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Reconfiguring what network? (Road) network synchronization in Dutch traffic management

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Abstract

Current sustainability challenges are increasingly acknowledged to reveal systemic flaws in societal systems such as energy, mobility and agriculture. Adequate solutions then require system innovations and societal transitions. The quest for system innovation is notoriously hard, however: In a polycentric society systemic problems tend to be elusive, and solution strategies are contested. So whereas the quest for system innovation is typically backed by substantive analyses of system pathologies, polycentric perspectives emphasize that the intrinsic properties of an innovation attempt are hardly decisive. Innovation attempts need to be relevant to the targeted actors in the first place. As 'intrinsic' transformative potential is not the sufficient criterion, the following question arises: *Taking into account the 'polycentric condition' and the consequent lack of foundational systemic knowledge, how can innovation attempts be devised with a reasonable chance of achieving system-innovative change? How to move from the perceived need for a particular system transformation to its being endorsed and acted upon by others?* This paper addresses the tension between the attempted innovation of systems on the one hand, and its relevance to diverse actors within these systems on the other. Based on multiple-case research after innovation attempts in the Dutch traffic management field (Pel, 2012), it is shown how the synchronization between translating actors is overriding, but the properties of an attempt do matter. The analysis highlights the emergence of transformative 'boundary concepts': The social sharing of space, the network-oriented handling of traffic flows, and the 'information chain' on traffic information. Each in their own ways these initiatives involved changes both in road networks and in the associated governance networks. Translation-dynamic analysis of these innovation journeys suggests that innovation attempts can be particularly effective when based on concepts with similarly 'networked' properties: Articulating innovative solutions to substantive problems, but also the governance interactions through which to shape and sustain those solutions in practice.

0 Introduction: System innovation and the polycentric condition

Current sustainability challenges are increasingly acknowledged to reveal systemic flaws in societal systems such as energy, mobility and agriculture. Further reasoning that systemic problems require equally systemic changes and solutions, there is an increasing research interest in ways to further system innovations and transitions towards more sustainable socio-technical systems (Rotmans, 2003, 2006, Elzen et al., 2004, Loorbach, 2007, Grin et al., 2010). This research field stands out as an ambitious attempt to direct systemic change through targeted innovations: As described by Rotmans (2006), system innovations are

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'organization-transcending innovations that drastically alter the relationship between the companies, organizations and individuals involved in the system', typically comprising innovations both in projects, products, as well as processes. Several of these system innovations can in turn co-evolve into societal transitions. A transition is a structural change of a societal (sub-) system resulting from a co-evolution of economic, cultural, technological, ecological and institutional developments at different scale-levels (Rotmans, 2006, Grin et al., 2010). The quest for such systemic transformations crucially requires underpinning by substantive knowledge about the systems to be governed, it is widely acknowledged. Therefore a rich literature is developing on transition dynamics (Geels, 2005, Geels & Schot, 2007, Raven & Verbong, 2007, de Haan, 2010, Frantzeskaki, 2011), and on transition management as a way to play into the opportunities for transformation in complex adaptive systems (Rotmans, 2003, 2006, Loorbach, 2007, Schot & Geels, 2008, Grin et al., 2010). Typically the analytical attention goes out to the systemic 'regimes' that account for locked-in and unsustainable practices, to the 'landscape' pressures that circumscribe the evolution of regimes and to the 'niches' that pose alternatives and challenges to these dominant structures. The multi-level perspective on transitions (MLP) helps map the societal configurations that make up a particular systemic problem; it guides system innovative action towards promising niches to cultivate, landscape pressures to modulate, and internal regime tensions to seize upon. Considering its promise to make the complex tractable, Smith et al. (2010) insightfully speak of an 'allure' that is hard to resist: *"The allure of the MLP is that it provides a relatively straightforward way of ordering and simplifying the analysis of complex, large-scale structural transformations in production and consumption demanded by the normative goal of sustainable development. Its conceptual repertoire links specific innovation activities configured in niches with structural transformations in regimes. Its terminology of niche, regime and landscape provides a language for organising a diverse array of considerations into narrative accounts of transitions".* (441/442).

Yet however great the allure and analytical force of this underpinning of system innovative action, it is not without its challenges (Smith et al., 2010). A number of theoretical comments and empirical findings have made it seem less appealing. The intended 'steps from theory to policy' (Frantzeskaki & de Haan, 2009) are problematic: As systemic, transformative and encompassing innovation processes, system innovations are notoriously hard to realize. Especially considering the high stakes involved with systemic changes, they are deeply political processes (Grin, 2010). Distinct challenges are the underestimated complexity of the systemic problems targeted (Shove & Walker, 2007, 2008), the intricate demarcation issues (Genus & Coles, 2008), the interpenetration and multiplicity of systemic problems (Schot & Geels, 2008, Stirling, 2009, 2011, Meadowcroft, 2009, Cohen, 2010, Jørgensen, 2012, Coenen & Truffer, 2012) and the contested nature of what counts as systemic problem and solution (Shove & Walker, 2007, 2008, Duineveld et al., 2007, Smith & Stirling, 2007, 2008, Hendriks, 2009).

