Adaptive management in agricultural innovation systems: The interactions between innovation networks and their environment

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Abstract

The purpose of this article is to investigate effective reformism: strategies that innovation networks deploy to create changes in their environment in order to establish a more conducive context for the realization and durable embedding of their innovation projects. Using a case study approach, effective reformism efforts are analyzed in a technological innovation trajectory related to the implementation of a new poultry husbandry system and an organizational innovation trajectory concerning new ways of co-operation among individual farms to establish economies of scale. The findings reinforce the idea, emerging from a complexity perspective on agricultural innovation systems, that interaction between innovation networks and their environment is only steerable to a limited extent. Nonetheless, innovation networks can enhance effective reformism by creating tangible visions that serve as vehicles to create understanding about the innovation and mobilize support for it, and by employing several kinds of boundary spanning individuals that are able to forge effective connections between innovation networks and their environment. Because innovation networks can only partially influence their institutional environment, and because unintended consequences of actions and random events influence the course of the innovation process, innovation network actors need to continuously re-interpret the contexts in which they move. This constant reflection by the innovating actors on their position vis-à-vis their environment needs to be supported by dedicated facilitators and monitoring and evaluation methods aimed at system learning. This implies that agricultural innovation policies should, instead of aiming to fully plan and control innovation, foster the emergence of such flexible support instruments that enable adaptive innovation management.

1. Introduction

Agricultural innovation systems (AIS) thinking has become an increasingly applied framework to analyze technological, economical and institutional change in agriculture (e.g. Hall et al., 2003; Morriss et al., 2006; Spielman et al., 2008; Devaux et al., 2009; see also Spielman et al. (2009), for an overview of its applications). In the AIS approach, innovation is considered the result of a process of networking and interactive learning among a heterogeneous set of actors, such as farmers, input industries, processors, traders, researchers, extensionists, government official, and civil society organizations (Leeuwis, 2004; Hall et al., 2006; Röling, 2009). The AIS approach emphasizes that agricultural innovation is not just about new technologies but also about institutional change; it requires alternative ways of organizing, for example, markets, labor, land tenure and distribution of benefits (Leeuwis, 2004; Spielman et al., 2009).

Given the interaction between heterogeneous actors, related to the several dimensions of agricultural innovations (e.g. technology development, institutional change, supply chain reorganization, market development, creating societal acceptance), it has been noted that AIS can be regarded as Complex Adaptive Systems (CAS) (Ekboir, 2003a; Hall and Clark, 2009; Spielman et al., 2009). These are defined as self-organizing systems “whose properties cannot be analyzed by studying its components separately […] formed by many agents of different types, where each defines his/her strategy, reacts to the actions of other agents and to changes in the environment, and tries to modify the environment in ways that fit his/her goals” (Spielman et al., 2009, p. 400). Elsewhere, this environment is indicated as the incumbent ‘socio-technical regime’ (Geels and Schot, 2007), and efforts to change it in favor of the realization and durable embedding of an innovation have been called ‘effective reformism’ (Roep et al., 2003).
There are several studies on the self-organizing nature of agricultural innovation systems and how this connects to effective reformism processes, but their analytical focus is often at a high level of aggregation, e.g. the macro-level of an entire country, and a very long time horizon, e.g. a change process that takes several decades. Examples are studies on zero-tillage innovation by Ekboir (2003b), Green Revolution developments in India (Biggs, 2007), innovation in food systems in Uganda (Hall and Clark, 2009), rice innovation in Nepal (Pant and Hamby Odame, 2009), Kenyan agricultural development (Ochieng, 2007), and innovation in irrigation systems in Morocco (Poncet et al., 2010). Despite the usefulness of such analysis for understanding major forces in socio-technical change in agriculture, such a focus runs the risk of not fully grasping the activities of innovating actors in the support of such change. The question this article therefore addresses is how forces at the micro level of individual innovation networks contribute to socio-technical change. By yielding detailed insights on how actors interact with their environment across different scales in agricultural production systems and agro-food chains in their effort to innovate, we hope to contribute to building blocks for adaptive agricultural innovation policies that can deal with the unpredictability of innovation processes. The article continues by drawing a conceptual framework of agency and innovation networks (Section 2). The research methods of the study are presented in Section 3, followed in Section 4 by two case studies in which the focus is on how innovation networks interact with their institutional environments in order to achieve their innovation goals. In Section 5, these findings are analyzed and discussed, and the article ends with some final reflections on implications for theory and policy (Section 6).

2. Innovation agency and structure

While the CAS perspective on AIS interaction comprises several types of interaction between actors and their environment (such as those between human actors and artefacts, i.e. technologies), in this article the emphasis is on social interaction in innovation processes. This focuses attention to the relationship between actors’ agency and social structure which has been described in Giddens’ (1984) structuration theory. Agency is the ability to take action and make a difference over a course of events (Giddens, 1984). In the context of innovation, ‘innovation agency’ is determined by the resources and competences that an actor or organization has at its disposal for innovation (i.e. knowledge, skills, material, and financial resources). It also includes institutional features such as actors’ norms and rules, a so-called ‘innovation template’ that orients and legitimizes action (Edwards, 2000). In self-organizing innovation systems, no single actor can pursue its innovation goals without taking into account other actors, because of a lack of sufficient power and resources to do so (Ekboir, 2003a; Aarts et al., 2007). This perspective sees actors interactively shaping a support network with a view to achieving individual and collective goals (Engel, 1995), and to obtaining resources, the nature and source of which is unknown ex-ante (Kash and Rycroft, 2002; Edwards, 2007). The idea of a support network presupposes an innovation network with voluntary membership, which have been referred to as ‘innovation configurations’ (Engel, 1995) and ‘coalitions’ (Biggs and Smith, 1998). This does not mean that innovation network partner interests automatically align, as innovation networks are the scene of negotiation (Wiskerke and Roep, 2007). Furthermore, an innovation network in the sense of a support network is not stable: it may change over time as regards composition.

