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Beyond ‘resistance to change’: Interference management in System Innovation

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Abstract

This paper addresses a recurring theme in system innovation and sustainability transitions research, pertaining directly to the politics of system innovation: The issue of ‘barriers’ and ‘resistance’ to change. Framed as such, they appear as accidental and unfortunate phenomena, as obstacles on the road towards transformative change. These framings do not do justice to the multisided and contested nature of system innovation processes, however. Introducing a unidirectional ‘race-track metaphor’ (Stirling, 2011), they normatively dismiss the voices of actors experiencing interference from change attempts. Taking a more polycentric perspective, by contrast, ‘resistance to change’ can be appreciated with more nuance, through the bidirectional concept of ‘interference’. Based on four in-depth case studies into innovation attempts in the Dutch traffic management field (Pel, 2012), it is argued that alleged ‘resistance’ and ‘barriers’ are by no means accidental, but are only regular manifestations of innovations interfering with stakeholders: Interference occurs even in cases of seemingly ‘incremental’ innovation. Compared as sequences of translations (Callon, 1982, Akrich et al, 2002^{a,b}), the cases bring forward various faces of interference. The key conclusion is that management of system innovation involves not only avoidance and reduction of interference, but also its somewhat paradoxical counterpart of interference-seeking. The term ‘interference management’ denotes the integrated handling of interference, offering both a framework for analysis and a repertoire for action.

0 ‘Resistance to change’, a cognitive barrier in system innovation

There is an increasing attention to fostering system innovations and sustainability transitions, amongst both researchers and practitioners. Yet while it is easy to agree that such strategies are indeed the appropriate responses to systemic problems, the politics of system innovation remain undertheorized. In this regard it can be considered how it tends to be portrayed as a ‘post-political’ (Shove & Walker, 2007, 2008, Kenis & Mathijs, 2012) activity. Indeed, the general system-innovative strategy to bend and ‘modulate’ ongoing developments implies that fundamental political imbalances and dominant ideologies are taken for granted to some extent. Apart from this political-philosophical critique, there is also a more praxis-oriented debate on the concrete politics of system innovation in-the-making (Smith et al., 2005, Meadowcroft, 2009, Voß et al., 2009, Kern & Howlett, 2009, Smith et al., 2010, Smith & Stirling, 2010):

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Whose system should be innovated by whom and for what? Who decides? Who is to 'manage' transitions, and who is part of the problem to be solved?

Arguably these questions keep being raised not for a sheer lack of answers: System innovation, both in theory and in practice, tends to involve a discussion of systemic problems and solutions. System innovation advocates cannot be charged of secrecy: Particularly clear displays of reflexivity about practical choices and theoretical selectivity can be found in (Rotmans & Kemp, 2009, Grin, 2010, Geels, 2010). The current 'polycentric condition' is almost axiomatic in this field. Yet as argued convincingly by Stirling (2009, 2011), the problem is rather that its ramifications are seldom acknowledged to the full: System innovations and transitions still tend to be portrayed as scalars, rather than as multidirectional vectors. The unidirectional 'race track metaphor' of progress is deeply entrenched in system innovation thinking: This allows transition theorists to distinguish patterns and phases, setbacks and accelerations, frontrunners and laggards. A similarly unidirectional imagery speaks from the recurring notions of 'barriers' to innovation, and 'resistance to change' – the implication being that these be removed. These notions do not do justice to the complexity at hand, however.

This contribution subscribes to Stirling's plea for plural understandings of progress in system innovation, and seeks to contribute to its operationalization. It will be argued that especially the unidirectional concept of 'resistance to change' needs to be abandoned as a cognitive barrier (sic). In similar contexts and related disciplines this unidirectional concept has had its downfall already; consider, for instance, the demise of the NIMBY (Not In My BackYard) concept in planning theory, or similar developments in organization studies. These examples encourage to explore the scope for a similar 'polycentric turn' in system innovation: *How to incorporate this polycentric wisdom in system innovation and transitions research? How to appreciate and interpret apparent 'resistance to change'? And when appreciating it in more bidirectional fashion, how to deal with 'resistance' in management of system innovations?* These questions will be answered as follows: First the unidirectional concept of 'resistance to change' is reworked into the bidirectional concept of 'interference' (**section 1**). Next, this theoretical position is developed into a method for empirical research. The tracing of translations is an interpretive undertaking that helps elicit the different faces of interference (**section 2**). The empirical examples are taken from an extensive study into system innovation in-the-making in the Dutch traffic management field (Pel, 2012a). They involve contested self-organization on the streets (**section 3**), rivaling innovation trajectories in traffic information (**section 4**), a politicized debate on speed limitation (**section 5**), and mildly irritating initiatives towards joined-up government (**section 6**). In the conclusion these faces of interference are reflected upon, so as to provide answers to the research questions. Elaborating the pluralist approach into 'interference management' in system innovation, its normative paradoxes raises further questions however. These open up a political-philosophical research program in system innovation and transitions research (**section 7**).

1 Interference: accounting for directionality

The quest for system innovation starts from the conviction that there are systemic, 'persistent' problems in need of resolution or mitigation. Focusing on the scope for systemic change, also system innovation *research* should be acknowledged to have an activist dimension: Transition pathways are projected, promising 'niches' are selected, and incumbent actor constellations are identified. The very concept of

