

Globalisation, regionalisation & systems

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[Work in progress]

1. Introduction

It is generally assumed that if we maintain current levels of consumption, earth's resources will exhaust rapidly. Even if we manage to reduce pollution and optimise production processes, our way of living is not sustainable. Then again, we also want to keep up our standards of living, and not trade in our lifestyle for one that is less luxurious.

To solve this dilemma, new patterns of production and consumption are needed (Geels et al. 2008). To compel a cultural and socio-economic transformation that leads to such new patterns, radical technological innovations have to be developed that allow sustainable management of resources (Geels et al. 2004; Mulder 2006). To describe the socio-technical conditions of such innovations, we can make use of system theories presented in innovation literature. In the next section, four different system approaches will be introduced and guidelines on how to stimulate sustainable innovate trajectories will be constructed. These guidelines will be confronted in the subsequent section with the expectation that in the near future the role of national boundaries will undergo substantial changes, due to the development of globalisation. These changes will affect the locus of governmental authority, and as such has consequences for institutional support for sustainable innovations.

One of the notable shifts in the disposition on the locus of authority is contrastive with, but perhaps also related to, the process of globalisation. What can be observed is a process of 'regionalisation', which involves a variety of social and institutional changes. In section the fourth section, this process will be provisionally described. The final section will explore whether system approaches can be applied at the regional scale in a constructive way.

2. Systems

There is an increasing interest for the question about the right socio-economic climate for sustainable innovations. Although there is a variety of approaches, many of these are *system approaches* (Carlsson & Stankiewicz 1991). They assume an epistemological framework that has the following fundamental characteristics. First, phenomena are viewed as belonging to a web of relationships among elements, in turn; these relations are subject to feedback interaction, which makes systems dynamic and complex entities. Second, at the system level there are comprehensible and retraceable patterns, in that sense, systems are synoptic: they provide an external point of reference from which the overall system can be understood (Kwa & Dresen 1999).

In concern with socio-technical systems, the presence of feedback relations suggests that technological developments are socially embedded: social developments influence the course of technological developments and vice versa. Moreover, this embeddedness implies that socio-technical developments have non-linear character, making the system intrinsically unpredictable.

In spite of this unpredictability and complexity, the synoptic character of systems suggests the synoptic promise of clues for monitoring and managing the system as whole. However, these clues may only be theoretical artifices, and not relate to practical points of application. The distinction between the theoretical and practical synoptic viewpoints has to be kept in mind in our analysis of system approaches, because it is the intention here to retrieve lessons for a *system's manager*. The question is how an actor can or agency can monitor and even control the systemic elements so that sustainable innovation can be facilitated?

Four systemic approaches will be analysed here. We will start with Thomas Hughes's approach of large *socio-technical networks*. Second, so-called *transition systems* are described, followed by a discussion of a variant on these transition systems, the *multi-level approach*. Finally, we will pay attention to *socio-technical innovation systems*.

Hughes socio-technical systems

The first system approach presented here is developed by Thomas Hughes (1983; 1987). He applies the notion of system directly to the technology itself, especially those technologies that require large-scale integrated organisations, such as public transport and utilities. Characteristic of Hughes's approach is that the technological system is almost given a life of its own. Metaphorically, the system has an innate desire to expand, using people and institutions as mere tools to realise that desire.

Elements that prevent technological systems from growing are so-called 'reverse salients' and 'critical problems'. Reverse salients are the areas of imbalance in the system, that are caused by the uneven growth of the system's components. If these occur, engineers and inventors have to transform them in critical problems: problems that are believed to be solvable. A difficulty of Hughes's approach is that he defines his system and its boundaries in terms of a central actor that controls the system (Mulder & Knot 2001). Such central control, however, is generally absent in modern market systems. Especially, if we strive for innovation, the availability of market plurality is usually seen as inevitable.

Hughes's approach is above all a perspective that allows a researcher to analyse the expansion of socio-technical phenomena. This approach teaches a system's manager that expanding technologies sometimes come across socio-technical boundaries which have to be removed. In other words, the manager's task is that of overcoming of barriers by unfolding translative activities: problems have to be reinterpreted into solvable problems, only then new heuristic approaches may be explored that lead out of the deadlock.