Such innovation networks are dependent on many other peripheral actors in their institutional environment whose involvement may not be voluntarily but, rather, predicated by mutual interdependence. In Giddens’ structuration theory, actors and the structures (i.e. their institutional environments) in which they are embedded have a dual relationship, because the “structural properties of social systems are both medium and outcome of the practices they recursively organize” (Giddens, 1984: 25). This implies that actors are conditioned by their environment, but by their actions they actively or passively change their environment, so that it in turn exercises another form of conditioning. In the study of innovation systems, this reflexive relationship between actors and their institutional environment that actors may adapt, change, or complement has been called mutual embeddedness (Markard and Truffer, 2008).

Actors reflexively monitor the actions and aspects of the environments within which they move, taking into account past, present, and future events (Edwards, 2007), thereby aiming to reach their goals and reduce uncertainty in the process of achieving these (Geels and Schot, 2007). Often, the goals of innovating actors are embodied by more or less articulated visions that have an influential guiding, convincing, binding, and uncertainty mitigating function (Berkhout, 2006). The latter is particularly important, because innovation exposes innovating actors to many uncertainties. These concern, for example, complementary resource acquisition, development of consumer demand, policy and legislative adversity or instability, and network partner and competitor behavior (Meijer et al., 2007 – see Table 1). Although actors may deliberately try to influence their institutional environment to reduce these uncertainties, they are always bounded in their influence. Unintended consequences of agency, as well as external events that lie outside the sphere of influence of agents themselves, play an important role in bounding or conditioning further activities. These thus constitute an important source of structure variation (Giddens, 1984; Alexiou and Zamenopoulos, 2008). Innovation is influenced, for example, by consumer preferences, government policies, and market factors at regional, national, and global level (Blay-Palmer, 2005).

From this review on innovation agency, it has become clear that shaping an innovation involves ‘selling a good story’ (e.g. visions, discourse), told by the right people (with conviction, credibility, power), at the right time, in the right place, and to the right people (acquiring complementary resources, building and capitalizing

<table>
<thead>
<tr>
<th>Type of uncertainty</th>
<th>Issues on which there is uncertainty</th>
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<tbody>
<tr>
<td>1. Technological uncertainty</td>
<td>– Characteristics of the innovation (such as costs or performance)</td>
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<td>2. Resource uncertainty</td>
<td>– Relation between the innovation and the infrastructure in which it is embedded</td>
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<td>3. Competitive uncertainty</td>
<td>– Uncertainty to what extent adaptations to the infrastructure are needed</td>
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<td>4. Supplier uncertainty</td>
<td>– Possibility of choosing alternative (future) options</td>
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<td>5. Consumer uncertainty</td>
<td>– The amount and availability of raw material, human and financial resources</td>
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<tr>
<td>6. Political uncertainty</td>
<td>– How to organize the innovation process (e.g. in-house or external R&amp;D?)</td>
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<td>– Behaviour of (potential or actual) competitors and the effects of this behavior</td>
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<td>– Actions of suppliers as regards timing, quality and price of the delivery</td>
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<tr>
<td>– Consumers preferences with respect to the innovation</td>
<td></td>
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<tr>
<td>– Consumers’ characteristics</td>
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<td>– Long-term development of the demand over time</td>
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<tr>
<td>– About current policy (e.g. regarding interpretation or effect of policy, or a lack of regulation) or about future changes in policy, as well as reliability of the government</td>
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upon momentum and using windows of opportunity (De Lauwere et al., 2006; Aarts et al., 2007; Swan et al., 2007a; Horlings, 2008). Given the fact that innovating actors have to react constantly to their environment, which they in turn actively try to modify in their favor, it has been argued that this calls for adaptive innovation management (Douthwaite, 2002; Loorbach, 2007; Smart et al., 2007), following ideas from generic literature on management of CAS (Westley, 2002). This implies that agricultural innovation policies should not seek to fully plan, control and manage the agricultural innovation system but to operate on the probability of events, to increase the odds of desired outcomes, and reduce the chances of undesired results (Hall, 2006; Spielman et al., 2009; Poncet et al., 2010). While the AIS approach has proved its value as analytical framework, it still needs to be transformed into an operational concept with policy options and targeted interventions to improve everyday innovation capacity (Spielman, 2006). The present study hopes to contribute to the understanding of the micro-foundations of innovation and thus enable the formulation of adaptive innovation policies optimally supporting these micro-foundations.

3. Methodology

For mapping the dynamics and a structured analysis of innovation system interaction at the micro level, Spielman et al. (2009) indicate that innovation history analysis focusing on important events is a useful method, which has also been applied in ‘mainstream’ innovation systems analysis where it is referred to as innovation journey analysis (Van de Ven et al., 1999). Data were gathered through semi-structured interviews with innovation network and institutional environment actors, who acted both as respondents telling about their own experiences and as informants giving the broader picture and observations. The interviews were fully transcribed, and analyzed with qualitative data analysis software (Atlas 5.0). The perspectives of both innovation network and institutional environment actors were analyzed in order to reconstruct agency-structure interactions. This analysis was complemented with analysis of a range of internal network documents (e.g. meeting minutes) and external documents (e.g. policy documents and newspaper articles). Furthermore, this multi-stranded approach permitted triangulation: a research methodology to prevent the risk of distortions in post-factual accounts, increasing internal validity. Table 2 outlines the data collection in both cases.

We discuss two cases of innovation journeys in the Dutch agri-food sector dealing with the creation of more sustainable forms of agriculture, in the social, ecological and economic sense, through both technological and non-technological innovation. Non-technological innovation is increasingly considered as important for more socially sustainable farming systems, for example by means of value chain reconfiguration (Devaux et al., 2009) and novel co-operation arrangements between different farm and non-farm businesses (Veldkamp et al., 2009). One case relates to a non-technological, organizational innovation to establish social sustainability among arable farms too small in scale to survive and with insufficient assets to sustain autonomous growth. This innovation can essentially be considered a ‘below-the-radar’ innovation. Such innovations are not induced by policy or research, but emerge from the bottom-up, and are increasingly considered as relevant sources of change (Roep et al., 2003; Hall and Clark, 2009). These farmers aimed to establish a formal pooling of land, labor, and other resources to increase scale, to establish a joint-venture (called Sjalon). This is an exception to the normal situation in the Netherlands of individually owned family farms. Other collective scale increase initiatives have emerged (Stevens, 2007), responding to the need to create economies of scale to cope with low prices for agricultural products (Röling, 2009). The other case deals with a research induced innovation, which relates to the development of an environmentally and animal-welfare friendly poultry husbandry concept (called Rondeel). This concept resulted from an interactive design process involving policy, business and societal stakeholders from the poultry sector (Groot Koerkamp and Bos, 2008). This case forms part of in broader developments in animal welfare innovations in Dutch animal husbandry (Wiskerke and Roep, 2007), in contrast to a production system characterized by industrialized animal production with low animal welfare. It combines both technological innovations (development of the Rondeel system) and non-technological innovations (value chain reordering and new market creation).

