Chapter 7. Reflexive interactive design as an instrument for dual track governance

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Abstract

Sustainable development cannot be attained by technical innovation alone; it calls for a reorientation of the existing socio-technical regime: a system innovation. This implies the coordination of the distributed agency of the actors that focus on structural change, as well as activities focusing on the development of novel practices. These two 'tracks' of governance activities may reinforce each other in a process of dual track governance if they 'reach out to each other', i.e. seek to make functional connections. The paper describes a design-oriented approach to this dual track governance issue, called *Reflexive Interactive Design* (RIO). This approach is based on the idea that one can anticipate and facilitate system innovation by the introduction of novel concepts midway between broad future visions and specific novelties. Design and the design process turn out to act as a good vehicle to align processes of change both at the regime level and the niche level. The paper analyses the application of the approach in two design projects on sustainable husbandry of pigs and laying hens. These projects evolved into concrete experiments and new farms that radically diverge from the dominant practice, and have clearly contributed to changes at the level of the regime.

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1. INTRODUCTION

One of the assumptions underpinning the idea of transition (Rotmans, et al., 2001; Grin et al, 2010) is that the persistence of some problems may stem from processes, which are firmly embedded in societal structures. As a consequence, their resolution is bound to involve both innovative practices and structural adaptation: system innovations and transitions. Such change, in other words, is fundamental as it goes beyond established practices and the structures that have co-evolved with them.

A core concept to depict such changes is the multi-level perspective (MLP; Rip & Kemp, 1998; Schot, 1998; Geels, 2005). In short, it conceives of a transition as the interference of processes at three levels: innovative practices (niche experiments), structure (the regime), and long-term, exogenous trends (the landscape). Only when these different dynamics come together in particular ways may mutual reinforcement emerge as a necessary condition for achieving a transition. Grin *et al.* (2003; cf. Grin, 2006) have proposed that, given the structural nature of transitions, it is important to further develop the concept from the perspective of structuration theory. From this perspective, transitions essentially become a matter of (1) redirecting the co-evolution of structure and agency towards (2) sustainable development as a normative orientation, (3) amidst the turbulence of a variety of exogenous trends. Crucial in the process of re-orientation is reflexivity, understood as what Voß & Kemp (2006) have called 'second order reflexivity': the self-critical and self-conscious reflection on processes of modernity, in which actors reflect on and confront not only the self-induced problems of modernity, but also the approaches, structures and systems that reproduce them (Grin *et al.*, 2004; Stirling, 2006).

Coordinating this process implies the coordination of the distributed agency of the actors involved in a range of activities focused on structural change. This distributed agency must then be explored in experiments and through novel practices and, from there, contribute to structural change. While transition management tends to depart from defining structural change and the direction of fundamental change in practices on basis of a vision (Rotmans, 005; Loorbach, 2007), the idea of strategic niche management for socio-technical transitions focuses more on change resulting from experiments in niches (e.g. Raven 2005; Schot and Geels, 2007; Elzen et al., 2005). To the degree that these two 'tracks' of governance activities manage to "strategically reach out to each other" (Grin, 2010: 232), they may actually start to reinforce each other in a process of dual track governance.' (Grin 2006; further elaborated in Grin, 2010: 265-284). In the terminology of the multilevel perspective, they are located on the regime and the niche level (two types of experiment, belonging to two different niches), as well as in between. Note that events and trends on the landscape level may influence or, often, be strategically used in all these different governance activities (Grin, 2010: 266).

In this chapter we will analyse two different cases of reflexive interactive design in animal husbandry in the Netherlands, and show how design and design practices mediate between the two tracks of niche formation and regime transformation. The main research questions are:

- What is the specific role of design concepts like these in processes of socio-technical change? What characteristics can be explanatory for their eventual success or failure in contributing to niche formation and/or regime transformation?
- To what extent does the design *process* contribute to eventual success or failure in niche formation and/or regime transformation? More specifically, how do design processes facilitate *second order reflexivity* by regime actors? And what characteristics of the approach chosen are especially important to this?

