Reflexivity and Learning in System Innovation Processes

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Abstract

In-depth insight into the relationship between reflexivity, learning and reflection is needed to enrich governance approaches for persistent sustainability issues. However, current conceptualisations of reflexivity seem limited for the understanding of system innovation processes – reflexivity remains highly abstract and often gets conflated with reflection, and, by extension, learning. In this article, we critique the concepts reflexivity and learning and then present an exploratory case-study of greenhouse vegetable production in the Netherlands to examine their relations. Results suggest a shifting compatibility between initiative and context – *reflexivity alignment*: the extent to which an innovation initiative shares an orientation towards structural change with its institutional setting. Furthermore, learning sometimes appeared to increase reflexivity, as often assumed, but we found evidence of the opposite as well – reflexivity changes *preceding* learning. Synthesising the results, we posit three archetypal modes that describe the relation between learning in and reflexivity of a system innovation initiative.

Introduction

Sustainability strategies aim to bring about change from situations of lock-in and to escape path-dependency by bringing about system innovations, but may be ineffective if the mechanisms that provide stability to unsustainable socio-technical systems remain unchallenged. This means that persistent problems need a loosening-up of rules and relations that guide actions and practices. Simultaneously, ways of thinking, of problem solving, of managing resources and people, and of planning, need to be reconsidered because, as Beck *et al.* (1994) state, they are in many ways part of the problem. Inspired by the seminal work of Beck *et al.* (1994), several transition scholars assert that persistent problems require reflexivity as a key characteristic of the change process or governance style (Voss *et al.* 2006; Geels & Kemp 2007). In the context of sustainability transitions, reflexivity tends to be seen as a quality of approaches that challenge institutionalised, undesirable practices by stimulating inquiry, dialogue, interactive learning and learning-by-doing. Accordingly,

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approaches to evaluate policy or other interventions from a system innovation perspective are said to have to stimulate learning and be reflexive (van Mierlo *et al.* 2010a; Arkesteijn *et al.* 2015).

In a similar vein, social learning scholars mention the importance of reflexivity when learning contexts are characterised by diverse values, interests and knowledge (Wals *et al.* 2004; Keen *et al.* 2005; Bos & Brown 2012). Studying multi-actor issues in the context of sustainability and natural resource management, these scholars place reflexivity as a condition for, or asset to, social learning: 'social learning requires reflection and reflexivity throughout the entire process, if only to monitor change and progress throughout' (Wals 2007, p. 500). The perceived relation between learning and reflexivity, however, tends to remain unclear in the abundant academic literature mentioning both concepts, while generally elaborating just one of them (e.g., Dewulf *et al.* 2005; Pahl-Wostl 2006; Bastrup-Birk & Wildemeersch 2011).

The value of the current conceptualisations of reflexivity seems limited for the understanding of system innovation processes. 'Reflexivity' remains a highly abstract term that is seldom operationalised. Hence, its relations with learning and reflection as the presumed conditions to learning have not yet been scrutinised empirically. Moreover, the concepts of reflexivity and learning as well as their relationship are loaded with positive, normative connotations, which may do little to inform strategies of system innovation.

In this article, we first critically explore the relationship between reflexivity and learning. To enable a systematic study of this relationship, we present an analytical framework that distinguishes learning from reflexivity, the value of which is illustrated with a longitudinal case study that traces changes in reflexivity as well as learning over time in the context of a system innovation initiative in the Dutch greenhouse sector. The Dutch greenhouse sector faces sustainability issues in both ecological and financial terms, being responsible for about 10 per cent of natural gas consumption in the Netherlands (van der Velden & Smit 2014) and lacking a market orientation while about half of the sector has severe financial difficulties (McKinsey 2014). Secondly, we investigate the relationship between reflexivity changes within the initiative and reflexivity changes in the initiative's wider context (in terms of changing rules, relations, institutions and practices), in order to be able to regard reflexivity as a characteristic of the relationship between the initiative and its institutionalised setting.

Our findings primarily concern the substantive and sequential relationship between learning and reflexivity in the case-study, but they also have wider implications for current assumptions about learning (especially the assumption of reflexivity as a beneficial human capacity) and system innovation (regarding to the dominant view of niches as 'protected spaces'; see Geels & Schot 2007; Smith & Raven 2012).

Analytical framework

In its most general sense, reflexivity entails 'some sort of recursive turning back' (Lynch 2000, p. 34) from the object to itself. This indicates that the term reflexivity, by and of itself, is rather abstract and very broad in its applicability. For that reason

we first delineate reflexivity conceptually in this section, in the context of system innovations.

Reflexivity

In their work on reflexive modernisation, Beck and colleagues relate reflexivity to persistent societal problems (Beck *et al.* 2003). From their perspective, it mainly concerns how modern society has come to (unintentionally) impact itself negatively through modernisation processes. Their thesis is that while modern society 'started out from' clear and simple distinctions between society and nature, between insiders and outsiders, and between knowledge and beliefs, in the process of modernisation people became more and more interconnected, blurring lines between nature and society, ever changing who are in- and outsiders, and rendering one set of beliefs just as true as another (Beck *et al.* 2003).

This then, according to Beck *et al.* (2003) is reflexivity: when the process of modernisation has undercut the basic tenets from which it originated. To give a real-world example, the accelerated burning of fossil fuels has led to possibly irreversible climate change due to the ways in which energy is produced, food is grown, dwellings are built, etc. This was never intended when people started producing energy with fossil fuels and as such it is an example of how the environment is turning back on society. The reflexivity changes involve co-occurring changes in the economy (markets, dominant consumer practices), politics (rules and regulations, policy networks, power), technology (infrastructure, technical standards), culture (value orientations, symbols), and science (knowledge in perspective, questioning the value of science; Beck *et al.* 2003; Smith & Raven 2012). In this interpretation, reflexivity is the condition of any modern society, regardless of whether society is aware of this. In their book on reflexive governance Voss *et al.* (2006) call this first-order reflexivity.