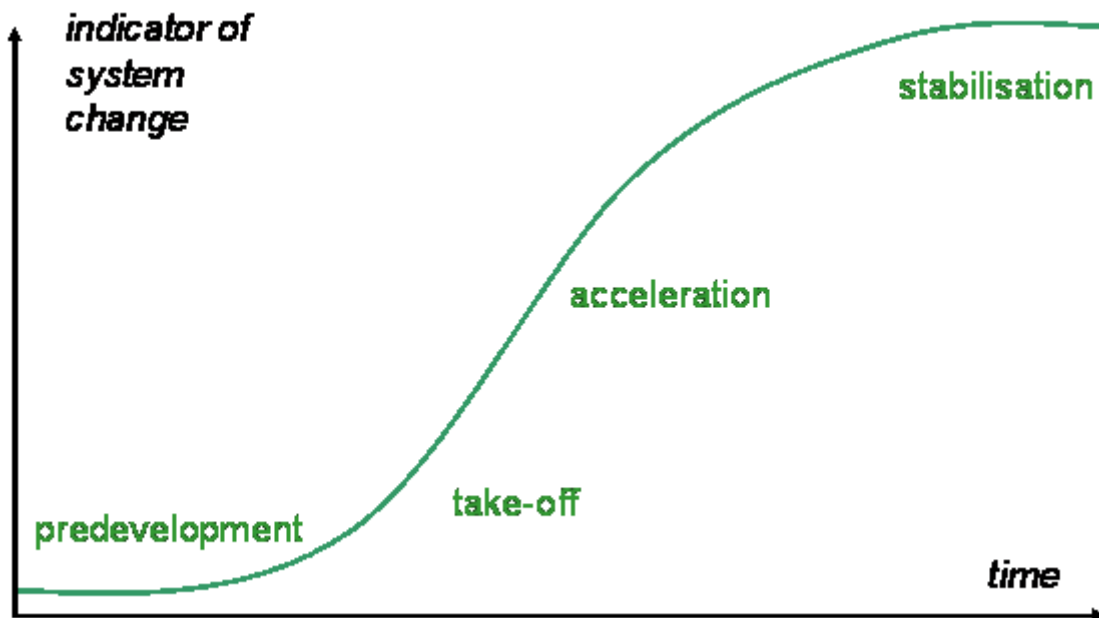
Hughes's approach focuses on socio-technical barriers that are directly related to one specific technology. In this paper, we are however more interested in generic conditions of innovative trajectories. The three system approaches discussed next address these generic conditions.

Transition systems

In Hughes's approach the system coincides with the technology. The systems' boundaries expand in as technology is assimilated by society. Opposite to that account, the 'transition' perspective fixes the boundaries, and poses how a technology is assimilated in the social realm enclosed by these boundaries (see Rotmans et al. 2000; Rotmans et al. 2001; Kemp & Rotmans 2004). Over time, innovations are claimed to proceed according to more or less

regular pattern. Similar to Hughes's systems, technologies have the tendency to expand, but the barriers that have to be overcome are, above all, of a social-institutional nature.

The structural societal change that makes up a transition progresses via four phases. The first phase involves a pre-development phase in which new ideas, concepts, or practices are introduced in a small section of society. Because of the small extent of the application of this novelty, the greater status-quo is not changed. In the subsequent stage, the 'take-off phase', there is a small but recognisable shift, which leads to the third stage, that of the 'acceleration phase' in which there are visible structural changes due to an accumulation of an interplay of social-cultural, economic, ecological, and institutional changes. Finally, there is the 'stabilisation phase' in which the speed of social change decreases and a new dynamic equilibrium is effectuated (Rotmans et al. 2000).