2. ANIMAL HUSBANDRY IN THE NETHERLANDS

Agriculture in the Netherlands can be seen as an exemplary success of modernisation, especially after its take off after World War II (Bieleman, 2000). Yet it has also experienced increasing pressure and criticism, already since the early 1970s (Grin, 2010: 249-264), when the first side effects of this success (over-production, emissions and losses, and over-fertilisation by manure) surfaced and became important societal issues. This is especially the case for Dutch livestock production: a series of dramatic epidemics and food scares framed the public image of Dutch livestock production as a disease-prone industry with disrespect for animals.

Since then, the sector has been confronted with a range of issues that are critical to its future sustainability. Its vast environmental footprint (both local, regional and global) is accompanied by increasing societal critique of the quality of life and health of animals, and debate on the acceptability of increasingly larger livestock (confinement) units in the rural landscape. At the same time farmers struggle to stay competitive in a liberalised global food market. Given not only the wide scope of these challenges, but also their seemingly contradictory nature, awareness is growing steadily – outside as well as inside the livestock sector – that in order to attain sustainable production a structural reorientation –or system innovation– is needed, both in production and consumption.

As emphasised above, such a process requires the – somehow – orchestrated action of multiple actors at multiple loci. However, attempts to coordinate action through the establishment of a vision on the future of livestock production in the Netherlands (Wijffels, 2001; Anonymous, 2005) have had a marginal impact until now. Despite global agreement between institutions over the need to take major strides towards sustainability, a coherent framework to align actions at the regime level and strategically manage niche experiments is lacking. Therefore, niche experiments that go beyond adaptations within the existing technological

trajectory will face considerable resistance from the incumbent regime, while the regime itself will not change its structuring characteristics as long as no viable alternatives to dominant practices exist, or are perceived to exist.

In our view, this dilemma may be overcome if we enrich the idea of strategic niche management by increasing the number of strategic connections between two tracks of governance of sustainable transitions – between the structure level (regime) and the niche level. One way to do this is by Reflexive Interactive Design, as developed and practised over the last couple of years in animal husbandry, by researchers from the Dutch agricultural research institute Wageningen UR. Reflexive Interactive Design (RIO – in Dutch) employs design and design activity as an intermediate intervention, simultaneously working on agency in experiments and novel practices and on structural changes that may help create space for such novel practices at the regime level.

3. REFLEXIVE INTERACTIVE DESIGN

RIO is an approach for *doing* reflexive modernisation (Bos and Grin, 2008). It is rooted in the recognition (Grin, 2004; Grin et al., 2004) that earlier forms of technology assessment do not fit problems that require structural change as well. It is a specific form of deliberative or participatory technology assessment (Gutmann and Thompson, 1996; Grin *et al.*, 1997; Bellucci and Bellucci, 2002) that adopts *design* of both the technical and social features of societal systems for production and consumption as its central activity and focus of deliberation. In this way, definition of both the problem and the solution takes place in a reciprocal and iterative argumentative exchange between stakeholders, and the people needed for implementation. Design thus becomes a matter of iteration between the desirable – in the sense of contributing to the desired change – and the feasible. The intended design should be understood neither as value consensus nor as a mere 'tit-for-tat' compromise, but rather as *congruency*: a course of action on the way in which modernisation in a specific instance should proceed, and that makes sense for each of the actors involved (Grin and Van de Graaf, 1996).

To reach congruency more is needed than negotiation and trade-off between different interests. The latter would be a repetition of the way modernity tried to solve its problems. Deliberation therefore has an important place in RIO. It should be performed so as to lead to second-order learning. Institutionally and technologically embedded assumptions, norms, knowledge claims, distinctions, roles and identities that are normally taken for granted must now be scrutinised. It should moreover support second-order reflexivity by *simultaneously* eliciting the introduction of novelties in practice, and stimulating changes at the regime level that enable these novelties to become successful niche experiments. RIO should yield a design process that produces concepts and propositions that are *radical yet feasible* enough to be realised in some form in the near future as a novelty in practice.

