DEEP TRANSITIONS LAB
FOR TRANSFORMATIVE INVESTMENT

Briefing package in preparation for the Deep Transitions Lab Session for the Complexity Summer School Session

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August, 2024

Contents

1. Introduction

A monumental task lies ahead of us. Unprecedented yet predicted heat waves, droughts, floods, food shortages and wildfires rage across Africa, the Americas, Asia and Europe. The evidence-based consensus among international organisations, such as the Intergovernmental Panel on Climate Change (IPCC) and the UN Office for Disaster Risk Reduction, is that a 'business-as-usual' approach will lead humanity to a catastrophe.

In order to avoid widespread human suffering and loss, the world requires committed individual and collective action. Nevertheless, while recognising the critical role of coordinated social action in transformation has fuelled increased initiatives to build a sustainable future, there is a long way to go. Simply doing 'more' is not sufficient to tackle these challenges. Neither technology alone can respond to the poly-crises that we are currently facing. Instead, finding our individual and collective role in changing provision systems, such as energy, mobility and food, towards a circular, low-carbon, more decentralised, inclusive, and resource-efficient economy is a responsibility we all share.

2. Systems analysis and rules for Deep Transitions

2.1. The Need for a Paradigm Shift

Disruptive, fundamental and systemic change is needed to transform global civilisation and move towards a more environmentally sustainable and socially just world. Decades of academic research, ambitious policymaking, and development practice have demonstrated the limited successes of addressing the twin crises of global environmental change (including climate change, pollution and biodiversity loss) and social inequality (including poverty, food insecurity and structural violence) through the pursuit of incremental change. A paradigm shift is needed in which more fundamental, systemic transformation is placed at the centre of such activities.

The Deep Transitions theory aims to understand and help catalyse fundamental, systemic, and lasting change. The result is a conceptual framework that places the process of multiple systems change at its centre, emphasising the need for the co-evolution of myriad aspects of society (such as businesses, policy, science, and culture) in new sustainable and equitable directions.

2.2. Socio-Technical Systems

Socio-technical systems are systems for the provision of societal needs, such as food, energy, or mobility. When we talk about systems change, this is the concept we propose.[1] Deep Transitions

[1] For a deeper explanation of all the core concepts included in this section, including socio-technical systems and their dynamics, rules and meta-rules, please see Schot & Kanger (2018) and Kanger & Schot (2019) in Further Readings.

provides a framework to understand how significant changes in systems (single and multiple) occur over time. In simpler terms, it allows us to analyse and influence the speed and direction of significant changes in various systems. A "transition" refers to the process of shifting from one state to another within a system. In sustainability transitions, a systemic transition is seen as an ongoing journey marked by various interconnected pathways evolving over time and space. In our upcoming discussions, we'll explore socio-technical systems, which consist of three key elements: 1) the individuals involved, 2) the rules guiding their behaviour, and 3) the visible outcomes of these rules in specific aspects of the system. (figure 2). These components support each other: actors use rules to construct, curate and maintain the elements. These elements then keep the actors and rules in place because they generate sunk investments, specific interests, power relationships, and cultures.

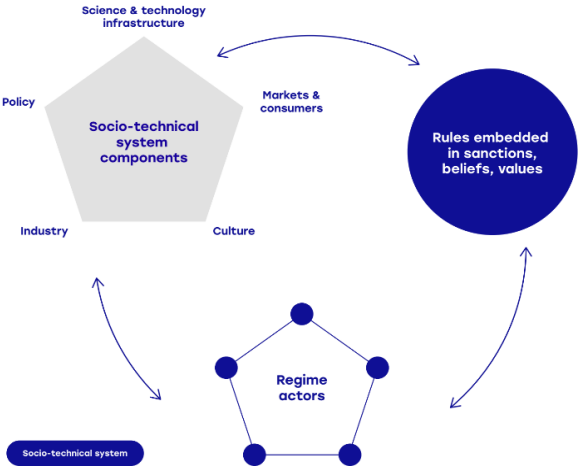

Figure 2. Configuration of socio-technical systems

Take a moment to look at the two figures below, one depicting ship production in the Venetian Arsenal in the 1790s and the other at a slaughterhouse in Cincinnati in the 1870s. Can you spot what they have in common?