In addition to these theoretical criticisms, a growing literature on system innovation 'in the making' substantiates how the step from theory to policy is far from straightforward indeed. A finding common to many of these studies is the apparent relevance of diverse contexts (Voß et al., 2009): However well-grounded in transitions analysis, attempts at transformation are often noted to be appropriated, captured, diluted or transformed according to diverse ambitions on the side of recipients (Heiskanen et al., 2009, Avelino, 2009, Jørgensen, 2012). Once confronted with ongoing policies, the typical result is one of policy mixes of old and new elements (Rotmans & Kemp, 2009, Kern & Howlett, 2009). These processes of domestication, selective uptake and hybridization are by themselves not new to innovation theory (Rammert, 1997, 2000, Leydesdorff, 1997, 2000). With regard to system innovation

these phenomena tend to be treated as unpleasant surprises, however: Reasserting that innovation takes place in a polycentric society in which neither problems nor solutions can be considered evident, the grounding in substantive system analysis is eroded (Rip, 2006). The polycentric perspective stresses that attempts at systemic transformation do not succeed for their 'intrinsic' value, i.e. their built-in aptitude to resolve certain systemic sustainability challenges. Instead, the evolutionary course of innovation journeys is seen to depend primarily on the attempted innovation's relevance to a diversity of recipient actors. If this premise is accepted, the worrisome implication for system innovation endeavors is that no solid systems-analytical grounding can inform the choice for one innovation attempt over another. Hence the central questions addressed in this paper: *Taking into account the 'polycentric condition' and the consequent lack of foundational systemic knowledge, how can innovation attempts be devised with a reasonable chance of achieving system-innovative change? How to move from the perceived need for a particular system transformation to its being endorsed and acted upon by others?*

These questions will be addressed as follows. First it is elaborated how to conceptualize and investigate system innovation from a polycentric point of view. Following polycentric outlooks such as actor-network theory and Niklas Luhmann's theory of self-referential systems, a key question becomes how system innovations could emerge from the interplay between actors with diverse system understandings. The issue is thus viewed from the side of the many *receivers* of innovation attempts. Analysis focuses on how the attempt arouses interest, how it becomes resonated, translated or rather dismissed as irrelevant 'noise', and how the various 'translators' manage to attune or 'synchronize' (Rammert, 2000, Leydesdorff, 1997) their particular appreciations and modifications of an innovation attempt **(section 1)**. Next, based on multiple-case research after innovation attempts in the Dutch traffic management field (Pel, 2012), four illustrative cases are briefly presented and analyzed for their translation dynamics: The introduction of the 80 km/h zones on Dutch highways **(section 2)**, the network-oriented turn in traffic management and transport policy **(section 3)**, the social sharing of space **(section 4)**, and the initiative to weld an integrated travel information chain **(section 5)**. In the concluding section the research question is answered through case comparison. It is shown that the synchronization between translating actors is crucial for sustained innovation. The properties of an innovation attempt do matter, though. Particularly instructive is the way in which three innovation attempts became 'boundary concepts': Each in their specific ways they changed both 'governing system' and 'system to be governed'. While addressing various systemic flaws in road network operation, they effectively catalyzed reconfigurations of the governance networks concerned. Analysis of these innovation journeys suggests that the quest for system innovation can be particularly effective when based on innovation concepts with similarly 'networked' properties: Articulating not only innovative solutions to systemic problems, but also the governance interactions through which to shape and sustain those in practice **(section 6)**.

1 Innovation attempts between systemic insight and diverse translations

The quest for system innovations and sustainability transitions is driven and legitimized by the diagnosis of particularly persistent systemic problems (Rotmans, 2003, Pel, 2012b). A transitions approach can be expected to achieve greater sustainability gains than more narrowly scoped 'conventional' approaches for its complexity-sensitive, multi-dimensional and *systemic* strategy. The crucial starting point of the transition management cycle is therefore the organization of visioning, i.e. the generation of system diagnoses and desirable futures (Loorbach, 2007). The participative 'transition arenas' are to devise 'baskets' of

multiple visions (Rotmans, 2003, 2006), which can then serve as a basis for the establishment of transition pathways and agendas. Now this pluralist approach to visioning sets transition management apart from objectivist approaches to devising 'grand schemes' (Scott, 1998). Still the foundational nature of substantive system analyses, the aforementioned 'allure of the multi-level perspective', is prominent in many transitions analyses: Typically these analyses start from the perceived need for a particular transformation or systemic solution. This content-driven attitude also speaks from the common focus on innovation attempts considered promising 'niches'.

Yet however well-grounded in substantive system analyses, many promising 'niches' fail to break through (Schot & Geels, 2008). Reasoning from the systemic need for the innovation this may seem irrational: Consider, for example, the many attempts at road pricing and other forms of environmentally-responsive taxation – hasn't the Pigouvian argumentation afforded an inescapable logic? Isn't the need for these changes obvious by now? The systems-informed attempts at system innovation are often considered to possess similar intrinsic value. Less than successful innovation journeys then appear as aberrations: This speaks from the well-known discourse describing these phenomena in terms of 'barriers to change', 'myopia', 'capture by incumbents' or 'dilution'. These terms reveal a certain bewilderment over system innovation failure. Systemic analysis is believed to afford the innovation attempt with an intrinsic value that is hard to resist.