strategic niche management, an important model for system innovative ambitions, hinges on the surmounting of adverse selection environments (Kemp et al., 1998). Similarly, as indicated instructively by Grin (2010), it can be said that the governance of transitions amounts to a large extent to the anticipation of resistance by 'regime actors'. And finally, as regards the design and maintenance of technological innovation systems, a crucial way to capitalize on this systemic perspective is to identify and target the 'barriers' that prevent a sustainable technology from taking off (Suurs, 2009). These functionalist approaches have met with both enthusiasm and criticisms: The former reactions rather embrace the developing scope to render complex issues tractable; the latter rather warn against reified system understandings and premature 'closing down' on policy options (Smith et al., 2010). These criticisms and suggestions for refinement remind that system innovation is an inherently political venture, the normative complexity of which cannot be abstracted from without pains. Most of these contributions are rooted in STS perspectives, in political science or in public administration. They have yielded mutually reinforcing arguments for more fine-grained analysis (Genus & Coles, 2008, Kern & Howlett, 2009), more fluid system understandings (Smith & Stirling, 2010, Guy, 2011), greater reflexivity on the side of the researcher (Shove & Walker, 2007, 2008), more sensitivity to the erratic behavior of nested, complex systems (Meadowcroft, 2009, Cohen, 2010, Shove, 2012), more attention to heterogeneity in transition contexts (Smith et al., 2005, Smith, 2007, Maassen, 2012, Jørgensen, 2012, Späth & Rohracher, 2012, Coenen et al., 2012) and a greater sensibility to the inclusion of marginal and subaltern actors (Hendriks, 2009, Avelino, 2009).

These critical contributions display different mixtures of analytical and political-ethical arguments: On the one hand, it is argued how refined system analyses are more adequate and yield more effective management strategies. On the other hand it is stressed that system innovation should not bypass the controversies and tradeoffs tied up with its very transformative ambitions². Still, the two kinds of arguments are intrinsically related: An appeal for greater analytical diversity also implies the inclusion of otherwise marginal viewpoints, and therefore tends to empower the less firmly positioned actors. As treated more extensively by Stirling (2009, 2011), the normative and analytical arguments for diversity deal with related but different issues. Stirling (2011, 83) demonstrates this by subsequently discussing the diversity of social evaluations of progress, of plural understandings of transition processes, and of the conceptualization and parameterization of diversity itself. These distinctions elicit how the analytical inclusion of diverse system understandings may still be only instrumental to the realization of a particular innovation trajectory. In that case the commitment to diversity is limited: The analyst's commitment to a particular destination shines through. The particular approach to diversity thus remains locked in within a unidirectional understanding of progress; system innovations and transitions are conceptualized through a 'racetrack' metaphor. Such limited acknowledgement of diversity speaks from the common vocabulary of transition 'phases', 'take off', 'acceleration' and 'stagnation', from the research foci on 'drivers' and 'barriers', from the distinction of 'frontrunners' and 'laggards', and, albeit more subtly, from the notions of 'niches', 'regimes', and 'upscaling'³.

Some of these unidirectional terms refer to systems and to innovation processes, others refer more directly to societal actors. The latter is clear in the 'frontrunner' - 'laggard' juxtaposition, and can also be found in references to 'niche players', 'regime actors' and 'incumbents'. In these cases, when societal actors and

² The first type of arguments seem to carry more weight in system innovation discourse, to my assessment.

³ To be sure, 'upscaling' as defined in van den Bosch (2010) accounts for directionality. The term is often used unidirectionally, however, referring to 'scale' in a literal sense, rather than a diversity of transition contexts.

stakeholders are referred to, the unidirectional view on system innovation becomes particularly worrisome: Reification of system understandings no longer remains limited to (more or less tenable) analytical simplification, but it also stages a division between enlightened and myopic actors, reformists and 'powers that be', heroes and villains. Once unidirectional system analyses turn into normative dismissal of actors' viewpoints, the outdated figure of the 'false consciousness' looms only just around the corner – relegating the system innovation project to the crude system analyses of its (neo-) Marxist predecessors. In such manifestations of unidirectional thinking any challenging visions, dissenters and critical voices tend to lose their faces. 'Resistance to change' marks the point when other viewpoints are no longer appreciated as such, but rather as nondescript manifestations of inertia. This concept's appropriateness in a diverse society can be considered normatively doubtful. Moreover, this simplification is even risky in its own unidirectional terms, and is likely to yield ineffective strategies. Considering the system-innovative bet on co-evolutionary change processes rather than on straightforward revolution, dissimilar others and parallel change trajectories are integral parts of its strategy. As such, unidirectional thinking needs to be toned down at least when actively engaging with apparent 'resistance to change': This term, and its associated line of thinking and acting, merits to be reworked into a polyvalent understanding that is more in tune with societal diversity.

Following Stirling's argument, the notion of 'resistance to change' is *itself* a barrier to system innovation. It confines change initiators and analysts into a unidirectional mindset. The strategic, moral and political drawbacks of such mindset have actually been discussed at length, in a variety of other but similar contexts: In planning theory an abundance of empirical studies has shown that civic resistance against spatial plans is seldom the result of merely self-centered protest. Instead of a display NIMBY (Not IN My BackYard), the story is often more checkered. Contemporary planners have come to realize how negligence of dissent does not only invite lengthy implementation trajectories, it can actually be a source of improvement. Similarly, innovation theory has been long acquainted with the phenomenon of 'disruptive' innovation, and with the ways in which conflicts can be used for targeted adaptations (Tushman & Anderson, 1986, Hargadon & Douglas, 2001, Harrison & Laberge, 2002). Also in organization studies, with the particular attention to the professionals who are to undergo, shape and deal with change, there is a longstanding appreciation of the various ways in which change may be resisted. Change is seldom embraced without questioning. Resistance is to be reckoned with, but neither is change likely to be resisted just per se (Waddell & Sohal, 1998, Diamond, 2002, Ford et al., 2002, Ferlie et al, 2005). These examples are encouraging: Even when they pertain to practices arguably less challenging than transformations in locked-in systems, they do remind that there are alternatives to unidirectional understandings of 'resistance'.

