

MISC: Mapping Innovations on the Sustainability Curve A methodological framework to accelerate the transition towards Commons Oriented Responsible R&I Systems

Dr. Anne Snick

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Summary

For decades we have thought the planetary problems could be solved by means of technological innovations. This nourished the idea that growth remained possible if only it became 'greener'. The emphasis on continuous growth is not based on knowledge of natural or physical laws, but on an (untenable) social construction. Therefore 'innovation' of these social constructs underpinning a lot of R&I is urgently needed today. This paper focuses on how this transition towards a broader paradigm can be facilitated. It proposes a methodological framework for unravelling lock-ins and facilitating transition by 'Mapping Innovations on the Sustainability Curve' (MISC). The framework consists in a dynamic systems maps reflecting the structural characteristics of sustainable systems and includes insights on economic and monetary transition. It allows to explore missing links and leverage points in a transdisciplinary and participatory context, and results in an 'ecosystem' of possible transition initiatives at different levels. It allows various actors to discuss leverages for transition in a transdisciplinary setting. This methodology has been tested in a number of contexts and was evaluated positively by all participants.

Introduction

In 2015 the UN adopted a global agenda for a more sustainable and just world, translated into 17 Sustainable Development Goals (SDGs). SDG 17 calls for all actors to 'join the partnership for the SDGs', thereby recognising that the transition will require the collaboration and cocreation among all societal partners. EU policies on R&I emphasise more and more that R&I should engage with society, respond to big challenges and have societal impact; this endeavour is summarised as 'Responsible R&I' (or RRI). Yet the R&I system is still mainly based on a specialist paradigm; academic experts aim at 'objective' knowledge and often ignore that their innovations in one domain may have unintended negative impacts in other parts of the global system; no one intended to create climate change, ocean acidification, increasing social inequality or super-germs, yet they are all 'man-made' problems. It is increasingly clear that solving these problems will not be possible by doing 'more of the same' but requires a more systemic approach that takes the complex, non-linear and unpredictable nature of our planetary and social systems into account.

The question 'how to accelerate transition?' needs careful reflection. Already in 1972 a report to the Club of Rome (Meadows et al. 1972) demonstrated that the dominant economic practice was not sustainable and would lead to depletion of several natural resources. Millions of copies of this 'Limits to growth' report were sold worldwide, yet the economic system did not change course. In his 2011 lecture in Brussels, Dennis Meadows addressed the question how this was to be explained. He argued that for the past forty years we have thought the planetary problems could be solved by means of technological innovations. Green technology and renewable energy saw the light of day. This however nourished the idea that growth remained possible if only it was made 'greener'. In fact, the focus on technological solutions kept us locked inside a growth scenario. Since – according to the first law of thermodynamics – no matter enters or leaves the earth, it is obvious that growth in one corner of the planet must cause depletion (and/or pollution) elsewhere. The emphasis on continuous economic growth therefore is not based on

knowledge of natural or physical laws, but rests merely on an (untenable) social construction. Meadows concluded that ‘social innovation’ is what is urgently needed today. The focus of this paper is on how this ‘social transition’ can be facilitated, using a methodological framework that is based on insights from systems theory and process ecology as well as on literature on economic and monetary innovation, and that allows different actors (representing politics, academia, business and civil society) to discuss and map innovations for transition in a semi-structured manner, viz. following the outline of a curve that visualises the sustainability parameters of systems.

1. Diagnostic

‘Limits to growth’ was not the only early warning for the present crises. In her publication ‘Silent spring’ (1962) marine biologist Rachel Carson argued that the large-scale use of insecticides would not only kill insects, but also – in the longer run – birds and other animals. Her report was foreshadowing the large (sixth) extinction we witness today. Yet, at the time of its publication, her book has been called ‘unscientific’ and was systematically marginalized. In a similar vein, many scientific reports on noxious effects of various products and practices on human and planetary health have been attacked by what Oreskes & Conway (2010) call ‘merchants of doubt’, scientists paid by industry to cast doubt on scientific evidence of its damaging impact. This reveals that for the transition to take place, knowledge about physical and biological facts does not suffice. As long as the economic interests of scientists and commerce depend on (institutions embedded in) the dominant regime, the latter will continue to win the battle for public and political support and transition will be impeded.

Of course, the economic interests of people - researchers, innovators and entrepreneurs, employees and consumers - are also a (social) ‘reality’ that can be (and frequently is) used as an argument in the debate. In fact, Western economic activity appears to not only cause ecological disasters, but also to keep us from reorienting ourselves. The loss of jobs, the decline of growth and of monetary profit are seen as ‘risks’ of the transition, and consequently economic and ecological concerns are usually seen as ‘opposed’. In other words, the current economic system is founded on premises that do not reflect (nor respect) the planetary reality, but because of its high degree of institutionalisation (in legislation, social security, monetary systems, behavioural patterns etc) many people – including scientists and politicians – think of economics as a ‘given’ phenomenon that must be taken into account in the same way as the planetary or natural system. This obscures the fact that economics are based not on natural laws but on social construction. Economics is a human science and many of its early theoreticians were moral philosophers, theorizing on the question ‘what should be done?’ in order to use scarce resources as efficiently as possible for fulfilling the needs of society (Lasida 2011, Heinberg 2011). It is increasingly clear that growth-oriented economic activity is at the basis of many of today’s crises (IST 2012). The economy is widely recognized as a human practice that endangers our very survival and therefore needs to redefine itself; in other words, economics need to be at the heart of the transition. Some alternative economic models (e.g. ecological economics, Blue economy, P2P economy...) are launched and create their own networks and institutions. However, mainstream economic science remains remarkably absent from sustainability research (Oreskes

& Conway 2014: 14-15). Even companies with an ecological concern still (must) hope to make a profit (and contribute to growth) out of 'green' business models, and so the need for radical economic or eco-monetary transition (away from the growth scenario driven by the 'hunger for more' of a debt-based currency) is obscured. Since economics – as a social science and practice – appears to be a key to transition, the methodological framework presented here brings the social dimensions of transition (and specifically economics) into the equation.