The system-innovative belief in intrinsic value is understandable: The aforementioned multi-level model captures and bundles an impressive amount of insights into societal complexity. This belief is also unfortunate, however, as the aforementioned road pricing example helps understand: Seemingly beyond contestation yet evidently still easy to object against, it would be unfortunate to see its stagnant trajectory as a mere display of irrationality. Such would not help to grasp and cope with the attendant challenges. For this reason system innovation researchers are well-advised to (re-)turn to more polycentric perspectives. Not driven by the activist 'need' for systemic change but rather by an interest in interaction between diverse actors, these perspectives approach innovation processes as multi-sided, contested practices. The argued need for change is highlighted alongside with the objections raised against it. In bidirectional fashion the evolutionary course of an innovation attempt is then described not only from the perspective of the enlightened innovation 'sender', but from the side of the many 'receivers' as well. The advantages of such approach to system innovation have been argued by an increasingly large group of system innovation researchers. Notable contributions were made by Smith (2007), Heiskanen et al. (2009), Stirling (2009, 2011), Hodson & Marvin (2010), Späth & Rohracher (2010), Maassen (2012), Jørgensen (2012). The argument for polycentric perspectives also recurs in agenda-setting articles such as Smith et al. (2005), Genus & Coles (2008), Voß et al (2009), Smith et al (2010), Grin et al. (2010) and Coenen & Truffer (2012). Geels (2010) insightfully deals with the associated pros and cons, also considering that the fine-grained relationist approaches do relinquish some of the explanatory advantages of the MLP.

Stirling (2011) summarizes the proposed 'polycentric turn' nicely when directing attention from 'integrative transitions' to 'diverse transformations'. Analytical focus should not be on the singular transformative pathway envisioned by one actor, but rather on the many pathways envisioned by diverse actors, and on the interplay between these potentially rivaling ambitions and actions. As mentioned, system innovation research along these lines can build on substantial earlier work on 'networked innovation'. Each in their own ways, the Social Construction Of Technology (SCOT) (Bijker & Law, 1992, Rammert, 1997), actor-network

theory (ANT) (Callon, 1980, 1986, Callon & Law, 1982, Czarniawska & Joerges, 1996), 'network management' (Koppenjan & Klijn, 2004) and the theory of self-referential systems (Luhmann, 1986, 1995) point out that innovation attempts are generally not taken up just for their presumed intrinsic value. Instead, the recipient actors are expected to appreciate the initiative through own particular system understandings. In this regard Luhmann (1986) indicates that innovation attempts are mediated through the 'resonance capacity' of self-referential systems. When being transmitted between self-referential systems with stabilized system understandings, attempts are likely to be received as 'noise': A major threshold for any diffusion is therefore that the attempt needs to be meaningful and relevant to recipients. This insight is formulated particularly clearly in Akrich et al. (2002a,b): *"The model of interessement allows us to understand how an innovation is adopted, how it moves, how it progressively spreads to be transformed into a success. The socio-technical analysis underlines that the movement of adoption is a movement of adaptation. The continuous flow method [an empirical example used in the text-B.P] does not exist in general. It must be transformed, modified according to the site where it is implemented.* To adopt an innovation is to adapt it*: such is the formula which provides the best account of diffusion".* (Akrich et al., 2002b, 209). To acknowledge that adoption generally involves adaptation focuses analytical attention onto the translations an innovation attempt undergoes. Latour (1986, 267) refers to translation as *"…the spread in time or space of anything – claims, artifacts, goods – in the hands of people; each of these people may act in many different ways, letting the token drop, or modifying it, or deflecting it, or betraying it, or adding to it, or appropriating it".*

The central research question is answered as follows. Building on in-depth research[1] as presented more extensively in Pel (2012a), four innovation attempts in the Dutch traffic management are briefly described and characterized in terms of their translation dynamics: An innovation attempt is launched by an initiator who perceives a particular system failure, and is received by actors with other system understandings who translate the attempt accordingly. This is how whole translation sequences emerge, and the patterns in these sequences are their translation dynamics. Pattern tracing has been guided by a translations typology, sensitizing translations tracing towards several basic responses to innovation attempts[2]. Next to these 'foreshadowed problems and issues' (Stake, 2003, 142/143), the innovation processes were studied for translators' efforts to coordinate. In this regard the emergence and construction of so-called 'boundary objects' and concepts (Star & Griesemer, 1989) was followed, as well as the attunement of translations. The latter 'synchronization' (Rammert, 2000, Leydesdorff, 1997) indicates a foreshadowed problem particularly salient to system innovation research: The variety of actors involved in broad innovation processes is bound to produce a cacophony of translations. This emergent incoherence (Kern & Howlett, 2009, Hodson & Marvin, 2010, Maassen, 2012) is worrisome, as the quest for systemic innovation implies an ambition for integrated and coherent innovation.