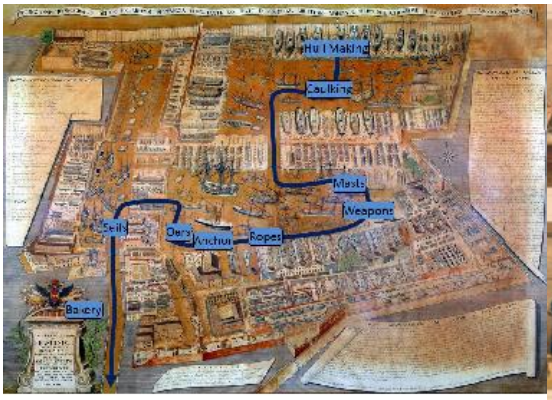

Figure 2. Venetian Arsenal in the 1790s

Figure 3. 1870s slaughterhouse in Cincinnati

If you think "they both seem to follow a similar production principle," you are off to a good start. It is indeed the case that both figures exemplify the "move work to worker" meta-rule, with Venetian workers driving the ship through a channel to assemble it and Americans moving pig carcasses around for a contrary purpose. However, regarding the shared underlying principle, both are arguably precursors for Henry Ford's famous moving assembly line.

The notion of "rule" is used in the Deep Transitions framework to spot such similarities between seemingly quite diverse socio-technical systems in different geographical locations and times. Socio-technical systems are understood as interlinked technologies, business models, regulations, user practices, and symbolic meanings providing crucial societal functions such as energy, food, mobility, or waste management. Rules are the underlying principles, values, norms and expectations that guide actions and behaviours among actors. The routines followed in factories, farms, bazaars, and government departments are all due to the rules embedded in systems.

Here is another example of similar rules in different systems: Food systems in the Central Valley of California in the 1960s and the Paris Basin in the 2020s might initially seem quite different. Still, a closer look reveals that the basic operating principles of the two are remarkably similar. For example, both rely primarily on mechanised commodity food production, extractive view of the environment, predictability, and stability through control and standardisation. The collection of interrelated and mutually reinforcing rules (thereby creating a stabilising effect) driving a particular system is called "regime" in systemic transitions theory. If the regime is unsustainable, it necessitates a fundamental shift, encompassing the transformation of underlying beliefs and values (rules). These three concepts, "socio-technical systems," "rules," and "regimes," are central to this workshop.

2.3. Meta, Vulnerable, and Resilient Rules

Rules, regimes, and systems are not static. They evolve over time because of technological, economic, political, social, and cultural pressures. This means that the strength of the rules driving the systems varies over time. Some rules may be quite resilient to change at a particular moment, whereas others may be more vulnerable. For example, the "use fossil fuels for propelling the vehicles" rule was extremely strong in the mobility system 50 years ago but has been steadily eroding with the emergence of electric vehicles. Vulnerable rules may act as starting points for changing regimes, thereby enabling systemic change.

Since a deep transition requires changes among different systems and implies creating and consolidating new linkages between systems as well as breaking unsustainable linkages, the concept of meta-rule is critical. A meta-rule is a rule manifested in multiple socio-technical systems, for example, using fossil fuels in energy, agriculture, and mobility systems. Unlike specific routines or practices which pertain to individual components or aspects of a system, meta-rules operate at a higher level, influencing the formation and evolution of rules themselves. In the next section, we will explore meta-rules characterising the influence of digitalisation and sustainability on existing socio-technical systems.

2.4. Surges of development

Historically, the Industrial Revolution has unfolded in five "great surges of development": 1) cotton and fabric production from the 1770s; 2) steam and railways from the 1820s; 3) steel, electricity, and heavy engineering from the 1870s; 4) oil, car and mass production from the 1910s; 5) information and telecommunication from the 1970s.

The foundational rules underpinning each surge were first connected to each other, particularly "exemplary" systems, e.g., mass production pioneered in the mobility system and digitalisation in the communication system. From there, these rule sets started to gain a foothold in several systems, thereby becoming "meta-regimes," e.g., mechanised and electrified production of standardised products from interchangeable parts being used for tractors (from the 1910s), consumer durables (from the 1920s), tanks (World War II), and electronic devices (from the 1950s).