Note that these 'social dimensions' of sustainability or transition do not coincide with the 'people-dimension' of the well-known triple bottom line 'People, Profit, Planet'. Usually the social dimension of sustainability is understood as 'fighting poverty and inequality', in other words correcting one of the *symptoms* of an untenable economic system. Not infrequently this people-dimension is 'opposed to' the planet-dimension. For example, one of the approaches to fighting poverty is (the claim) to allocate 0,7 percent of the GDP to development cooperation. This does not question the growth paradigm (and its impact on the planet) but on the contrary requires an ongoing growth, regardless of its ecological impact. What MISC proposes therefore is not limited to the 'social symptoms' of the present crisis, but addresses its 'social causes', viz. socioeconomic practices as *social constructions* that are the root cause of both social (inequality, poverty, migration...) and ecological (depletion, pollution, climate change...) crises. The economic transition is a 'social' one in the sense that it rests upon the development of a new paradigm and of new systems to 'allocate scarce resources to the needs of all people – including future generations – while sustaining the ecological conditions of life'. This of course has a much larger scope than the concept of 'social economy' as it is used today within the context of neoliberal economics. There 'social economy' refers to initiatives that aim at the (re)insertion of various target groups into the economic system, without however questioning or tackling the mechanisms that lead to their exclusion in the first place. The MISC-methodology concerns the economy in general as a 'social construction' that needs redefining with a view to avoiding both social (exclusion, poverty) and ecological (pollution, depletion) damage. 'Social economy' here refers to economics that are (again) recognized as a human, ethical enterprise that serves needs of all people, including their need for a healthy environment.

Given this 'diagnostic' (of economics as a social construction that plays a key role in the transition) the central question is how to facilitate the 'cooperation' of economic, social and ecological interest groups and how to avoid an ongoing trench warfare among them. The hypothesis at the core of MISC is that a methodological framework based on a combination of process ecology and systems theory can offer a solution; more specifically the hypothesis is that the sustainability curve offers an outline for a systems map that can allow stakeholders from different corners of the system to reflect on what hinders or facilitates transition and to create common ground for political claims.

2. Theoretical underpinnings of MISC

The MISC-methodological framework basically consists in a ‘systems map’ reflecting the structure and parameters of the ‘curve of sustainability’ as described in process ecology. So the theoretical underpinnings of MISC consist in a combination of insights from systems thinking (Meadows 2008) and process ecology (Goerner et al. 2009; Ulanowicz 2015). Moreover, it integrates insights from literature concerning tools and mechanisms for scaling up niche innovations. Orsi (2012) explores legislative frameworks needed to accelerate transition to a sharing economy. Lietaer et al. (2013) offer an alternative for the financial lock-in keeping the regime growth-oriented. These authors offer insights and inspiration for leverages facilitating legislative and monetary break-outs. Previous research on the capacity of the Research and Innovation sector to provide adequate and timely answers to the big challenges has offered insights into paradigmatic, political and eco-monetary lock-ins (IST 2012).

Note that the aim of the MISC-methodology is not to develop scientific or theoretical knowledge, but to facilitate (cooperation of different actors to) the transition and to the development of creative solutions for the complex problems of today. In that sense the concepts developed by process ecology and systems theory are ‘translated to’ a practical context. In order to judge the adequacy of these theoretical underpinnings, the results obtained with the MISC-methodology are more decisive than the theoretical accuracy of (the interpretation of) the concepts underlying it. Yet, these underpinnings show that MISC was not invented out of thin air but was developed as an ‘educated guess’ based on theoretical insights.

2.1. Process ecology

Research into the characteristics of sustainable systems allowed Goerner, Lietaer & Ulanowicz (2009) to describe two parameters determining sustainability. They found that the most sustainable systems are structured as networks (or in ways that can best be described by the metaphor of a network). “Networks depict ... not a determinate world, but one that is partially constrained and otherwise free to change – just the right metaphor to depict process dynamics” (Ulanowicz 2015: 18). The ‘fittest’ networks appear to be characterized by a high level of both efficiency (or ‘order’) and resilience (or ‘freedom’), with a slightly higher emphasis on resilience. “[It] was originally thought that an ecosystem would develop over time in the direction of increasing its efficiency. This hypothesis was not confirmed. Rather, ecosystems networks [...] in a myriad of habitats and environments showed a surprising consistency in their degrees of order at around 40%. Such near-constancy suggests that a particular balance is being struck between internal order (and efficiency) and freedom (often in the guise of redundancy of pathways or inefficiencies)” (Ulanowicz 2015: 20).

Fitness (or sustainability) represents the potential of the system to evolve further, and this is the product of the system’s order (‘efficiency’ or ‘determinism’) times its relative disorder (‘reliability’ or ‘freedom’). These parameters in turn depend on two structural characteristics, viz. diversity (the number of elements in the system), and interconnectivity (the number of nodes connecting those elements). Efficiency is characterized by streamlining, standardisation

and limited diversity. In hyper-efficient systems, diversity is low and is considered a disturbing factor. This limits the capacity of the system to adapt itself to changing contexts and thus makes it brittle. Resilience on the contrary depends on sufficient diversity and interconnectivity, allowing the system to switch to other (diverse) paths or solutions in times of a change in the context. These ‘diverging’ solutions evidently diminish the efficiency of the system since they dissipate the flow and increase the overhead energy required, yet they are of crucial importance for the system to be able to adapt to ‘diverging’ contexts and to rebound in case of a crisis. If the diversity is too high, the flow (of energy or matter) will be dissipated too much, weakening the flow in the system and leading to stagnation. A system is highly sustainable if it maintains a balance (within a window of viability) between resilience and efficiency, parameters which in turn are based on a balanced (‘good enough’) level of (structural) diversity and interconnectivity.