The above examples are rather dispersed, and of only indirect relevance to system innovation practice. They do converge on a both simple and important shift of perspective, however; the receivers, rather than the 'senders', of change are in the centre of analytical attention. Now the point is not that the receiver side should be identified with unconditionally. Such would merely change one unidirectional view for the other. Rather, these examples pave the way for a bidirectional view on resistance. In this regard Luhmann (1997, see also 1995) instructively situates the experience of 'resistance' in a network perspective. He reminds that the dichotomous scheme of action/resistance is only meaningful under the supposition of a certain theory (or a direction, as Stirling would say). Yet when looked at through a singular theory, and thus dividing the world in the two halves of action and resistance, 'does one see everything that is to be seen' (Luhmann, 1997, 47)? The answer to his rhetorical question is a clear no, and this is indicative of the

complexity of a networked world of systems-of-systems. The difficulty is that the phenomenon of 'resistance' does not exist as such, but is rather a particular interpretation of an action. The innovation attempt of a 'sender' may invite a response from a 'receiver', after which further exchanges may follow. Both sender and receiver can describe either of these communicative moments as 'resistance' or 'action'. Both parties may hold strong opinions about who interferes negatively with whom (i.e. the first may speak of 'market distortion' and the other may believe to be correcting 'market failure'). Neither, however, can claim an objective vantage point from which to decide who 'resists' and who does the more positive 'action'. What is more, also a third party observer (such as a system innovation researcher) can only make such distinctions under the presupposition of a certain direction or system understanding: Did actor X resist innovation, or did he rather have another innovation in mind (Pel, 2012a, 42)?

The above complexity of meaning cannot be dissolved, Luhmann holds; it can and should be included in societal analysis, however (1997, 54). For present purposes, his analysis has helped to develop an enriched understanding of 'resistance to change'. Following his idea to treat innovation 'senders' and 'receivers' alike, as self-referential systems with particular directions for change in mind, 'resistance' is better appreciated as 'interference'. This concept leaves open who interferes with whom, and rather refers to the transmission process in between⁴. Whether and to what extent this transmission process can be considered as 'interferential', i.e. as problematic or deviating from expectations, is then a further methodological question. In the next section it is exposed how to appreciate 'interference' from the perspectives of 'senders', 'receivers' and analyst, and how this was done in a study into traffic management innovations in-the-making.

2 Analyzing interference: Translations analysis in traffic management innovation

The concept of 'interference' helps to do away with unidirectional ideas about 'resistance to change', appreciating apparent struggle in rather bidirectional terms. It then remains to be seen whether and how it can help empirical analysis, and inform a polyvalent management of system innovation.

As regards a more operational *understanding* of 'interference', few problems arise. The examples from planning theory, organizational studies and innovation theory provide ample foothold, to begin with. They hold up various mirror perspectives to the change initiator's intended transformation, allowing to reconstruct its reception by various stakeholders. To paraphrase Yanow (1997), these perspectives articulate the many ways in which an innovation attempt means. Yet in contrast to the still rather binary focused on interactions between initiators and stakeholders⁵, Luhmann's emphatically polycentric view requires elaboration into a similarly network-oriented perspective: This retains the pertinence to innovation in wide actor networks and composed systems. In this regard the sociology of translations is most helpful, as also becomes evident from a range of contributions to system innovation research (Smith, 2007, Heiskanen et al., 2009, Maassen, 2012, Jørgensen, 2012, Raven et al., 2012). This kind of analysis fits well with Luhmann's 'Babylonian' worldview, eliciting how objects and ideas flow through (and are constituted by) essentially heterogeneous networks (Callon & Law, 1982, Bijker & Law, 1992, Czarniawska

⁴ This conceptual move can be usefully compared with Stirling's shift from integrative transitions to diverse transformations. The latter concept of 'transformation' is more open and less teleological (Stirling, 2011, 86).

⁵ The stakeholder is defined by his stake in an initiators' plans, after all.

& Sevon, 1996, Latour, 2005). Focusing on ontogenetic processes, translations analysis is particularly useful to study innovation processes (Akrich et al., 2002^{a,b}, Bijker & Law, 1992). And as ontogenesis is situated in heterogeneous and volatile contexts⁶, struggle, negotiation and interferences are recurring themes in these empirical analyses (see Callon & Law, 1982 on 'counter-enrolment', for example).

Translations analysis helps understand the evolutionary process of system innovation in bidirectional fashion. As described more extensively in Pel (2012a), these processes can be investigated by following innovation *initiators* with particular *system understandings* and *ambitions* who wage *innovation attempts*, as well as various translators with other system understandings and ambitions who *translate* (appropriate, modify, reject) the innovation accordingly in particular ways. Following the leads obtained from initiators and translators, entire *translation sequences* can then be reconstructed, and these translation sequences can *intersect* in different ways. Through comparative analysis it is then possible to establish more generic *translation-dynamic patterns*. This brief methodological summary substantiates what it means to investigate 'resistance to change' in polycentric fashion: Actors' system understandings, ambitions and engagements with others need to be reconstructed meticulously, through interviews, document analysis and field observations. It is thereby essential not to side with any of the actors, and maintain symmetry in observation⁷. For the reconstruction of translation sequences and the understanding of process it is further important to continuously alternate between data gathering and interpretation; an innovation processes' relevant branching and boundaries are carved out gradually. A case study of this type can be considered finished once an attempted innovation has become 'saturated' with the main translators' narratives. At that point the researcher can finalize the interpretive process of establishing a cases' translation-dynamic 'footprint'.

In order to enhance such translation-dynamic theory-building, the research underlying this paper was sensitized by a translation typology. The typology captured the foreseeable modes of translations, which could be more or less appreciative, for example, and were expected to involve greater or lesser modifications by translators or the initiators themselves⁸. As methodological heuristics these ex ante distinctions do not directly inform the desired understanding of 'interference', of course. They do signal, however, that it needs to be considered as a particular dimension of translation processes. The empirical observations below thus constitute exemplars rather than integral cases. In order to maximize the elicitation of 'interference' (as opposed to the unidirectional 'resistance to change'), the case material will therefore be presented in the rather fragmentary form of 'faces of interference'. Referring back to Luhmann, these faces show more concretely how assessments of 'action' and 'resistance' presuppose a certain system understanding.