4. Results

We first crudely describe each case, followed by a more in-depth description of specific interactions between the innovation networks and their institutional environment (called ‘agency-structure interaction loci’) within both case studies. First, we discuss Sjalon (Sections 4.1 and 4.2), then Rondeel (Sections 4.3 and 4.4).

| Table 2 |
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| **Data gathering methods.** |  |

<table>
<thead>
<tr>
<th>Type of data gathering</th>
<th>Case</th>
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<tr>
<td>Semi-structured interviews geared at identifying actor experiences and perceptions</td>
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<tr>
<td>32 interviews</td>
<td>24 interviews</td>
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<tr>
<td>6 with Vencomatic/Rondeel Ltd. staff</td>
<td>2 with participating farmers</td>
</tr>
<tr>
<td>1 with Kwetters staff</td>
<td>2 with non-participating farmers</td>
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<tr>
<td>5 with civil servants (Barneveld/LNV*)</td>
<td>4 with civil servants (Province/Municipality/LNV*)</td>
</tr>
<tr>
<td>4 with interested farmers</td>
<td>2 with banks</td>
</tr>
<tr>
<td>7 with service providers (architect, environmental consultant, ASG researchers)</td>
<td>4 with service providers (accountants and researchers)</td>
</tr>
<tr>
<td>4 with facilitators (Transforum/Transition and Society)</td>
<td>4 with facilitators (TransForum/hired facilitator/facilitating researchers)</td>
</tr>
<tr>
<td>3 with funding agencies (Oost NV/Gelderse Vallei)</td>
<td>1 with TD*</td>
</tr>
<tr>
<td>2 with representatives (ZLTO/APS*)</td>
<td></td>
</tr>
<tr>
<td>Observation of actor interaction</td>
<td></td>
</tr>
<tr>
<td>At 8 meetings (3 workshops and 5 steering committee meetings)</td>
<td>At 2 meetings (1 planning meeting and 1 group dynamics monitoring workshop)</td>
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<tr>
<td>Document analysis</td>
<td></td>
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<tr>
<td>Analysis of meeting minutes over 3 years (2006–2009), newspaper articles over 4 years (2005–2009), communication with LNV</td>
<td>Analysis of meeting minutes over 7 years (2001–2008), newspaper articles over 6 years (2002–2008), communication with TD*</td>
</tr>
</tbody>
</table>


b Southern Farmers’ Organization.

c Animal Protection Society.

d Treasury Department.
4.1. Event analysis Sjalon

Sjalon’s starting point (see Fig. 1) was the recognition by a farmer that his farm was too small to create a sustainable farming future for his son. He decided to form a brainstorming group with non-farming actors (e.g. a machine vendor, an agricultural researcher) to develop the idea of scale increase through the establishment of a collective farm with a clear division of tasks. The project was called Sjalon, after a land measuring device symbolizing expansion. Brainstorming gradually transformed into actual plan development after a facilitator was hired to structure the process and assist in acquiring resources such as funding and knowledge to concretize and materialize the plan. An important event was a research project by the Free University of Amsterdam, calculating what the effect would be of setting up a collective farm, hence making the vision more tangible. This enabled Sjalon to get funding from Flevoland Province to have an initial business plan drawn up, assisted by an accountancy firm and an applied research institute that made scenario calculations on collective farm costs and returns.

This business plan was instrumental for Sjalon in getting further support from influential parties such as the Ministry of Agriculture, Nature, and Food Quality (Dutch acronym: LNV). LNV referred the Sjalon initiative to TransForum (Veldkamp et al., 2009), an innovation program to fund and facilitate the transition towards sustainable agriculture. Furthermore, having clear figures proved instrumental for Sjalon in recruiting potential participants into the plan and in approaching banks for credit facilities. However, Sjalon never succeeded in attracting sufficient participants to establish the initially planned 600 ha farm (which is large by Dutch standards); this also influenced the willingness of banks to provide loans, but eventually the three remaining participants succeeded in starting a 100 ha farm.

A legal issue that ran from 2004 to 2008 was whether a collective farm would be legally permitted, given land tenure legislation. The land that Sjalon wanted (which was personal title), a situation that amalgamated several leaseholds (as would be the case in Sjalon) would be considered as illegal sub-lease. After lengthy negotiations between Sjalon and the TD, an arrangement was made in 2008 that made it legally possible to join individual farms into a collective farm. So, on 14 March 2008 Sjalon was founded as a limited liability company.

4.2. Agency in particular agency-structure interaction loci in the Sjalon case

In the timeline in Fig. 1 of a number of agency-structure interaction loci in the Sjalon case are indicated that we will further analyze. These reflect how the Sjalon innovation network dealt with reducing a number of uncertainties in interaction with the institutional environment: (a) obtaining financing for their collective farm venture (financial uncertainty), (b) getting legal approval for a farm type that did not fit leasehold legislation (political uncertainty), and (c) getting farmers in the NEP interested in participating in Sjalon (resource/competitive uncertainty).

4.2.1. Sjalon interaction locus a: finding funding to sustain the development and implementation of the innovation

Sjalon’s efforts to obtain financing can be split into two separate but intertwined efforts: one to obtain funding to sustain the search and development process, and the other to obtain financing for the eventual collective farm.

