process (quality circles)...• Employee-driven innovation, transformation, digitalization• A lot (but not everything) from lean | <ul style="list-style-type: none">• Individual employees who raise their voice at general meetings• Employee groupings that discuss the company's disposal of the profits• Individual employees who elect their representatives• Work organization who makes collective decisions |
| REPRESENTATIVE CO-DETERMINATION | <ul style="list-style-type: none">• When the work council (BU) deliberates and makes decisions about improvement initiatives (from departments, trade unions, the management)• When the HSE forum (AMU) deliberates about topics and measures based on the latest HSE statistics | <ul style="list-style-type: none">• When the work council (BU) discusses new long-term investments in new technology• Discussions and decisions at board meetings about overall direction |



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Human centrality

- some presumptions (we see in Norwegian companies)



I-5.0 skills developed where employee involvement and corporate democracy have been practiced over time (Norway):

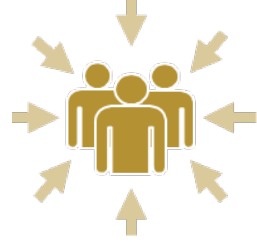
- Responsibility skills
- Conflict solution skills (justice, conflict resolution ability)
- Holistic focus on value creation
- Involving management
- Rich communication
- Technology made available
- Technology competence





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Human centricity - technology enabling



In Industry 5.0 technology is defined by- and adapted to- the context of the company and the workers. Examples:

- Making work more safe reducing stress ie:
 - Exo-skeleton – advanced suit for extra strength/work more safely,
 - Augmented Reality(AR)- combines data from the physical and virtual world, e.g. sensors monitor loads (e.g. temperature, gases) alerts of dangerous exposure.
- Improving Quality of Worklife
 - Human-machine relationship
 - Automation(e.g robots) – reducing routine work, liberating time for more job satisfaction/meaningful activities, reducing dangerous- and exposed operations
- Cognitive support systems, enabling the enhanced role
 - Decision support (e.g LCA/EPD), intelligent digital assistance context-based guidance
 - Technology-supported learning. Onboarding
- Technology integrating users - personalization/customization





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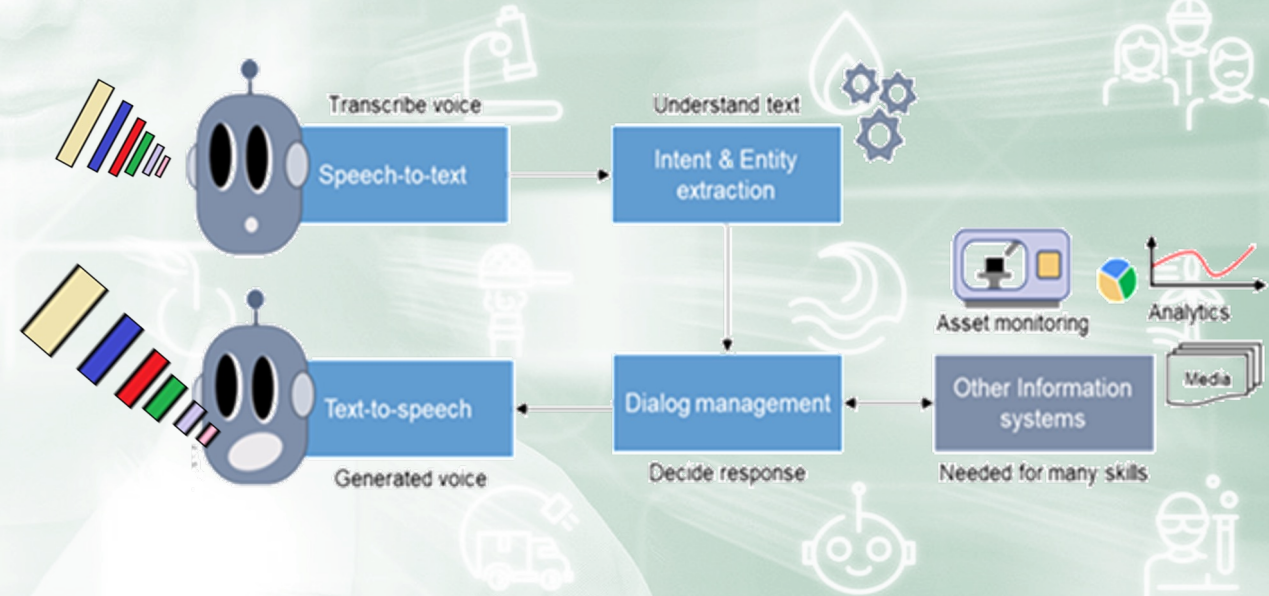
Human centricity