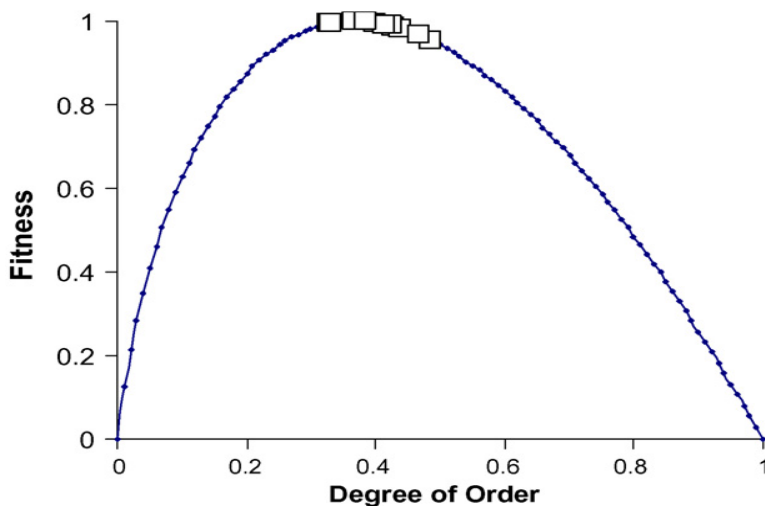


Figure 1: The clumping of articulated ecological trophic networks around the “degree of order” $a = 0.40$ (Ulanowicz 2015: 21)

The balance represents a trade-off between the mutually exclusive properties of efficiency and reliability (Ulanowicz 2015: 21). An example can elucidate how this curve is to be understood. If you have an exploitation of wood for the furniture business, the most ‘efficient’ will be if you have only one kind of wood (say oak) on straight lines with no undergrowth beneath it. This will allow for industrial-scale planting and harvesting (monoculture). However, in case of a crisis (an illness of the oaks, a change in the climate or in consumer preferences ...) the business will go bankrupt (it is not sustainable). A diversification of wood (including e.g. chestnut, beech ...) makes the enterprise fitter, for it can rebound and continue to produce even if there is a problem with one of the stocks (oak). Both ‘alternative’ types of trees also serve the systemic goal (producing wood for furniture), and so the business becomes resilient (or ‘reliable’) in case of a crisis or dramatic change in the context. Should however the diversity become so extreme that there are too many plants that do not serve (or hinder) the goal of the enterprise (e.g. kudzu, black cherry ...), too much energy will go to the ‘overhead’ task of pest control, the energy of the business will be dissipated, and its health will be under pressure.

This analysis has been applied to social systems, and more specifically to economic and financial systems (Goerner et al. 2009; Lietaer et al. 2013; Dron 2015). ‘The necessity of retaining inefficiencies contradicts the conventional wisdom that always advocates maximal efficiency. An example of too much efficiency exists in the economic realm where the efficiency of the market is considered a sine-qua-non. Allowing unfettered market efficiency can lead to social instabilities due to inequities and monetary crises’ (Ulanowicz 2015: 21).

This curve offers a heuristic for judging the sustainability of various systems. By evaluating systems in terms of their efficiency and resilience, it is possible not only to judge their sustainability but also to visualise what is needed to make them more sustainable (e.g. increasing their resilience or their efficiency, governing the balance allowing it to adapt timely, shortening the time lapse in which the system can be readjusted so as to remain within the window of viability etc). This heuristic is useful for evaluating the fitness of different systems, whether it is the fishing business, the economic fabric of a region, the monetary system or a

forestry exploitation. In each of these systems the tendency to streamline processes with a view to increasing the efficiency must be kept in balance with processes that increase the resilience, allowing for a timely adjustment (governance within the window of viability) in case of a crisis or changing context.

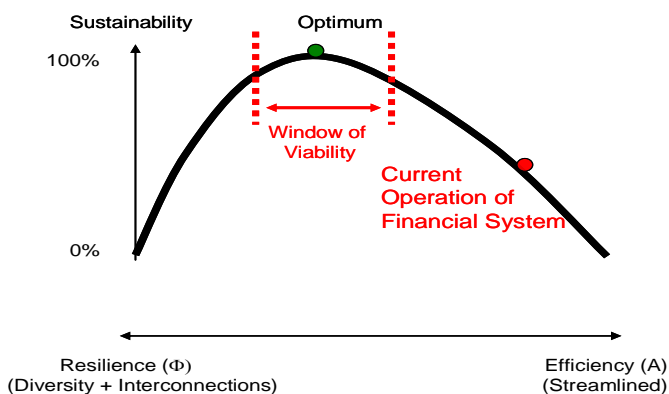


Figure 2: Curve of sustainability of the financial system (Goerner et al. 2009)

In transition literature (Block & Paredis 2012), institutions that are highly efficient and slow to adapt to a changing context are called the ‘socio-technical regime’. It concerns the mainstream institutions that are backed up and reinforced by the dominant paradigm, policies, legislation, behavioural habits etc, making them hard to change. Initiatives that aim at transition by developing alternatives for the dominant model are called ‘niches’. They work ‘outside the box’, and therefore often lack the efficiency and impact to contribute to a timely transition. To give another example, in a successful company the production units will be responsible for the efficiency, producing as much throughput of goods or services at as low a cost as possible (supported by efficient administration, logistics etc), whereas resilience is embodied by the R&D unit that develops new products or services (backed up by specific budgets and management support etc). Both units have different aims (productivity versus innovation), which require

specific infrastructure, procedures, staff qualifications, budgets, performance criteria, etc. If we look at the 'big challenges' of today, often there is so much emphasis on 'efficient' (productive, growth oriented) processes that the 'innovative capacity' of society diminishes; all social institutions are being subjected to the same 'cost-efficiency' parameter, which weakens the social fabric and threatens to make other 'values' disappear. People and nature become exploitable resources for making profit or creating growth, and the capacity to leave this destructive course to safeguard the health of the planet or the social fabric (resilience) is weakened. This explains why strong sustainability needs transdisciplinary innovation including both regime actors and innovators outside the regimes (Dedeurwaerdere 2012) and depends on a quadruple helix (Dijkgraaf 2012) including ngo's that mainly defend systemic goals rather than (or against) private profit or (academic/political) power.