Each translation sequence has its particular evolutionary course. This is why they are often called innovation 'journeys' (van de Ven et al., 1999). Establishing case-specific translation dynamics offers a basis for comparison, however. With respect to the research question, the following issues are particularly important to compare: First of all, it is important to describe

[1] This four-year dissertation research project involved document analysis of newspapers, evaluation reports, official minutes and traffic-related journals and websites, attendance of meetings, as well as 48 transcripted interviews with key actors.

[2] These translation types were Non-translation, Interference, Embracement, Modification, Alien modification, and Self-translation (Pel, 2012a, Ch.3).

what the respective innovation attempts consisted of, what they were meant to achieve, and what resulted in terms of system innovation. Of particular relevance are the initiators' analyses of the problem and its solution. Second, it is shown to what extent and how the presumed intrinsic value mattered to key translators, i.e. how they translated the innovation attempt. Third, it is verified to what extent the translation sequence was marked by synchronization, or its absence. The analysis will bring forward how some translators emphasized the attempt's problem-solving potential, i.e. its impacts on the system to be governed, while others emphasized its function to align actors, i.e. its impact on the governing system. In the concluding comparative analysis it is shown how the three more prolific innovation attempts displayed intriguing processes of synchronization. Part of the explanation for this does seem to reside in the properties of the innovation attempts: They articulated not only innovative solutions to substantive problems, but also the governance interactions through which to shape and sustain those solutions in practice.

2 Reconfiguring the road network (I): The 80 km/h zones

This case concerns an attempt to reconfigure the road network with respect to the environmental side-effects of traffic. In spring 2002 the Dutch minister of Transport announced the opening of the first 80 km/h zone on Dutch highways. The zone implied the imposition of a lowered speed limit (compared to the usual 100 or 120 km/h) on a road section of the A13 highway through Overschie, a Rotterdam borough. The speed limit was strictly enforced through the installment of so-called section controls, automatically fining any speeding. The zone was introduced to curb the local violation of air quality standards, as well as the noise suffered by many Overschie citizens. These adverse effects the Ministry had reckoned to diminish through the lower speeds themselves, but also through the expected homogenization of traffic flows.

The experiment was intensively monitored for air quality, noise and congestion effects. After the evaluations in 2003 proved positive, the Minister decided to accord the experiment permanent status. Broad societal support came up for the environmental solution to be 'rolled out' onto other air quality bottlenecks, but the ministry stressed that much of the measures' effectiveness depended on highly context-specific factors. After careful selection from a 'longlist', the Minister opted for four other 80 km/h zones in the fall of 2005. Soon after their opening, alarming congestion reports came out, however. In Spring 2006 the congestion figures still displayed dramatic increases, and this immediately led MPs to approach the Minister with critical inquiries about the zones' proneness to congestion. Eventually the Minister took to remedial measures (lineage, information provision), but also declared to seriously reconsider the measure. This reconsideration was pulled through by her successor, who also undertook further preparations for experimentation with a dynamic speed regime. In 2008 he declared his preference for the latter option, announcing to phase out the 80 km/h zones and starting experiments with dynamic speeds. All of these measures would have to be tested against air quality and noise regulations. All in all, the decision for phase-out reflects how the innovation attempt became a doubtful asset to its ministerial initiators, and how it failed to attract sufficient societal support. The innovation attempt was not successful, and in this respect the 80 km/h zones constitute a negative case.

The 80 km/h zones translation sequence is exemplary for the cacophony of translations that is so likely to occur in differentiated societies. Moreover, it shows how this can undermine an innovation journey if no or little synchronization is reached between translators. The translation sequence was marked by a process of politicization that tore the intended

evidence-based experimentation trajectory apart. In the first place there was a group of translators who embraced the zones as forceful environmental solutions: Overschie citizens who had campaigned and protested for action, health researchers who had established the adverse traffic-related health effects, various media that reported on the dire situation of Overschie citizens, various government officials at the decentralized levels who saw similar problems in their own areas, advocates from academia, the environmentalist and left-wing parties in parliament, and various NGOs. From the latter especially Milieudefensie/Friends of the Earth was a prominent translator, launching a national campaign for what they called 'health cordons' – large-scale application of the 80 km/h measure, well beyond the restrained implementation strategy upheld by the initiators. Eventually Milieudefensie even took to the administrative Court of Appeal to wrest loose the measure from what had become reluctant innovation owners. This reluctance becomes understandable through the presence of another prominent group of translators. Second, there were those who framed the zones not so much as a solution to environmental problems, but rather as a problematic interference with the congestion-plagued driver. Prominent translators within this group were the centre-right parties in parliament, the right-oriented Telegraaf newspaper that actually engaged in activism against intrusions on driving freedom, and also various organizations representing the interests of the transport & logistics sector. Even various 'environmental solution' translators came to frame the zones as 'congestion inducers' once the later four zones proved less successful than the Overschie zone – especially the A12 Voorburg zone became notorious for its congestion levels. The third group of translations were focused on the enforcement arrangement introduced through the zones. Amongst a minority of drivers the section control system of camera surveillance and automatic fining evoked outrage. To them the zones' environmental gains were marginal or not relevant, and in any case they did not justify the grave intrusion on driving freedom. To this discourse coalition of right-wing and populist political parties, activist websites and newspapers, the zones primarily represented a form of hidden taxation – extorting revenues from the already over-taxed driver.