To steer this process, 'transition management' is required. Here a problem emerges; the description of the systemic elements that make up transitions is theoretically clear, but not very instructive from a practical perspective. It proposes a bird eye's view over history, without giving direct clues about how to intervene. Also the nature of the causal relations that lead to from one phase to the next remains unclear, while the transition management seems to be all about the question how to make a technology enter a new phase. Another

lack of clarity concerns the question about *who* does the managing. Looking at further theory development and policy programs held under the denominator of 'transition management' (Rotmans et al. 2001), the central agency often relies, somewhat conveniently, in the hands of the central government. Authorities have to play a director's role and support new ideas and set up an agenda that brings together actors and which also lead to commitments.

Multi-level socio-technical systems

A variant of the transitions approach is the multi-level socio technical system approach – denoted as multi-level approach –, which connects the different phases of the transition system to different societal levels (Geels 2002; 2004). With that, some of the criticism given above is countered. The multi-level approach enables to identify the empirical social elements that are significant in socio-technical change. Hence, a system's manager may learn some lessons from this multi-level approach to transitions.

The social level at which new ideas are developed is called the *niche*-level. Niches are spaces protected against a harsh market environment, for instance R&D branches of large firms, or subsidised market segments. The availability of niches can figure as incubators for innovative ideas and products, and also as testing contexts. A second level consists of a patchwork of socio-technical *regimes*. Such regimes are defined as semi-coherent sets of rules carried by different social groups. By providing orientation and coordination to the activities of relevant actor groups, socio-technical regimes account for the stability of socio-technical systems. This stability is of a dynamic kind, meaning that innovation still occurs but is of an incremental nature (Geels 2004: 33-34). A third level, that overarches the other two, is the so-called *socio-technical landscape*, consisting of a set of deep structural trends. This landscape contains a set of heterogeneous, slow-changing factors, long-term economic developments, accumulating environmental problems, growth, and emigration.

Both the transition approach and the multi-level provide two basic strategies to support innovative trajectories. First, it is proposed that innovative ideas have to be sheltered from the social-institutional aspects that diminish the chance of a technology to become expansive. The second strategic element is that in respect with the creation, protection, and expansion of a technology, cooperation between different socio-technical actors is required. The gathering of actors from different societal angles enhances the social robustness of a

new technological design, because of two mechanisms. First, the social value of a design can be tested in the context of a more or less protected set of actors. Second, actors may show the tendency to become committed to a certain innovative strategy, increasing the amount of vested stakes in that technology (cf. Schot & Rip 1996).

Especially in the first stages of a development, the novelty has to be protected against harsh market conditions or lack of social demand. This consideration has been transformed into the method of *strategic niche management* (Kemp et al. 1998; Hoogma et al. 2002; Van der Laak et al. 2007; Verbong et al. 2008; Schot & Geels 2008). In later stages, cooperation of involved stakeholders becomes increasingly importance. The involvement of different technological, industrial, political and societal actors might lead to the commitment and conviction of these actors, smoothing the process of social acceptability, hopefully triggering the acceleration phase (Raven 2006).

The task of the system's manager is to assemble a set of actors that can both contribute to the technological design by representing the broad social context in which the technology has to be introduced eventually as well as having the societal leverage to stimulate the social introduction of the technology.

A problem however is how these strategies relate to the three stages of the transition (Berkhout et al. 2004; Genus 2007; Markard & Truffer 2008). Niches, regimes and landscapes are not descriptions of exclusive social domains, in fact, from the niche perspective, all surrounding context can be seen landscape. At the same time, one can also imagine to apply the notion of a regime to a social context for which innovations are landscape-factors. For instance, in case of the development of certain technology that takes place abroad.

From a practical perspective of the system's manager however, this theoretical criticism is not as urgent as it might seem. The right selection of participants of a certain innovative trajectory implies the involvements of actors who can effectively create a niche and of actors who can decisively influence the rules that make up the regime. In other words, both the niche and regime are dealt with simultaneously, whereas the landscape-level by definition is an entity exogenous to the influences of the actors involved.

Socio-technical innovation systems

Whereas the systemic approaches covered above are predominantly theoretical tools that necessitate a thorough reinterpretation to gain practical relevance, the approach of innovation systems is precisely aimed at giving concrete policy advice. One can see that innovation systems as a supplement to the focus of economists on national production functions. It builds forth on economic policy analysis, and aims to give guidelines on how to spend the public budget and stimulate socio-economic sectors in order to increase national economic performance. According to the advocates of innovation systems, traditional macro-economic perspectives fail to do right to the sophistication of current economies, which have been fundamentally changed due to globalisation and a new role of knowledge (Johnson & Lundvall 2000).