Although inspired by Beck, in the literature on sustainability transitions reflexivity is usually seen as a virtue. Being reflexive refers to being aware of the reflexivity of modern society. This entails knowledge of how society is changing, how the changes may impact actors and how actors contribute to changing society. The elaboration of complex problems into practical options for action requires 'a critical scrutiny of things that are usually taken for granted, in such a way that their historically grown self-evidence (path dependency) is challenged' (Loeber *et al.* 2007, p. 84). Being reflexive is thought to allow people to act more in accordance with their changing environment and in this way to increase the chances for society to become more sustainable (Hendriks & Grin 2007; Owen *et al.* 2013). In this sense, reflexivity is a human (group and/or individual) capacity, that may be present to a varying extent, and which can be supported and enhanced. Indeed, many authors appear to suggest that facilitation of reflection/reflexivity (in general) will stimulate learning and innovation (e.g. Wals *et al.* 2004; Keen *et al.* 2005; Bos & Brown 2012). This is what Voss *et al.* (2006) call second-order reflexivity, which is at the core of reflexive governance (Voss *et al.* 2006).

The meaning of this kind of second-order reflexivity is close to a specific kind of reflection, that is, the scrutiny of the assumptions and values underlying current

governance approaches, ways of conducting research and evaluations, including the presumed categories of for instance facts versus values (Hendriks & Grin 2007). Beck *et al.* (1994), however, warn against conflating reflexivity with reflection. They are concerned about the inherent optimism of conceptualising reflexivity as a conscious activity: the system is expected to open up with more experts, more self-criticism, and more knowledge, while the assumptions on which these strategies build are concomitantly major contributors to the persistence of modern societies' problems. As a consequence, the mental and communicative activity of (re-)considering knowledge, ideas, assumptions and values is too uncritically seen as something that can be organised, facilitated and planned and moreover, as something that might directly promote relevant change.

In this article, we are interested in the reflexivity of network initiatives that aim to contribute to system innovation, that is, those initiatives, in the form of experiments in practice, pilot projects that are part of niches, which are essential for sustainability transitions in the making (Seyfang & Smith 2005; Raven & Geels 2010). Following Geels & Kemp (2007) and Smith & Raven (2012), system innovation is understood as the change of existing socio-technological regimes in a more sustainable direction, including a change of user preferences, market structure, physical infrastructure, symbolic values, et cetera. A system innovation initiative proposes an alternative to the dominant system, by developing a socio-technical system of its own while seeking interaction with the regime. Furthermore, if successful it helps to breakdown or at least adapt the dominant, incumbent system. This implies that it is successful only if the institutional setting of the initiative changes alongside the initiative itself (Regeer *et al.* 2009; Elzen *et al.* 2012). Following this through to reflexivity, it means that reflexivity is a feature of the system innovation initiative that develops over time and can only be assessed in relation to its context. In this way, and in contrast to most literature on reflexivity, we see it as a possible outcome *of* rather than a condition *for* (or asset to) learning.

In the practice of system innovation initiatives, reflexivity is defined as an initiative's ability to interact with and affect the institutional setting in which it operates and can be recognised as the emergence of new (semi-coordinated) practices of participants in the initiative as well as their wider networks, and as new associated rules and discourse enabling and constraining these practices. This is in line with, for instance, ideas about reflexive governance involving a change of assumptions, practices, institutional arrangements (Hendriks & Grin 2007) and reflexive monitoring (van Mierlo *et al.* 2010a,c). For the empirical study examined here reflexivity is thus operationalised in terms of: 1) rules guiding actors' practices (organisationally, legally, politically, symbolically), 2) relations between actors, and between the initiative and context, 3) practices (common ways of working) and 4) discourse related to the future of the initiative's sector.

Learning

System innovation processes invariably involve learning. In local experiments, participants learn about how they can change their institutional and physical environments.

Local learning experiences with social and technical novelties and innovations, are translated into more generic rules and hence foster sustainability transitions in the making (Smith & Raven 2012). Such learning takes place in a situation of actors collaborating within and across social networks, in an ever-changing environment. The associated learning processes are fraught with uncertainties, value differences and a diversity of time horizons.

In recent years, researchers have started to develop learning concepts that are specific to system innovation (e.g., van Mierlo *et al.* 2013; Beers *et al.* 2014, 2016). Such perspectives have been developed to take into account the actor diversity in system innovation initiatives, the institutional setting and the temporality in the related innovation processes. For example, the concept of system learning has recently been developed further as a process by which actors learn to redefine external barriers in the dominant system into opportunities and are thus inspired to design activities that would contribute to systemic change (van Mierlo *et al.* 2013). System learning is thought to require reflection on the assumptions underlying proposed actions, on perceived boundaries between a system innovation initiative and context and on the actions of external actors, which may be perceived and handled as barriers or windows of opportunity. A conducive learning process, in turn, may stimulate the reflexivity of a system innovation project. Reflection, learning and reflexivity hence are assumed to be separate but positively related concepts.

In this article, we take a discursive perspective to learning that integrates the strengths of social learning theories with those of education studies (Beers *et al.* 2016). In this perspective, the initiators and their partners are regarded as giving meaning to problems, new technology, social innovations, societal developments, etc. in communicative interactions (see van Mierlo *et al.* 2010a; Leeuwis & Aarts 2011; Dewulf & Bouwen 2012). The discursive perspective acknowledges that learning may occur during regular meetings as well as during specific learning-oriented occasions such as workshops. It is a process perspective in the sense that it treats learning as part of an on-going sequence of various types of meetings and conversations in which issues may come and go and learning is temporal and fluctuating, rather than progressive.