We are currently on the verge of another surge, focused on sustainability-related solutions. This one effectively aims to address the global socio-environmental impacts of the 4th surge (mass production/consumption), hoping that the potential of the 5th surge (digitalisation) can be at least partially harnessed for this purpose as well.

We will now proceed to briefly sketch the general features of the digitalisation and sustainability meta-regimes (collection of rules manifesting in multiple systemic regimes).

2.4.1. Digitalisation

The fifth surge is constituted by the meta-regime of digitalisation. Digitalisation is central to discussions around the direction of prospective transitions to sustainability and the prospects of a second deep transition. The story is complex, but research undertaken in Deep Transitions has highlighted how the build-up of digitalisation has, at best, contributed to the optimisation of the First Deep Transition (through, for example, greater efficiencies in the manufacturing process) and, at worst, contributed to unsustainable trends. This is evident by the increasingly large energy use of computer servers and infrastructure, the continuation of a linear production model and built-in obsolescence (mobile phones), the continuation of north-south divides, and resource exploitation for rare earth metals. This has contributed to the negative effects of digital technologies in terms of polarisation and social disunity and increasing societal inequalities related in part to the vast concentrations of wealth in a few large technology companies. On the other hand, to integrate multiple systems, such as energy and mobility, the rapid exchange of information is required to enable flexible systems that can respond to varying demands in real-time. More human-centred use of digital technologies to empower communities and utilising digitalisation to contribute towards sufficiency rather than efficiency are also increasingly discussed. Thus, the crucial consideration is to what extent digitalisation can contribute to sustainability pathways and how current rules need to be adapted or changed to achieve this contribution. Several rules that constitute the current digitalisation meta-regime have been proposed in the DT lab research:

1. **Datafy:** aim to convert information or processes into a digital or structured data format.

2. **Personalise:** aim to tailor or customise according to individual preferences, characteristics, or needs.
3. **Servitise:** strategic shift of a business model from product-oriented to service-oriented, emphasising the provision of services alongside or instead of traditional products.
4. **Gamify:** incorporating game elements or principles into non-game contexts, such as applications or processes, to enhance engagement and user experience.
5. **Design for modularity and interoperability:** aim to create products with interchangeable, independent components to enhance flexibility and compatibility.
6. **Intensify interactivity:** aim to enhance and increase the level of engagement and collaboration within a digital environment.
7. **Predict behaviour:** forecasting or anticipating future actions and responses based on observed patterns and data analysis.
8. **Trade user data:** exchanging or selling personal information of individuals for targeted advertising or analytics.
9. **Platform economy:** aims to facilitate user exchanges and interactions, creating value through network effects and shared resources.
10. **Move fast and break things:** a rapid, experimental approach to innovation, accepting that some failures may occur in the pursuit of progress.

2.4.2. Sustainability

In contrast to historical meta-regimes, the direction of sustainability-related solutions is very uncertain and heavily contested. Nevertheless, it is possible to identify at least 10 nascent rules guiding technological and social innovation in a number of systems, sectors, markets, and geographical locations. While some of these have already been linked to each other (e.g., rules 1-5 in the circular economy vision), there is currently no "exemplary" system connecting all of them. The rules are:

1. **Refuse:** aim to prevent the use of unnecessary items.
2. **Reduce:** aim to prevent the amount of waste generated.
3. **Reuse:** aim to maximise the use phase of the product.
4. **Repurpose:** aim to adapt existing products for multiple uses.
5. **Recycle:** aim to turn waste into input for another product cycle.
6. **Design for durability and circularity:** aim to enable new types of product handling such as pervasive repairability or rent-based consumption.
7. **Decarbonise:** aim to minimise carbon emission throughout the product's entire life-cycle from raw materials extraction to disposal.
8. **Internalise environmental costs:** an effort to ensure that pricing mechanisms would consider all kinds of environmental burdens on a systematic basis.
9. **Adopt a precautionary principle:** whereas the principle of erring on the safe side has a 50+ year history in environmental policy, recent developments such as Responsible

Research and Innovation have advocated for extending this approach to new technologies, e.g. AI and geoengineering.