Each in their own ways, the above three groups of translators turned the zones into a political symbol. In this way the diverging translations were continuously juxtaposed instead of attuned, and the responsible Transport minister wound up with a politically highly sensitive innovation attempt. Synchronization of translations, which could have staged a debate over remedial treatments and improvements, remained very limited in this case.

3 Reconfiguring the road network (II): Area-oriented traffic management

This case concerns an attempt, or in fact a cluster of attempts, to arrive at an integrated way of dealing with transport flows. In 2003 a ministerial commission delivered its advisory report 'Movement through cooperation'. This 'Luteijn' commission, named after its chairman, consisted of high-ranked officials from both public and private sectors. Its mission had been to address the accessibility problems on the A4 highway as they occurred especially in the Greater the Hague area. More specifically, the commission was to develop further the concept of a 'mobility market', addressing not only the supply of transport solutions but also the demand for travel. During the commission's deliberations the associated road pricing schemes perished in a heated political debate, however, which limited its scope somewhat. The report retained the initial ambition towards integration, however. Its key message read that the A4 highway issue should no longer be treated as a transport axis problem, but rather as a problem of network malfunctioning. A4 accessibility could be understood only through the commuting flows in the entire surrounding metropolitan area. This 'network problem' crucially required to be managed integrally, the report read. However, the network was noted to be fragmented

into a large number of central and decentralized government agencies, various public transport operators, and a private sector that hardly acknowledged its role in the generation of traffic flows. The proposed solution strategy aimed to carefully build up the requisite integration, reminding the targeted actors that 'to the road user, administrative boundaries are irrelevant'. The commission established a growth model that specified several clusters of 'network-oriented' measures, the easy picks within which would create the trust for the more challenging ones. The model would be tested through a pilot in the Greater the Hague area.

The 'Luteijn approach' became a national benchmark for integrated transport policy and 'area-oriented' traffic management. The Greater the Hague pilot yielded a variety of effective collaborations and innovative transport solutions, which in turn inspired similar initiatives in other regions. All in all these initiatives can be summarized under the 'network turn', for the shared rationale that 'to the road user, administrative boundaries are relevant'. The system-innovative importance of this 'network turn' resides in the shift towards an integrated, system-responsive approach to mobility problems, often involving the ever-contested application of demand management as well. The innovation attempt, or rather the family of network-oriented innovation attempts as they were launched in different areas and in various traffic-related activities, was successful: The network-oriented way of thinking became a standard in Dutch transport and traffic management policies, and the integrated approach spurred various transport innovations in turn.

The evolution of the innovation attempt shows particularly well how synchronized innovation helps to sustain an system-innovative process despite the diverging system understandings of actors involved. Typical for the translation sequence as a whole was the range of innovative projects that were undertaken as boundary-transgressing collaborations. This involved coordinated slippery road abatement, an experiment with the opening and closing regime of bridges, coordinated incident management, an open tendering procedure for private-sector traffic information services, area-oriented optimization of traffic light cycles, the development of a methodic for area-oriented traffic management and its multiple applications, an 'inverse pricing' experiment with Rush Hour Avoidance, the introduction of the 'mobility broker' and related initiatives to self-regulate traffic-generation, the 'traffic mariner' arrangement to coordinate the operational challenges of immediate traffic problem-solving, and schemes for joint infrastructure financing and the associated bids for national-level support. All of these activities involved a range of actors; as network-oriented initiatives this is what they were meant to do. As the variety of translations was accordingly great, this 'cloud' of translations is hard to capture in a short description: Hardly surprisingly, the gains from network-oriented actions were not equally clear to all translators, and the assessments of this also changed over time.

Within the large and diverse group of translations, the following two-fold division is striking, however. To some, the proposed 'network turn' was significant especially as an effective traffic solution. Especially the content-oriented traffic professionals saw it as an opportunity for 'serious', well-founded and integral management of traffic. They applied the 'network logic' in regional 'network analyses' and traffic scenarios, emphasizing the added value of reasoning from the state of the 'system to be governed'. By contrast, the more process-oriented administrators, managers and consultants were somewhat less impressed by the content-driven logic. To them the demarcation of a particular road network and the establishment of attendant network challenges remained a deeply political issue – let alone the implementation and financing. In this translation the 'network turn' revolved not so much around the diagnosis and resolution of road network problems – the network logic was rather

a lever for fruitful cooperation and generation of trust, and a way of thinking through which to establish shared problem ownership. The above two types of translations are clearly distinct, yet they proved fairly easy to synchronize: Apparently, the 'network idea' possessed the qualities to become a 'boundary concept' appealing to diverse users.