2.2. Systems theory

The aim of MISC is to discuss how transition can be accelerated. It offers a methodological framework to cocreate local solutions to global problems. By bringing together various groups of stakeholders in a transdisciplinary process aimed at a specific goal – without losing sight of the global perspective – it contributes small, feasible and acceptable steps towards a new approach to the challenges and societal goals of today. While the curve of sustainability visualises the structural elements that determine the sustainability (or lack thereof) of a system, systems theory allows us to understand how this can be changed. If the curve of sustainability allows us to make a 'map' of a certain field with special attention to both its efficiency and its resilience, systems thinking allows us to bring in 'the fourth dimension', turning it into a dynamic heuristic for fostering change.

Systems theory is a rich and varied domain; the epistemological justification for the systemic approach at the basis of MISC, see Midgley (2000). Donella Meadows' book 'Thinking in systems' offers a very clear and concise introduction to how complex systems function and gives an overview of possible leverages that can be used to influence the way systems function (Meadows 2008: 145-165). For MISC the following elements are especially relevant.

1. **Stock-and-flow structures.** These describe the 'physical systems and their nodes of intersection'. For MISC relevant stocks will typically be the institutions – within the regime as well as niches – active in a certain social domain or on a specific theme (e.g. the domain of health care or agriculture, the theme of ageing populations or youth unemployment ...). It is important to bring into the picture all the institutions that influence the ability of this field to adapt to changing contexts and to map institutions that represent the quadruple helix: politics, academia, business and civil society. The 'flows' describe the relations among those institutions (e.g. niches receive less government support than regimes; the performance of both niches and regimes is evaluated by the administration using indicators that were developed with a view to economic growth and are therefore inappropriate; the media do not inform the public of the complexity of the theme etc). Since the focus of MISC is on social innovation, the stock-and-flow structures will concern institutions, legislations, behaviour patterns,

methodologies etc, elements based on social constructs that can be identified as having an influence on the 'behaviour' of the field under consideration.

2. **Goals – the purpose or function of the system.** The way the goal of the system is defined influences the way it functions. Crucial in MISC is to define the goal of a certain domain (or theme) in a holistic and sustainable way. This is especially relevant for economics. Economics has been described by early theoreticians (moral philosophers) in terms of a function, viz. 'to efficiently allocate scarce resources to the needs of people'. During the industrial age, this function has been embedded in specific institutions, and gradually 'the economy' has become synonymous to these institutions rather than to the function they are meant to fulfil. Consequently, the goal of the economy has become to stimulate the health, growth and competitiveness of these institutions, whereas human and planetary resources were turned into 'means of this goal. To illustrate this means-end reversal, politics use GDP as an indicator of the 'health' of the economy, rather than its capacity to efficiently allocate scarce resources to all people (including everyone, now and in the future). It is crucial to think (again) in terms of functions (rather than just structures) in order to evaluate and redefine the role different institutions (and the flows between them) play in realising (or hindering) this goal. So if the theme or field you want to explore is (the role in transition of) '*education*', one should avoid of thinking of 'the education sector' as it is institutionalised today, but define it again as a goal, for example 'the capacity of a society to foster the development of the necessary skills, attitudes and knowledge in (young) people to deal with the planetary problems'. This then allows the participants to judge whether or not existing institutions contribute to this goal, and what other institutional elements or flows would enhance or restrain their capacity to do so.
3. **Balancing feedback loops.** These are elements (or 'controls') that keep the system stock fairly constant near a desired level. In agriculture, for example, the desired outcome (or goal) could be '(to guarantee) high quality food that is accessible to the – present and future – world population'. Since MISC is developed with a view to fostering urgent transitions, the balancing loops in the domains it explores will often be rather weak. Usually it is the niches that aim at providing balancing feedback to the system. So, for example the bio-label on consumer goods is meant to correct an imbalance in the agro-industrial business and can be seen as a balancing feedback. However, this feedback loop does not have a big impact on the dominant way the regime functions, because for example at the political level only monetary parameters are used as an indicator of the 'health' of a system (making moneymaking the actual aim of agribusiness). A strong correcting feedback would be if 'organic' (niche) products could be sold at a lower tax-rate (influencing both the strength and 'efficiency' of the niches and the behaviour of the consumers).
4. **Reinforcing feedback loops.** Whereas balancing feedback contributes to the self-correction of the system, reinforcing feedback is what drives the system in one direction and diminishes its capacity to readjust with a view to realising the systemic goal.

‘Reinforcing feedback loops are sources of growth, explosion, erosion and collapse in systems’ (ib. 155). In the present global context, ‘growth’ has been defined as the goal of the system even by governments. An important driving factor is the monetary system which uses one type of (bank-issued) money, a currency that is debt-based and comes with a positive interest, and so (virtually) grows. The real economy has to ‘repay’ this debt by growing productivity, and in a planet that does not grow, this must lead to crises. To give an example, the regime measures the ‘success’ of the fishing industry by its financial results, by the amount of fish that was caught and sold. If industrial fishing leads to depletion of a certain type of fish, (given dominant pricing mechanisms) the price may go up, which creates an extra incentive (or reinforcing feedback) for catching it; therefore – given an economic paradigm that defines pursuing private interests as ‘rational behaviour’ – investing in more aggressive fishing technologies can be considered smart, and once this investment has been done it needs to pay off, so another reinforcing loop installs itself. In this case, government issued quota can be seen as ‘correcting’ feedback, but it is clear that a fishing company is not ‘paid’ for not fishing, so the reinforcing (financial) feedback remains stronger, and ecological legislation will be seen as ‘harming’ the business rather than as ‘benefiting’ it (or its sustainability).

In MISC these theoretical insights are used to organise a dialogue between participants coming from different corners of the system on what innovations could facilitate the transition in a certain (societal or economic) domain.