This combined character of radical *and* feasible is essential for the intended mediating function of design and design processes. These processes should be radical enough to question basic assumptions within the incumbent regime, and at the same time feasible enough to enable initiative by actors at the level of practice. Therefore, the concepts produced cannot and should not be mere technical replacements or a technical fix.

In recent years, Bos and others have elaborated these basic notions, originally inspired by various sources in innovation and policy science (Grin *et al.*, 1997; Grin, 2005; Grin and Van Staveren, 2007; Schot, 1992; Rip and Kemp, 1998; Loorbach, 2007; Rotmans, 2003; Weaver *et al.*, 2000). A crucial point of improvement and extension has been a far better accounting for the needs of key actors in the system to be redesigned, for both methodological and substantial reasons. Substantially, the aim of RIO is to synthesise the needs of different stakeholders (including animals) in design, rather than trading them off against one another. Methodically, needs are also the starting point in a systematic design methodology called *Methodisch Ontwerpen* (the Dutch for 'Structured Design') that is adopted in RIO. Structured Design (SD) (Siers, 2004; De Beer, 1997) aims at making the design process of artefacts like buildings and machinery more rigorous and traceable. SD emphasises rigorous analysis of the client's needs and of their translation into an elaborate set of quantitative requirements, based on traceable sources. The combination in RIO of a thorough system analysis and a structured design approach makes it especially appropriate to reduce the number of trade offs between seemingly conflicting needs, and the number of system failures that have been built up during years of co-evolution.

The general approach of RIO is built upon three cycles of activity with a feedback flow between them:

- **System and actor analysis:** systematic reflection on the current structural arrangements of the system at hand, and the needs of key actors involved. This is done analytically and interactively, in order to facilitate the opening up of the problem and the solution space (i.e. the number of possible solutions as perceived by actors) (Voß and Kemp, 2005).

- **Designing new systems or arrangements using Structured Design** (Siers, 2004). This is done in an interactive way, in order to incorporate practical and tacit knowledge, and to prevent a research bias in value incorporation. The results are feasible and attractive concepts that might be applied in the near future.

- **Anticipating niche and structural change**: strategically using concepts and reflection to facilitate effective reformism (Roep *et al.*, 2003) i.e. creation of niches, as well as proposals and interventions for structural changes in the current system that create the space for changes in daily practice.

These three cycles are not a chronological sequence, although the main focus in RIO projects will change over time from the first to the last. Due to both their

reflexive and their interactive nature, several iterative cycles may be completed over time. Problems may be redefined and proposed structures reassessed, and new actors may shed new light on the proposed solutions.

4. Design as an intermediate intervention between niche and regime

“Design” is clearly central to our RIO approach; it refers to both the verb, “to design” and the noun, "a design". By “design” as a noun we mean tangible, visual material proposals for alternative systems or sub-systems that integrate a range of existing and new solutions in a way that is plausibly realisable in the near future, yet contain significant (system innovative) challenges on more than one dimension of sustainability, e.g. a drastically reduced environmental footprint and improved animal welfare, in combination with mid-term economic feasibility. As a verb, “design” is a process, in which knowledge, interests and values of a broad range of disciplines and stakeholders are reflexively scrutinised, translated and synthesised as far as possible, alternately by a broad range of stakeholders in an interactive fashion, and by a smaller group of less directly involved professionals pairing specific skills to a broad system orientation.

RIO shows at the same time what is actually possible and what has to be done to reconcile goals that seem to contradict one another in the short term. It can be used in setting institutional agendas at the regime level, and at the same time elicit the development of novelties and niche experiments that fit the larger picture.

In addition to this general function, the following more specific functions can be recognised, that will be shown in the cases below:

At the niche level:

- Designs suggest the further development of novelties that fit in a more encompassing and coherent trajectory,
- Designs suggest possible niche experiments and inspire niche players to act,
- Designs serve as a shared framework for several niche experiments, for identification and mutual learning.

