Industry 4.0, Systems and the Circular Economy

Dr David Cole. Edinburgh Business School

Bruce McNaughton

Seymour Hersh MA

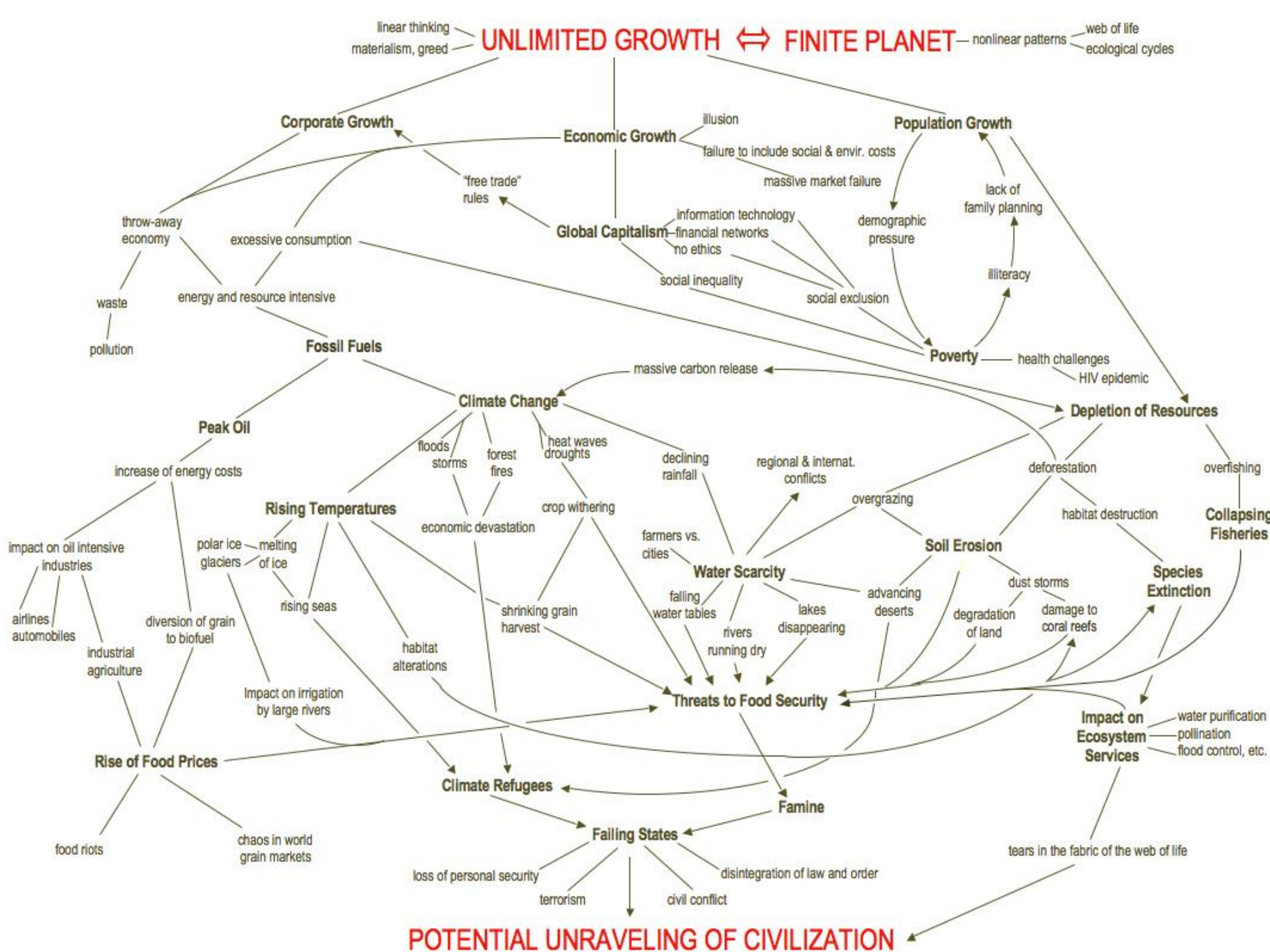
- Two areas of unprecedented change are underway
- The root cause of the crisis should be seen as largely a crisis of perception. We are some way into a paradigm shift
- Technologies are increasingly being used to augment human cognition, the digital is merging with the physical, and is ever more encroaching into the processes of life. We need a moral compass.
- Technology is not neutral, it both shapes and is shaped by consciousness
- As an antidote to the mechanistic metaphor we present a biomimetic model of a city as a living complex adaptive system, where the circular economy is central, that is being used to align technology projects with social and ecological priorities