- Digital assistance technology (EU-WASABI project)



A **conversational agent** is an application that accepts user input in the form of voice or text to interact with complex software and provides responses in natural language

The solutions will assist, for instance, situation analysis, intervention identification, action planning and execution, and impact monitoring and mitigation.



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Technology for a better society



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Human centricity

- Conventional technology (Agri-IPNproject)

Competitiveness and sustainability

Sustainability

- Reduced climate footprint (water, energy, materials, emissions, transport)
- Reduced negative environmental impact
- Natural diversity, land use
- Strengthened social responsibility
- Reputation in the local community

Human centricity

- Better working environment – quality of worklife
- Better work assignments
- Competence development
- Training and education
- Motivation
- Resources in improvement work
- Better decision support

Resilience/flexibility

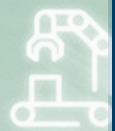
- Flexibility in production and in the value chain
- Effective handling of unexpected disruptions in the market, supply chain, global turbulence
- Tailoring, modules, 1-piece production
- Purchase of raw materials (component shortage)
- Efficient flow, lean

Strengthen capabilities/resources in the factory within 3 core areas

Introduction of new digital technology (laser cutter) in the factory

Requirements

Exploitation

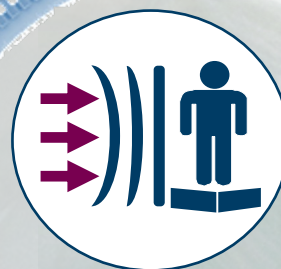


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The basic elements are individually important - but human centricity as particularly important?

Have a life outside as
citizens having concerns,
commitment and lives with
consequences



Has the ability to see
consequences and “improvise”,
motivate, mobilize



What does this mean for the worker of the future?

The World Manufacturing Forum top-10 set of skills for the industrial worker of the future.

Four of them for digital skills: "digital competence, AI and data analysis", "working with new technologies", "cyber security" and "data mindfulness".

The remaining skills are related to creative, entrepreneurial, flexible and open-minded thinking.



Industry 5.0



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Changes can be scary with all the technology coming (tumbling down) on us



Cloud computing

Digital Twins

Chatbot
NewBING

Big data

Machine learning

IOT

Sensors

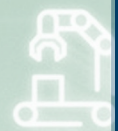
Robots

Augmented

Reality

Teknologi for et bedre samfunn





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We can surf the possibilities that lie in digitization and radical new technology

We must be able to make the right choices

We must have skills and tools

NewBING

Big data

AI

Robots

IoT

Machine learning

Sensors

Augmented Reality



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Teknologi for et bedre samfunn



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Competence and technology enable management and extra speed



*And it is often those who are
closest to the waves who see
best what is smart to do*

*We must have
competence, skills,
resources and tools*



Big data
IOT
Robots

AI
Machine learning
Sensors
Augmented
Reality



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It may be possible to go against the wind, for better opportunities and goals



LCA

Visionary, involving top management

AI

EPD

Digi. laser

Employees must have the opportunity to manage and have some control

Industry 5.0 is about looking beyond one's own business. Sustainability and social goals are the important things

We must have competence, skills, resources and tools

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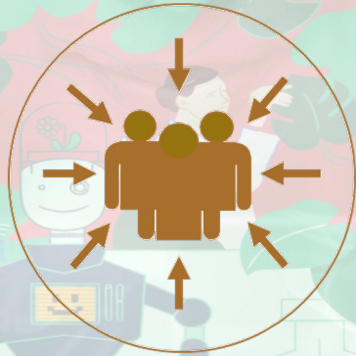
Industry 5.0 in summary

- key aspects

I-5.0 is an evolution that includes a broader set of values: human, sustainability and societal needs at the center. The central elements are:



Sustainability

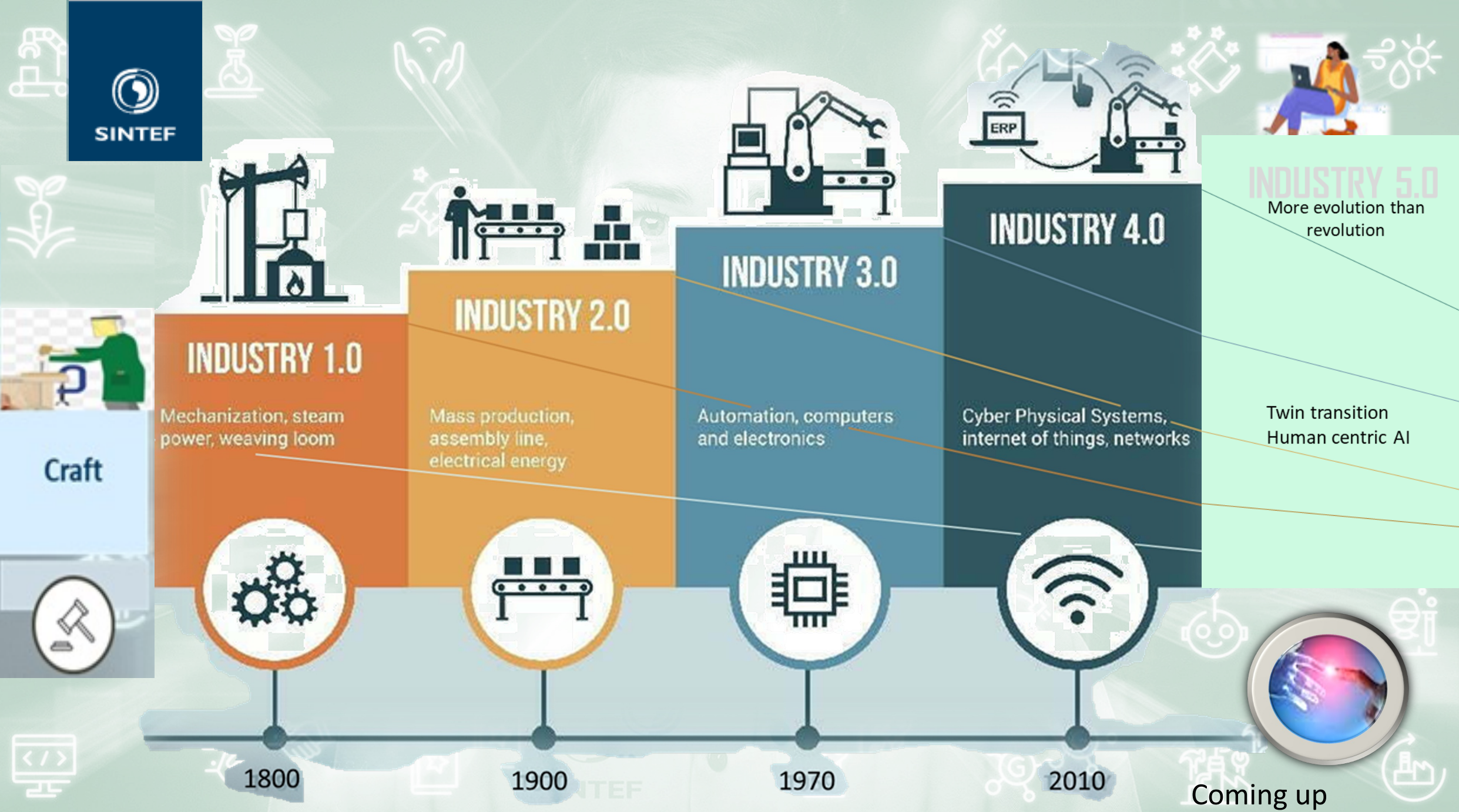


Human centric



Resilience

The idea is to choose technologies based on how they support sustainability/societal interests and not on what they can accomplish from a purely technical/economic perspective. Employees must be enabled to choose the right technology based on needs and context. We must be able to "raise" the technology,



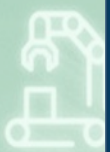
INDUSTRY 5.0

More evolution than revolution

Twin transition
Human centric AI



Coming up



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Technology for a better society

