



DANISH
TECHNOLOGICAL
INSTITUTE

The 4th Industrial Revolution also needs a socio-ecological revolution







"We believe that technology has the power to improve business, society and people's lives."

Independent and not-for-profit



The four industrial revolutions

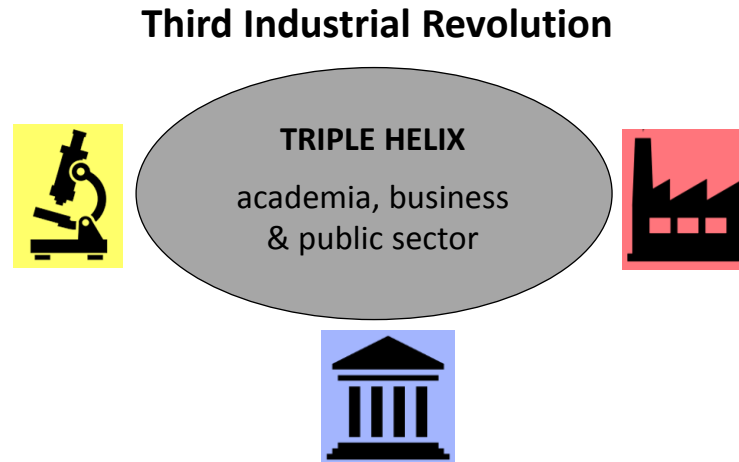
Revolution	Year	Information
	1	1784 Steam, water, mechanical production equipment
	2	1870 Division of labour, electricity, mass production
	3	1969 Electronics, IT, automated production
	4	? Cyber-physical-biological systems





Societal responses to previous industrial revolutions

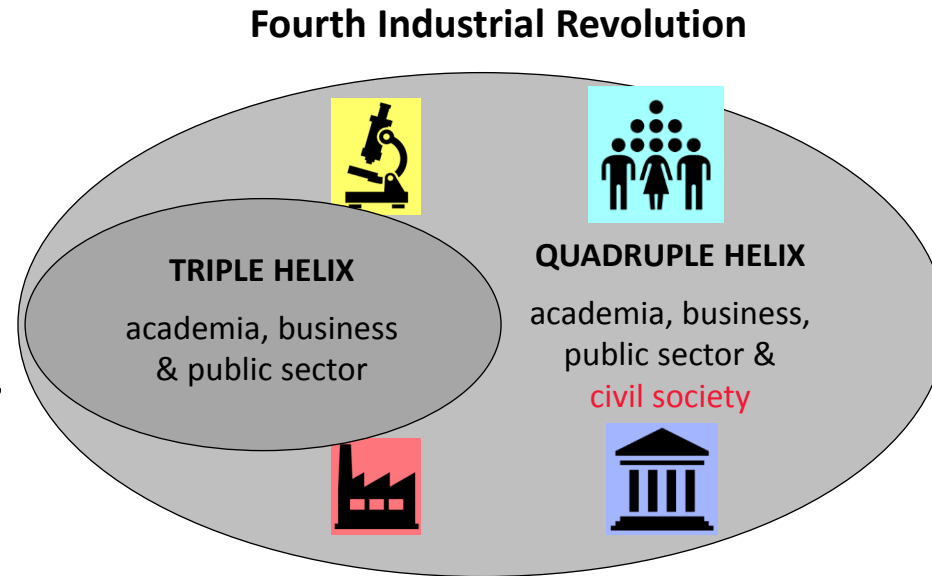
- Previous industrial revolutions produced an explosion in new forms of social activity and organisation:
 - United Nations, trades unions, welfare state, centralised & hierarchical governance, shareholder value business models, market-led policy
 - new systems and partnerships were designed to ease the transition from one socio-economic order to the next
- Predicated on innovations from interaction between all actors of the **triple helix**





Societal responses needed for Fourth Industrial Revolution

- New forms of social activity and organisation, most of which are known:
 - De-centralised & linked horizontal-vertical governance, shared-value business models, sharing & collaborative economies, cooperatives, employee-ownership, citizen assemblies, evidence-based policy
 - Civil society, social entrepreneurs, voluntary sector NGOs, social movements, e.g. Transition Town Network
 - Social innovation alongside technological innovation, citizen science, behavioural insight, nudge, design thinking
- Predicated on innovations from interaction between all actors of the **quadruple helix**