Before presenting these 'faces of interference', the choice of cases merits attention. The empirical material is taken from an extensive study after system innovation in the Dutch traffic management field. The

⁶ Geels (2010) indicates that this volatility tends to be overemphasized in translations analysis, at the expense of attention to solidified, systemic structures. While agreeing that this tendency limits translations analysis' pertinence to transitions research, I believe this objection is less serious in the context of present purposes. As the intention behind the paper is to disclose diversity, diversity should be allowed to surface in the first place.

⁷ In ANT tradition, to 'maintain symmetry' should also extend to the non-human elements of socio-technical networks. More in SCOT tradition, this analysis focuses on humans – as is usual in innovation and deliberate change oriented applications of translations analysis.

⁸ See Pel (2012a) for the description of these translation types: 1.Non-translation, 2.Interference, 3. Embracement, 4. Modification, 5.Alien modification, 6. Self-translation.

sections correspond with distinct case studies that together formed a nested-case study. They were selected as 'diverse transformations' (Stirling, 2011), representing alternative envisioned 'routes' towards a somehow more 'sustainable' traffic management practice. The 'faces of interference' thus represent diverse viewpoints *within* the diverse cases. Meanwhile, several authors have exposed why especially the traffic management field, or at least the wider field of mobility governance, is bound to yield a considerable deal of interferences (Hajer, 1995, van Wee, 2002, Goldman & Gorham, 2006, van den Bergh et al., 2007, Valderrama & Jørgensen, 2007, Cohen, 2010, Geels et al., 2012). The ones encountered concern road design (section 3), traffic information arrangements (section 4), speed policy (section 5) and cross-boundary mobility policy (section 6). After an introduction of the attempted innovation and the interference diagnosed to be at issue, two faces of interference are shown; first as 'resistance' and then as 'alternative action'. Intermediary conclusions on interference patterns are briefly summarized for later comparison.

3 Shared Space: Empowering self-organization or Law of the jungle?

Attempted Innovation. Shared Space was an attempt to move towards a more 'humane' traffic order, also seeking to restore the balance between spatial quality and traffic concerns. The approach to road design acquired fame and notoriety primarily for its 'safety through chaos' principle: Traffic order can and should rely more on the self-organizing capacities of citizens, and less on the traffic signs, lineage and traffic controls held necessary by a dominant and introverted traffic management sector. Public space should not be divided technocratically, but it should be shared socially: Whereas a fully regulated road yields 'pseudo-safety', a more chaotic traffic situation reminds road inhabitants to take each other into account. Shared Space became internationally known as a daring concept to roll back traffic management. The approach initially developed through several road design schemes in the north of the Netherlands. Later it 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 'safety through chaos' concept was eagerly disseminated through various media, not in the least because of the missionary work by its late standard bearer Hans Monderman and his associates. A series of inconspicuous road reconstructions was successfully welded into a well-known innovative 'brand'. On the other hand, in many cases the radical concept materialized in rather watered-down fashion.

Within the Shared Space translation sequence the central interference revolves around the 'safety through chaos' principle, i.e. the mixing rather than separation of traffic modes. Was this bet on self-organization empowering, or did it rather expose vulnerable road users to the law of the jungle? How to understand this interference?

Faces of Interference (I): Resistance. Shared Space acquired fame for its daring approach to road design. Its rise can for a large part be attributed to its appealing storyline: Juxtaposing impersonal and 'technocratic' traffic management practice against decency and common sense, the innovators found a willing target in the traffic safety doctrine of separation and meticulous ordering. The iconoclasm against traffic 'furniture' resonates well with more widespread resentment against overregulation and bureaucracy. Yet throughout Shared Space evolution its advocates also encountered considerable opposition: First of all there were the objections and outcries of various groups of road users, worried whether the 'safety through chaos' would

really work. Representatives from the elderly and parents with school going children asserted that these vulnerable road users should not be exposed to the 'law of the jungle'. Also bicyclists and representatives of the visually challenged, a particularly vulnerable group in traffic worried about their position amidst motorized traffic. Second, the Shared Space initiators also met with skepticism and resistance from the professionals upholding existing traffic regulations. Traffic safety experts pinpointed the lack of evidence for the concept; from police quarters the deregulating approach was dismissed for its erosion of enforcement; politicians were reluctant to expose themselves to possible charges of irresponsibility.

From the initiators' point of view, their change attempt met with considerable 'resistance to change'. Citizen's fears for a 'law of the jungle' must have seemed particularly misguided: The very Shared Space concept exposed how feelings of insecurity in traffic create alertness, and how self-organization can be invited through careful design – 'the road tells the story' (Shared Space, 2005). As an alderman commented afterwards on citizens' complaints about the chaos on the street: *"Well, then you understand exactly what it was intended to be; you may not agree with me about it, but at least you saw its purpose..."* (Pel, 2012a, 193). Similarly, the many appeals to road design guidelines and expert opinion missed the point from a Shared Space perspective. This only led back to the one-dimensional traffic safety approaches that eroded public space design; a conservative loop preventing people from independent thinking. Suspicions from the traffic management 'regime' could therefore easily be dismissed as self-referential; reducing the design of public space to the engineering of traffic space, the objections confused the issue. Well-founded or not, these 'resistances' explain how many Shared Space initiatives became implemented in 'diluted' form (Shared Space, 2008). The initiators therefore concluded that in future Shared Space practice, more attention should be paid to the participative design process.