At the regime level, designs question basic assumptions and rules underpinning the incumbent regime, and:

- Designs help in redefining central guiding concepts and norms (animal welfare / intensity), both in the sector and in the knowledge infrastructure,
- Designs provide a common agenda that is feasible enough to take concrete action on the institutional level (alignment),

- Designs provide opportunities for new forms of collaboration and alliances between regime actors.

5. THE "PIGS IN COMFORT CLASS" PROJECT

5.1. Patterns of the process

In 2001 the project 'Diergericht Keten Ontwerp' (Animal Oriented Chain Design) was inspired, and actively guided, by a representative of the *Dierenbescherming* (DB, the Dutch Society for the Protection of Animals), which responded to a call for tenders by Wageningen University and Research Center (WUR). The DB's proposal was to take animal welfare as the sole starting point for the design of husbandry systems for production animals. For practical and budgetary reasons the WUR interdisciplinary project team eventually narrowed down the focus of the design goal to welfare improvement of fattening pigs only.

The project team then defined 'good animal welfare' as the situation in which 'the needs of the animal' are fulfilled. The underlying assumption is that this will result in a quality of life that is experienced as 'good' by the animals (De Greef *et al.*, 2006). Since animals do not speak for themselves, these needs were taken from reports of a group of experts (see for instance (Anonymous, 2001). Subsequently, the project team identified the functions that are necessary to fulfil those needs, as well as the specific requirements that solutions for these functions should meet.

For the argument of this chapter, it is important to note that this specific operationalisation of animal welfare represents a specific interpretation of an inherently normative concept. This interpretation was (and still is) contested not only between, but also amongst, animal scientists, citizens and farmers. However, the needs approach to animal welfare took the debate on animal welfare to another level by stressing the goals to be attained, rather than the solutions required, thereby circumventing debates on the necessity of specific solutions (like outdoor areas and straw) that are perceived to be good for animal welfare. The project internally redefined animal welfare (as fulfilling needs using husbandry elements) and chose a specific level of ambition for the design (fulfilling the identified needs), with active support by the main stakeholder involved: the representative of the DB. These criteria were laid down in a Brief of Requirements for fattening pigs (Schouten and Groenestein, 2003), and a list of possible solutions for fulfilling the animals' needs was generated. Based on that, the project team elaborated the notion of structured design to produce a concept for a barn for pigs in which all their ethological needs were fulfilled (Groenestein et al., 2003; Siers, 2004). A sketchy representation of this concept was included in a popularised magazine-like report (Welzwijn/CC, 2003). Shortly afterwards, the internal project leader translated the chosen level of animal welfare into an

air-traffic metaphor, *"Comfort Class*", as the level between Economy and Star Class.

The magazine-like report and the accompanying design caught the attention of members of the Dutch Parliament, who urged the Minister of Agriculture to encourage similar developments and make Comfort Class the national minimum standard (Vos and Van der Ham, 2004). The president of the pig farmers' section of the Dutch farmers' organisation *LTO Nederland* publicly adopted the principles of Comfort Class by offering the Dutch government an alliance between LTO and DB to develop the idea and implement it in farming practice (LTO-Nederland, 2003). Together, they planned to build a housing facility according to 'Comfort Class principles' as a step in improving animal welfare in the sector. This was a unique alliance of the parties involved, who were traditionally opponents. It signalled that both organisations had taken a new strategy in dealing with society's growing unease over animal welfare in intensive livestock farming. The farmers' organisation LTO changed its tone from resistance to an approach of taking small steps ahead. DB chose to focus on helping animals living now by cooperating with and actively sustaining improvements, rather than criticising any practice that did not conform to their ideal.

Despite their public enthusiasm, neither LTO nor DB were willing or able to pay substantially for further development and construction. After a year, several (mainly public) actors supplied funds, and it was decided to build a pilot of the CC barn on one of the experimental stations of the WUR in Raalte. Economical, intellectual and public ownership would all be in the hands of the two initiators. In addition, a connected network of conventional pig farmers was established with interest for the CC-development. The explicit ambition was to use this group to translate features of the CC into practical terms, on farms.