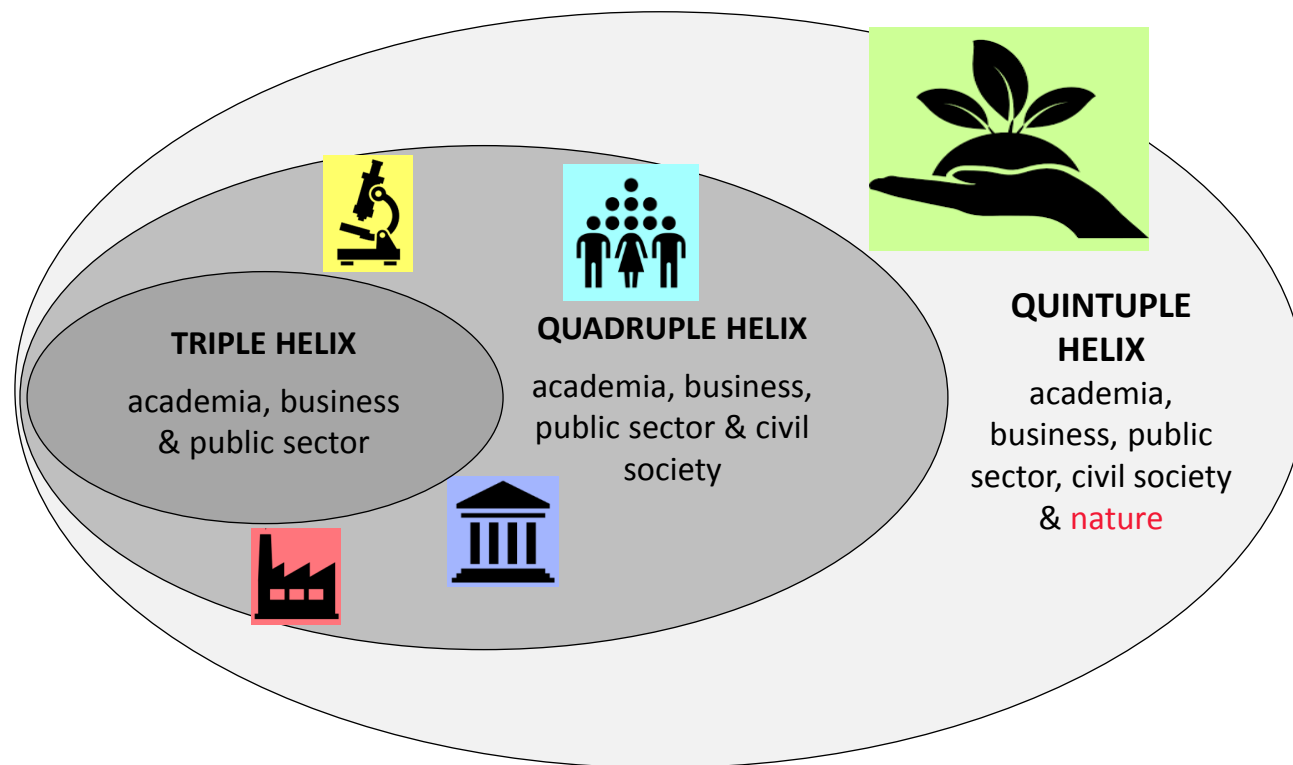




Societal responses needed for Fourth *PLUS* Industrial Revolution

- Completely new forms of social activity and organisation, few of which are experimental and only some are on the drawing board:
 - Ecosystem governance, 'green' business models, nature-based innovation and solutions, eco-based policy
 - Bio-mimicry, bio-based industries, circular & iterative systems (no such thing as 'waste'), e.g. hydroponics, rewilding
 - Nature-based societies, 'doughnut' economy
 - E.g. local currencies, Extinction Rebellion?
- Predicated on innovations from interaction between all actors of the **quintuple helix**

Fourth *PLUS* Industrial Revolution: the SOCIO-ECOLOGICAL TRANSITIONS

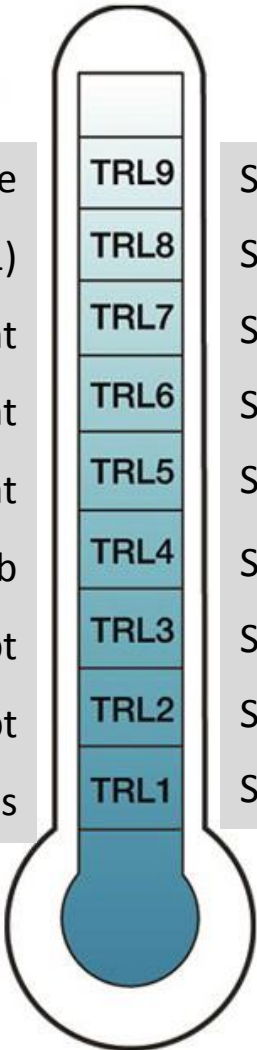




Aligning SERLs with TRLs

Technology Readiness Levels

- TRL 9 – successful user deployment in real life
- TRL 8 – final user testing in real life (check TRL 1)
- TRL 7 – demonstrated in operational user environment
- TRL 6 – demonstrated in simulated user environment
- TRL 5 – validated in simulated user environment
- TRL 4 – validated in lab
- TRL 3 – experimental proof of concept
- TRL 2 – technology concept
- TRL 1 – basic principles