Introduction

David Cole
Bruce McNaughton
Seymour Hersh

HERIOT WATT UNIVERSITY

The GRID


linear thinking
materialism, greed
UNLIMITED GROWTH ⇔ FINITE PLANET
nonlinear patterns
web of life
ecological cycles
Corporate Growth
Economic Growth
illusion
failure to include social & envir. costs
massive market failure
Population Growth
"free trade" rules
throw-away economy
excessive consumption
Global Capitalism
information technology
financial networks
no ethics
social inequality
social exclusion
demographic pressure
lack of family planning
illiteracy
waste
pollution
energy and resource intensive
Fossil Fuels
Poverty
health challenges
HIV epidemic
massive carbon release
Climate Change
Depletion of Resources
Peak Oil
increase of energy costs
floods
storms
forest fires
heat waves
droughts
declining rainfall
regional & internat. conflicts
deforestation
overfishing
overgrazing
habitat destruction
Collapsing Fisheries
Rising Temperatures
economic devastation
crop withering
impact on oil intensive industries
polar ice
glaciers
melting of ice
farmers vs. cities
Water Scarcity
Soil Erosion
Species Extinction
airlines
automobiles
industrial agriculture
diversion of grain to biofuel
rising seas
shrinking grain harvest
falling water tables
rivers running dry
lakes disappearing
advancing deserts
dust storms
degradation of land
damage to coral reefs
habitat alterations
Impact on irrigation by large rivers
Threats to Food Security
Impact on Ecosystem Services
water purification
pollination
flood control, etc.
Rise of Food Prices
Climate Refugees
Famine
Failing States
food riots
chaos in world grain markets
loss of personal security
terrorism
civil conflict
disintegration of law and order
tears in the fabric of the web of life
POTENTIAL UNRAVELING OF CIVILIZATION

The 4th Industrial Revolution Megatrends

- Artificial intelligence
- 3D printing
- Robotics
- Materials science
- Token Economies
- Hydrogen storage cells/ battery
- Game based learning
- Blockchain
- Big data/machine learning
- EdTech
- Biotechnology
- Cloud Computing
- Solar cells/wind turbines
- FinTech
- EdTech
- Cloud computing
- Solar cells/wind turbines
- Nanotechnology
- FinTech