3. How does MISC work?

3.1. Preparatory phase: drafting a systems map

In order to draw the curve of sustainability for any given domain or sector (system), the following steps have to be taken. These steps can be prepared by the facilitator but should be presented as a ‘proposal’ to be understood and approved by the participants and the groups they represent. Formulating a proposal may be more efficient: as many participants may not be familiar with a systems approach, a totally open, unstructured cocreation runs the risk of falling back into ingrained patterns of thought, entrenched positions of niches against regimes and of discouragement. Since the draft is only a draft and the input of the participants is needed to finalise it, their ownership increases throughout the mapping.

1. Define the **aim of the system** (domain, field) so as to include future generations, other species and the ecosystem (elements that are typically left out of the picture by regime institutions). For the field of ‘agriculture’ e.g. this aim can be ‘to guarantee access to quality food for the world population now and in the future while sustaining the ecological conditions of life’. This goal will therefore be broader than that of the regime (which may e.g. be ‘producing a maximum amount of a certain produce at a minimum cost’). Remember that the goal functions like the needle of a compass: it is specific enough to indicate the general direction but allows the group to co-design the best route

to get there. So, don't spend too much time on defining a very specific goal, but make sure everyone agrees on the general direction; different views on the goal can usually be translated into different views on the best way to achieve a goal, and so can be picked up and valorised at a later stage of the mapping.

2. List the main institutions of the socio-technical **regime** that play a role in that domain and their relations, representing the domain as (or in the form of) a network. In the example of agriculture this may include agribusinesses, supermarkets, farmer corporations, the ministry of agriculture, (a DG in) the European Commission, consumer habits etc. Typically, these regime institutions are recognised as representative of a certain 'sector'. These are drawn on the side of the curve that represents 'efficiency'.

3. List the main **niches** that play a role in the systemic goal; in the above example this may include CSA-farmers, permaculture initiatives, ngo's active in the South, organic food shops, ethno-botanic experts, local initiatives such as 'Transition towns' etc. Typically the niches use a more holistic approach; therefore they may not be active within a well-defined sector, but come from totally different corners. They may include concerned citizens, environmentalists, cooperative enterprises, schools, scientists and journalists with an interest in transition etc. These are represented on the side of the curve that represents resilience. Working with MISC so far has revealed that transition requires the interlocking of four types of innovation; therefore, it is interesting to include 'experts' in all four these domains:
 - a. **Sharing** (changing the relationships among actors in the socioeconomic system); e.g. car sharing initiatives or LETS groups make cars or household tools available to large groups of consumers without them having to buy or own these tools, diminishing the throughput of materials and energy while maintaining or even facilitating 'access' to them (Orsi 2012: 4-10).
 - b. **Circular** (changing the use of natural and technical resources); e.g. recycling material, Cradle-to-cradle labelled products, etc.
 - c. **Eco-monetary** (changing the economic and monetary 'infrastructure' – financial, legal, business models...) e.g. exchanging services by means of time credits instead of euro's, community currencies, social crowdfunding etc. The eco-monetary strand of transition is usually the least developed or not even recognised (causing even circular and sharing initiatives or smart technologies to remain locked-in in 'growth' scenarios) (IST 2012). The MISC-methodology aims at a more just/justified economy whereby economic growth is no longer seen as an aim in itself but is (again) seen as a 'function' (of resource allocation) again. Eco-monetary transition concerns the new types of 'agreements' people will (have to) make for regulating their transactions in a more sustainable way (Lietaer et al. 2013; Orsi 2012).
 - d. **Paradigmatic** (changing the definition of 'knowledge' or 'science' from specialized to holistic/systemic); e.g. ngo's in the field of ecology or poverty, holistic approaches to health care, expertise in systems theory etc.

4. List the **governance** institutions (ministries, administrations, public services ...) that are responsible for (and should be capable of) maintaining the system within a certain state. These are to be noted at the top of the curve; governance elements that support transition will be more on the resilience-side, whereas elements that reinforce the regime will be more on the efficiency side. So, it may be made visible that the niches only receive support from government agencies responsible for social work and nature conservation, whereas the agribusiness is supported by agencies (with larger budgets or power) responsible for economics or finance that are more at the efficiency side (and do not communicate or cooperate with the services responsible for ecology or social services).
5. Draw a rough outline of the **reinforcing and correcting feedback loops** among the elements on the map. Reinforcing loops can be represented by one colour (e.g. blue) and correcting loops by another colour (e.g. green). If a certain 'resilient' innovation receives no (significant) government support or attention, there may be no arrow between the niches and the agency concerned. By varying the thickness of the arrows, one can 'quantify' the strength of the feedback, thus creating a 'weighted digraph' (Ulanowicz 2015: 17).
6. Map the '**externalities**' or problems that the current regime cannot solve or even reinforces, or the mechanisms that keep the niches from gaining impact (e.g. inadequate legislation or indicators). These will be drawn in a red arrow or cloud (signifying increased 'fever' or chaos as a result of the regime's activities). Very often these very 'externalities' are the source or origin of resilient alternatives, therefore these 'symptoms' will be drawn under the zero line of sustainability and situated on the side of resilience. Sometimes a crisis can encourage the system to pursue its goal more rigorous without changing course (e.g. depletion of oil reserves can be an incentive to invest in bio-fuel as a way to maintain growth and to keep the regime functioning; this is drawn as a blue arrow from the externalities towards the regime).

The map doesn't have to be complete in order to be useful for the discussion; in fact, it is very difficult if not impossible to visualize every stock and flow that influences a system's behaviour. The main objective, however, is to help participants understand the systems dynamics leading to lock-ins and get a grasp of what transitions are needed to restore the balance between resilience and efficiency so as to reach the 'window of viability'. It is however important to make sure four strands of transition (circular, sharing, eco-monetary and paradigmatic) are brought into the picture. Also, for using MISC one doesn't have to be an expert in a certain field (e.g. housing, fishing, poverty...), for the methodology focuses on system dynamics and lets the participants themselves (coming from regimes, niches and politics) bring in their knowledge and expertise of the domain or theme under investigation. MISC therefore is very useful as a methodological support for transdisciplinary research and innovation.