There are different articulations of innovation systems; here we will concentrate on the approach developed by Hekkert et al. who distinguish seven 'functions' of innovations. These functions figure as motors for innovation, in order to have a well-performing innovative system they have to be effectuated (Hekkert et al. 2007a; 2007b; Negro et al. 2007)

The functions that have to be present in an innovation system are: (1) entrepreneurial activities; (2) knowledge development; (3) knowledge diffusion through networks; (4) guidance of the search; (5) market formation; (6) resources mobilisation; and (7) creation of legitimacy/counteract resistance to change. In practice, these functions show a large amount of overlap with the factors named above in the transition and multi-level approach, be it that they are much more specified and categorised. In that sense, the theory on socio-technical innovation systems teaches us, on the one hand, about which institutional actors are important, namely actors from policy, industry, and knowledge institutes, and, on the other hand, which resources are important, namely finances, knowledge, and institutional support.

The biggest contrast between the socio-technical innovation approach and the other approaches is that innovation systems are above all aimed at strengthening the innovative capacity of an industrial sector, and not of a subset of companies that are concentrated around a specific innovative trajectory. This sectoral focus means that stimulating measures are directed at a promising technology, but at the conditions that improve the chances of technologies to emerge and disperse (Bergek et al. 2006).

3. Globalisation

It is clear that sustainable innovation takes a long time; a transition is generally assumed to take 30 to 50 years. In order to be able to manage the system, the duration of this period requires that the system's external boundaries are relatively stable. If the institutional parameters change continuously, it is hard to maintain that the system in thirty years is basically the same system as it is today.

Most applications of the systemic approaches presented in the preceding section appear to identify the institutional range of the system with national boundaries. However, how stable will national boundaries remain in the next two generations to come? If we think about globalisation, then it we see that the nature of national boundaries has changed dramatically in the last decades, and that there is not much that indicates that the rate of these changes is decreasing (Giddens 1999). Although 'globalisation' is a notion that is often used in a vague manner, it is possible to identify a number of distinct social developments that comprise this notion. We will distinguish financial-economic, technological, educational, cultural, moral, ecological, and institutional aspects of globalisation.

Globalisation is most often associated with financial-economic developments. Indeed, one can observe how in the last decades, production and consumption chains have become increasingly international. Streams of commodities now span the whole globe. Also the financial markets – as is harshly illustrated by the current economic crisis – make up worldwide system, hardly restricted to national boundaries, especially as banking activities are so deeply intertwined.

These economic and financial activities could only occur because of the rise of new technologies. International trade requires improvements in transport and logistics. Container shipping, the increased availability of commercial flight, computers, internet and other forms of communication technology are all foundations of the current financial-economic system.

To make and maintain technologies, education has to be attuned. Especially in higher education we can observe an increased orientation towards globalisation; the *lingua franca* of universities becomes English, and educational programs are adjusted to attract students from all around the world. The global transport of people for work, study or holidays leads to an increasing harmonisation of culture. This cultural harmonisation contributes to the

establishment of global morality. While critical observers of globalisation such as Naomi Klein (2001) show the undesirable side-effects of worldwide economic system, the awareness of the moral uniformity of humans all over the world is growing. Instead of reserving loyalty or solidarity with people who share nationality, a more cosmopolitan fraternity emerges – very slowly, but still steadily (Singer 2002).

Another aspect of globalisation is the recognition that eco-systems cover the whole globe, which means that many environmental problems transcend national boundaries. Global warming, the hole in the ozone layer, acidification and so on are genuinely international problems, requiring international policies to be developed and implemented. The acknowledgement that many problems are exceeding traditional institutional boundaries, leads to new approaches that are probably most important for our discussion on sustainable innovation and system approaches.