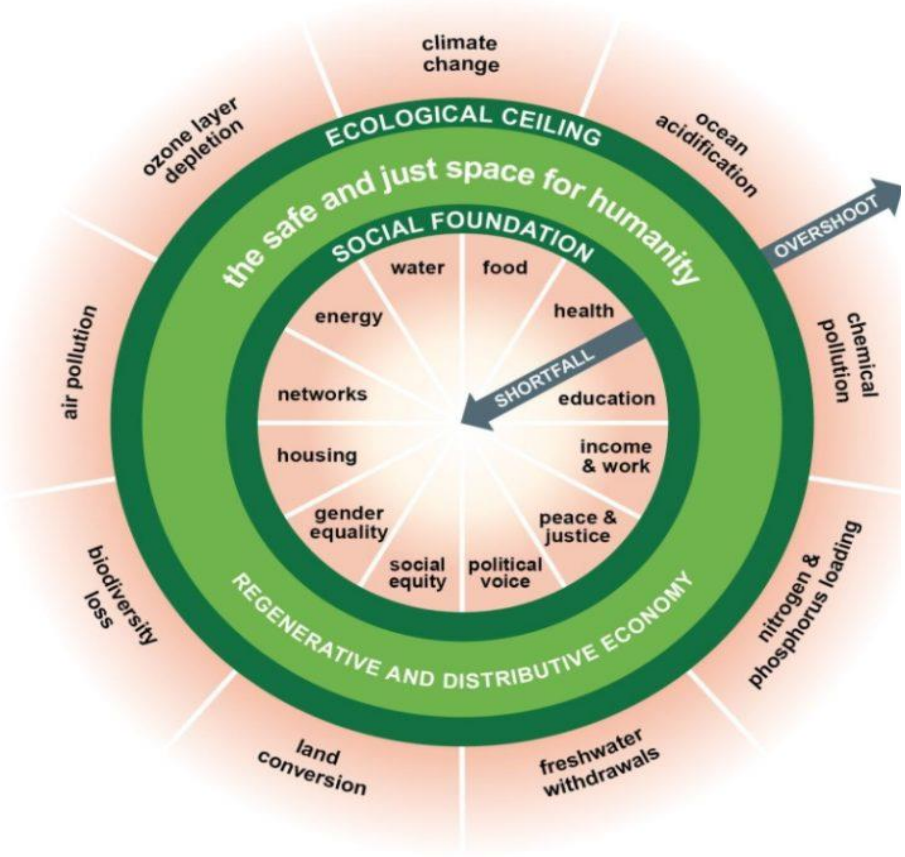
Goal seeking – Values and aspirations

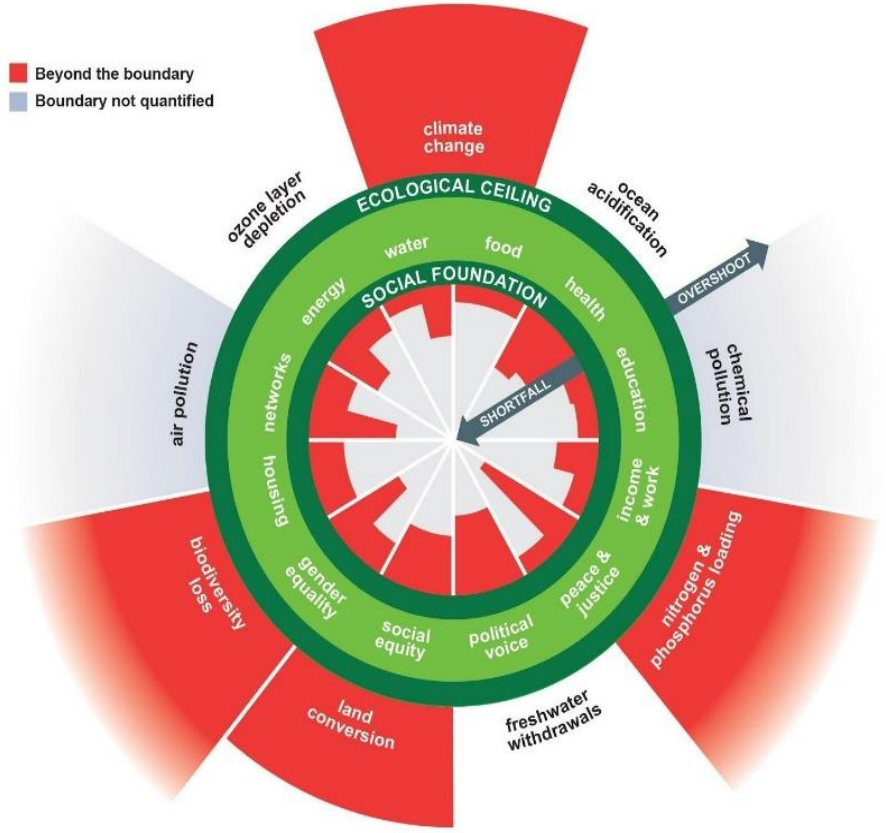
The United Nations Sustainability Goals

EARTH CHARTER PRINCIPLES

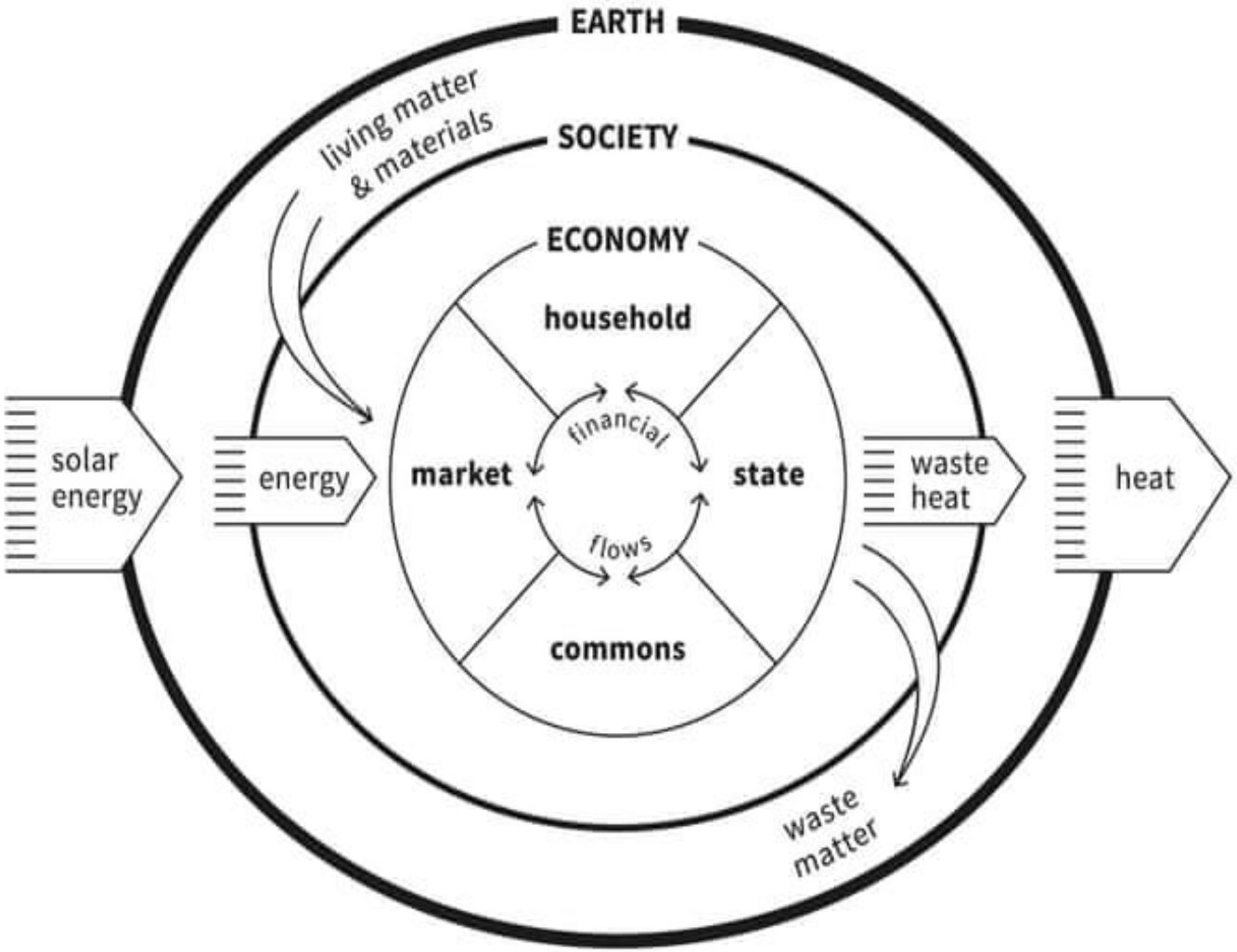
- *Respect and Care for the Community of Life*
- *Ecological Integrity*
- *Social and Economic Justice*
- *Democracy, Nonviolence and Peace*