As regards the former, although the brainstorming group initially funded the facilitator, the Sjalon needed to find additional funds for R&D and consultancy. Through his network of contacts, the facilitator arranged for students from the Free University Amsterdam to undertake a feasibility study, free of charge. This study proved instrumental for Sjalon in getting funding from the Flevoland Province deputy, who was approached through informal contacts of the facilitator. For the province deputy, the Sjalon idea...
arrived just at the right time and was in line with the deputy's own ideas and sympathies. Despite there being no clear provincial development policy on scale increase initiatives, Sjalon was able to apply for and obtain an innovation subsidy. This subsidy financed a legal-fiscal exploration of Sjalon’s legal form, and a business plan was drawn up. This plan showed that considerable up-scaling was needed, to over 600 ha, to make the plan viable. The province could not support this financially because of state support limitations. They could only help further in the sense of enabling spatial planning. The province thus referred Sjalon to LNV who would have more funding at its disposal (although LNV stated that this fell more within the remit of provinces and municipalities). The Sjalon network met initial skepticism at LNV and felt that they were not being taken seriously. However, as the researcher in the brainstorming group was the nephew of the then minister of agriculture, he approached his uncle informally. Because the minister felt that Sjalon was a self-organized initiative that fitted well with the agricultural innovation policy aimed at bottom-up induced change, he ordered that a formal letter sent to LNV by Sjalon should be taken seriously. LNV officials then engaged in talks. As a result of these talks, the LNV officials referred Sjalon to the government-funded innovation program, TransForum. TransForum took over the financing of the previously hired facilitator and funded additional R&D and consultancy (to recalculate and adjust the earlier business plan), and also provided facilitation itself. The business plan was also key in dealing with the bank. It served a dual purpose. First, it created a positive attitude towards the idea by the then director of the local co-operative agricultural bank. This director started to champion the idea and gave the Sjalon network the impression that the bank was willing to take a risk and support an innovative endeavor. Later on, it served to convince the bank that there was a prospect of return on investment, when a new bank director judged the plan on normal credit provision criteria and was hesitant to provide a loan because they had no comparative cases to assess the risks and returns. According to the Sjalon network, it was unfortunate that the old director had left, because they had to face a less conducive financing environment that had become risk averse. Furthermore, because the business plan now envisaged a farm of just 100 ha, it did not live up to the initial expectations of the bank.

4.2.2. Sjalon interaction locus b: overcoming legislative barriers to collective land tenure

The first phase of the relationship between Sjalon and the Treasury Department (TD), between August 2004 and March 2006, was initially troublesome, despite that the Sjalon actively sought contact because it was expected that Sjalon would attract many leaseholders. The Sjalon realized in an early stage that their ideas would have legal consequences for leaseholding arrangements. According to the TD’s interpretation, Sjalon’s plans to amalgamate lands would be an illegal sub-lease. The TD considered this an undesirable phenomenon that occurred often but which it could not tolerate. The illegality would arise because the user of the lands should also be the lessor for a determined period, but in the Sjalon case there would be multiple users who could enter and leave the enterprise. Consequently, according to the TD, Sjalon could become a way for individual leaseholders to sub-lease their land without participating actively in Sjalon, and for Sjalon it could be an easy way to up-scale. As the TD pursues a public good goal, they preferred those lands to become available for other purposes. The TD proposed a solution whereby individual leaseholders would render their individual leasehold rights to Sjalon, who would then become the collective lessor. Because this was emotionally unacceptable to some potential participants— they would lose their individual tenure rights if they left Sjalon—the TD built in a special clause. This clause encompassed that upon leaving Sjalon, leasehold rights would be returned to the individual farmer if he could show that the new individual farm would be viable. This was a custom-made solution of the TD that stayed within the current law, although because of its unusual nature it had to be fine-tuned with the Ministry of Finance. The TD communicated this solution to Sjalon, but it did not find favor there. Because Sjalon thought that no further discussion was possible, they did not enter into further discussions. Instead in June 2007, Sjalon sought expert advice from a professor in land tenure law, who advised that use (by Sjalon) and tenure (leasehold by the participants) could be legally separated. The TD thought that Sjalon needed time to assimilate their proposal and waited for their reply. The TD was however unpleasantly surprised when it received a letter from the professor on Sjalon’s behalf proposing the alternative. The TD thought that Sjalon was being too pushy, wanting the leasehold formulated on their terms, which would one way or another lead to an undesired sub-lease situation. This conflict was mitigated by the facilitator of TransForum, who characterized it as follows:

Through the eyes of Sjalon one gets the image of the TD as a bureaucratic hindering force, blocking participation in Sjalon, whereas the talk with the director of the TD gave me the impression of an organization that within its own limits is willing to go very far in supporting Sjalon, to the limit and even a bit further, but that has to operate within the complex tenure situation in the North-Eastpolder.

The facilitator organized an open discussion, in which once again it was explained what the TD proposal entailed; this resulted in Sjalon accepting the proposal.

4.2.3. Sjalon interaction locus c: “selling the story” to recruit potential participating farmers

Starting with a vision of a 600 ha collective farm, Sjalon needed to attract many farmers who would be willing to amalgamate their lands and conform to a less individual entrepreneurial orientation than they were used to. As many respondents indicated, the enthusiasm and active networking of the main championing farmer to engage potential participants was instrumental in recruitment. Besides this championing, a supportive factor was that a buzz was created through service providers assisting Sjalon and through articles in agricultural newspapers and magazines. The implications of participating in Sjalon in terms of labor and capital input, returns, and other figures were made tangible in the business plan and a prospectus, all of which were instrumental in the recruitment of other participants. The Sjalon network presented the plan and prospectus during a number of special meetings in 2006. This resulted in six farmers signing a letter of intent to participate. However, finally only three participants signed up, resulting in a 100 ha farm. One reason for potential participants not committing was that, despite the prospectus and additional explanations, they could not get a clear image of what Sjalon entailed and feared that they would lose their work independence and their leasehold contract. Many respondents indicated that this difficulty in interpreting the plan correctly was said to be due to the fact that during a long time it was developed within a relatively small circle. Then it was being sold as a readymade package to potential participants, who did not have full knowledge of the underlying ideas and assumptions. Another dilemma arose in that the Sjalon idea started with a planned size of over 600 ha but. When it became clear that this could not be attained, to many farmers the plan lost some of its attractiveness. On the other hand, farmers that were not willing to participate indicated that they wanted to see the “proof of principle” of the concept, so it was better for it to start soon, albeit smaller in size. The Sjalon network experienced this as a major...
incentive to really start the initiative with the hope of attracting others by showing positive results. Another reason for non-interest was that other farmers very much associated the concept with the championing farmer. In the case that they had negative personal (“wants to play the boss”, “does not listen to you”) or social associations with him (the NEP is a tightly knit community in which reputations are well-known) they also dismissed the Sjalon concept.