Obvious institutional changes are the growing practical relevance of political bodies such as the United Nations and the European Union. Such political bodies lead to new patterns of judicial sovereignty and a shift in the accents of diplomatic activities (Suvarierol 2007). Also other international agencies such as IMF and the World Bank have an increasing impact on national policies (Stiglitz 2003).

It is not likely that national boundaries will disappear, but what can be perceived is a changing disposition about the role of these boundaries. Instead of being firm frontiers that safeguard sovereignty, national boundaries receive the role of administrative entities that have to implement policy measures that have been established elsewhere. Production, consumption, culture, morals and politics all gain a more international dimension that is added to long established national commitments.

This account on globalisation offers an interesting contrast with the system approaches presented earlier – especially the transition and multi-level approaches. These approaches deal with long-term innovative strategies, predominantly connected to national frameworks of policymaking. So, while the institutional form of the world is expected to have changed dramatically over thirty years, strategies for the same period are being developed that do not take these changes in account.

For the approach of innovation systems this problem is not as acute as for the other approaches. In fact, according to Johnson and Lundvall (2000), their approach only gains

relevance, because it involves the enhancement of those institutional structures that facilitate innovation. In turn, the capacity for a state to innovate is a huge competitive benefit in a globalised economy.

The transition and the multi-level approach do not have the principal ambition to increase the innovative capacity of a specific country; instead, their goal is to stimulate innovations that are more sustainability in general. National boundaries are the more or less contingent context in which these innovations have to take place. Still, the boundaries of such national boundaries will in all probability become more and more porous, which requires another perspective on the functioning of the system. Moreover, it is not merely the institutional set-up that is subject to change, also the other elements that are significant in these approaches, are closely interrelation with all of the processes that were associated with globalisation.

The problem of sustainability quite clearly transcends national boundaries. Moreover, if the economic patterns that are connected with globalisation become more intense, the scope of environmental burdens expands as well. Economies that are rising due to globalisation, such as China and India, will lead to the exhaustion of more and more natural resources. The interwovenness of the economic system implies that it is not simply up to China and India to solve this problem; the responsibility is diffused all over the world along with economic relationships.

The core of the success of technologies lies in their capacity to expand. Obviously, this implies that successful technologies do not stop at national borders. In fact, the central claim of the innovation systems approach is that a national state's competitive position depends on the capacity to export technologies. At the same time, foreign technologies can easily invade a domestic market. In other words, technologies are usually not bothered by national boundaries. This indifference of technologies seems to complicate a clear-cut strategy to facilitate sustainable innovation.

From an institutional point of view, the system approaches are very much orientated towards the integration of actors from the public and private sectors. Industry, authorities, societal actors are all addressed to cooperate in establishing a common course. The question is whether these actors are still willing to commit themselves to such a common course in the future. National governments will be increasingly bound to international agreements and with, perhaps less consent, by international market conditions. At the same time, the nature

of the private sector changes, taking national affairs less and less in concern. Companies may become increasingly inclined to move their financial headquarters or production centres to the economically spoken most beneficial country – although the harmonisation of morality might invoke more uniform legislation and the enhancement of working and social conditions for employers.

The combination of all these developments appears to weaken the aspirations of the transition and multi-level system approaches. The question becomes whether there is a way to keep the strengths of these approaches, while being less susceptible to the impact of globalisation.

5. Regionalisation

Scaling-up of societal practices is not the only development that can be linked to globalisation; a general pattern leading into the direct opposite direction can also be observed, there appears to be an increasing commitment towards local or regional affairs. This commitment is manifested in different forms, related to a range of apparently unconnected practices and ideologies. The question is whether these developments of regionalisation are not in some reciprocally related to globalisation.

An interesting picture in which globalisation and regionalisation are sketched as related developments is given by the Netherlands Environmental Assessment Agency. In their *sustainability outlook* (RIVM 2004), the conventional approach to distinguish political preferences on a left-right scale was refined by introducing a coordinate system which plots 'efficiency' versus 'solidarity' on one axis, and 'globalisation' versus 'regionalisation' on the second axis. The four quadrants that emerge are connected to four different worldviews (see box 1). The notions featured in the sustainability outlook will be used to develop further ideas on regionalisation as counter-movement of globalisation.