Goal seeking, values and morals – The Doughnut Economy

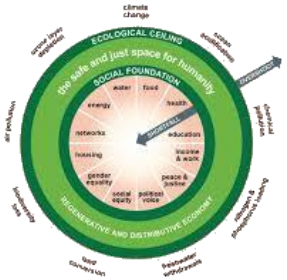




The embedded economy



WHY



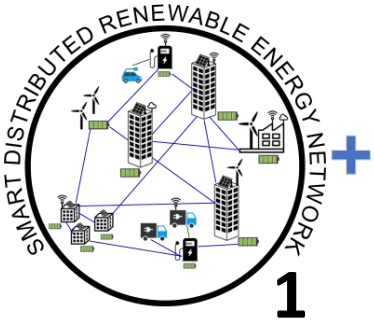
Doughnut economics

EARTH CHARTER PRINCIPLES

- *Respect and Care for the Community of Life*
- *Ecological Integrity*
- *Social and Economic Justice*
- *Democracy, Nonviolence and Peace*

Non - linear Macro Economics
The "doughnut economy"
"meeting the needs of all within the means of the planet"

UN Sustainability Goals



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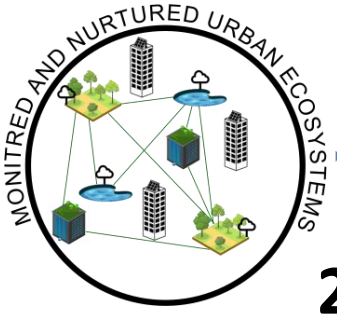

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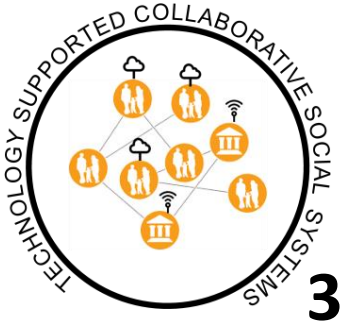

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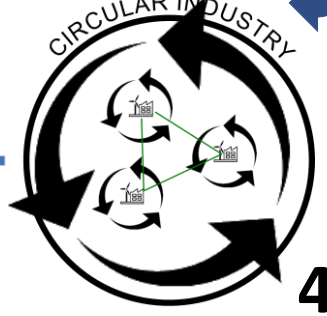