A redesign phase from the original idea began, in which the Comfort Class principle was translated into a practically feasible construction that would allow for testing the effects on animal welfare, answering farmers' questions, testing the opportunities for practical application, and serving as an inspirational demo for pig farmers who would like to adopt Comfort Class principles in their own practice.

On 26th April 2006 the Dutch Minister of Agriculture (LNV) opened *Varkens in Comfort Class* (ViCC; 'Pigs in Comfort Class'). ViCC (http://www.comfortclass.nl/) is positioned as a pig housing facility with a high standard of animal welfare since pigs can meet their ten basic needs (like feeding and drinking, resting, social behaviour, and thermoregulation). A non-expert visitor to Raalte would notice the amount of space for pigs, the daylight coming from the transparent roofs, and the pens with straw that occupy part of the space. A more knowledgeable visitor will also notice the fact that the pigs have complete tails and interact peacefully and socially with one another.

ViCC received positive attention in the general public media. Within the turmoil of public debate on animal welfare in general, and the fierce resistance on several

locations in the Netherlands against large-scale piggeries, ViCC served as a contrasting example of what pig welfare could be like. The Minister even put Comfort Class for Pigs at the heart of her new policy on sustainable animal husbandry, along with the search for partners to create a 'plus- or in-between segment' (cf. (Hoijtink, 2004) market for food produced according to sustainability criteria, with retail prices between those of regular and organic products.

After three years of testing and demonstration, the pilot phase came to an end in December 2009. It resulted in a 'soft yes' (De Greef *et al.*, forthcoming) on the question of whether the proof of principle would bring "animal welfare (quality of life as experienced by the animal) to a level that is at least neutral to the husbandry environment" of the animal – a 'soft' yes because we cannot directly assess the quality of life as experienced by the animal, and the available set of welfare indicators is currently too narrow and too rough to discriminate between conventional approaches and the needs approach applied in the experiment. Nevertheless, no welfare infringements were observed in the Comfort Class piggery, and the findings on behavioural synchronisation suggest an even more positive result.

During the last years of the project, the participating animal protection organisation (*Dierenbescherming*) developed the *Beter Leven Kenmerk* ('better life hallmark') for identifying meat products from improved animal facilities. For pigs, the standards were derived from the Comfort Class experiences.

At the festive close of the pilot project, two Dutch retailers announced they were willing to sell improved welfare meat in their supermarkets. Seven of the farmers involved in the experimental phase did test CC-principles by changing their own facilities or in the design of new facilities.

5.2. Interpretation: a practical standard

Several features are worth mentioning for the general argument of this paper. The first is the role of (visual) design in shaping a new, unique alliance. The artistic impression of the first design (Figure 3) combined a promise of much better animal welfare with a promise of possible realisation, into an attractive visual. Although the design was primarily meant as an illustration of the more fundamental take on animal welfare, without its visual representation the Comfort Class approach probably would not have caught the attention of members of parliament and LTO.

Secondly, and at least as importantly, the design was also a (visual) representation of a more abstract idea of what animal welfare is about. Part of its strength was that it derived legitimacy from translating animal welfare into needs and the accompanying requirements for animals' living conditions, drawing on scientific ethological knowledge. In this respect it created new common ground, at least for the representatives of the farmers and those of the animals. This was not exclusively due to scientific authority, as the knowledge

applied was not new in itself. More essential was the establishment of a certain level of abstraction, that enabled proper deliberation: animal welfare is not discussed and operationalised in terms of preferred *solutions* but in terms of a problem definition that took due account of the stakeholders' reasons or motives (Grin & van de Graaf, 1996).

Thirdly, by choosing a specific *level* of animal welfare and calling this Comfort Class, the project team created a practical reference that was both empirically testable and practically feasible, as well as being an anchor point for guiding societal dialogue and debate. This is reflected in the political decision to make Comfort Class a national minimum standard, and in the way in which Comfort Class is used by farmers and by the farmers' press as a reference to a general level of animal welfare, rather than a specific housing system. Finally, the clarity, feasibility and measurability of the reference allowed both main stakeholders to commit themselves.