Box 1: Four world views on sustainable development

The Netherlands Environmental Assessment Agency (MNP) has, in its 'sustainability outlook', used the concept of different views on sustainable development to design a framework to structure these views (MNP, 2004). Several surveys held under the Dutch population have resulted in four clusters of world views

best distinguished by two axes. One axis represents the scale level (local/global), and the other the different opinions with respect to how means (resources, money etc.) should be used (efficiency/equity).

Four clusters emerge, showing the following characteristics:

- Global Market (A1): globalising economy free trade, efficiency, strong economic growth, individualisation, privatisation
- Safe Region (A2): block formation, trade with partners, efficiency, strong economic growth, individualisation, privatisation
- Global Solidarity (B1): global institutional cooperation, rules and conventions, solidarity, tempered economic growth, intergenerational and international responsibility, role for government
- Caring Regions (B2): local cooperation, rules and conventions, solidarity, tempered economic growth, community spirit, role for government

Characteristics of the four world view clusters on sustainable development

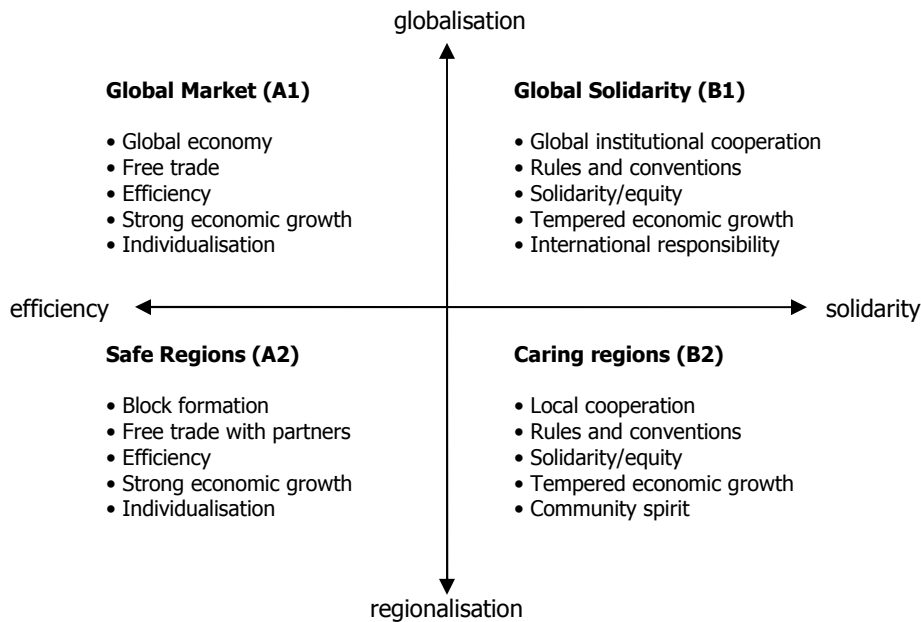


Figure 1: Characteristics of the four world view clusters on sustainable development derived from public surveys (RIVM 2005).

The world views presented by MNP say something about preferences certain groups might have. However, it is not necessary to see globalisation and regionalisation as exclusive dimensions; it is also interesting to see how patterns of globalisation lead to changing institutional practices on a local scale. Said in a popular way, are there any patterns that connect to the slogan of 'think globally, act locally'?

Some examples of practices that can be connected to the regionalisation axis will be featured here. Admittedly, these examples are chosen rather arbitrarily, based upon familiarity of the author.