Socio-Ecological Readiness Levels

- SRL 9 – successful deployment in real socio-ecological context
- SRL 8 – final testing in real socio-ecological context (check SRL 1)
- SRL 7 – demonstrated in operational socio-ecological context
- SRL 6 – demonstrated in simulated socio-ecological context
- SRL 5 – validated in simulated socio-ecological context
- SRL 4 – socio-ecological context validated
- SRL 3 – socio-ecological context proof of concept
- SRL 2 -- proposed solution in socio-ecological context
- SRL 1 – societal problem in socio-ecological context

Need S-KPIs and SE-KPIs



Living assets: the real and only source of innovation

People and organisations learning from nature

Six critical nature-inspired qualities of a growing number of the most successful companies (nature's good advice)

1. ***Decentralised, self-organising networked structures:** e.g. self-leading teams*
2. ***Regenerative life strategies:** e.g. evolutionary principles of survival and reproduction*
3. ***Frugal innovation:** optimising resource use, as in circular systems*
4. ***Openness to feedback:** internal and external communication for adaptive learning*
5. ***Symbiotic behaviour:** linking individual and societal wellbeing*
6. ***Consciousness:** (an emergent quality)*

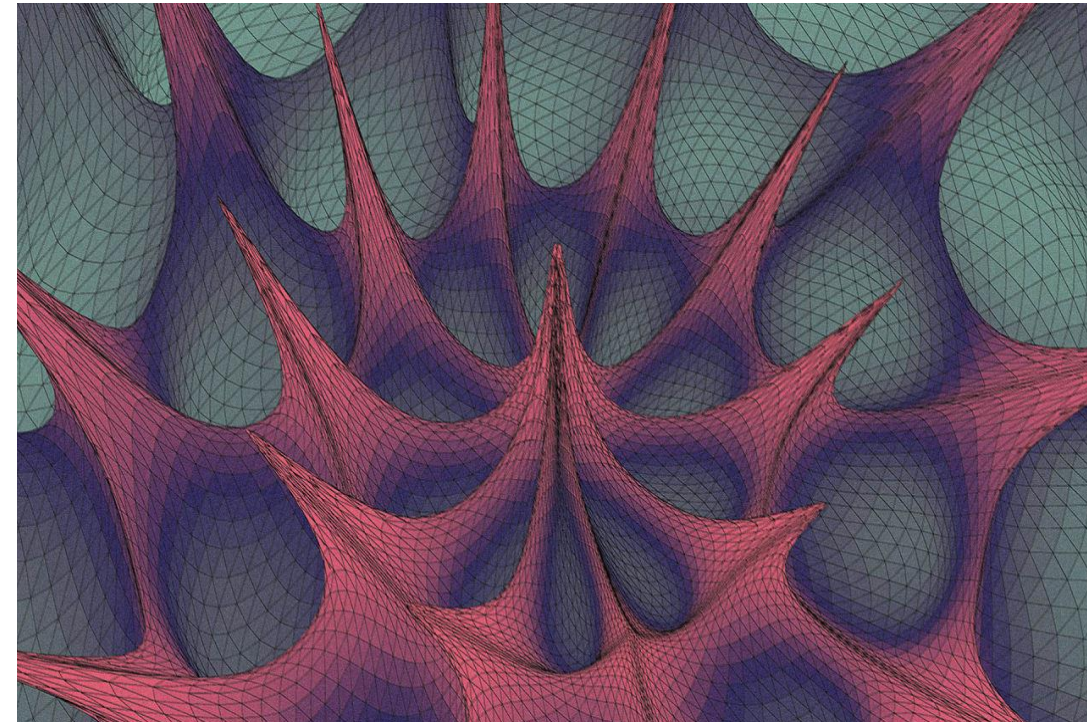


Living assets: the real and only source of innovation

Technology learning from nature

- Nature has had 3.8 billion years of making evolving successful and resilient designs from simple materials
- Re-design manufacturing to mimic nature and escape mistakes of previous industrial revolutions
- Additive manufacturing (including 3D printing) creates little or no waste because it forms objects to shape without molds or cutting.
- Most material can be sourced from local, common and abundant ('waste') feedstocks: plastic, metal, glass, fabrics, biomass, etc., thus is part of a local circular economy that drastically reduces shipping.
- Nature creates spiders webs, silk, bones, shells, skins, feathers, etc. in same way: strand by strand, layer by layer.
- Four key aspects: local sourcing, smart structure, safe chemistry, and reverse logistics (i.e. 'unzippability', dis-assembly & re-assembly)

3D
PRINTING



(Benyus, 2015)



Final thoughts on the 4th Industrial Revolution and the socio-ecological revolution

- When we have a societal or technological challenge: the first impulse should be how has nature solved it?
- The real enabler of innovation is not smart data or smart technology (these are simply tools) but the living assets of people and nature.
- Don't 'exploit' living assets (people and nature) as this creates systemic resistance. Instead, nurture them as both are the source of all value and innovation (both monetised and non-monetised), in addition to having their own intrinsic value.
- With people and nature in symbiosis "there resides enormous intelligence, much of which remains untapped...for example, we should model organisations and technology on living systems.." (Bragdon, 2016)