4 Reconfiguring the road network (III): Shared Space

This case concerns an attempt to reconfigure the road network towards a more 'humane' traffic order, also seeking to restore the balance between spatial quality and traffic concerns. Shared Space became internationally known as a daring and intriguing concept to roll back traffic management, in favour of a less regulated, more 'democratic' and more attractive public space. One of the earlier showcases for the emblem was the Haren town center reconstruction, involving a much-debated shift to a mixing of traffic modes. Together with similar schemes at other sites this led to a Shared Space approach. The approach was laid down in booklets, applied in an EU-Interreg project, further developed in a Shared Space institute, embedded in traffic-related curricula, discussed with traffic safety experts and applied at various sites in both the Netherlands and abroad. Meanwhile the intriguing concept of 'safety through chaos' was eagerly disseminated through various media, not in the least because of the missionary work by its late standard bearer Hans Monderman and his network of advocates. A series of inconspicuous road reconstructions was welded into a well-known 'brand'; in this respect the innovation attempt can be considered successful. On the other hand, in many cases the radical concept materialized in rather watered-down fashion.

The Shared Space translation sequence displays widely diverging translations that initially proved hard to synchronize. In this respect the Haren town center reconstruction acts as a pars pro toto: The officials from local government and their alderman enthusiastically embraced the plans to 'mix traffic', which had been developed in a series of participatory design sessions with citizens. To them it was an innovative way to deal with traffic, while simultaneously ensuring an upgraded town centre – the main road no longer divided the town center in two. On the other hand the plan met with considerable resistance from various stakeholder groups: The large group of elderly citizens felt threatened by the plans to do away with the separate bicycle lanes and the suggestion to negotiate traffic order amongst road users. Similarly, parents felt insecure about the safety of their children, and the bicyclist's association deplored the removal of separate bicycle lanes; their hard-fought achievement in the struggle with car-dominated traffic. Also the police forces were less than enthusiastic, considering that the deregulating approach robbed of them the legal ground for enforcement. Similar translation dynamics can be seen more broadly; established traffic institutes warned that the 'safety through chaos' principle had yet to prove itself; its application better be restricted to 'dwelling areas' with low traffic intensities, in line with existing guidelines. Others were less concerned about the questions about traffic safety, and emphasized that Shared Space's removal of traffic signs and insistence on the 'self-explaining road' made for more attractive places and empowered citizens.

Shared Space acquired fame and notoriety primarily for its 'safety through chaos' principle, the controversial idea that traffic order should rely more on the self-organizing capacities of citizens. On this point synchronization proved hard, often leading to unresolved battles from entrenched positions – some emphasized the vulnerability of non-motorized road users, others emphasized their resilience and capacity for improvisation. The Shared Space initiators found that an important aspect of their concept had become 'lost in translation', however. The concept had never been meant as recipe for management of traffic, they held, and at least as

important was their argument for shared spatial design: Shared Space was also a way of negotiating space, of participative and interdisciplinary design and of exploring ways to share space. The 'traffic solution' translations did not appreciate that the concept was about much more than traffic. The partners in the EU-Interreg Shared Space program, reflecting on their experiences and the compromises they made, laid this down in a second official Shared Space publication. In this 'from project to process' booklet they effectively argued for a 'process turn', asserting the primacy of the participative design process over the implementation of traffic solutions. The earlier iconoclasm against the dominant traffic safety doctrine was toned down, and instead Shared Space was presented more and more as a model for participative governance. In other words, they took to a synchronization strategy, focusing on the attunement of different conceptions of how to share space. This can be seen in the deliberative processes started from the Shared Space institute, the research and education projects conducted with polytechnics, and also in the later discussions about future Shared Space application in Haren. Highly symbolic value is the research project undertaken in collaboration with an organization for the visually impaired: This group of particularly vulnerable road users, evidently less capable of negotiating traffic order through eye contact, had initially been overlooked by the enthusiastic innovators. The research project shows a shared scanning of the concrete challenges and opportunities. The 'safety through chaos' principle is subject to joint fact finding, which may bring forward new ways to share space. The 'process turn' made Shared Space into a more flexible boundary concept around which it was easier to synchronize – from Shared Space to the shar*ing* of space.

5 Reconfiguring the road network (IV): The travel information chain

This case concerns an attempt to integrate and improve information provision on the Dutch road (and rail) network. In 1996 a group of policymakers from the ministry of Transportation launched a policy paper on travel information, sketching a future vision for 2010. By 2010 the traveler was to be able to make an 'informed choice' on his travel modes and routes, through reliable travel information covering entire trips 'from door to door'. Inspired by the ICT-boom of the 1990s, the initiators foresaw great possibilities for technological advances. These opportunities would be seized best through entrepreneurial innovation, they held. The vision therefore contained a new model, an 'architecture', for information provision: It would be crucial to arrive at an integrated 'chain' of data acquisition, information processing, and information provision. The chain's development the initiators sought to secure through a public-private division of labour: Government would retreat somewhat, retaining control over information processing. This retreat would then stimulate the development of a market for information services: Entrepreneurs could develop new forms of data acquisition, next to the traditional system of detection loops and human observations, and they could develop customer –oriented information services. The latter would move beyond the governmental information provision that primarily served traffic control purposes.