The learning process in communicative interaction that contributes to system innovation is operationalised as discursive changes regarding knowledge, actions and relations (Beers *et al.* 2016). In the learning process, knowledge refers to the content that participants exchange and produce in the communication: new insights, ideas, changed views, and new visions, while they are pursuing goals (Wals 2007). Knowledge concerns, among others, individual or shared information and ideas, such as new problem definitions, ideas for how to solve problems, values, etc. With action, we indicate the agreements, decisions, and other forms of action that are voiced during communicative interaction. The third aspect concerns relations between actors in terms of relative roles, identities and positions (e.g., Pahl-Wostl 2006; van Mierlo *et al.* 2010a; Leeuwis & Aarts 2011). For instance, discussions about external actors can result in changed relations between the initiative and these actors. Similarly, when a previously unknown resource or capability of a participant comes to the fore, this may change his/her status within a network.

Not only is the learning process important, but also learning outcomes occur in a discursive setting and this needs to be captured. A learning outcome occurs when knowledge (the what), actions (the how) and relations (the who) become substantively interwoven (Beers *et al.* 2016). Such an interweaving then constitutes a learning outcome. It is important to note that this definition yields a rather straightforward distinction between learning outcomes and the real-world actions that possibly follow as well as their impact in terms of system innovation.

Research design

A longitudinal case-study of an innovation initiative in the Dutch greenhouse sector provides the empirical focus of the paper. The innovation aimed to change the entire sector and hence needed to increase its reflexivity in order to be successful. We joined and studied this initiative for a period of 14 months (January 2014 – March 2015). In this section, we describe the case, the research activities and our role as researchers and how we analysed the collected data.

Case

The case-study initiative was an innovation of greenhouse growers, researchers, educational institutes and intermediaries. The initiative was referred to by participants as STAP, which stands for Foundation for Strengthening the Sales and Marketing Position of Greenhouse Vegetable Producers in the Netherlands (in Dutch: *Stichting versterking Afzetpositie Producenten van glasgroenten in Nederland*). STAP was an initiative of specific greenhouse growers who regarded themselves as innovative and who were concerned about the future of the sector as a whole. In STAP's view, growers generally were too focused on decreasing production costs, were lacking market orientation and faced low financial margins. Companies in the food production chain were seen as both part of the problem and the solution for improving the market position of greenhouse growers.

At the beginning of the study, STAP consisted of an executive board with three members and a larger general board. The boards consisted mainly of greenhouse growers, some of whom were also active as salespersons and traders. Meetings of the general board were attended by representatives of the Dutch Federation of Agriculture and Horticulture. Soon after the study started, STAP also established a platform of research and education institutes and intermediaries: the Chain Knowledge Platform (henceforth: STAP-CKP; see Figure 1).

STAP initially conceived of its role as making the sector more consumer-oriented. In the words of a STAP Executive: 'The central issue: a more competitive position for greenhouse growers [than now]' (2 December 2013). In early 2013 STAP had started to search for new change strategies because an earlier round of workshops had had limited success and a separate initiative for 'horizontal bundling' in bell peppers had failed. The executive board concluded that it could not change the sector on its own and needed to involve sales and trade parties because of their unique knowledge

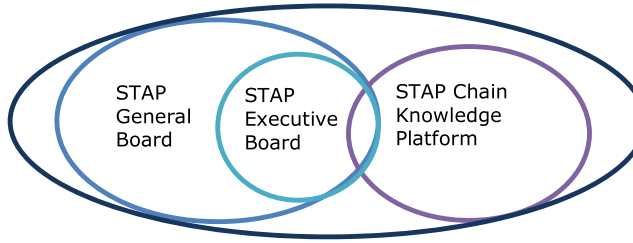

Figure 1: *STAP organisation [Colour figure can be viewed at wileyonlinelibrary.com]*

about the market necessary to turn it into a more consumer-oriented sector. In light of this, STAP started to seek collaboration with such actors in the sector.

Research methodology

Reflexive Monitoring in Action (RMA) was used to study learning and reflexivity, while supporting an interactive learning process (van Mierlo *et al.* 2010a,c). It is a form of action research in which the researcher acts as a sparring partner, facilitator, analyst and critical outsider of an innovation initiative, in various ways stimulating reflection on the outcomes of activities in the name of the initiative in the light of the system innovation ambition and developments in its context. As a result, the initiators may adapt their actions which ultimately may increase the initiative's ability to interact with and affect the institutional setting in which it operates. The first author acted as reflexive monitor in STAP (predominantly the Chain Knowledge Platform) by supporting and advising on STAP's innovation processes. The STAP members were informed that we also had a scientific interest in the communication and learning processes.

Data sources

Given our view of reflexivity as an emergent property of a system innovation initiative in its context, data were needed both about the initiative itself and its changing context. In line with Beers *et al.*'s (2016) view of learning, as a process of changing, temporary configurations within and across the network of an innovation initiative, we also needed data from different moments in time (see Jørgensen 2012).

Data regarding reflexivity consisted of interviews and documents originating both from inside the initiative and outside it. We collected a total of about 115 documents, which included email messages, written notes by people and initiatives within and around our case, as well as notes for three additional interviews, three additional meetings, notes for 11 short conversations (often by phone) and the transcripts of the 16 meetings mentioned below.

To assess learning, we observed the communication at 16 meetings of the initiative, using the moments of interaction as organised by initiatives themselves itself as the main source of data. Meetings lasted, on average, about two hours. The first meetings, seven in total, were selectively transcribed based on extensive notes taken

during the meetings, because we did not yet have sufficient rapport yet with the initiative to obtain permission for making audio recordings. Nine subsequent meetings were transcribed verbatim from audio recordings.

Analysis

The analysis was a three-step process of analysing 1) reflexivity changes, 2) learning outcomes and 3) relations between reflexivity changes and learning outcomes. Open coding of both learning outcomes and reflexivity changes was done using the AtlasTI software package and the results of the analyses were double checked in the team.