A first manifestation of local concerns for sustainability issues is the development of sustainability plans by authorities such as municipalities or provinces. For instance, the Dutch city of Rotterdam has started the *Rotterdam Climate Initiative*, which is an initiative of the Rotterdam municipality, the Port of Rotterdam, the regional environmental protection agency and the industrial partner organisation to reduce CO₂ emissions by 50% in 2020 compared to 1990-levels. Also other Dutch cities and regional authorities start developing such plans which have higher ambition levels than national or international agreements. The ambitions of such local and regional initiatives might not always be completely realistic, but compared to policy plans developed at a higher level, the great benefit of such sustainability plans is that these can be associated to concrete projects.¹

Another field of interest is the rise of the 'industrial ecology'-doctrine (Garner & Keoleian 1995). Industrial ecology proposes that an industrial system can be seen as an ecological system. Instead of thinking about different companies as isolated entities, industrial ecology takes a holistic perspective and tries to see whether waste material of one production process can be used as raw material for another production process. In that way, industrial metabolisms may emerge. Ideally, industrial ecology would not just refer to local industries. However, real life materialisations of industrial ecology are still very much rooted in local practice and they are also only partial, for instance one may think of companies that use the residual heat of a power plant to attain a temperature that is needed for certain production processes.

It is possible to observe regional initiatives, next to specific projects. Also from an institutional perspective, there is an increasing amount of cooperative practices. For instance, Regional Centers of Expertise are established under auspices of the United Nations.² Networks are organised to enable the effective gathering of knowledge about sustainability – instead of seeing universities as competing institutes.

It is important to notice that regionalisation not only refers to changes in institutional orientations, but is also relates to the orientation of individuals – both in respect to the political and economic domain.

¹ <http://www.rotterdamclimateinitiative.nl/>

² <http://www.ias.unu.edu>

Citizens are far less disposed to accept political decisions just like that. Citizens have become better educated, more critical, more demanding, and more engaged. In national politics, this leads to political instability – at least in the Netherlands. The citizenry are even more 'rebellious' on a local scale; discontent is easily expressed by letters to newspapers or by addressing befriended city councillors. Such local activities of citizens often involve very local concerns. NIMBY still remains to be a strong motivation, but one can also see traces in local debates of the appeal to more universalist moralities.

There is an increased interest in academic literature for developing institutional arrangements to streamline these articulate citizens. All kind of representative forums have been invented, which are also increasingly applied in practice (Huitema et al. 2007). The functioning of these applied participatory decision-making schemes can be disputed, but the necessity for bottom-up participation is clearly present.

Also in the field of technology development, there are indications that customer engagement is an issue of increasing relevance. In the first place, one might think here of computer software, which is quite receptive to involvement by a selected group of users. Also in other sectors, producers try to engage consumers in the development and design phase of a new product (Von Hippel 2005).

Although plenty of reservations still have to be made, the examples given tend to show that globalisation has concrete ramifications for local activities and dispositions. The central relevance of the national governmental level seems to give way to local interests for global concerns. Therefore, it seems worthwhile to think about a shift of systems' approaches to a regional or local scale. First, because these regional and local developments appear to raise the need for theories that can be applied at that territorial scale. Second, because a shift from a national to a regional or local scale offers opportunities to clear up some of the theoretical and practical setbacks of system approaches. The question that will be dealt with in the next section, be it in a very tentative manner, reads whether it is possible to apply insights derived from systems' approaches in a territorial scale that is relatively modest.

6. Regional systems of sustainable innovations

There is nothing in theories on system innovation that excludes a shift from the national level to the regional or local level – or, for that matter, a shift towards a bigger territorial level. Indeed, in many respects a shift in territorial scale concerns just a gradual difference, also having advantages; by moving to smaller scale, a system approach allows projects to become more concrete and the interaction among actors easier and more direct. However, scaling down the system also involves a fundamental difference. The instigation of an innovative trajectory often necessitates a considerable scope, so that in a regional scale the system becomes immediately 'saturated' – there is no room to expand inside of the system. In this final section, these issues will be reflected upon, though only provisionally; these reflections will be used to establish a list of research questions that have to be addressed in order to know whether system approaches can be used effectively in a regional or local context.

National approaches have the tendency to be generic, oriented towards policy conditions instead for direct support for concrete projects. In that sense, innovation systems connect well to national policy approaches. In many respects, such a generic approach is beneficial, because innovation thrives in a framework that allows diversity instead of steering. However, the transition model and the multi-level approach are more directly connected to concrete technologies. As presented earlier, these two approaches suggest that innovative trajectories have a better chance if different groups of actors are involved in the design, protection, and expansion of the technology.