By 2010, the horizon set by the 1996 initiators, part of the envisioned changes have materialized. The information landscape for the traveler has undergone several significant changes, and the proposed public-private cooperation in information chain development has become institutionalized in traffic management policy. In these respects the innovation attempt can be considered successful. Still information chain development proved a bumpy road, with several telling setbacks underway: First of all, the policy makers had to deal with their colleagues from Rijkswaterstaat, the Transport ministry's powerful executive department. The latter, responsible for the operation of the national main road network, felt little inclination towards a retreat from information provision: The mounting congestion

pressure rather urged for more extensive management of traffic, through Dynamic Route Information Panels (DRIPs), for example. This even led to a law suit filed by VID, a commercial traffic information provider, charging government with market distortion. This appeal was granted, and Rijkswaterstaat was summoned to limit its travel information services through internet and SMS. The information chain initiators therefore sought to restore public-private cooperation through the installment of an official commission, charged with further elaboration of market ordering principles and 'rules of conduct'. Rising congestion levels continued to fuel governmental information provision and control, however; the decentralized-level governments undertook initiatives in this direction as well. Second, the entrepreneurial activity on the envisioned information market took long to take off. Apart from the aforementioned VID and the motorists' association, little initiatives could be noted. The information chain initiators undertook various network meetings and pilots and funded experiments, but for a long time the private sector investors struggled to round the business case. For several years the experimentation phase was never followed up, but eventually the development of data acquisition through mobile sources was pushed through by navigation systems producer TomTom. Around 2005 they and their competitors did unleash the foreseen innovation race. Again conflicts arose around the proper way of information provision, though; many governmental actors feared for the consistency and reliability of information provision, and the issue of the 'socially unwanted routes' had to be settled. Third, the advances in information on public transport lagged behind those on car traffic. Public transport operators altogether felt little urge to disclose and integrate their data; it implied risks as it might expose their relative performances to their principals and consumers. There were collaborative initiatives to integrate information provision from within the sector, but the intended integration into a multi-modal information chain has yet to materialize. In 2010 the 'chain' initiators undertook a new action plan in this direction.

The case instructively displays how translators can run into mutual interferences, but also how repeated synchronization efforts can keep a joint effort such as the 'information chain' from halting. Chain development benefitted from several crucial synchronization processes: Between public and private parties (Through network meetings, experiments, the governmental commission and the data exchange project to resolve the 'undesirable routes' issue), between public parties (the negotiations between the innovative policymakers and their traffic control colleagues, the initiative to build a national repository for traffic data), and between private parties (entrepreneurs forming alliances to optimize their value chains, public transport operators joining hands for information provision services). All in all, chain development was a turbulent clew of translations. What stands out is that translators entertained divergent ideas about what 'informed choice' should look like: Customer-oriented, serving traffic order and traffic management objectives, or a means through which to keep public transport travelers on board. From these perspectives the concept of an integrated information chain wasn't always as relevant. On the other hand, the translation sequence also displays that the concept did gain foothold amongst a diverse group of translators; the basic idea of creating synergies between data acquisition, processing and dissemination survived the tensions amongst translators.

6 Conclusions and discussion of findings: Playing out the network rationale

The presented cases display 'diverse transformations' (Stirling, 2011) in the traffic management field. They show, to use an obvious traffic metaphor, that many routes for systemic change can be taken (or at least considered). This observed diversity is of transition-theoretical significance in itself (Schot & Geels, 2008). Yet these miscellaneous innovation

journeys also allow to answer the central research question through translation-dynamic comparison. *Taking into account the 'polycentric condition' and the consequent lack of foundational systemic knowledge, how can innovation attempts be devised with a reasonable chance of achieving system-innovative change? How to move from the perceived need for a particular system transformation to its being endorsed and acted upon by others?* The table below summarizes the cases for the content of the attempted innovations, the innovation achieved, the key translations they underwent, the synchronization between translators, and the ways in which the attempts were taken to address the 'system to be governed' and the 'governing system', respectively.

Translation sequences and their key characteristics

	80 km/h zones	**Network turn**	**Shared Space**	**Information chain**
Attempted innovation	Reducing environmental impacts	Boundary-crossing traffic management & transport policy	Rolling back traffic control	Integrate and improve travel information
System innovation achievement	-	+	+/=	+
Key translations	*Environmental solution *Congestion-inducer *Hidden taxation	*Effective traffic solution *Vehicle for cooperation	*Contested traffic solution *Enhancement spatial quality *Governance model	*Contested information provision arrangement *Collaboration model
Synchronization	**-**	**+**	**+/=**	**+/=**
System to be governed	Focus on air quality bottlenecks	Integral road networks	'Humane' traffic order	Travel information landscape
Governing System	Contested imposition	Boundary-crossing collaboration	Towards shared responsibility	Public-private cooperation