On a higher level, out of the direct reach of the Sjalon network, there were a number of non-conducive factors in the socio-economic environment of potential participants. One factor was that the municipality was not in favor of the idea of the Sjalon. This was because it was a plan to strengthen agricultural activities, whereas the municipality favored other economic activities to make the municipality less agricultural. Also, within the municipality, an influential alderman who was both a farmer and an ex-official in the farmers’ organization was critical of the plan. He personally regarded the idea as unviable. Although he did not use his position to openly and publicly oppose the plan, this contributed to a non-conducive atmosphere. Sjalon’s strategy was to bypass such persons and not involve them other than to arrange formalities, but they nevertheless influenced Sjalon’s development. Furthermore, because of a lack of a final business plan (the initial one had rough estimates) and despite the buzz created by the magazine and newspaper articles, banks and accountants of potential participants had not previously actively pointed to the Sjalon as a good opportunity for “weak” farmers to keep a viable business (which was how Sjalon wanted to sell itself). In the eyes of the Sjalon network and facilitators, their advice was conservative. The banks and accountants rebutted with the argument that they either could not act as an advocate because of their position as neutral service providers (accountants) or had to stick to certain judgment criteria (banks). Other factors were that, in the meantime, other co-operative farms had collapsed because of internal power struggles and this influenced the image of Sjalon among potential participants. Also, prices for agricultural products had risen considerably. Many respondents indicated that this reduced the need for less well-endowed farmers to look for survival strategies such as the one proposed by Sjalon. Consequently, in March 2008, finally only three farms joined together in a limited liable company, with the hope that it would become attractive to other farmers if it functioned successfully.

4.3. Event analysis Rondeel

Rondeel (see Fig. 2) started with the interactive design project Caring for Hens (CfH) (see Groot Koerkamp and Bos, 2008), resulting in visualsizations and briefs of requirements (BoK) for novel poultry husbandry systems (Plantage and Rondeel). The Rondeel concept has as it most apparent distinctive feature that it is a round hen housing system (see Fig. 3), as opposed to the normal rectangular ones. It furthermore integrates animal welfare standards comparable to free range and organic (open air) laying hen husbandry (e.g. natural shelter) with the advantages of closed hen housing systems producing cage eggs or barn eggs (e.g. protection against aviary airborne diseases). After a failed attempt at co-operation between Kwetters (an egg packing firm participating in CfH) and the Animal Science Group (ASG – a research institute that facilitated the CfH project), Kwetters and Vencomatic (a poultry husbandry systems manufacturer) teamed up and formed a technical committee to develop a working prototype. Vencomatic dealt with technical issues, such as nesting, egg collection, and manure transport. Kwetters dealt with marketing a segment that would come in-between free range and organic eggs, having increased animal

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Fig. 2. Timeline development Rondeel with important events.
welfare as its main selling point. They were supported by the ASG researcher who managed the CfH project and who acted as a technology champion.

Alongside technical development activities (e.g. a manure drying carrousel based on a chimney effect airflow), the technical committee sought suitable places to build the new system. The search was initially concentrated in Barneveld, a municipality in which poultry-related industry is clustered and that positions itself as a global poultry centre. Members of the technical committee approached Barneveld officials, as well as several Barneveld farmers interested in building a Rondeel system. They also contacted different service providers (architect, construction contractors, feed suppliers, ASG researchers, environmental consultants, animal welfare consultants, and business incubator organizations). This networking supported the fine-tuning of the design, facilitated the permit obtaining process by checking compliance with building and environmental norms, and provided access to subsidies. Simultaneously, the technical committee started talks with the Dutch Animal Protection Society (APS). APS had been a partner in CfH and was piloting a certification system indicating animal welfare value (by assigning welfare stars), in an in-between segment for poultry meat (the Volwaard Chicken). Later on, they hired a specialized consultant on animal welfare and corporate social responsibility (CSR), who assisted them in these talks. The goal was to negotiate criteria for the assignment of one, two, or the maximum of three welfare stars. APS provisionally assigned two stars to Rondeel, and later on, even three.

In their search for development funds, Kwetters and Vencomatic, together with the CSR consultant, successfully applied for funding and facilitation from TransForum. After Rondeel became a TransForum project, internal strategic choices at Kwetters induced their withdrawal from the project. Vencomatic then set up a spin-off development firm, Rondeel Ltd. The withdrawal of Kwetters opened new perspectives, especially on alternative ways to distribute and market the egg. To support new idea formation and network consolidation, TransForum instigated workshops on the network’s functioning, marketing and future development steps. This led to a greater sense of co-development between Vencomatic and farmers, who were first seen as mere Rondeel adopters. Besides the existing network partners, such as Vencomatic staff, the CSR consultant, the architect, Barneveld officials and farmers, other consultants and champions of other welfare innovation networks (e.g. the Volwaard Chicken network and the pork network described by Wiskerke and Roep (2007)), participated. These workshops also led to co-operation between Rondeel Ltd. and the Southern Farmers’ Organization (ZLTO) that had experience with marketing the Volwaard Chicken.