10. **View humanity as part of nature:** modernisation ideology has often viewed humanity as a pinnacle of nature. The humbler framing recognises humanity's deep embeddedness and dependence on the welfare of the land, water, air, and living things.

2.5. Multiple Systems Change

The Deep Transitions theory of systems change necessitates changing the configuration of a socio-technical system, including the actors, rules and materials. However, simply changing one system is not sufficient as systems are interlinked, and their dominant rules and practices mutually reinforce each other. Therefore, Deep Transitions emphasises the need for aligned co-evolution across multiple socio-technical systems, changing not only single-system rules but cross-system *meta-rules* too. This is the heart of Deep Transitions theory: multiple systems change.

In Deep Transitions, systems change is both fast and slow, complex and uncertain. It is conceptualised as an evolutionary process, constantly moving, acting slowly in principle but also subject to sudden accelerations. The Multi-Level Perspective (MLP), an influential conceptual framework on which Deep Transitions theory is based, emphasises the uncertainty in this process by describing systems change through the interactions between three separate analytical levels: niches (sites of radical innovation, such as new technologies, business practices, consumer behaviours, cultural meanings, policies and more), socio-technical regimes (stable system configurations - collections of actors, rules and materials), and a socio-technical landscape (a broader background context within which systems function). An ideal type transition process is described in Geels & Schot (2007):

> (a) niche-innovations build up internal momentum, price/performance improvements, and support from powerful groups,
> (b) changes at the landscape level create pressure on the regime and
> (c) destabilisation of the regime creates windows of opportunity for niche-innovations.
>
> The alignment of these processes enables the breakthrough of novelties in mainstream markets where they compete with the existing regime (p.400).

This dynamic interaction between niche, regime and landscape varies depending on several factors, so the transition process is not always about regime destabilisation. Sometimes, it involves reconfiguring or renewing regimes. Importantly, as this process unfolds at the scale of systems, no one actor can control the process. Instead, actors, including investors, must navigate systems change through collaborations and conflicts in the context of uncertainty. This navigation can be made more robust through a clear understanding of systems-change dynamics, increased collective action and coordination, and the explicit recognition of systems change as the desired outcome of investments. This is why we argue that investors must reorient their activities towards

multiple systems change while embracing the uncertainty and limited scope of influencing by being just one actor in a much broader and more complex system.

3. Desirable Futures as Guiding Stars

3.1. What is desirability?

While Deep Transitions theory provides a conceptual framework for understanding how multiple systems change unfolds, it is highly valuable to complement this focus on process with a vision of the intended outcome. For example, when developing systems change pathways, it is helpful to first develop a 'guiding star' - a vision of the kind of future system configuration one aims to realise.

Over the course of the Global Investors Panel[2], the Deep Transitions Research Team and a global panel of public and private investors co-created three archetypical future worlds that represent potential alternatives for the food, energy, and mobility systems. These worlds were developed to be *desirable* - meaning that they would address the needs of environmental sustainability and social justice. They would do so in highly different ways. As such, each of these visions embodies differing trade-offs, synergies, costs and rewards for different actors, groups and communities. In short, the degree of distributive, procedural and recognitional justice of each world differs, as does the paradigm through which sustainability is achieved.

Although imaginaries, these three future worlds can help us understand what kinds of futures are ahead of us and can be shaped through collective action. The three worlds' possible transitions in food, energy, and mobility systems can be extended to other systems or re-imagined in specific localities. Importantly, due to their differing implications, these worlds can be used as heuristic devices to encourage us to perceive and situate our actions within a broader context. Through this reflection, we might better recognise and embrace our roles as stewards of change and as world-builders who play critical roles in developing future socio-technical systems.

The three desirable future worlds developed within the Global Investors Panel, in the Deep Transition Futures project, are discussed below:

[2] For more information on the Global Investors Panel, and Deep Transitions Futures Project, please see Schot et al. (2022) in the Further Readings.

3.2. A sufficiency world: After the Frugal Turn

This is a future in which limitless consumption is rejected in favour of living within the earth's means, with minimal needs. Humanity has reduced its global footprint by considering that 'less is more' and has shifted attention to more equitable resource distribution than ever before.