These three features *together* constitute the potential of designs in mediating between the levels of the regime and the niche. The initial concept of Comfort Class 'talks' to the regime level, by simultaneously suggesting a *redefinition* of animal welfare on a more fundamental level (the needs), by identifying a *specific level* of animal welfare based on this redefinition, by making it *plausible* that this level could be achieved in practice, and by translating this into an *iconic visual form*. This combination allowed different regime players to form a unique alliance, and has since served as a useful, legitimate, minimum standard for improved animal welfare, both in politics and in practice.

The initial design concept at the same time suggests a framework for niche experiments. It contains specific solutions for desired functions, i.e. fulfilling the needs of the fattening pig. These solutions might be novelties by themselves (for instance: the micro-climate zones in Comfort Class that enable pigs to choose between zones and floors with different temperatures, in order to stay within their thermo-neutral or comfort zone), or be a novelty by a new combination of existing solutions. Both the CC concept as such, and the implied specific novelties gave rise to experiments in practice. The pilot of Comfort Class at Raalte was a first realisation of the concept as a whole, but was explicitly positioned by the initiators as a demonstration site for farmers to pick *specific* ideas to implement on their own farms. Farmers were not expected to adopt the whole concept, for economic reasons. Surprisingly, farmers performed experiments that required far more radical alterations to their facilities. It is expected that these alterations will be the cornerstone for a plus-segment of meat in the supermarket, as a result of an agreement between the largest Dutch slaughterhouse and the largest Dutch retailer.

6. THE HOUDEN VAN HENNEN PROJECT (KEEPING AND LOVING HENS)

6.1. Patterns of the process

The Comfort Class case, while exclusively oriented to improving animal welfare, laid an important foundation for later projects by introducing the needs approach to animal welfare into a structured design process. One of these later projects, '*Houden van Hennen*' (a Dutch title meaning both 'keeping hens' and 'loving hens'), focused on keeping laying hens. It took the needs approach a step further, by taking the needs of the three 'actors' in or around the system as the starting point for a design trajectory: the laying hen, the poultry farmer and the citizen, partly also in her role as consumer. *Houden van Hennen* strived to synthesise their needs into design, rather than trading them off against each other. Referring to (Bos, 2008; Groot Koerkamp and Bos, 2008) for an elaborate discussion of the first phase (2003-2004), we focus here on the functions of the designs of *Houden van Hennen* in later stages.

The project *Houden van Hennen* (*Houden van Hennen*, 2004) took place at a stressful time for the egg-producing sector in the Netherlands. The massive outbreak in 2003 of avian influenza spreading over areas where chicken farms were concentrated provided an opportunity to discredit the growing alternative practice of free ranging in outdoor areas, based on the risk of contamination of hens by wild fowl carrying the virus (Koch and Elbers, 2006). At the same time the sector had to prepare itself for two highly controversial regulations that were to take effect in 2006 and 2012 respectively, aiming (1) to stop the practice of trimming the beaks of chickens, and (2) to forbid the use of traditional un-enriched cages for laying hens (European Union, 1999) respectively.

Houden van Hennen thus had to operate on highly contested ground, without any consensus on the need for change. Yet it was clear to some that a fundamental shift was needed in Dutch egg production due to: animal diseases related to high stocking densities; increasingly stringent animal welfare standards; effective resistance from the animal protection movement; and very thin margins on the product. It was highly questionable whether a further optimisation for cost-reduction, control and efficiency – the route already taken for decades – would solve this multiplicity of challenges. In fact, one way to interpret the stalemate at this point is to say that the sector did not see how animal welfare concerns could be respected without jeopardising other considerations in egg production. In these terms, the project's objective was to design a production system that the various stakeholders would deem satisfying in all respects.