Because the Rondeel housing system requires higher investments than normal hen housing systems, the welfare value egg has higher production costs. This makes it more expensive than normal barn eggs. For the Rondeel network, a great uncertainty was whether consumers will see the difference and pay extra (a typical problem for welfare innovations (Binnekamp and Ingenbleek, 2006)). Hence, interested farmers, as well as their banks, were hesitant to invest if the risks of non-return on the extra investment were not covered (if the eggs had to be sold as barn eggs). This was a typical ‘valley of death’ (Meijer, 2008) or “chicken and egg” (Ansari and Garud, 2009) situation between concept development and application that inhibited further development. The problem was that to have sufficient product volume, there have to be sufficient Rondeels, but to have sufficient Rondeels, there have to be sufficient guaranteed egg purchases by retailers (supermarkets); however, supermarkets were hesitant to market the egg because of the risk of their not selling, and they also demanded a large volume right away; but supermarkets were not yet thinking about marketing the egg, they first wanted to see the Rondeel functioning, but without guaranteed purchase, no Rondeels would be built. To resolve this dilemma, Rondeel Ltd. engaged in talks with ZLTO and LNV to obtain a guarantee that would cover the extra investment in the event of the Rondeel eggs not being successful and having to be sold as normal barn eggs at a lower price. In July 2009 LNV gave this guarantee, thus enabling the construction of the first hen housing systems.

4.4. Agency in particular agency-structure interaction loci in the Rondeel case

On the timeline in Fig. 2 a number of agency-structure interaction loci in the Rondeel case are indicated that will be further analyzed. These reflect how the Rondeel network dealt with: (a) getting building and environmental permits for a hen housing system design that did not fall neatly into an established category (political uncertainty), (b) getting a guarantee to cover the extra investments in the event of Rondeel failing (financial uncertainty), and (c) getting certification from the Animal Protection Society as a proxy for consumer approval of the egg (consumer/political uncertainty).

4.4.1. Rondeel interaction locus a: getting a new design accepted by current environmental and construction legislation

The Rondeel design is different from other hen housing system forms, because it is round. Hence it is not integrally described within legislation on hen housing system construction and environmental prescriptions. This could cause potential conflicts with regulatory bodies on issues such as construction dimensions, fire safety, aesthetic fit within the landscape, and gas emissions. However, in the case of Rondeel, both construction and environmental permits were given rapidly. This was due to a number of factors. One factor was that the Barneveld municipality embraced the innovative Rondeel concept, because it could be used by Barneveld for profiling itself as an international poultry centre. Kwetters’ marketing manager framed Rondeel within this aspiration (helped by vivid illustrations from the CfH project and a scale model built later). Barneveld’s willingness was further enhanced by Kwetters’ CEO who strategically mentioned that other municipalities were also interested; this made Barneveld even more eager to have the first Rondeel built there. As a result, the civil servants involved in economic development acted as innovation champions within their organization. They did this by chasing up their colleagues, the civil servants responsible for the permit procedures, by stressing that this was an innovative concept that would be beneficial for the municipality.

A parallel purposive strategy of the system developers (i.e. Vencomatic R&D staff and ASG researchers who advised them) was to fit out the Rondeel with existing husbandry sub-systems (feeding, manure extraction, ventilation, etc.) that were already ap-
proved for ammonia emission norms. Authoritative ASG calculations supported this approval, despite the fact that the researchers and environmental consultants acknowledged that these figures might be different in practice. Nonetheless, instead of having to go through a protracted admission and verification procedure for emissions (taking >5 years), the hen housing system fitted existing norms. Furthermore, because Vencomatic hired a local environmental consultancy firm and architect, with good connections with the Barneveld civil servants, some remaining conflictive issues were fine-tuned in interaction. This concerned for example the fit of the Rondeel with its round form within the landscape. An issue that was more troublesome was getting approval for fire safety. This was because despite having outdoor spaces the Rondeel was considered as a closed building with resultant safety issues. However, because the responsible fire department official liked the project, he helped the architect to look for a solution in close interaction with the fire department. This solution, fireproof curtains that drop down in the event of fire, was later verified by a specialized consultancy agency. This strategy to frame Rondeel’s component technology and appearance to fit with existing rules was thus enhanced by Vencomatic using specialized consultancies and researchers to verify its compliance with existing norms. This enabled the integral concept to be executed as designed, with only minor adaptations.

4.4.2. Rondeel interaction locus b: overcoming risk adversity towards non-proven market concepts

As mentioned in Section 4.3, to overcome the lock-in situation whereby hen housing system building depended on guaranteed sales volume and vice versa, and hence make investment risks acceptable to Rondeel Ltd. and farmers, Rondeel Ltd. needed to find ways to cover this risk. Whereas for coverage of R&D costs innovation subsidies from innovation programs such as TransForum were available, a major problem was finding a risk funding (in the form of venture capital) or a guarantee. This was needed to cover the risk of the surplus investment that was needed as compared to normal barn hen housing systems. Rondeel Ltd. and the support network around it noted in this respect that public policy discourse was very supportive of animal-welfare-enhancing innovations such as Rondeel (e.g., Verburg, 2008), but that in practice they were not willing to provide financial guarantees. This was problematic, because Vencomatic as the mother organization of Rondeel Ltd. could cover only part of the financial risk. Banks would only fund up to the amount for a normal barn hen housing system, the returns on which are known.

An initial search of the Rondeel technical committee (as this took place before Rondeel Ltd. was established) for risk funding with Oost NV, a business incubator, proved unsuccessful. This was because Oost NV targets Gelderland Province in which Barneveld is located. As Vencomatic was from Brabant Province, Oost NV, regarded it as not being its concern. Furthermore, Oost NV is funded by the Ministry of Economic Affairs, and the Rondeel system was regarded as an agricultural affair pertaining to LNV. To obtain risk funding or at least a guarantee, later on Rondeel Ltd. tried to convince ZLTO and LNV that they needed to provide these. They did this by organizing high level talks between the Vencomatic CEO, the president of ZLTO, and high LNV officials. Both ZLTO and LNV, however, stated that they could not give support to specific firms: ZLTO because it is a political representative of all farmers, and LNV because of European state support rules. ZLTO, however, offered in-kind support by providing their experience and expertise with the Volwaard Chicken because they endorsed the Rondeel concept. LNV stated that their responsibility had been funding the CTI project, a feasibility study, and that they now provided R&D financing and facilitation through TransForum. LNV stated that businesses should take some risk and should not merely rely on government. For the state to play a role, they would need to develop generic instruments because state support rules prevented support to individual firms.