Faces of Interference (II): Alternative action. From the side of the 'resisters', few would admit to 'mere conservatism'. The various groups of 'vulnerable road users' rather considered the supposedly empowering concept to have been thought through insufficiently for its practical consequences. People negotiating right of way and coordinating by eye-contact, that would only go in particular situations and with particular groups of road users. What to think of children's lack of oversight over a traffic situation, or the generally lessened agility of the elderly? What to think of the visually challenged, who were hardly served by the suggested 'coordination through eye contact'? What to think of the tainted windshields of cars, diminishing the scope for coordination? Would Shared Space work in situations with low intensities of bicycle traffic? And then there were the host of more detailed issues (about appropriate materials for paving, about parking regulations, about proper placement of 'street furniture'): Other than mere 'resistance to change', various translators rather proposed other forms of change, and ways to better fit in the attempted innovation. This alternative ambition speaks especially from the bicyclist's perspective. To them the removal of separate bicycle lanes threatened to undo the achievements of an emancipatory struggle⁹; they sought to find safeguards against automobile dominance. Finally, none of the translators resisted Share Space's idea that public space could be made more attractive and less jammed with traffic signs. In this regard a traffic expert reminded that such approach had in fact been developing for years already; Shared Space wasn't that distinct from the practices it was pitted against (Pel, 2012a, 186).

Interference patterns. Overseeing the perspectives of initiators and translators¹⁰, the question can be raised of who interferes with whom? Instead of a clear-cut picture of 'empowerment' or 'law of the jungle',

⁹ See Shove (2012) for the ongoing nature of this struggle.

¹⁰ The analyst's is a third face of interference.

different reasonable framings of Shared Space have come to the fore. In the same vein it is hard to distinguish ‘innovators’ from ‘resisters’; the controversy rather involves *different change ambitions*. In this regard it is also interesting how the Shared Space initiators did not only compromise through the aforementioned ‘dilutions’, but also seemed to seek interference: Through their iconoclastic storyline they managed to attract attention for their not *that* radical initiative¹¹. A second striking pattern is this *productive use of interference*.

4 The public-private ‘information chain’: Conservatism, or competing innovations?

Attempted Innovation. This innovation attempt was aimed to integrate and improve travel information provision. In 1996 a group of policymakers from the ministry of Transportation launched a policy paper on travel information (Min. V&W, 1996). In their future vision for 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. It would therefore be crucial to arrive at an integrated ‘chain’ of data acquisition, information processing, and information provision, they held. The vision therefore contained a new organizational ‘architecture’ to secure the chain’s development. The perceived opportunities would be seized best through entrepreneurial innovation: 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 customer –oriented information services. The latter would move beyond the governmental information provision that primarily served traffic control purposes.

Involving a series of setbacks and breakthroughs, travel information chain development turned out as a particularly erratic innovation ‘journey’ (van de Ven et al., 1999). The general idea to improve and integrate travel information provision was widely subscribed to, but ideas diverged on how this should be done and what ‘informed choice’ actually meant. The pivotal interference stems from the redistribution of public and private responsibilities: Who was hampering chain development? Who was best able to secure ‘informed choice’?

Faces of Interference (I): Resistance. Initially the information chain plans went smoothly. The initiative was passed through parliament without much ado, the Traffic Information Centre was opened as the intended central repository, and soon after the first commercial information provider started its activities. 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. 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

¹¹ In Pel (2012c) this interference-seeking strategy is characterized as an inversal of the Trojan horse-theme.

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. Rijkswaterstaat was summoned to limit its internet and SMS services. The 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'. Governmental information continued, 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 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. 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, however; 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 public transport information lagged behind. Public transport operators altogether felt little urge to disclose their data. There were initiatives to integrate information provision 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.

From the initiators' point of view, their intended innovation trajectory suffered from considerable 'resistance to change'. Even when the aims for 'informed choice' seemed hardly controversial, the whole process seemed to be hampered by various conservative forces. The road managers seemed little inclined to concede information provision to the private sector, nor did the public transport operators prove enthusiastic about the liberalized arrangement. And even when the initiators undertook various market-stimulating actions, the entrepreneurs seemed rather risk-averse. As one of the key actors indicated, he understood well that these translators had had their reasons for their cautious behaviors. Yet beside these more substantive issues (quality of information, costs, control over data and information), he also signaled matters of image-building and narrowly perceived self-interest to have played their parts: Road managers upholding a profile of competent guards of the common good, entrepreneurial parties positioning themselves against a sluggish government (Pel, 2012a, 218). Meanwhile, the public transport operators seemed preoccupied with maintaining their market shares, rather than considering the scope for improvement.

Faces of Interference (II): Alternative action. Regarding 'resistance to change', a Rijkswaterstaat official did acknowledge that his organization was relatively immune to policy changes. As an executive department charged with infrastructure maintenance and operation, they strived for continuity as a matter of course (Pel, 2012, 221/222). To them the 1996 attempt at liberalization appeared rather as just another movement in their organization's environment, the further development of which had yet to show. Furthermore, they were the ones who had to deal with its practical ramifications. To 'leave it to the market' was popular at the time, but their concerns for a smoothly flowing and safe traffic faced only rising levels of traffic. The tension mounted, while entrepreneurial innovation didn't take off as hoped for: no wonder that road managers were eager to take innovative action themselves, and no wonder that they warned against inconsistent or flawed information provision by commercial parties. Unsurprisingly, private sector translators challenged the view of being not ready for the task: First of all, they reminded that the slow

market take-off had everything to do with government's half-hearted retreat. Especially on the far from level and volatile playing field, returns on investment remained nebulous. Their apparent unwillingness was rather a matter of caution. Second, they felt the 'undesirable routes' issue was well overblown, and falsely attributed to them alone: Rather than unveiling their apparent irresponsibility towards collective goals, the issue rather showed government's poor job in facilitating an information market. Finally, the 'resistance to change' on the side of public transport operators had its mirror side as well: As a professional in the rail sector explained, there was indeed a certain reluctance to embrace the information market. Yet the operators did have to cope with increasing competition in the sector. To disclose their real-time traffic data would leave them vulnerable to their tendering principals, to competitors, but also to demanding 'customers'. They therefore developed new information services under their own control.