Reflexivity. Reflexivity was analysed by first identifying and coding changes over time in four analytical dimensions of 1) *rules* guiding actors' practices (organisationally, legally, politically, symbolically), 2) *relations* between actors, and between initiative and context, 3) social *practices* (common ways of acting) and 4) *discourse* related to the future of the initiative's sector as described above.

Coding of rules was guided by Klein Woolthuis *et al.* (2005; also see van Mierlo *et al.* 2010b), who include standards, laws and the legal system as a whole (e.g., contracts, intellectual property rights), the political culture, as well as social norms, symbols and values. Applied to our case, we categorised for instance the establishment of a new platform as institutional change, as well as the policy changes announced in a new policy letter from the Dutch Minister for Agriculture, since it changed the innovation initiative's context in a relevant way.

With regard to relations, coding focused on interpersonal and inter-organisational relationships and strategic alliances and coalitions, in other words, changes in organisational ties (see Klein Woolthuis *et al.* 2005). This included also how actors are related in terms of interdependency as well as the way in which the initiative positioned itself towards external actors. Applied to our case, changes regarding which body was the lead were categorised as a change in relations, for example.

Practices are characterised broadly, concerning not only practice in the sense of a shared enterprise with an associated repertoire of actions (see Wenger 1998) but also decisions and developments that (may) change the practices of the initiative. For instance, when changes in the network rendered earlier future plans of the system innovation initiative unfeasible, it changed its course of action from market-oriented sector-wide change to being focused on societally-oriented front runners. This was categorised as changed practice.

For discourse, we analysed mainly changes in terminology, 'language' and elicited common future perspectives (van Mierlo *et al.* 2010b; see Grin 2006; Beers *et al.* 2010), in other words, the way in which initiators spoke or wrote about their main ambition and how to realise it. This can be recognised in explicit comments in writings about the sector, but also implicitly in the initiative's materials and anecdotes. Note that this concerns 'shared' expressions, to the extent that the individuals appear to agree, or at least that the expression is non-controversial. An example from our case was when the main challenge in question was reframed from being insufficiently market-oriented to being insufficiently society-oriented.

The case history resulting from this analysis constitutes an account of increases and decreases in reflexivity, based on changes in rules, relations, practices and discourse. After identifying these changes, we categorised them according to whether they were internal to the innovation initiative or external, in terms of being within direct control of the initiative or part of its context. The set of *internal* changes was then used to identify what we call, *reflexivity turns*, that is, those relatively stable periods during the case study that could be characterised by one set of rules, relations, practices and discourse, demarcated by the identified reflexivity changes. The analysis resulted in the identification of six reflexivity turns. The reflexivity turns were then mirrored against the increase and decrease of the context's 'reflexivity' to see whether and how internal and external reflexivity changes were mutually supportive or not. The identification of these *reflexivity alignments*, made it possible to define to what extent and how the reflexivity turns can be regarded as changed relations between initiative and context.

Learning outcomes. To identify learning outcomes we analysed the 16 meeting transcripts using the coding definitions and procedure described by Beers *et al.* (2016). First, the transcripts and meeting notes were segmented into interaction episodes related to one topic. An episode was coded as having resulted in learning if 1) it contained conceptual content, relational content and actions, 2) clear conceptual relations existed between these content types and 3) at least one action discussed concerned a decision, meaning that an intention existed to carry out that action. This procedure led to the identification of 21 episodes with a learning outcome.

Relations between reflexivity turns and learning outcomes. In the final step of the analysis we identified whether the content of the learning outcomes related to the changes in reflexivity and in what chronological order. For each of the reflexivity changes (in a rule or relation for instance) we explored whether they could be traced back to any of the 21 learning outcomes. This enabled us to identify which learning outcomes were and which were not represented in a reflexivity change, and which reflexivity turns could and could not be traced back to a learning outcome.

Results

We first report the direct results of the data analysis, which include the reflexivity turns, the learning outcomes and the chronological and substantive relations between them. A synthesis of the results is then presented, from which we identify three archetypal modes of reflexivity alignment (*paving the way*, *easy ride* and *roadblock)*, supported with examples from the case study.

Reflexivity turns

From January 2014 to March 2015 six reflexivity turns were identified involving changes in rules, relations, practices and discourse. The summary in Table 1 suggests that STAP's reflexivity did not progressively increase over time, but alternately

Table 1: *Reflexivity turns in STAP*

	Reflexivity turn	Associated reflexivity changes
1	Establishing the CKP ↑	Establishing a precompetitive, sector-wide knowledge platform, as linking pin between STAP and production chain parties DPA and FrugiVenta changes STAP relations
2	Towards an experimentation approach ↑	New problem orientation; the sector needs to become society oriented, not only market oriented. Also, since few entrepreneurs have the necessary capabilities, an approach of experimentation in proposed instead of the earlier sector-wide uniform approach of greenhouse growers
3	Weakening Ties ↓↑	STAP's General and Executive Boards and the CKP appear to be drifting apart. The leading role shifts from STAP's Boards to the CKP.
4	Stagnation? ↓	The STAP Executive Board announces discontinuing its activities. The CKP and the STAP General Board stop meeting. One board member keeps meeting with the Minister for Agriculture and other important officials in the sector
5	A fresh impetus ↑	The Minister for Agriculture announces a Chain Innovation Programme (CIP), to be carried out by Syntens, an innovation institute and member of the CKP. The CKP now is in the lead, pursuing experimentation with STAP
6	Mired in bureaucracy ↓	Contracting the CIP is carried out by Ministry and the Rotterdam Chamber of Commerce (after merger with Syntens). It becomes clear that the CKP cannot be involved in the CIP, after which the CKP starts reorienting on its tasks

increased and decreased. Furthermore, several reflexivity turns were clearly related to external developments, such as actions by the Minister for Agriculture. Looking at the reflexivity turns in more detail, we found that it mattered whether the institutional setting was open to the goals and changes pursued by the initiative.