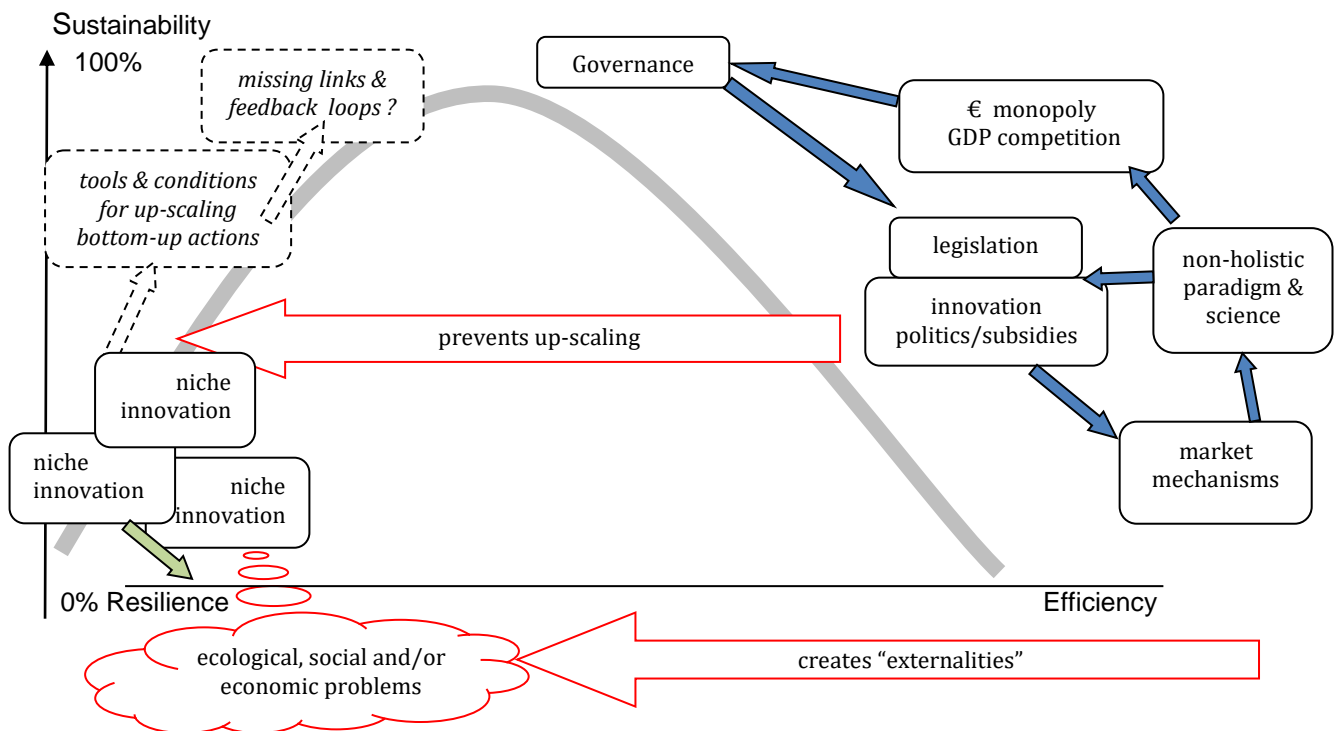


Figure 3: Basic outline / example of a MISC-map

3.2. Invitation phase

A list of all relevant actors in the field under consideration is drawn up. Representatives of both the niches and the regime are to be invited to participate in a MISC-exercise. It is important to have a ‘balanced’ group of participants, meaning that both regime and niche-experts should be more or less equally represented, and that most relevant actors in that field are present. The participants ‘represent’ not so much the size or financial importance of their ‘subsector’, but the expertise that is present in that corner of the system. Since the aim is to facilitate transition, expertise from the niches (contributing to ‘diverse’ approaches and therefore resilient) is at least as important as the expertise from regime-actors. When inviting representatives of the regimes it may be interesting to turn to ‘pioneers’ that are open to change (e.g. businesses active in Corporate Social Responsibility), but their ‘expertise’ also concerns the factors that block the willingness or ability of their subsystem to change. Depending on the theme, it may be interesting to have a (preparatory) workshop with representatives from niches and regimes separately, but of course dialogue between them is the most desirable and effective (if well prepared).

In order to find the relevant participants, snowball sampling is a very useful strategy. It implies asking experts in the field whom else they think should be invited. Keep in mind though that most actors often mainly know like-minded actors; e.g. regime-actors know other regime-actors within their field, but often are unaware of what happens in terms of social innovation and grassroots initiatives. Therefore, it is important to find niche initiatives in the domain you will

work on and consult them to detect other relevant actors. Organisations in the ecological movement may be aware of initiatives in the field of sustainable consumption etc. Since MISC-mapping (cocreating responsible R&I projects for sustainable goals) can be applied to all SDGs, it is impossible for a facilitator to personally know all actors in all the domains that are involved, so selecting the group of participants will itself be a cocreative process most of the time.

Since it is impossible to include all 'affected' parties (especially marginalised groups, but also future generations, people in the global South, non-human agents), it is important to remain critical of the boundaries that were imposed (by time pressure, budgetary limitations, facilitator blind spots etc) and to reiterate this process as often as possible, including an ever wider group of stakeholders to help you redefine the best way to reach the goal in the local context.

3.3. Workshop phase

MISC has proven useful for discussing transition with individuals as well as groups. Here we will describe the 'maximum' scenario of working with a large group. A full day workshop is organised with regimes and niches present. The first part of the workshop is used to explain the curve of sustainability in general (the principles of efficiency and resilience) as well as the workings of feedback loops and their impact on a given system. Next the (redefined) aim of function of the domain under consideration is presented, stressing the need to bring needs of future generations (and/or other species) into the picture. This goal should be presented as a working definition, a guideline for the discussion that can be handled with the necessary flexibility, and not in itself the object of the debate. Next the preparatory map (draft MISC-map) of the domain in question is explained and also presented as a 'work in progress'. It works best if certain arguments (e.g. demonstrating externalities or expected negative side effects) are expressed by experts that are well recognized in the field (regime). If e.g. a world authority on human genetics says that DNA-research will lead to an increase in abortions because of the financial risk involved in 'potential' diseases, 'increased abortions' (and/or related problems written in the red cloud) will more readily be accepted as a problem. For the niches it is important that they are represented not as 'critics of the regime' (leading to defensive reactions in the regime and blocking its capacity to learn and evolve), but as experts that pursue the same (broadened) goal as the regime but propose other solutions to reach it.