Interference patterns. Overseeing the perspectives of initiators and translators, it is striking how all 'resisters' did their share in innovation too. They did so under different circumstances, however, and with *different change ambitions*. Especially the 'resistance to change' from road managers and entrepreneurs reveals parallel and sometimes mutually disturbing innovation trajectories - the one heading for a more centralized, the other heading for a more self-organizing traffic order. In this regard it is interesting how the 'chain' initiators repeatedly sought to synchronize translations and reduce interferences.

5 The 80 km/h zones: Reactionary forces, or progressing insight?

Attempted Innovation. This innovation attempt was aimed to reduce 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 to curb the local violation of air quality standards, as well as the noise suffered by many Overschie citizens. The Ministry had reckoned to achieve this 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 the relevance of contextual factors. After careful selection 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, and this led to critical inquiries about the zones' proneness to congestion. Eventually the Minister took remedial measures, but also declared to seriously reconsider the measure. This reconsideration was pulled through by her successor, who also undertook further preparations for a more 'dynamic' speed regime.

The decision for phase-out reflects how the innovation attempt became a doubtful asset to its initiators. It failed to attract sufficient societal support, and especially the section controls met with considerable opposition. The key interference revolves around the environmental gains of the speed limiting measure and its unpopular constraint on drivers. Was the phase-out a matter of reactionary forces, or rather a matter of progressing insight?

Faces of Interference (I): Resistance. The initiators carefully phrased the first 80 km/h zone to be an experiment; its merits had yet to turn out. As the former project leader recalled, there was considerable nervousness about the zones: The speed limitation was likely to be unpopular amongst drivers, and the slightest hitches in the automatic enforcement systems could cause considerable problems in the administration of fines. The zones entailed serious political risk for the minister of Transport, but also for her involved colleagues from Environment and Justice. The attempted innovation managed to survive this early critical stage however, and the initiators even received considerable support for what seemed a neat environmental measure (Pel, 2012a, 86/88). What is more, Milieudefensie (Friends of the Earth) even initiated a campaign for more widespread application of the zones, and managed to gain support from many local-level politicians, scientists, NGOs, academics and local civic action committees. Generally their pleas for ‘health cordons’ had good media coverage. The calls for innovation diffusion being that strong, the Ministry decided for four more zones - be it under strict side constraints concerning environmental effects, congestion effects, safety effects, and cost-effectiveness. As mentioned, the ministry anticipated resistance. This resistance, stemming mostly from a discourse coalition of right-wing media and political parties, the transport and logistics sector and car drivers, did rise soon after the new zones were opened. Several of the zones displayed alarming rises in congestion, and this added to the unpopularity of the automatic enforcement systems. The transport minister thus wound up in the precarious position of apparently creating the congestion problem she was supposed to solve; hence the ‘reconsideration’ and phase-out. As the support for the innovation attempt crumbled, the minister gave in – yet Milieudefensie continued to demand the ‘health cordons’, even taking to legal procedures to wrest loose the measure from the minister. As their spokesman saw it, the minister had all too eagerly given in to oppositional forces, seizing them rather as an opportunity. He considered the measure to be hardly interferential; a matter of releasing the accelerator a little. The political ‘reconsideration’ reflected unwillingness to face the traffic-related health problems, more than anything else (Pel, 2012a, 102/103): The car lobby had successfully defended their interests again.

Faces of Interference (II): Alternative action. Contrary to the viewpoint of the disappointed translators, the ministerial initiators considered to have been careful. Rather than giving in to ‘reactionary forces’, their reconsideration was rather a matter of progressive insight. As various translators brought to the fore, there were reasonable arguments for discarding the zones: Researchers had found several of the new zones to be less suitable for the lowered speed limit, resulting in serious capacity drops. Traffic psychologists added that the rigid limit was counterintuitive to drivers, considering the ‘design speed’ invited by the motorway layout. Meanwhile, technological advances had opened the way to ‘dynamic’ speed arrangements, in which speed limits could be adapted to circumstances. And also the need to address air quality ‘bottlenecks’ had diminished, both thanks to cleaner combustion technology and to more lenient air quality regulations. Finally, and somewhat in the background of societal debate, the zones did meet with fierce resistance however. The cameras of the section control systems, as resented machines of governmental control, repeatedly fell victim to sabotage. To some extent, this may be self-interested resistance, motivated by anger about speeding tickets. Yet part of the resentment seems to stem from uneasiness with automated surveillance – the emerging ‘digital panopticon’ can be considered an undesirable system innovation on more principled grounds¹².

¹² See for example Adams (2005) and Urry (2008) on this relatively silent transformation.

Interference patterns. Overseeing the perspectives of initiators and translators, ‘resistance to change’ is too simple a concept to describe the interferences at issue. Only few translators seemed just to resist in ‘reactionary’, self-interested fashion, and most translators showed concerns about the zones’ side-effects. In many ways the opposition, including the reluctant minister of Transport, also envisioned alternatives to the rather rigid arrangement. Again, a picture arises of *different change ambitions*, rather than one of innovators and resisters. A second striking pattern is the politicization of the attempted innovation: Whereas the consecutive Transport ministers sought to move carefully and avoid major interferences, various translators rather played out its controversial character. The campaign for the ‘health cordons’ made the zones into a symbol in the struggle against pollution and health hazards; inversely, the more centre-right oriented translators made it into a symbol of single-minded environmentalism, infringing upon the rights of drivers.

6 The ‘network turn’: Prolonging turf wars or acknowledgement of complexity?

Attempted Innovation. This attempt was meant to arrive at an integrated way of dealing with transport flows. In 2003 a ministerial commission delivered its advisory report ‘Movement through cooperation’ (Cie. Mobiliteitsmarkt, 2003). The commission 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. Its key message was that this 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 metropolitan area and crucially required to be managed integrally. The network was noted to be fragmented, however, involving 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 build up the requisite integration carefully, 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, where the easy picks would create the trust for the more challenging ones. The model would be tested through a pilot in the Greater the Hague area. This ‘Luteijn approach’ became a national benchmark for integrated transport policy and ‘area-oriented’ traffic management. The pilot yielded a variety of effective collaborations and innovative transport solutions, which in turn inspired similar initiatives in other regions. These related initiatives can be summarized under the ‘network turn’.