Looking at the changes in reflexivity from turn to turn, one might say that before the first turn (the baseline), STAP was more reflexive than its environment (the greenhouse sector itself), because STAP aimed for a market orientation while the sector was predominantly focused on optimisation of production and supply. Indeed, most greenhouse growers were 'shoving boxes', a figure of speech indicating that they had no idea about what the market wanted. Interview data suggest that, at the time, no other efforts existed to make the sector more market oriented, despite a widespread dissatisfaction with growers' market position.

When the STAP General Board established the Chain Knowledge Platform (CKP), leading to the first reflexivity turn, internal reflexivity increased because of the broader coalition working with STAP (*relations* and *rules*). External reflexivity increased simultaneously because envisioned partners from the production chain

(the sales organisations represented by DPA and the trade organisations represented by FrugiVenta) responded positively to the intended collaboration. Until that time, the production chain was seen as plagued by problems very similar to the growers' problems, that is, a lack of market orientation and a bad market position, but not addressed collaboratively. Data suggest that the chairpersons of DPA and FrugiVenta shared STAP's concerns about this and the need for more collaboration among the actors in the production chain.

The second turn, towards experimentation, involved an increase of internal reflexivity in the sense that STAP changed its own problem orientation (*discourse)*: the sector needed not only to become market oriented, it should also be societally responsible. This represents an increase in terms of internal reflexivity because the scope of envisioned change broadens and becomes more far-reaching in ambition. Given the expected collaboration with production chain parties the reflexivity was well aligned. However, from a wider perspective the new problem orientation also worsened the alignment between STAP and its context (external reflexivity) because it deviated more from the dominant sectoral orientation than before.

During the third turn, the envisioned partners DPA and Frugiventa hesitated and ultimately failed to actually commit their support to STAP, hence decreasing external reflexivity. This did not happen at once, but developed slowly over the course of several months (approximately March-May) in which mixed signals about DPA's and FrugiVenta's positions surfaced during several meetings. Meeting data suggested that, despite their initial support to the CKP, these organisations were unable to convince their constituencies. This contributed to a weakening of the internal ties between STAP and the CKP (*relations*). The STAP Board's strategy of working together with production chain partners was still predominantly oriented at sector-wide change, and without these companies' support, the STAP board remained mostly inactive. However, while the STAP board decreased the internal reflexivity, the CKP was getting more and more up to speed focusing on societally responsive innovation by frontrunners and contacting external parties, thereby maintaining internal reflexivity.

The fourth turn of stagnation was heralded by STAP itself when in a press release it announced to discontinue its activities, citing a lack of urgency and support in reaction to the official withdrawal of the envisioned partners. This can be seen as decreased internal and external reflexivity. STAP denouncing its position signified a drop in *actions* towards sectoral innovation. The CKP persisted (indeed, STAP's press release mentions the CKP as a way to move forward, in case the production companies were to commit after all) but did not meet for several months (including summer holidays).

The tables turned when the Minister for Agriculture announced to provide an impetus to the sector via a Chain Innovation Programme (CIP), with one of the CKP parties (Syntens) in a leading position. Syntens and STAP both saw opportunity to connect the STAP and CKP agenda to the CIP, and the impression emerged that the CKP might have an important role in substantive co-ordination of projects in the CIP. The fifth reflexivity turn hence started with an increase of external reflexivity, when actors (mainly the government) began to advocate a problem orientation and practice well aligned with STAP's approach of experimentation. This appears to

directly lead to an internal reflexivity increase – the experimentation approach further cements the relation between the two STAP Boards and CKP (*relations*) and it sets the CKP and the STAP Board (again) in motion to develop an innovation platform (*practices*).

However, the alignment decreased again during the sixth turn when the ideas about production chain innovation and experimentation got watered down in the confrontation with the bureaucracies of the Ministry of Economic Affairs and the Chamber of Commerce (with whom Syntens got merged at that time). The policy makers at the Ministry treated the CIP as a 'standard' innovation programme, focusing on a high success rate for supported projects instead of a learning-oriented programme for transitions, in which 'failures' are off-set by the relevance of lessons learnt. The initial reaction of the Chamber of Commerce was to use the CIP to fund their own advisers and let them support entrepreneurs. This ran directly counter to the initial CKP-idea of putting most of the funding in the hands of the entrepreneurs for a more demand-oriented focus on innovation. The consequence of this decrease of external reflexivity was that the CKP was left bare-handed and again was urged to reorient its role and approach (*practices)*.

At the time of writing, the CKP persists in its orientation but has not secured any funding for itself. In that sense, it merely exists as a small network of transition-oriented individuals in the Dutch greenhouse sector. Nevertheless, CKP members meet from time to time and their ideas are still alive and being spread across the network.

Looking at the relation with developments in the context of the initiative in more detail, we found that it mattered whether the institutional setting was open to the goals and changes pursued by the initiative. As Figure 2 shows, increases in reflexivity within an initiative and in its context may occur in the same period. Hence, we suggest *reflexivity alignment* as the extent to which the initiative is working towards structural societal changes – having a structurally different problem orientation and advocating a different practice than the status quo – while its direct context seems to be receptive to such changes.

The relation between internal and external reflexivity obviously alternates: an increase of internal reflexivity may contribute to an external reflexivity increase (*Establishing the CKP*); alternatively, an external reflexivity increase may trigger an increase of internal reflexivity (*A fresh impetus*), or an external reflexivity decrease leads to a decrease of internal reflexivity (*Mired in bureaucracy*).

The above account suggests that regarding the relation between a system innovation initiative and its institutional setting we need to distinguish between *fit*, that is, the extent to which an innovation initiative fits with its context – having the right connections, sharing a similar problem orientation, advocating similar practices – and *reflexivity alignment*.