The second part of the workshop is more active and participatory. Depending on how many participants are present, the methodology may be different. In case of a large group, the methodology can be as follows. Small groups of participants (about 8 people, mixed in terms of niche/regime and representing the quadruple helix as much as possible) work on a copy of the (draft) MISC-map to discuss what can be or needs to be done

1. to allow the regimes to change course
2. to allow the niches to upscale
3. to develop a governance that supports both resilience (niches, radical innovators) and efficiency (regime actors), and that stimulates the cooperation between them (in a transdisciplinary way).

This part of the workshop can be facilitated by moderators familiar with participatory processes or using existing tools (e.g. Map-it; cf. <http://www.map-it.be/>). The participants (or a reporter)

are asked to write their ideas on the MISC-map (maybe using certain symbols or visual aids). The results of the discussions can be summarized and presented to the other subgroups. The ideas participants formulate are simply added to the map without discussion on their importance or feasibility. So the MISC-map serves as a support to brainstorm on an ‘ecosystem’ of possible actions to enhance the transition. The image of an ‘ecosystem’ of solutions helps the participants to keep in mind that all initiatives (be it grassroots or international politics) have their role to play; what is important to visualise is that all these initiatives have to be linked in a ‘sustainable’ system/network and cooperate. While grassroots initiatives embody the basic resilience of society (people start to behave, consume and organise themselves differently), politics (at local to international level) may reinforce these initiatives and embody the meta-resilience of society, creating ‘a set of feedback loops that can restore or rebuild feedback loops’ and thus leads to resilience at a higher level (Meadows 2008: 67).

3.4. Precautionary principle

MISC is a framework that takes into account the complex and non-linear dynamics of global systems and offers a framework for strengthening local resilience while taking into account global justice. This mapping allows a group of stakeholders involved with or affected by a certain theme (related to a sustainable development goal) to make careful and responsible judgments as to what innovation might be the most promising and feasible among many possible responses to a problem. Moreover, it allows them to brainstorm beforehand on potential rebound effects (or on the conditions that need to be fulfilled to avoid them).

Every (potential) solution should be evaluated in terms of material throughput as well as energy and water use it requires. This evaluation should take into account both the extraction and the discarding aspects of material throughput. The ‘extraction’ side includes questions such as:

- where do the resources come from?
- what is the impact of their extraction?
- how much is our fair share?
- does their extraction create conflict?

Questions on the ‘discarding’ side include

- How easy is it to recycle the materials after they are (re-)used?
- Do we control what happens to the materials after they are used?
- Are the technical, social, economic and political conditions for recycling fulfilled?
- How to make sure the entropic loss of materials will not pollute the soil, water or air and affect the health of living beings?

Using social and low-tech innovations may come to the fore as more responsible innovations (more accessible to everyone, also to people in the South, and less risk of non-renewable extraction and pollution). For example to address the problem of mobility, a technical solution like producing and selling ‘cleaner’ cars may create rebound effects and increase the global conflict over resources, whereas a merely social innovation such as ‘organising food teams whereby a local farmer brings packages of locally grown food for a group of families to a neighbourhood once a week’ reduces material and energy throughput while increasing well-being in an inclusive way.

Another crucial question to ask when judging and selecting a solution (a project proposal) is if it allows for timely adjustments if negative side-effects appear. Once antibiotics get into the water

system, it is very hard to ‘correct’. Nano plastics in the oceans (and in the human food chain) are hard to remove. Once a species has disappeared, it is impossible to bring it back. Once the climate system reaches a certain threshold, it is impossible to control (or correct) further reinforcing feedback loops. The precautionary principle offers a crucial guideline in judging possible solutions: if foreseeable negative effects cannot be undone, then the solution should not be chosen, even if from a scientific or technological point of view it may seem promising. Responsible R&I should (again) be at the service of society (and its global agenda), and therefore all stakeholders should have a voice in the choice of R&I projects, especially if they are funded with public money.

3.5. Example

To make the above description more concrete, we will take the example of a MISC-exercise on the theme of (transition to) sustainable fishery. In the draft map the *broadened goal* of fishery as a system can be presented as ‘Providing consumers worldwide with quality fish now and in the future while safeguarding the health of ecosystems’.

In this map, socio-technical *regimes* (with high ‘ascendancy’, i.e. streamlining and institutionalisation but low flexibility and resilience) will include fishing companies embedded in networks of other actors (competitors, supermarkets...) or monetary factors (banks, investors, shareholders, quarterly reporting) that drive them to ever more ‘efficient’ (productive) fishing technologies (including pricing mechanisms, financial indicators, innovative technologies, consumer demand etc). *Externalities* of current regimes (written in the red cloud) can be problems such as ‘depletion of marine populations’, ‘loss of income for fishing communities in countries in the South’, or even ‘overconsumption of animal protein in affluent countries’.

Resilient *niche* alternatives can include the Marine Stewardship Council label, WWF’s overview of safe versus endangered species for consumers, biomimicry based (blue economy) fishing technology, the vegetarian movement, etc. These niches still lack impact on the systemic goal and therefore are situated on the lower left of the sustainability curve (they are resilient but for lack of ‘efficiency’ do not yet increase the sustainability of the system). Small scale initiatives emerging from regime institutions (e.g. Corporate Social Responsibility, selling MSC-labelled fish etc) can be written down on the resilience side as well. The question then is why these initiatives remain ‘add-on corrections to a basically extractive system’ rather than becoming a ‘prototyping of fundamentally regenerative activity models’.