Aided by the above table, the following comparative observations can be made. First of all, even when relative innovation success is hard to assess[3], the 80 km/h zones are the odd one out. The initiator tellingly came to phase out the attempt that became a millstone on the neck. Against this negative case the other three can all be considered successful to a greater or lesser extent. A second observation is that synchronization was important: In the negative 80 km/h zones case it was conspicuously low, whereas the more positive cases are marked by higher levels of synchronization. This is in line with the polycentric wisdom introduced upfront: The diverse selections upon an innovation attempt are bound to diverge, and unless attunement takes place, a cacophony of translations arises. The attendant fragmentation makes it unlikely that the collective innovation process can be sustained. This speaks from the

[3] This difficulty is of course inherent to the polycentric perspective adopted. Other complicating factors are the circumstances that the translation sequences are ongoing, and that they are intertwined with other translation sequences.

excessively controversial 80 km/h zones, and from the ways in which 'network management', Shared Space, and the 'information chain' became common references and institutionalized practices over time. In the latter translation sequences translators could slowly, sometimes hesitantly, converge onto shared or at least not opposed understandings of the attempted innovation.

The observed relevance of synchronization for system innovation achievement confirms the polycentric wisdom that an innovation's relevance to translators supersedes its (presumed) 'intrinsic value'. It challenges the rather objectivist, content-driven conviction that systemically well-considered innovation attempts will be the most successful. In this respect the cases are reassuring for polycentric thinkers, and startling for those who believe in evidence-based innovation: How could it be irrelevant whether Shared Space is safe or not? How could it be irrelevant whether 'network management' practices match the road network properties established or not? How could it be irrelevant whether the 'information chain' arrangement yields adequate travel information provision or not? And how could the so extensive modeling and monitoring efforts be irrelevant to the fate of the 80 km/h zones? Haven't the translators involved been clearly concerned with the problematic properties of the road networks targeted, and haven't they been clearly engaged in analytical verification of the attempted innovation's problem-solving merits?

From a polycentric perspective, these incredulous reactions could be dismissed as predictable objections from idealistic system innovation champions or 'technocratic' traffic experts. Yet this would overlook in turn what also transpires through the respective translation dynamics: Taking a closer look at the translation sequences' key translations, it can be observed that indeed, many translators displayed clear concerns with substantive issues. This also goes for the relatively successful cases: The Shared Space case can be appreciated as a process in which translators not only considered the (process-oriented) distribution of responsibilities, but also the scope for concrete applications of the traffic-ordering principle implied. Similarly, the information chain translation sequence was not only about public-private cooperation, but about well-developed information provision as well. The 'network turn' case is particularly telling: Its synchronization processes can be seen to revolve around attempts to organize a collaborative network of public and private actors, but the systems rationale was a common reference: To the road user, administrative boundaries are irrelevant – it is the state of and the interdependencies within the *road* network that should count.

Reasoning back from the innovation attempts' main translations, the key finding from comparative analysis is thus the intriguing type of boundary concept that can be discerned. The three relatively successful innovation attempts had in common a double denotation that was most clear from the 'network turn': The attempt invoked the typically content-driven argument to achieve a fit between 'system to be governed' and 'governing system', but left it to translators to shape it. As far as this can be inferred from a limited set of case studies, a successful property of innovation attempts thus seems to be this double denotation, articulating not only innovative solutions to systemic problems, but also the governance interactions through which to shape and sustain those in practice.

What is the significance of the above key finding? Returning to the theoretical discussion in section 1, it seems that it brings nuance to the juxtaposition constructed there. On the one hand, it offers further evidence that the supposed 'intrinsic value' of systems-analytically led innovation attempts is not as great as the allure of the MLP suggests. The diagnosis of system pathologies and matching solutions still leaves the system innovation champion with

considerable ‘steps from theory to policy’. In this respect it resonates arguments for relevant, interesting (Luhmann, 1986, Akrich et al (2002a,b), ‘transferable’ (Smith, 2007), ‘organic’ (Goldman & Gorham, 2006) and ‘adaptive’ (Nooteboom, 2006) innovation attempts. Similarly the importance of ‘connective capacity’ (Bekkers et al., 2011) is underlined. The system innovator should seriously consider the bricolage of multiple cultural frames into ‘clumsy solutions’ (Verweij et al., 2006). The finding also highlights how the governance of transitions crucially requires transitions in governance (Teisman & Edelenbos, 2004). On the other hand, apart from confirming polycentric wisdom, the findings also assert the key system innovation tenet that innovation attempts should articulate systemic problems and corresponding solutions – not isolated and incremental tinkering with bottlenecks and problem symptoms. The particular transferability of the more successful innovation attempts does seem to reside for a considerable part in addressing the ‘fit’ between ‘system to be governed’ and ‘governing system’ (Folke et al., 2007). The innovation concepts did not specify this systemic match for the translators, but did incite them to investigate and negotiate how it could be achieved. In other words, they mobilized the transition-theoretical notion of ‘systemic failure’ in a particularly flexible fashion, as a boundary concept (see also Pel, 2012b). They thus withstand the ‘allure’ of the multi-level perspective on transitions, emphasizing instead how such perspective should primarily be a vehicle for institutional learning and sustained system innovation. The suggested value of such ‘networked’ innovation attempts merits further investigation.

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