Thus, *Houden van Hennen* adopted a design strategy in which a small team of young researchers from various disciplinary backgrounds alternated between desk analysis and a variety of close interactions with a heterogeneous group of actors from within and around the sector: farmers; other actors within the production sector like egg traders and equipment suppliers; government officials; non-governmental organisations; and consumers. The team tried to

maximise the influence of actors on the goals of the project and the values embedded in its results, while at the same time challenging them to look beyond their immediate short-term needs and prevent the perpetuation of incumbent practice.

The end results were shaped substantively by the interactions with prospective users and consumers. Moreover, by the interactive definition of an elaborate brief of requirements, starting from the explicated needs of actors, a permanent entry point for future designs was created, allowing actors previously not involved to make their own basic design choices, instead of being limited to adapting a pre-existing complete design.

The first phase ended mid-2004 with the presentation of two new concepts for laying hens systems: the Plantation and the Roundel. Importantly, both design concepts were technically feasible in most respects in the foreseeable future, since the concepts rearranged existing technologies, rather than presupposing new developments. Economically, the concepts presupposed specific markets willing to pay more for the eggs – markets defined by the consumer groups to which these concepts were tailored.

With their uncommon design, they attracted attention in the Dutch agrarian media, and received recognition from government, civil society organisations and agricultural engineering firms. Initially however, they also met with scepticism, the fiercest of which was amongst poultry farmers. First and foremost, these farmers feared very high construction costs. Additionally, they interpreted the concepts as blueprints for future laying hen husbandry. This reflected the traditional pattern of knowledge development and transfer in animal husbandry in the Netherlands. This time, however, the concepts were not meant as a prescription, but as examples of 'how it could be done'. Therefore *two* concepts rather than one were presented, differing in key respects (for instance the availability of outdoor access).

Therefore, in a subsequent phase, effort was put into communicating, along with the concepts themselves, the basic principles underpinning them: substantially more space per hen; spatial differentiation of functions in the system; and the possibilities of differentiation of these systems according to ethical, aesthetic and economic values of different groups of consumers and farmers, along with the promise of solutions to technical and managerial as well as marketing challenges facing the current systems.

This phase of *Houden van Hennen* led to at least three important developments: two different pilots and a policy change towards system innovation. The first successful pilot was realised in 2007 by a poultry farmer in the province of Gelderland, who participated in the original design trajectory and was also starring in a national educational children's TV programme (*'het Klokhuis'*) on the initial project[3]. His *Lankerenhof* (www.lankerenhof.nl) was his own variation, inspired by the Plantation.

[3] See http://player.omroep.nl/?aflID=10098388

A second pilot was initiated in 2005 with the aim of realising several instantiations of the Roundel before the end of 2011, and marketing the eggs produced in these systems under a special brand. It was run by a consortium of a large and well-known egg trading company and an internationally operating company, which develops and manufactures complete poultry husbandry systems. This cooperation between different sides of the production chain was rather unique. The consortium adopted (and reflected) one of the main suggestions of *Houden van Hennen*: that there could be a more intricate connection between the form and function of husbandry systems for laying hens, and the corresponding product in the market. Although the egg trading company withdrew in the course of the project for internal business reasons, this close connection between production and marketing has remained a vital element of the project.

The consortium needed approximately three years to redesign the basic concept of the Roundel into a system that could actually be built at acceptable costs, through extended deliberative learning and reflection by the participants (for a much more elaborate analysis see: (Klerkx et al., 2010a, Klerkx et al., 2010b and Klerkx *et al.*, 2012), and funded by a special innovation programme (*TransForum*). For instance: a big hurdle turned out to be aligning the important marketing argument of hens that can roam freely in the open, and the above-mentioned reluctance within the sector regarding free range, because of health and safety risks. Finally, the Roundel concept was supplemented with outdoor access, but *quantitatively* less than what is required per hen for free range (2,5 m^2) or organic (4 m^2).