The attempted network-oriented approach was generally successful, yet its translation sequence also displays various difficulties towards network action. The key interference involves the tensions between the network rationale and the modus operandi of the constituting partners. These boundary conflicts raise the question whether apparent resistance was a matter of defensive ‘turf wars’, or rather a counter indication that administrative boundaries *are* relevant?

Faces of Interference (I): Resistance. As innovation trailblazers, the ‘mobility managers’ and their teams were meant to initiate and spur boundary-crossing problem solving. In the beginning they had had to maneuver carefully, a former mobility manager explained. The administrative partners had yet to be convinced of their added value, and any impressions of nibbling at discretions they had to avoid: The lasting

controversy over centralized 'mobility authority' arrangements could easily lead them into considerable turmoil. Anticipating resistance, they were keen on gathering inspiring 'quick wins'. The trick was to establish fairly obvious bottlenecks in the transport network first, and then confront the parties involved with it. The need for integral solutions would be hard to object against, and they actually tried to play into administrators' feelings of shame – how could this be explained to citizens?! Generally these mildly irritating network initiatives paid off through resolved problems and innovative solutions (Pel, 2012a, 122/123). Yet 'network action' also had its hitches, as several network advocates remarked: There were recurring 'relapses into the old ways of thinking', i.e. into the administrative logic based on discretions rather than substantive problems. Administrators proved not always ready to give up autonomy over mobility issues, self-interest often resurfaced, and boundary conflicts were often evaded rather than faced: If networked action was to move beyond the easy picks, more confrontational attitudes would be essential. The developed trusting relationships posed a good basis for this, preventing it from escalating interferences.

Faces of Interference (II): Alternative action. As the 'network logic' proved productive in many ways, its threats to established discretions did not lead to its dismissal. Yet where the initiators with met skepticisms, hesitation and apparent and 'resistance to change', this signaled that administrative boundaries continued to matter to translators. Even when endorsing the general network logic, translators struggled to reach agreement about its concrete implementations. As various involved professionals indicated, apparent resistance can be understood through various complicating circumstances: Local conditions made for unequally distributed benefits of joint investments; not all partners could easily provide the requisite staff and capacity; the election cycle interrupted developed network relations; reward structures were unfavorable to action 'between the lines'. As a later mobility manager indicated, a key difficulty was that network partners had to fit in collaborative action with the sometimes turbulent dynamics of their home organizations. So however inspiring the functional-systemic approach, and however useful the reassertion of traffic professionals' substantive insights, the network approach should be better attuned to the administrative complexity at hand¹³. He proposed a concept that focused more on governance networks than on road networks (Pel, 2012a, 135/136).

Interference patterns. Overseeing the perspectives of initiators and translators, the attempted network approach did meet with 'resistance to change'. Yet again, the picture of this resistance is checkered, and the network idea was certainly not rejected per se. The 'relapses' in the innovation process can be appreciated better as struggles over which kind of network action to take. Again, a picture arises of *different change ambitions*, rather than one of innovators and resisters: To some extent the 'turf wars' continued, but translators also reminded that the network logic had to operate under considerable administrative complexity. A second striking observation concerns the tactics of the initiators: On the one hand they sought to avoid interferences, showing the network logic to be instrumental to its intended adopters' goals. They also sought to keep things informal, steering away from the sensitive issues of power balances and administrative discretions. On the other hand they also modulated these tensions somewhat, however, subtly reminding administrators of their limited sensitivity to network problems. Attempting to make *productive use of interference*, they also provoked reflection on the adequacy of administrative logic.

¹³ See Teisman et al. (2009). Van den Bergh et al. (2007), reach a similar conclusion on (Dutch) mobility innovation more generally. They signal that innovation in mobility tends to be guided by an ex ante logic that focuses on technical-functional considerations rather than the complexities of implementation.

7 Conclusion & discussion:

System innovation research and practice are hampered by a unidirectional mindset, it has been argued at the outset, and this becomes particularly unfortunate when it comes to assertions of ‘resistance to change’. In related fields the latter term has been proven to be inadequate, not doing justice to the complexity at hand. These considerations led to the following questions: *How to incorporate this polycentric wisdom in system innovation and transitions research? How to appreciate and interpret apparent ‘resistance to change’? And when appreciating it in more bidirectional fashion, how to deal with ‘resistance’ in management of system innovations?* The first question has been answered by proposing ‘interference’ as a polyvalent alternative to unidirectional conceptions: It allows to appreciate apparent resistance from the perspectives of initiators, translators, and analysts. Regarding the second question, analysis of translation sequences makes this theoretical concept operative for empirical research. Reconstructing different ‘faces of interference’, the complexity of system innovation in the Dutch traffic management field has been elicited. Comparing these empirical findings and developing a more general understanding of ‘interference’, they can inform system innovation practice. A first step in this direction is to summarize the empirical examples: The table below briefly describes the innovation attempts, the faces of interference encountered, and striking patterns.