Combining the two, a first type of fit exists when neither initiative nor context are reflexive. The second type occurs when an initiative retains or increases its reflexivity while increasing its fit; a reflexivity alignment. Our study shows that a system innovation initiative does not necessarily divert from the situation in its institutional setting if the latter is open to change, meaning that the latter is not necessarily representative of the status quo, or the incumbent regime. Conversely, when the status quo is

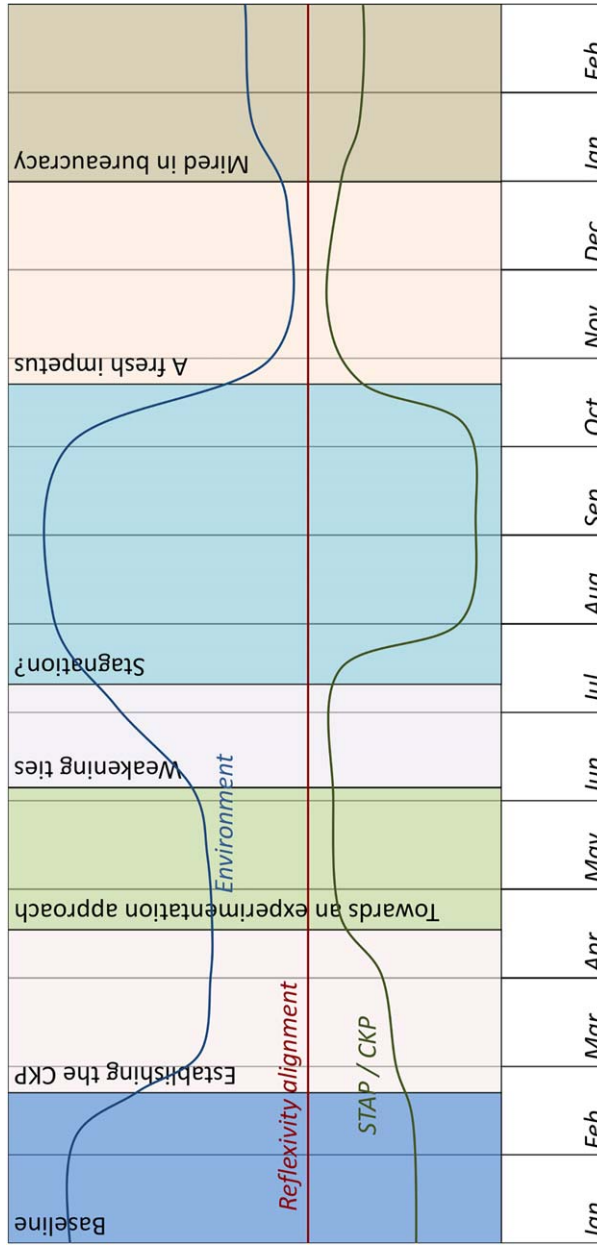

Figure 2: *Learning outcomes and reflexivity alignment. The green and blue curves suggest the distance of the STAP/CKP initiative and its environment from reflexivity alignment [Colour figure can be viewed at wileyonlinelibrary.com]*

Table 2: *Learning outcomes and their relation to reflexivity changes*

Learning outcomes...	Number
... preceding reflexivityincrease/decrease 	5
... following reflexivityincrease/decrease 	6
... unrelated to reflexivity changes 	10

very change averse, an innovation initiative can increase its fit by losing its reflexivity, which happened one might argue in the period of stagnation, when STAP announced that it was to discontinue its activities.

Relations between learning outcomes and reflexivity

During the sixteen meetings that we attended 21 learning outcomes occurred. Table 2 shows their relations with reflexivity turns. Ten learning outcomes shared no content with reflexivity changes, suggesting that they are unrelated to reflexivity. Of the learning outcomes that were content-wise related to reflexivity changes, we found five that preceded increases in reflexivity. This result suggests that learning outcomes sometimes contribute to reflexivity. However, we also found six opposite examples: learning outcomes that reacted to, or built upon reflexivity turns that had taken place earlier. This result suggests that reflexivity changes can lead to, or even necessitate learning.

Figure 3 plots the learning outcomes and their relations to the reflexivity turns. It shows that some learning outcomes are oriented at establishing reflexivity turns and contribute to a reflexivity alignment between the initiative and its context. This suggests a large extent of control of the initiative over itself and its institutional setting. Conversely, 'external' changes outside the control of the initiative may impact the reflexivity alignment as well. In this case, the learning outcomes may again reflect the reflexivity changes, but appear to be a reaction to, rather than a preparation for a reflexivity turn.

Modes of reflexivity alignment

Regarding the relationship between reflexivity and substantively associated learning, our results suggest that innovation initiatives can operate in three different modes that can be described by reflexivity alignment and the direction of learning outcomes. We name these modes *paving the way*, *easy ride*, and *roadblock*.

In the first mode, *paving the way*, learning outcomes in the initiative increase internal reflexivity and trigger the (apparently associated) emergence of reflexivity alignment: learning appears to increase reflexivity. In this mode, the initiative exerts

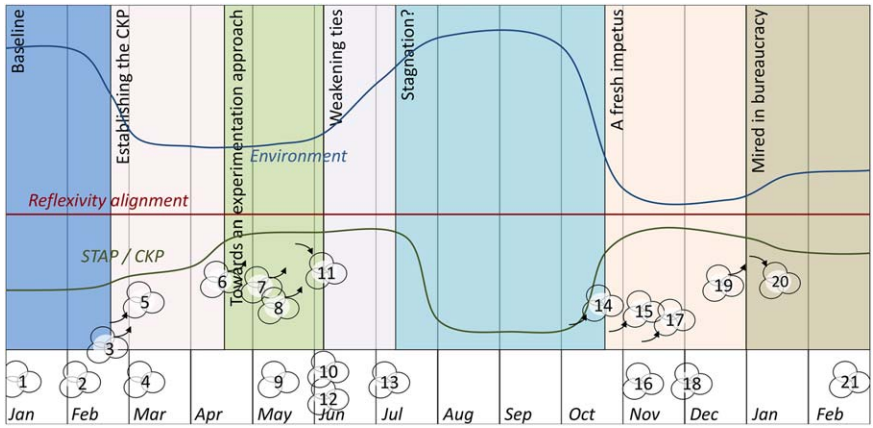

Figure 3: *Learning outcomes (21, numbered) and reflexivity turns. Arrows pointing to a learning outcome indicate a reaction to a reflexivity turn. Arrows pointing from a learning outcome indicate an orientation towards a reflexivity turn. Learning outcomes in the lower pane have no bearing on internal reflexivity [Colour figure can be viewed at wileyonlinelibrary.com]*