4

HOW

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5

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6

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7

Non - linear Micro Economics City Economy

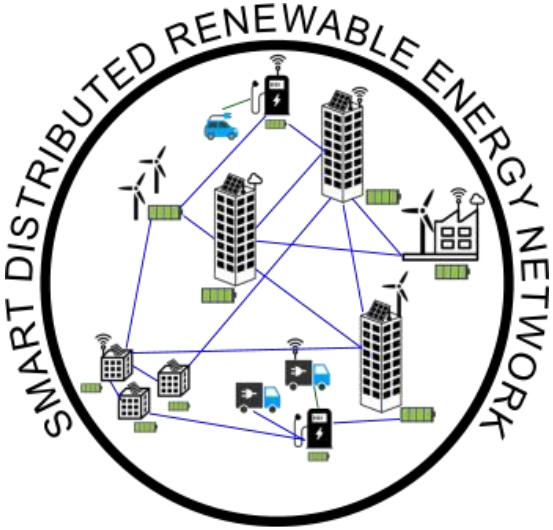
WHAT

Sustainable Society

Human Cognition

Living Systems Paradigm

Smart Distributed Networks of Renewable Energy and Transport



- ReFLEX Orkney
- Smart Energy Systems Group
- Smart Transport Systems Group

Doosan Babcock

Orkney Islands Council

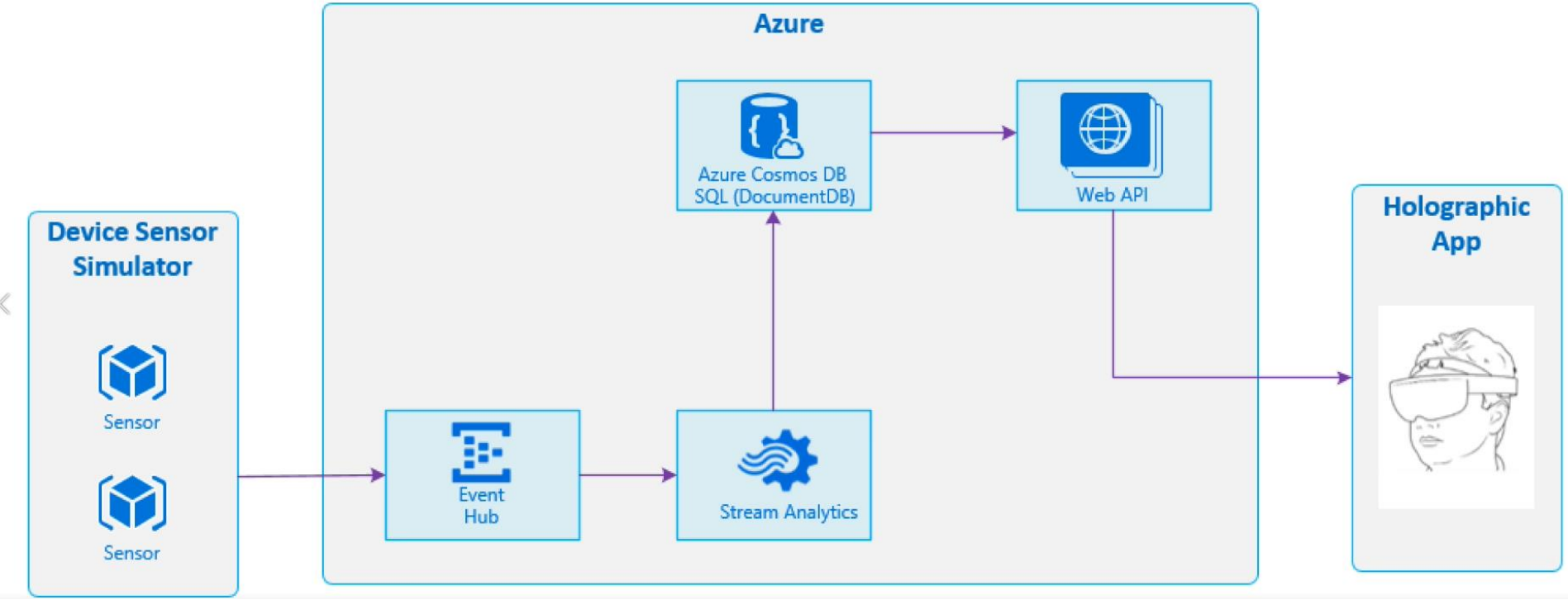
Video Placeholder

- http://www.emec.org.uk/press-release-energy-system-of-the-future-to-be-demonstrated-in-orkney/

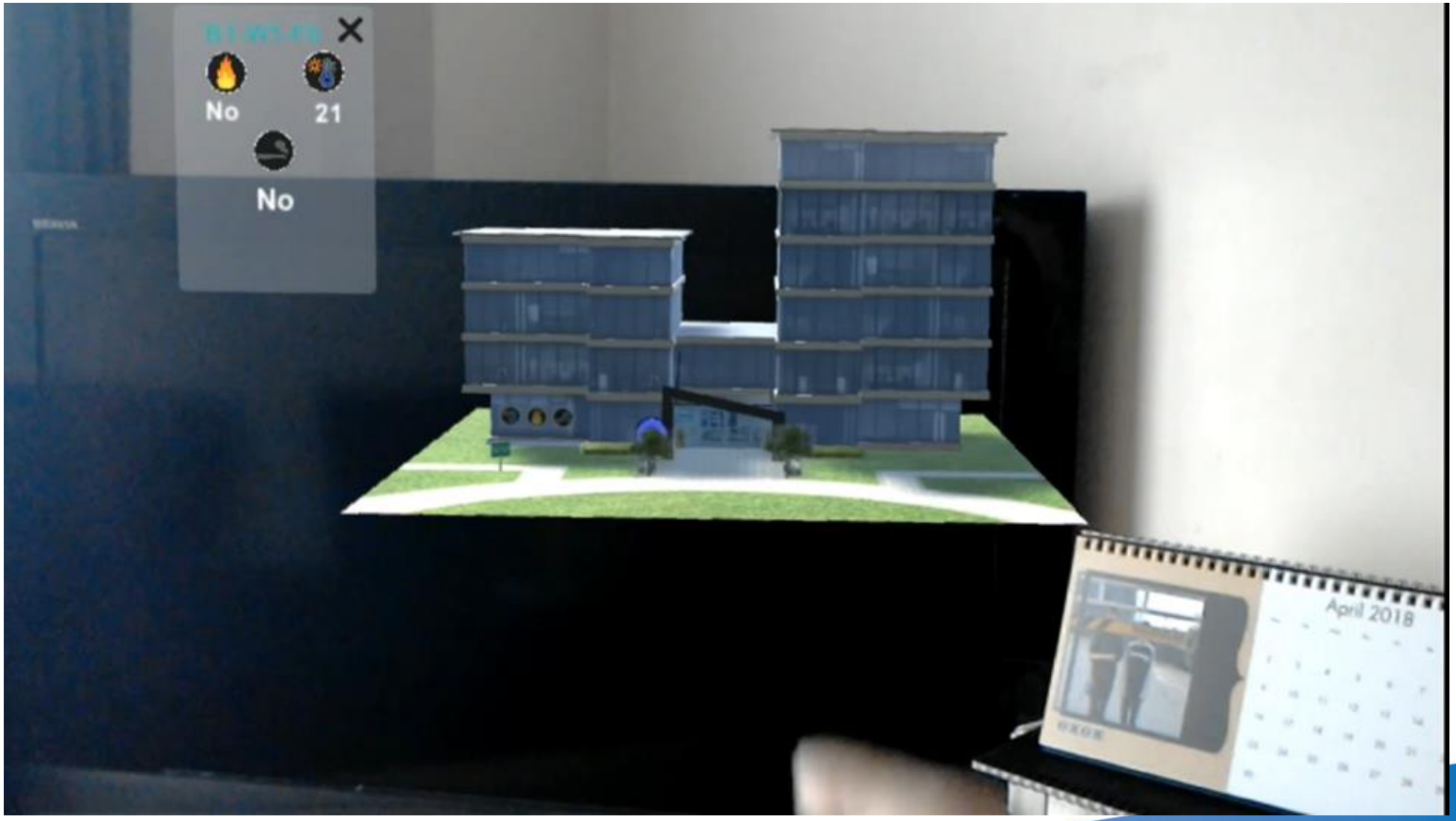
CIRCULAR INDUSTRIES

	INTELLIGENT ASSET (IoT) VALUE DRIVERS		
CIRCULAR ECONOMY VALUE DRIVERS	Knowledge of the location of the asset	Knowledge of the condition of the asset	Knowledge of the availability of the asset
Extending the use cycle of an asset			
Increasing utilisation of an asset or resource	SMART manufacturing	SMART temperature sensors SMART manufacturing	SMART manufacturing
Looping/cascading an asset through additional use cycles			
Regeneration of	Fish-Eye, CBED, IWKRAMA		

Smart temperature sensors with holographic interfaces



Smart temperature sensors with holographic interfaces



Regeneration of Natural Capital

- Iwokrama's invisible river carbon: Bringing rainforest science into our daily lives using the digital revolution