Because the risk funding/guarantee issue could not be resolved through formal means, Rondeel Ltd. tried to influence LNV first through informal probing by an ASG representative, but this was not appreciated. Furthermore, LNV stated that it was unrealistic for Vencomatic’s CEO to expect that on the basis of the Rondeel vision alone a guarantee could be provided. Despite this setback, thanks to the mediation of the CSR consultant hired as part of the TransForum project for process facilitation and expertise on marketing of welfare innovations a new opening for contact was forged. This was due to his good connections with LNV. The people at Rondeel Ltd. highly esteemed the role of this consultant, as the following quote shows:

[The consultant], we call him here “the crowbar for opening closed doors”.

Rondeel Ltd. sent a formal written request for support, and arranged a new formal meeting. On the basis of this meeting, a more detailed business plan with well calculated financial figures was drawn up. The minister had frequently mentioned Rondeel as a promising concept, so explicit reference to this was made in the request and the business plan. LNV was willing to see what would be possible, given the state support rules it was tied to. Coincidentally it was discovered that Rondeel could make use of an existing guarantee regulation to individual farmers for large investments. Thanks to a recent change in this regulation, the maximum amount for the guarantee had risen. This meant that Rondeel could be accommodated within this scheme. The obtainment of the guarantee enabled Rondeel to re-open negotiation with banks on financing the building of individual Rondeels. Furthermore, it facilitated the interaction with retailers. Retailers had earlier been hesitant to co-develop the Rondeel egg concept until there was a perspective of guaranteed supply, but now they became committed.

4.4.3. Rondeel interaction locus c: getting societal support for Rondeel’s husbandry concept

The third interaction locus concerns the dealing of Rondeel Ltd. with what could be seen as a friendly actor in the environment of Rondeel, the Animal Protection Society (APS). This is because APS embraces animal welfare innovations. This issue of welfare stars is connected to the negotiation with retailers, to convince retailers of the ‘unique selling point’ of the egg. Particularly the Rondeel visualization/scale model and the BoR opened the doors to negotiations on the welfare stars, as these made visible that there was a clear fit with APS’ interests. However, in the certification process, hurdles needed to be overcome. One hurdle was that the APS needed to interpret and have approval of its members for the outcomes of the pilot project it had executed with its welfare certification system. This pilot project was about awarding the welfare stars to the Volwaard Chicken. APS perceived certain risks in attaching their reputation as a civic advocacy organization to a product (e.g., in case of a food safety scandal with the certified product). Therefore, they first had to assess the experience with Volwaard Chicken before proceeding with the assignment of welfare stars to other products. These deliberations caused a delay in the awarding of the stars that were in turn instrumental for Rondeel Ltd. in convincing others in the quest for support, such as LNV in the guarantee issue. Furthermore, although the vision and BoR had attracted APS, the fact that the hen housing system could not yet be tested in practice meant that provisionally two stars were awarded. Rondeel had aimed for three, and based its arguments on this number of stars. Another issue that needed to be resolved was interactional uncertainty between Vencomatic’s
CEO and the APS representative. Conflicts about APS' critical opinion on other Vencomatic products, coupled to the straightforwardness of the CEO as an innovation champion, were bound to negatively influence the Rondeel trajectory. This was mitigated by appointing the CSR consultant that also mediated the LNV guarantee issue (see Section 4.4.2) as a neutral go-between to take the sharp edges off the interaction and mediate an agreement.

5. Analysis and discussion

5.1. Effective reformism requires adaptive management

From the agency-structure interaction loci presented above can be derived, in line with earlier observations by several authors (e.g. Westley, 2002; Smart et al., 2007; Hall and Clark, 2009; Spelman et al., 2009), that adaptive management is essential in the effort of effective reformism. Innovation is dependent on the outcome of the interactions between many self-organizing actors, which makes it a highly unpredictable process. Innovation networks may purposefully try to influence their environment, but unanticipated effects of their actions and random external events out of reach of the actors may either reinforce or counteract their actions. In line with CAS thinking, occurrence of emergent properties and self-reinforcing effects can be seen, which can be either negative or positive for the innovation network. Our findings confirm earlier observations by De Lauwere et al. (2006) and Meijer et al. (2007) that both internal project factors (e.g. new actor involvement or actor exits) and external project factors (e.g. economic developments, policy discontinuities) can induce both positive interaction cycles (decreasing uncertainties) and negative interaction cycles (increasing uncertainties) that influence the agency of innovators.

On the negative side, this is demonstrated a number of stagnations in the Sjalon case: the relationship between the effect of the cumbersome negotiation with TD and the willingness of potential participants to enter Sjalon, and the fact that fewer potential participants means a weaker financing negotiation position; although the municipality can be bypassed in the formal institutional sense, the disapproval of the NEP municipality and alderman influences the social climate for Sjalon; failures in other innovation networks influence the attractiveness of Sjalon; the departure of the bank director leads to changes in the financing regime, i.e. the bank. Whereas the former issue mainly related to the direct institutional environment, the influence of higher level external events could be seen in the Sjalon case where rising world market prices for agricultural produce instated a less conducive environment to ‘sell their story’. In the Rondeel case such stagnations also occurred: innovation financing by Oost NV is prevented by higher level ministerial territories, and innovation financing by ministries is prevented by European legislation; the no guarantee–no built Rondeel–no retail space dilemma. On the positive side, different innovation networks that work on similar or different issues, and thus can mediate an agreement.