considerable influence on its institutional setting, hence paving the way for change. In the second mode, *easy ride*, an increase of reflexivity in the institutional setting is beneficial to the structural changes pursued by the innovation initiative. It does not need to pave its own way, since other actors are paving the way. In this case, learning outcomes are in line with reflexivity changes, but build on them instead of initiating them. In the third mode, *roadblock*, a decrease of reflexivity in the contextual environment is detrimental to internal reflexivity and necessitates an adaptation of the initiative to a conservative disposition in order to survive. Again, learning outcomes follow upon, and reflect a reaction to external reflexivity changes, but in this case the internal reflexivity decreases and the actors involved in the initiative reconsider their strategy for structural change.

Below, we illustrate each of the reflexive modes on the basis of one of the reflexivity turns in the STAP-case. The numbers refer to the associated learning outcomes – the interweaving of new ideas, relations and actions in a conversation – see Figure 3.

Paving the way: Establishing a platform

In a general board meeting on 20 February, STAP officially established what it termed the 'Chain Knowledge Platform' (CKP), intended to share precompetitive knowledge in answer to questions from entrepreneurs in order to help them innovate, thereby strengthening the relations with knowledge institutes. Though established by STAP alone, the CKP was intended to be directed by STAP, DPA

(representative of sales organisations) and FrugiVenta (representative of trade organisations) together, since STAP sought to collaborate with them and planned to form a coalition. The CKP was intended to be a platform by and for the greenhouse sector as a whole.

The initial members of the CKP included Inholland, a higher agricultural education institute, the Agricultural Economics Research Institute, Syntens, an institute that facilitates innovation and Wageningen University. The production chain parties, who were supposed to contribute financially, reacted positively. This can be seen as an increase of reflexivity in terms of relations.

The main learning outcome in this period emerged when it was decided to establish the platform:

> 3: The meeting started with the idea that STAP's previous strategy of creating awareness has not sufficiently paid off and that it is better to collaborate with partners in the production chain. As a new, intermediate action, the board decided to establish a knowledge platform for exchanging and sharing pre-competitive information and to invite DPA and FrugiVenta, as representatives of important parties in the production chain to co-guide the platform.

This learning outcome hence prepared for reflexivity turn 1 and contributed to the reflexivity alignment when the envisioned partners responded positively.

Easy ride: a fresh impetus

After a period of decreased reflexivity, the Minister for Agriculture announced a Chain Innovation Programme (CIP) of €1,000,000 in her horticulture policy letter (reflexivity turn 5). This programme emphasised experimentation and value chain innovation. The CKP regarded this as a huge opportunity since the institute that was supposed to manage it, Syntens, was one of its members. The CKP hence asked the STAP Executive Board (in a dormant state since 10 July) to support the CIP, to which it agreed. The CKP also developed a plan including a short-term strategy of developing new business models for sustainability and society, experimentation aimed at consumers, and a long-term strategy aimed at society as a whole. In addition, it quickly started to establish relations with external organisations, such as SIGN (the Society for Innovating Dutch Greenhouse horticulture). After about one-and-a-half months, the CKP members were discussing how to conduct the initial workshops of the CIP.

The first learning outcomes that were substantively related to these developments followed shortly upon the release of the policy letter.

> 14: At a CKP meeting the members discussed whether STAP should continue to exist, touching upon the changed relations between the CKP and the STAP Executive Board, given the discontinuation of board meetings and activities in the light of the Chain Innovation Programme announced by the Minister for Agriculture. The members confirmed their earlier idea of experimenting with new business models which seemed to fit the policy brief very well and decided to act and try to get the STAP executive board to support this idea.

A second learning outcome occurred in the following joint meeting with the CKP and the STAP Executive Board:

> 15: The participants brainstormed about a future vision. As a basic idea, they concluded that structural sectoral change is needed to preserve a role for the greenhouse sector, which fitted well with the CKP plan to experiment with frontrunners. The STAP-board then decided to support the CKP in its leading role and it was agreed that the CKP would write a first draft of an innovation plan to be submitted to the Ministry.

These learning outcomes hence can be seen as strengthening the earlier reflexivity turn.

Roadblock: Mired in bureaucracy

The roadblock is exemplified by the decrease of reflexivity alignment at turn 6, following the reflexivity turn mentioned above. An important contextual development was the merger of Syntens and the Rotterdam Chamber of Commerce (CoC). This implied that the CIP was commissioned to the CoC instead of Syntens, partner of the CKP. The CoC however is not as innovation oriented as Syntens used to be. In addition, the policy makers of the Ministry appeared to regard themselves solely in the role of commissioner rather than in the role of partner in transition-oriented programmes. The CKP tried hard to preserve some control over the CIP to preserve its transition-oriented nature, but lost the initiative to the CoC.

Two learning outcomes followed these relational and institutional changes and made STAP/CKP's orientation fit with this decrease in reflexivity. The first learning outcome occurred in a CKP meeting addressing the transitional phase CKP was in.