Dr Ryan Pereira, Sara Trojahn The Lyell Centre. Heriot-Watt University

Dr David Cole. Edinburgh Business School. Heriot-Watt University

nctech
virtualizing the world

Iwokrama

- promote conservation and the sustainable and equitable use of tropical rainforests in a manner leading to lasting ecological, economic and social benefits to the people of Guyana and the world by undertaking research, training and the development and dissemination of technologies
- Understand carbon transport with regards to land use an ecosystem services

CBED – citizen science

Michel J. Kaiser, Jo Porter, Kate Johnson, Mike Bell & Sandy Kerr
Lyell Centre Heriot-Watt University

- This citizen-science project will develop data resource of the diversity of life living on the seabed around Orkney.
- Green-tourism activities (e.g. wildlife watching boat trips) are used to create an interactive image database of what is on the seabed
- Tourism funds the project
- Engage fishers, schools, communities and citizens

CBED – citizen science

Pressures on the sea bed:

- Trawling and creeling
- Renewable infrastructure
- Pipelines, cabling, anchoring
- Maintenance dredging

CBED – citizen science

Ecosystem services

- Nutrient Cycling
- Carbon storage
- Biodiversity

FishEye

Michel J. Kaiser Lyell Centre Heriot-Watt University

- Over a billion people depend on fish as their primary source of protein
- However, most of the world's fish stocks (90%) have zero information about what, where, when and how much is being caught. True in developed and developing nations

Species on the Edge

- Scottish Natural Heritage
- Amphibian and Reptile Conservation
- Buglife
- Butterfly Conservation Trust
- PlantLife
- The Bat Conservation Trust
- RSPB Scotland

Working across taxa, the partnership aims to safeguard a suite of our most vulnerable species, in need of urgent conservation action.

3D Printing

- Increasingly Biomimetic and materials need to be common, abundant and local.

- Local and small scale businesses serving local needs – GVCS (Global Village Construction Set)

1. Distributed Networks of Finance, Values and Trust

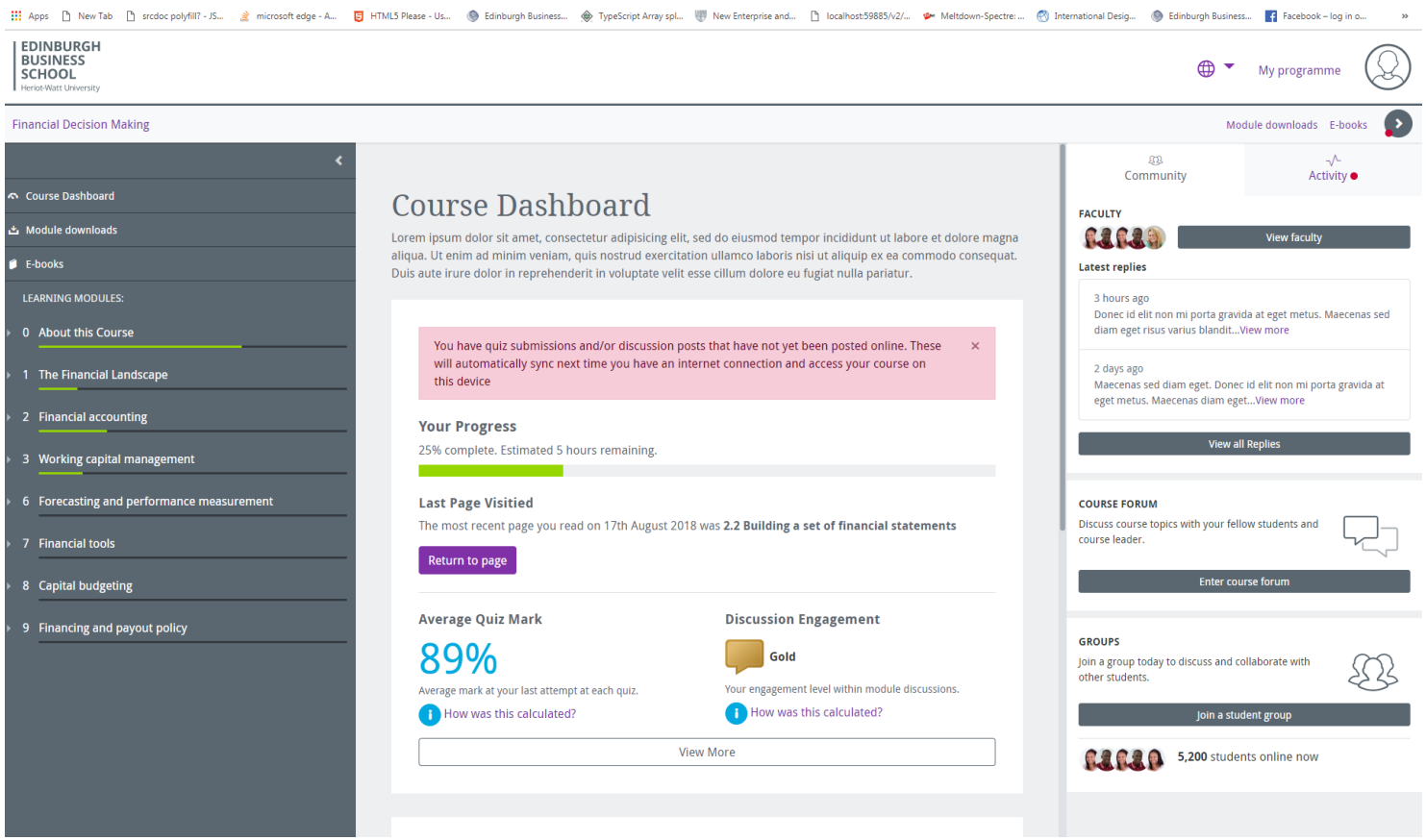
- Blockchain & the Token Economy
- Citizen Science and reward systems
- Behavioural rewards in games
- GRID Multidisciplinary Digital Economy Centre