5.2. The role of boundary spanning actors and tangible visions as boundary objects in enhancing adaptive management capacity for effective reformism

While from Section 5.1 has become apparent that innovation networks have only limited possibilities to fully steer effective reformism, they have a number of tools at their disposal for enhancing their adaptive management capacity. The instrumental role of extensive networking, shape shifting, using visions to sell the story, and using influential and boundary spanning individuals has become apparent. When agency-structure interaction is troublesome, either because there is: (a) no contact, (b) conflict, or (c) major uncertainty at both innovation network and institutional environment level as to how to resolve an issue, we see the importance of boundary spanners and mediators on interfaces at which there is no contact, disturbed or otherwise dysfunctional contact. These actors may be casual actors that are used as boundary spanners, such as ASG researchers in the Rondeel–LNV interface. This resonates with findings by several authors about the importance of informal interaction in innovation and the role of boundary spanning actors herein (Aarts et al., 2007; De Lauwere et al., 2006; Horlings, 2008; Kristjanson et al., 2009; Pant and Hambly Odame, 2009). However, it also stresses the importance of having specific and dedicated actors for these roles. For example, in the case of the Sjalon–TD interface (b), and the Rondeel–APS interface (c), specialized consultants fulfilled these roles in order to complement or mitigate the actions of championing actors who generally also fulfill such a boundary spanning function. Such actors, who...
function as independent ‘innovation brokers’, have a relatively neutral position (see Morriss et al., 2006; Klerkx and Leeuwis, 2009; Klerkx et al., 2009; Regeer et al., 2010). From this position, they can more easily resolve the interactional uncertainties and impasses that have built up between innovation network and institutional environment actors, and hence facilitate solutions.

In a similar vein, both the Sjalon and the Rondeel case highlight the importance of influential and powerful external innovation champions in creating conducive institutional environment conditions (such as the ministers of agriculture, the Barneveld officials, scientific experts) when the institutional environment – or key actors therein – is not supportive of change. Such a role, albeit in the intra-organizational context of large firms, has been denoted that of a “godfather of innovation”, such as a CEO who despite having little active involvement in the innovation process may induce activities in other parts of the firm (Smith, 2007). Our study shows that this role also seems a feature of broader, more heterogeneous innovation networks and agency-structure interaction, as has been found elsewhere as well (Swan et al., 2007a).

Besides persons fulfilling boundary spanning functions, the case studies confirm the role of visions as having a guiding, convincing, binding, and uncertainty mitigating function in innovation (Berkhout, 2006). What we see, however, is that the breadth or depth of the vision matters for effectively selling the story, and that visions are not automatically vehicles for supporting an innovation process. In the Rondeel case the vision included a promise for all (i.e. local and national government, consumers, APS, retailers), which was not surprising given the preparatory work done in CH to base the design upon preferences of a multi-stakeholder audience (see Groot Koerkamp and Bos, 2008). In the Sjalon case it was harder to sell the story. Here it met more resistance from the institutional environment, despite the vision being developed in a broadly composed brainstorming group. In both cases however, the people that would have to realize the concepts (i.e. farmers) were not involved in further vision development and adaptation, and that made them hesitant to incur risks. Jointly building up a common discourse and symbolism is conducive in the process of radical change, as Plowman et al. (2007) and Swan et al. (2007b) have shown. As our results show, this is a process that continues throughout the innovation process as partners leave or enter the network, or circumstances change. Our findings support Wiskerke and Roep’s (2007) observations that this is a process of contestation and negotiation.

Linked to this, the tangibility of the vision appears to be an important factor in the realization of an innovation. It appears to matter how the vision has been materialized in, e.g. detailed business plans and scale models in the process of the realization of the innovation. Tangible visions help create shared understanding and support of actors within the innovation network and from the institutional environment. These hence become so-called boundary objects (see Swan et al., 2007b) that enable several different actors to understand what the innovation is about, and thus increase the attraction value of the vision and help mitigate actors’ uncertainty. This could be clearly seen in the Rondeel case. However, on the other hand, such visions as boundary objects may also cause a lock-in, and may actually draw up boundaries. In the Sjalon case, the fully developed business plan that was presented to potentially interested farmers gave them the feeling that it left no room for their input and scared them off. Albeit unintended, it thus functioned as an exclusion mechanism. Also, sticking too long to planned size of 600 ha inhibited the Sjalon to be more pragmatic about the expected returns on investment. Tangible visions may thus also perpetuate situations of stagnation in the innovation process if they prevent innovation network partners from reacting adequately to changing environments, as Wiskerke and Roep (2007) also observed.

6. Conclusions

Seeing innovation systems as complex adaptive systems and accepting the notion that innovation networks self-organize, limits the possibility of fully steering these, as is acknowledged in recent approaches on adaptive management of innovation (Aarts et al., 2007; Spielman et al., 2009). Although effective reformism is thus neither predictable nor fully steerable, the present study has highlighted some key supportive factors. An important outcome of this study is that innovation networks may support their effective reformism efforts by using different types of boundary spanning actors to defend and advocate their interests, broker new contacts, and mediate in case of conflict. Furthermore, using tangible visions and artifacts helps them to create understanding about and support for their ideas. However, when these visions become too rigid, they may lead to the innovation process becoming locked-in.

Recognizing and accepting self-organization may increase opportunities for innovation when self-organizing initiatives are properly facilitated to create and use windows of opportunity. In terms of making innovation policies adaptive, as opposed to a rigid planning and control orientation, the importance of having innovation system facilitation becomes apparent. A promising approach seems the employment of specialized innovation brokers such as TransForum. Such innovation brokers assist in vision formulation and reformulation, continuous network formation and adaptation, and facilitation of multi-stakeholder interaction by means of network coordination and mediation (Klerkx and Leeuwis, 2009; Klerkx et al., 2009; Kristjanson et al., 2009), by applying monitoring and evaluation methods which are aimed at learning (Horton and Mackay, 2003; Thiele et al., 2007). Given the interaction between different system levels in effective reformism efforts, such methods need to support continuous reflection on the micro position of the innovation networks and their goals versus macro-level systemic possibilities and constraints. Methods such as reflexive process monitoring incorporating innovation system failure analysis (van Mierlo et al., 2010a,b), the interactive learning and action monitoring approach (Regeer et al., 2009) and participatory impact pathway analysis (Douthwaite et al., 2003, 2008), all designed to pro-actively create awareness amongst innovation network actors as regards their position vis-à-vis their institutional environment, seem promising in this regard.

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