- **Energy:** Regulation and funding drove innovation of low-energy intensive products, services, and industries. Energy efficiency is the key guiding principle.
- **Food:** Scarcity caused by crop failures led to a race to zero waste. Local, national, and global agricultural systems were optimised to provide equal and sufficient food, with the few no longer able to enjoy excess. Precision agriculture, localisation of food markets, and degrowth are key in this world.
- **Mobility:** Individual mobility is no longer associated with freedom. Instead, societies embraced a localisation of needs-provision. Advances in digitisation removed the necessity of excessive travel.

Challenges still remain, and the world is far from fully sustainable. Nonetheless, striving for reduced consumption and well-being through redistribution, brought a tremendous improvement in the climate, as well as a stunning decline in inequality across the globe.

For more information, see: https://vimeo.com/624596058/cda631d3d2

3.3. A 'Do No Harm' world

As biodiversity plummeted and the degradation of millennia-old ecosystems became ever more apparent, we were shaken out of our profound neglect and disregard for the living world around us. We resolved to transform our systems, working 'with and through nature', understanding that we are only one part of a spectacular indivisible web of life.

- **Energy:** Tremendous gains in the fields of renewable energy sources and decarbonisation. Energy poverty is reduced, even in remote regions. Global society is more connected yet less intensely concentrated.
- **Mobility:** Major investments in public transportation and mobility-as-a-service provided the means for radical change. The 'mobility-as-a-right' movement demanded low-cost, fast, and efficient public transit within and between communities. These services are accessible in both urban and remote regions.
- **Food:** Agriculture transformed from an extractive, polluting, resource-intensive industry to one that is in harmony with nature, and regenerates the natural world. Farmers are recognised as ecological stewards, managing ecosystem health, including both biodiversity and soil health, above all else. Science and policy now engage with the public and indigenous knowledge. Food sovereignty is key.

We are beginning to see the fruits of our labour. Our impact on the planet, in terms of emissions, resource costs, and biodiversity, which was once degrading exponentially, has now stabilised.

For more information, see: https://vimeo.com/624606098/e7083427c1

3.4. An Earthshot world: From Moonshot to Earthshot

Inspired by the spirit of the 20th-century missions to put humans on the moon, a new movement emerged in the 2020s determined to finally deliver on the promise of solving the grand challenges of our time through technological innovation, entrepreneurial spirit as well as rewilding the Earth. The result? A world that only 30 years ago would have sounded like a utopia but is now a reality with a renewed and more than ever emphasis on nature-based solutions, sustainability, and justice.

- **Energy:** Mega-projects in renewable energy sources. The energy system is a globally designed infrastructure that consolidates balanced power dynamics through a principle of interdependence.
- **Mobility:** Technological advances in the energy system enabled an entirely new mobility system of autonomous, connected, electric and shared vehicles. Immense green subsidies allowed lower-income markets to leapfrog developed countries directly into electric mobility, while electrified delivery by quadcopter drones drove innovation in product design to the point that aerial delivery became an option even for most rural and remote areas.
- **Food:** Growing networks of DIY biohacking 'communities'. New food products emerged to suit all conditions across the globe including efficient use of land, such that parts of the

land can be used for rewilding the planet; building open-source digital libraries of genomes to allow new foods to rapidly proliferate across the world.

The realisation of green growth for all, through technological change and ecological resilience has been made possible with the consolidation and democratisation of global systems of innovation. This system epitomises the triumph of the '*homo faber*' over nature: the ability of human beings to control their fate and their environment through good intentions and innovations.

For more information, see: https://vimeo.com/624522171/e7e634622d

4. Use of concepts in the session

We have delved into the key concepts that will be pivotal in the upcoming session. The focal point is to explore rules, encompassing both present norms and future expectations and look into the role of niches in transformation pathways. This exploration aims to enhance our comprehension of the existing food, energy, and mobility systems, delineate necessary changes, and identify opportunities for transformation. We will explore how niches are keystones for making the transition feasible and will ignite discussions to confront complexity and uncertainty from a framework that allows us to understand system change processes. The session will be a space for knowledge co-creation (one where we believe each participant has new insights to offer; we learn from each other and co-produce new knowledge on the systems, rules and visions) to collectively establish the foundations for deep sustainability transition practices.

5. Further Reading

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