5. Educational networks
Teaching Ecoliteracy

- Edinburgh Business School Distance Learning Platform
  - Game Based Learning
  - The Virtual Classroom
  - Systems Thinking Workshops

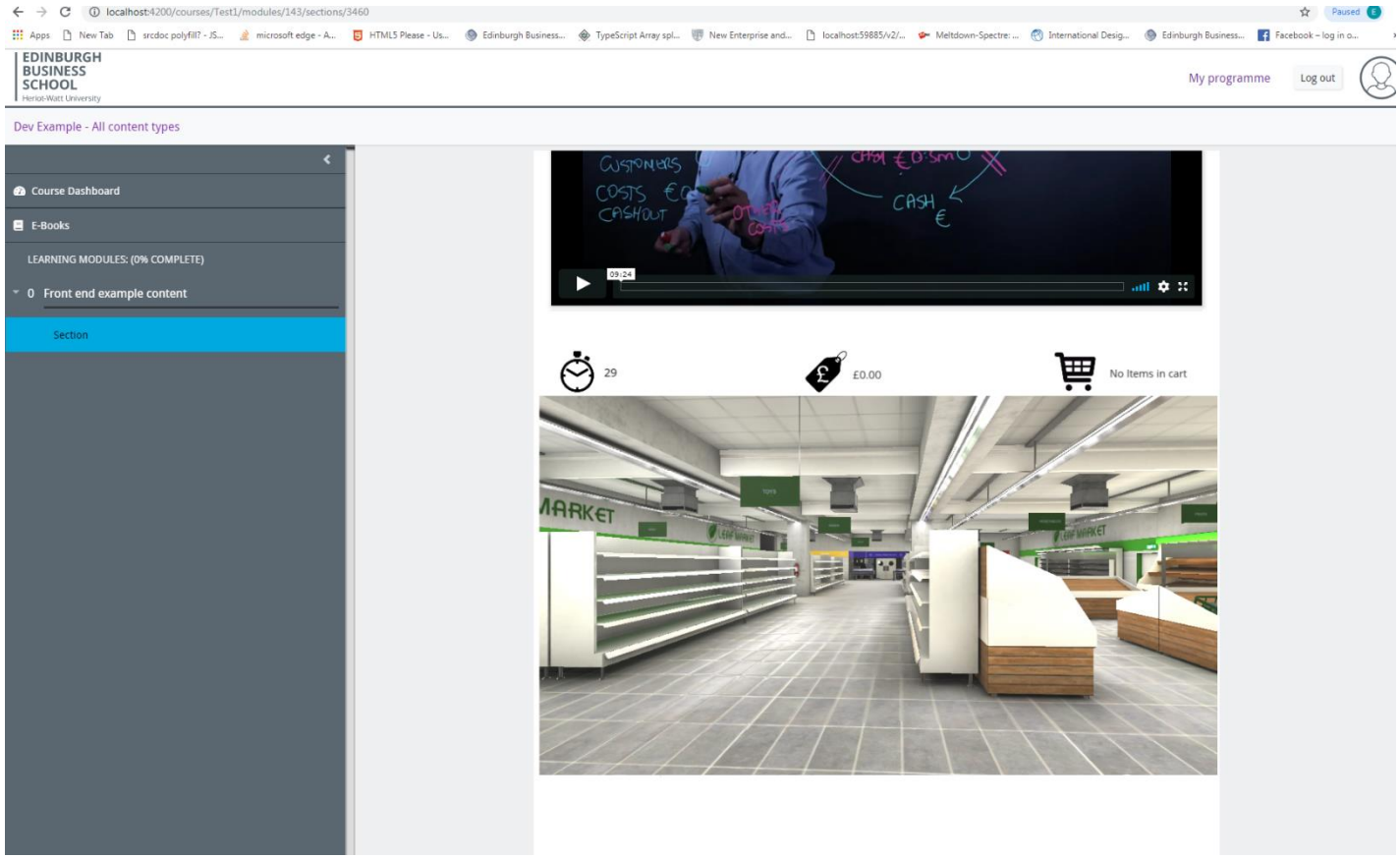
- Cyber Physical Systems

EBS Learning Platform



EBS Learning Platform

Supermarkets and plastics game



beaconing

BREAKING EDUCATIONAL BARRIERS WITH CONTEXTUALISED PERVASIVE AND GAMEFUL LEARNING

Mixed Reality VET

Heriot Watt University

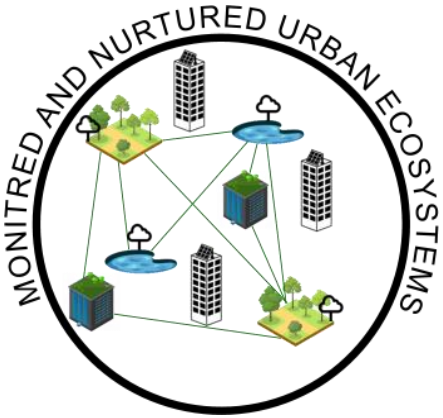
Sam Harper

Theodore Lim

Aparajithan Sivanathan

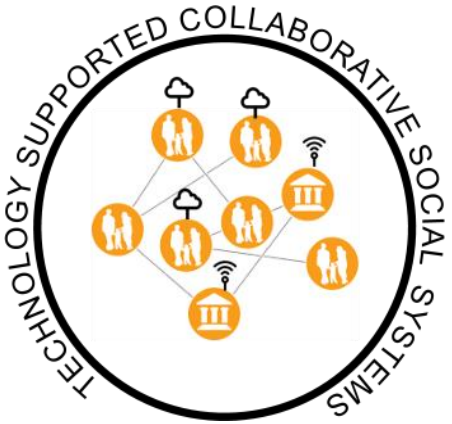
Co-funded by the Horizon 2020 Framework Programme of the European Union
BEACONING - Grant Agreement 687676

Monitored and Nurtured Urban Ecosystems