> 20: The members explicated that while they had presumed the CKP to being charge of the CIP through Syntens, it had become clear that only the CoC was leading. This raised the question of what the CKP should be doing in relation to the CoC and other actors in the sector. It was decided that CKP actions are the sole responsibility of the CKP members, who from now on will act to determine the CKP agenda, separate from the CIP.

The second learning outcome, one meeting later, is on the (same) topic of professionalising the CKP and concerns what every member needs from the CKP, what they will contribute, whose interests will be served that way, and who else should become part of the CKP:

> 21: The CKP discussed how it can further develop, in terms of its goals, functions and organisational structure. Every member's stake in and contribution to the CKP must be clear. It was decided that every member outlines their stake and contribution in a one-pager.

Conclusions and discussion

In this article, we set out to critically discuss the often presumed tight, intrinsic relationship between reflection, learning and reflexivity in order to better inform approaches and methodologies that support system innovation initiatives. Our

conclusions build on a conceptual reflection and an in-depth analysis of the relationship between learning and reflexivity in a horticulture case-study based in the Netherlands. Reflexivity has hardly been operationalised in the literature and to date has not been studied empirically. Given the imprecise meaning of the term reflexivity, we proposed to distinguish it more clearly from reflection and learning and to regard it as a property of the social object to which it relates (such as monitoring, research, governance or learning). In the light of the ambition of initiatives to change entire socio-technological systems, we operationalised their reflexivity as changes in rules, relations, practices and discourse.

Regarding reflexivity, we observed a dynamic, shifting compatibility between initiative and context that we characterised as *reflexivity alignment*, that is, the extent to which an innovation initiative shares an orientation towards reflexivity with its societal environment. At first glance, this seems to be related to what Ingram *et al.* (2015) term 'niche-regime compatibility' (see also Smith 2006). However, niche and regime can be compatible (or 'fit') without reflexivity alignment, if neither are oriented to change. Our results, showing an active role of external actors such as the Ministry of Agriculture, confirm earlier critique of the multi-level perspective picturing regime actors as resisting change due to vested interests (e.g., Elzen *et al.* 2012; Berggren *et al.* 2016; Hoes *et al.* 2016).

In addition, the findings draw attention to an initiative's success as resulting from interactions between initiators' actions and developments in the institutional setting, and not only the quality of the initiative's strategies to make connections with the regime (Smith 2006; Elzen *et al.* 2012). This inference is confirmed by another finding; the various roles of learning in reflexivity alignment. The empirical findings suggest a rather loose relationship between learning and reflexivity. If substantively related, learning outcomes may lead to increased reflexivity, but according to our data, they can also result from reflexivity changes. Additionally, much learning was unrelated to reflexivity changes; many learning outcomes appeared to be directed 'inwardly' rather than (further improving) the initiative's position *vis-à-vis* the wider societal context.

Hence, our study indicates that an initiative's reflexivity may be at times relatively independent of learning, and at other times a contingent outcome of both internal as well as external developments. This led us to posit three archetypal modes that describe the relationship between learning and reflexivity:

1. Paving the way – The learning outcomes of the initiative help to increase the reflexivity of a system innovation initiative.
2. Easy ride – External reflexivity increases the reflexivity in the initiative. Learning outcomes follow on from these reflexivity changes.
3. Roadblock – The initiative's setting becomes more change averse, hence hindering the realisation of the structural changes pursued by the initiative. Learning follows upon these changes for the survival of the initiative but at the cost of a reflexivity decrease.

Together, the three modes in which system initiatives may operate, depict the interplay between an innovation initiative and its context from the perspective of the

initiative: initiating changes in the institutional setting, seizing provided opportunities or adapting to a change-averse environment. The resulting dynamic can be characterised as a succession of switches between these modes.

In STAP the initiators responded to external dynamics, grasped opportunities and were obstructed in their change ambition. This conclusion deviates, in terms of niche-regime interactions, from the dominant view of niches as 'protected spaces' or 'incubation rooms' that temporarily need to be protected from their selection environment (Geels & Schot 2007; Smith & Raven 2012). The literatures on strategic niche management and, albeit to a somewhat lesser extent, on transition management both advocate that radical innovations are nurtured and sheltered in niches from outside influences to let them mature and empower in a first phase of niche development. Conversely, our results suggest that ongoing niche-regime interactions may be necessary from the start to safeguard room to develop alternative, sustainable ways of fulfilling societal functions. Thus, rather than seeking protection or shelter, it may be more relevant to seek beneficial developments increasing the reflexivity in an initiative's context and be sensitive to counter-developments that affect the potential of innovation initiatives.

The findings confirm our conceptualisation of reflexivity as an emergent property of a system innovation initiative. This conceptualisation links to ideas of reflexivity as a condition or property of social networks or societies rather than a human capacity and awareness. Hence, it is close to Beck *et al.*'s (2003) first meaning of the reflexive society, albeit as its positive counterpart, not further undermining modern society but gearing it towards structural change.

In relation to reflexive governance, reflexive research and reflexive monitoring, the study contributes the insight that conscious reflection on assumptions, values and the basic premises of the system that is supposed to be in need of change may not be the sole leverage to work towards system change. The familiar strategies of supporting reflection and learning in workshops and other special learning events are likely to be a hit-and-miss strategy. Scholars have arguably overestimated the relationship between organised learning and transformative change and collective action. Our results suggest a more modest expectation regarding the importance of organised learning within an innovation network or group.

Safeguarding room for change may instead be supported by monitoring reflexivity changes and alignments, for instance with reflexive monitoring (van Mierlo *et al.* 2010c). Our research design and findings suggest that it is possible and relevant to distinguish learning and reflexivity and investigate their relationship and interaction more in-depth. Tracing learning in the discursive interaction of a system innovation along the way of the innovation trajectory, and combining it with an analysis of the reflexivity turns, alignments and their relations with learning, may provide an intensive but valuable way to stimulate learning towards system innovation. We think that collective reflection of the initiators on the reflexivity of an initiative will help to increase its reflexivity.

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