Two major obstacles can be identified that possibly diminish the effectiveness of the transition and multi-level approach in an extensive territorial scale. First, certain alternatives have to be singled out as being more promising than others. One might doubt the availability of tools or expertise to identify favourable options, but one can also argue that it is by definition impossible to know which technology is potentially successful; transition theory exactly tells us that there are a many unknown social factors that influence the innovation trajectory. Second, an appropriate selection of actors has to be made. These actors have to be influential in that sense that their assembly has enough capacities to both establish a protective niche and influence the rules that make up the regime, so that the innovation trajectory can reach a next transition level.

The extent of these obstacles is decreased considerably if one takes a regional focus. It is obviously much easier to recognise the availability of innovative qualities on a lower scale, as well as it is easier to identify actors that can be significant in relation to the conditions sketched above. These considerations suggest that, especially from a practical viewpoint, it seems sensible to apply system approaches also on a regional or local scale.

Then again, how legitimate is it to use a system approach in case of innovative trajectory that reaches its systemic limits almost in simultaneously with its establishment? Some reformulation of the central elements of system approaches appears to be required. Here, we will concentrate on the multi-level approach and the socio-technical innovation system approach, as these have been the main suppliers of the framework used in this paper.

A first obvious consequence of the application of the multi-level approach to a regional or local scale is that the extent of landscape-level increases. A larger share of developments will be exogenous to the system and the system's manager. However, if globalisation is really taking place, the same will hold for national systems. To settle this issue it seems important to pay serious attention to the relationship between globalisation and the multi-level approach.

The most elemental difference between national and regional systems probably relates to the relation between the niche and the regime level. On a national scale, these two can be separated, if only by convenience. Regime actors are generally found at echelons dealing with national affairs; in turn, niches are constructed at a sector level or at a regional level, and as such, are to be found at more detailed social level. If the multi-level approach is used in a regional context, the situation changes profoundly. The niche and the regime basically become the same: actors involved in the design, protection, and proliferation of the technology can be expected to be so closely cooperating that it becomes practically useless to make a distinction.

In other words, the nature of the multi-level approach is changed drastically if applied to a regional or local scale. What becomes of the utmost importance is to establish more knowledge on the transfer from a technology on the niche and regime level to the landscape-level. This implies that the nature of the relation between globalisation and regionalisation has to be described in detail, so that we can analyse how exchanges of practices and ideas between the regional and the global sphere take place.

Socio-technical innovation systems approaches are very much orientated towards the national level. The functions of innovation very much refer to standardised set of rules, laws and institutions, which pertain to the national level. For instance, a market or a university system is generally established by national laws and practices, not by local ones. Looking at regional innovation systems this might imply that not all functions of innovation have to be present at that region, as long as they are provided for by the national state. At the moment, it seems too early to make definite claims about these reflections.

What are the research questions that have to be addressed in order to find out whether system approaches can be applied to a regional or local scale? First, a more detailed sociological account on the relationship between globalisation and regionalisation. This includes issues such as how patterns of globalisation lead to processes of regionalisation – and if so, what then do these processes signify? Furthermore, the question has to be asked whether there are discernable mechanisms that lead from regionalisation to globalisation.

A second subset of questions relates to the different theoretical perspectives on systems. In this paper, we have taken rather a pragmatic approach; lessons from different perspectives have been drawn, without worrying about their commensurability. At the same time, quite some theoretical and epistemological reservations have been mentioned, which deserve more attention. A relationship that might be similar to the one between globalisation and regionalisation is the relationship of the landscape-level on the one hand and niche and regime levels on the other. Also this relationship needs a lot more theoretical elaboration.

Most important, however, is the third subset of question, which pertains to empirical questions that allow the testing of regional systems of sustainable innovation. Concrete local and regional projects have to be singled out and investigated. Do these projects give rise to systemic description, and if so, which elements of the system approaches are most appropriate to focus upon? In turn, such case research should be used to develop concrete projects that incorporate its findings, so that innovative trajectories may indeed be initialised on a local or regional scale.

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