- Monitoring and encouraging urban ecosystem health, regeneration and connectivity
- Provide natural spaces to engage and learn from nature

Collaborative Social Systems

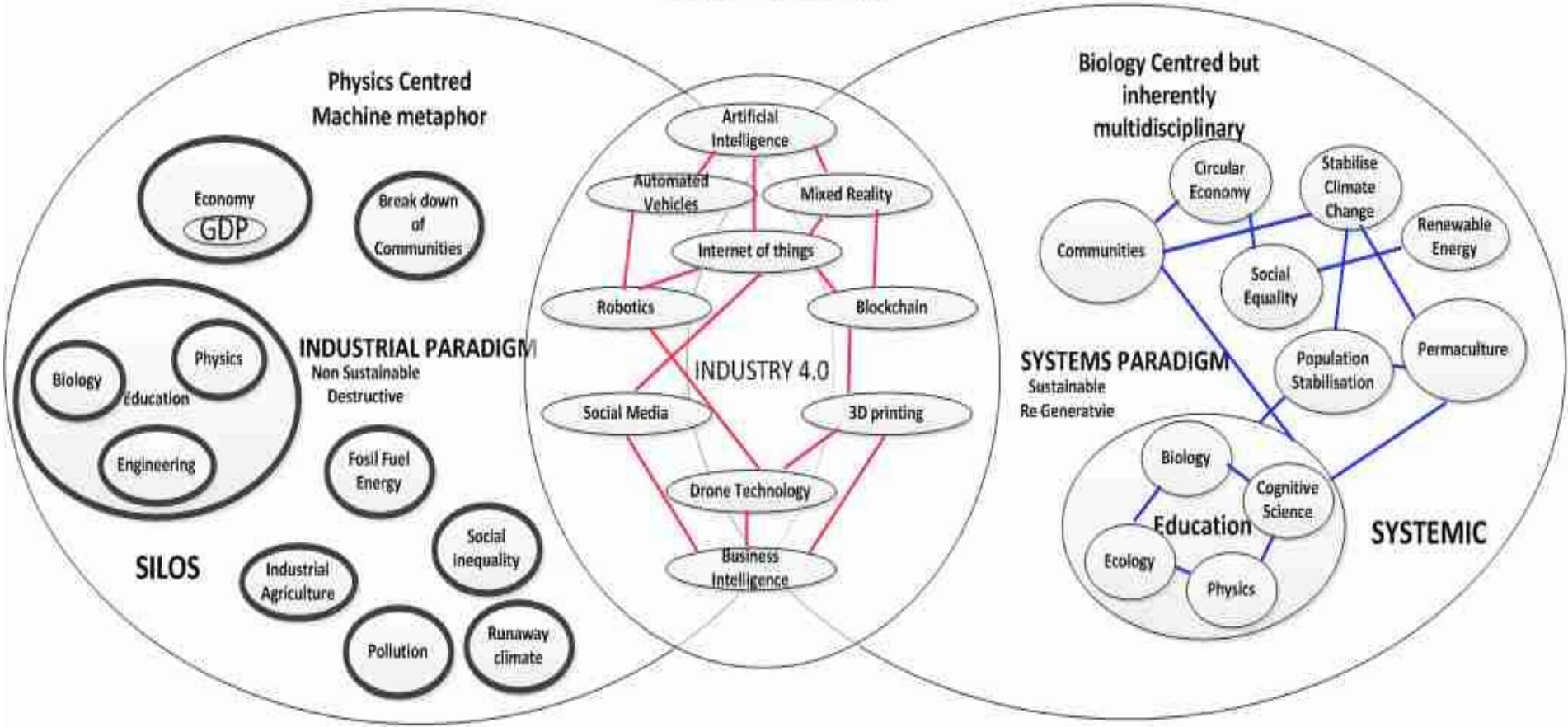


- Support the emerging collaborative commons
- Therapeutic Virtual Reality

Mel Mckendrick School of Social Sciences
Amelia Morgan Chief Exec Venture Trust

The Dark Web and the Shadow Side

- Fake news, disinformation, state interference
- Dangerous and anti-social behaviour
- Cyber crime, Cyber warfare, terrorism
- Systems failure and fault tolerance

The Double Edge Sword

From Parts -> Whole
Objects -> Relationships
Quantities -> Qualities
Structure -> Process
Objective -> Epistemic
Cartesian Certainty -> Approximate knowledge
Competition -> Collaboration
Linear -> Non-linear