Table 1: Faces of interference

	Shared Space	Traffic information	80 km/h zones	Network approach
Attempted Innovation	Towards self-organizing traffic order; alternative road design	Towards ‘informed choice’; public-private information chain	Reducing traffic-related pollution and health hazards; speed limitation	Towards network-oriented mobility policies; boundary-crossing action
Interference (I): Resistance	Irrational fears, conservatism, overreliance on experts, self-referential traffic sector	Risk-aversion, unwillingness, image-building, myopia	Political unwillingness, Reactionary forces	Turf wars, conflict-avoidance, myopia
Interference (II): Alternative action	Attention to context, refinements, care for evidence base, struggle for bicycle emancipation	Attention to context, changes in environment, necessary caution, innovation hampered by others	Attention to context, problem solved, progressive insight, alternatives available, undesirable side-effects	Attention to context, changes in environment, administrative complexity, unclear benefits
Interference patterns	Various different change ambitions, productive use of interference	Various different change ambitions; repeated attempts to reduce interferences	Various different change ambitions, productive use of interference	Various different change ambitions, productive use of interference

The table helps to draw out some general conclusions from separate case observations: First of all, the sheer manifold of interferences is striking. Even the not that radical innovation attempts involving considerable interference, it can be considered a regular phenomenon. Initiators do regularly meet less than approving reactions; the critique on 'resistance' should not suggest this to be illusory. Second, none of the cases displayed the clear divisions between 'innovators' and 'resisters' that are suggested through unidirectional framings. Instead, there is the recurring picture of co-existing change initiatives that interact more or less harmoniously. This further substantiates the claim that unidirectional conceptualizations can be adequately replaced by a polycentric understanding. Third, comparison of initiators' and translators' 'faces of interference' reveals several telling juxtapositions; actors often define themselves through the apparent 'resistance' by others. These mutual simplifications, or 'pigeonholing' as it is sometimes called nowadays, exemplify what Luhmann posited earlier: The faces of interference presuppose a certain system understanding¹⁴. Finally, all cases show initiators actively seeking to reduce and resolve interferences. Their adaptations and negotiations confirm the key message of earlier translations analyses: Successful innovation requires a good deal of versatility, progressive refinement and self-translation to avoid interferences (Hargadon & Douglas, 2001, Akrich et al., 2002a,b). The apparent need for interference reduction rather confirming well-established wisdom, the signaled productive uses of interference are all the more striking, however: Especially the Shared Space protagonists relied to a large extent on this strategy, but similar provocations can be noted in other cases as well. Interestingly, these examples show different ways of questioning who interferes with whom.

These observations and generalizations substantiating a polyvalent *understanding* of 'resistance', the last research question is how to deal with it. The observations offer fairly specific indications for a better practice: Management of system innovation's interferences should, first, involve sustained attempts to understand, anticipate, negotiate and reduce interference. This can be effectuated through adaptive self-translations and flexible innovation designs with boundary object properties (Star & Griesemer, 1989, see also Rotmans & Kemp, 2009 and Heiskanen et al., 2009). This somewhat evasive strategic element corresponds with Sun Tze's age-old martial art principle of 'shapelessness'. Yet system innovation is not only about the implementation of projects and the selling of products, it is also crucially aimed to induce learning, reflection and more 'sustainable' system understandings. Interference management, in other words, should not drive shapelessness to the point where it becomes toothless as well. A crucial second element of interference management is therefore the productive use of interference. In the context of system innovation this productivity does not reside so much in the inducement of adaptations and improvements (see section 2). Rather, this interference-seeking behavior serves reflection on received understandings and *modus operandi*, and helps articulate systemic flaws that are seldom obvious. Typical is its *inversal-of-logic*: Who interferes with whom?

Interference management as presented shows how Stirling's call for pluralist understandings of progress can be made operative. Arguably this polyvalent approach to 'resistance to change' helps change initiators navigate between different 'matters of concern' (Latour, 2004). Yet the above is only the beginning of what can be called 'interference management'. To begin with, both elements of interference-avoidance and interference-seeking merit further development. *How can it be done? How can they be combined? Under which circumstances are they feasible?* Yet beside these possible refinements, it is especially instructive to

¹⁴ Actually his example of 'market distortion' versus 'market correction' (section 2) can be found in the traffic information case (section 4).

consider what happens when the polyvalent understanding of interference is transferred to the strategic outlook of a single actor. The acknowledgement of co-existing ambitions for change (compare Maassen, 2012, Hodson & Marvin, 2010) is one step away from the unidirectional ‘resistance to change’, it needs to be said. Similarly, Tummers (2012) exposed a framework through which to understand and deal with ‘policy alienation’. Yet by mobilizing the gained understanding primarily for the removal of alienation, this study is also illustrative for the easiness with which unidirectional thinking can return through the back door (see also Lee & Hassard, 1999). Thought through consistently, polycentric awareness should also feed back onto the concept of the innovation ‘initiator’¹⁵: They are generally initiators amongst other initiators (whose initiatives they might resist).

Who of the initiators to assist in their coping with interference? Why should which interference be reduced or modulated? These questions mark the paralyzing aporia that arises from a more fundamental accounting for diversity. Again, meaningful answers to the questions can only be given with a certain direction for change in mind. This system understanding of the analyst/policy advisor is perpendicular to those of the analyzed innovators/resisters, Leydesdorff (1997) and Rip (2006) discuss in more detail. Recommendations to the latter could then be limited to procedural guidelines; for instance the rationale to uphold and stimulate evolutionary diversity, mutual adaptation and reflection on system understandings (Verweij et al., 2006). Another answer to the questions resides in a Machiavellian approach. Starting from a situated actor’s particular system understanding, this suggests to play into other system understandings through somewhat manipulative Trojan horse strategies (Pel, 2012c). Finally, there is of course the option to persist in unidirectional thinking, which is more easy to handle (presupposing a justifiable system understanding). As this is bound to lead back to the earlier questions on the politics of system innovation, this position is not recommended however. Rather in line with Shove & Walker (2007, 2008), the acknowledgement of directionality is better coped with through more explicitness about the normative dimension involved. *Why is a particular system innovation needed? Can undesirable system innovations be distinguished* (the rise of the ‘digital panopticon’, for example, see section 5)? *And more specifically, what criteria apply and what justifies the intended system innovation* (beyond the less than concrete appeal to sustainability)? These follow-up questions open up a political-philosophical program within system innovation research – mediating between analysis of complex systems on the one hand, and political ambiguity on the other.

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¹⁵ This concept ‘asymmetricizes’ translations analysis – in the empirical research underlying this paper, this was mainly done to structure the presentation of empirical material. In other respects the investigated actors were treated symmetrically.

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