At the top of the curve the elements at *government* level are indicated (e.g. EU market politics use only euro-monetary parameters for evaluating the ‘health’ of the fishing industry and consider ‘growth’ as desirable; the government supports innovation in more aggressive fishing technologies to increase competitiveness; sustainable community initiatives and social innovations are not seen as crucial actors in the R&I system and have too little access to funding etc).

The ‘flows’ between those stocks show the mechanisms that keep the regime from changing course (lock-ins represented by loops of blue arrows) and that prevent niches from scaling up (e.g. the scarcity of fish makes it expensive and therefore interesting for the fishing industry to catch; innovation funds are given to technologies with market value but not to ‘social

innovations' such as MSC; current fish quota do not allow for biomimicry fishery to be introduced in the EU; consumers are not aware of the urgency of buying only MSC-labeled fish; a feedback loop to EU economical politics based on ecological indicators is lacking; EU political structures are based on a non-holistic paradigm so EC 'Ecology' and 'Social inclusion' act separately from and have no impact on 'Market' and 'Competition', etc).

Discussing this map helps participants to understand that current 'environmental policies' (e.g. fishing quota) mainly serve to 'keep the fever down' but do not address the systemic causes of the problem. It also makes visible that 'scaling up niches' can never consist in 'dropping the quota', since regime industry still uses 'throughput' technology and not 'circular' technology. It shows that specific and complementary eco-monetary instruments (legislation, community currencies, commons ...) for niche innovations to scale up are needed. The map works as a heuristic that helps them to formulate alternatives and possible solutions. It is important to note that the MISC map is a heuristic tool that helps to make prudent judgments and initiate the 'best possible' innovations in a complex system. The ambition is not to make an 'objective' systemic map, for in our interdependent world it is impossible to be exhaustive. The aim is not to pursue the truth about the system, but to select those elements that may help the participants and the community they represent to connect the dots in a way that will help them to stay on course towards a more generative system. Every project that is co-designed in this way should be seen as an experiment that needs ongoing follow-up and correction. Relevant questions are: whom did we exclude from the system map and needs to be included now? what unforeseen side-effects (positive or negative) emerge? What does this teach us about the dynamics of the (i.c. fishing) system and how can we use that insight to reach our goal even better?

4. Positive experiences

The hypothesis underlying MISC was that the sustainability curve offers an outline for a systems map that can allow stakeholders from different corners of the system to reflect on what hinders or facilitates transition and to create common ground for political claims. This hypothesis was tested by applying the MISC framework in various cases. Some examples (non-exhaustive list):

1. Wijze Wetenschap : mapping the transition needed in Research & Innovation politics for great challenges (2012)
2. Bazaar Cocreatief (Flora vzw 2013): a 'market place' for cocreative initiatives with a reflection on their underlying economic assumptions and the legal frameworks needed to upscale them (including the role of the social economy, community currencies, e-learning, participation and co-creation with groups living in poverty)
3. Ageing populations in Europe: challenges and perspectives (European Commission – DG Inclusion - EMPL/D1 Social policy Innovation and Governance 2013); explorative discussion
4. 'Charting Values for the Future' (working title) (Club of Rome 2014) – defining values as 'drivers' in the system, and identifying values counterbalancing patriarchal /yang drivers

5. The 'new' economy' emerging as a response to context changes in the wake of industrial economy and the role of community currencies therein (UAB vzw, Voka Leuven, Resoc/SERR Midden West-Vlaanderen 2013-2014)
6. The potential of community currencies on aims of the Covenant of Mayors (EC 2014)
7. A transition experiment on sustainable energy in the Madonie Region of Sicily – Italy
8. Various transition experiments and research projects (among others on refugees and women with disabilities) at the Universidad Complutense de Madrid – Spain
9. A transition experiment on sustainable food at the Interdisciplinary Research Centre for Technology, Work and Culture (IFZ) in Graz – Austria
10. A transition experiment on strengthening the local economy in Wekerle District by ESSRG – Corvinus University Budapest – Hungary
11. Two transition experiments on materials scarcity (in housing materials and small household electric and electronic appliances) in Antwerp – Belgium.

The test cases reveal that the MISC methodology indeed functions as an eye-opener to all stakeholders involved and facilitates dialogue between participants from all corners of the system. The data corroborating this are mainly qualitative, based on feedback from participants that allows us to understand the success of the MISC-methodology.

1. Participants from regimes are confronted with the externalities their actions (indirectly) lead to, but are also given the opportunity to map systemic mechanisms that keep them locked-in. This meta-level communication allows them to analyse their position without systemic punctuation ('who is to blame?'). It makes them less defensive and offers them an alternative, since the curve shows that efficiency is positive (and even necessary) as long as it is connected in 'shorter loops' with (resilience stemming from) niches. It also offers them the opportunity to formulate political measures that could free them from their locked-in position (e.g. more access to subsidies for social dimensions of research).
2. Participants from niches and civil society organisations feel strengthened because their crucial function in transition (creating balancing feedback loops for keeping the system goal central and inventing resilient alternatives) is made visible. Also, they acquire a common language and analytical tools, increasing their efficiency. MISC allows them to argue political claims with scientific arguments (based in systems theory, process ecology and eco-monetary research).
3. MISC not only anticipates problems that will arise due to a necessary transition and will cause resistance. It also explores leverages needed to overcome those lock-ins. The test resulted in maps showing 'ecosystems of (small or large) transitions', recognizing their interdependence and thus avoiding pseudo-conflicts on 'which transition is more crucial'.
4. By making visible that transition happens at different levels in the system (from niche resilience to meta-meta-resilience at governance level) it also avoids a false discussion between 'bottom-up' and 'top-down' (or 'representative') democracy but focuses on how the meta-level (representative politics) can reinforce cocreative actions or create conditions for up-scaling commons-based organisations.

Participants from highly specialized innovation institutions (after a MISC-exercise on the capacity of Research and Innovation institutions to offer responses to the big challenges) said it

was the first time they were offered a platform where they could express what they have long felt: that their models need drastic changing. It was also the first time they had a dialogue with niche innovators and they appreciated the richness of this encounter for (the social/societal relevance of) their work.

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Author: Dr. Anne Snick