During this development a close dialogue was sought with the DB, which was preparing the aforementioned *Beter Leven Kenmerk* for animal friendly products. The hallmark awards one to three stars to products of animal origin that can be positively differentiated in terms of animal welfare. The highest degree –three stars– is awarded to organic systems or similar. This dialogue led to a public announcement in November 2008 at an agribusiness innovation symposium at which the director of the DB was granted the honour of symbolically drilling the first foundation pole for the first Roundel-inspired layer facility. He in turn awarded the Roundel concept two of the three stars of the *Beter Leven Kenmerk*. The first Roundel was opened in April 2010 by a representative of the Dutch Minister of Agriculture. On that occasion, DB granted the concept a third star, while a major Dutch retailer Albert Heijn announced that it would sell the eggs in its supermarkets[4]. While both actors' appreciation obviously contributed to the concept's legitimacy amongst particular constituency, the fact that *both* gave their blessings to one and the same concept may have had even more of a legitimising impact.

A third development was that the Dutch Minister of Agriculture took 'system innovation' as one of her main policy instruments (Verburg, 2008) in her future

[4] More information can be found at http://www.rondeel.org/

vision of fully sustainable animal husbandry, mentioning the Roundel and Plantation concepts as exemplary cases. Of course, one could easily criticise the ambiguous and even sloppy use of the term 'system innovation' here and object that the design concepts cannot be said to be ‘fully sustainable’ and not breaking radically enough with existing patterns of food consumption and production. Nonetheless, the political acknowledgement that adaptations to current systems will not suffice in making a leap towards sustainability can be seen as a significant effect of these projects and designs on the regime level.

6.2. Interpretation: Heterogeneous consortium

Three features of designs can be shown to facilitate alignment between work on the niche level and on the regime level. Firstly, and obviously, the designs did lead to pilots that could be considered as innovation niche experiments with a strong commitment to developing into a market niche. Differently than for the Comfort Class prototyping, these pilots were initiated by private entrepreneurs rather than by a coalition of institutional regime players. The first pilot was driven by idealism and an explicit vision of animal welfare; the second primarily by a keen eye on (future) market opportunities. Key characteristics of the designs were important motivators in both cases: significantly improved animal welfare in combination with a differentiating visual form and market proposition.

A second feature is the explicit way the designs have shown how heterogeneous requirements - that often seem contradictory- can be integrated. The Roundel in particular has proved to elicit enthusiasm and initiative from farmers and animal protectionists, as well as a major egg packer, a system developer, and local and national authorities. This heterogeneity can at least partly be explained by the design approach that took the synthesis of the different actors' needs as a starting point.

Closely related to this, a third feature of the initial and rather unique consortium of two hitherto distant players in the supply chain in one of the pilots can be explained by this integrative approach as well. *Houden van Hennen* translated societal ideal images into features of the production process that ran parallel to requirements of the laying hen and the farmer. In the Roundel, important themes for specific citizen groups (‘care’, ‘safety’, ‘privacy’) were linked to functions in the system that are important for the farmer (‘oversight’, ‘controllability’) and for the laying hen (‘room to escape’, ‘shelter’, ‘private laying nests’), as well as in the actual form (the round shape, the sheltered scraping area). Thus, a new production system was intricately linked to a market opportunity, and a new coalition of important players was the (unforeseen) result. Although the egg trader withdrew, the link between market and production system remained and –ironically–grew even stronger because of this withdrawal. In fact, the presence of the egg-packer led to innovative options in which there was no need for an egg-packer (Klerkx et al., 2010a).

The integrative approach does have its drawbacks as well. With Comfort Class, we saw how an explicit focus on animal needs in design has resulted in the establishment of a useful standard reference for 'good animal welfare', both within the branch itself and in its institutional environment. This is also expressed in the name of the design: 'Comfort Class' expresses a level or norm, whereas 'Plantation' or 'Roundel' do not. Although *Houden van Hennen* had analogous standards for animal welfare, this was only part of the message of the designs. The difference partly explains why the *Houden van Hennen* project elicited more response in the private sector than did Comfort Class, but had a less immediate effect on the institutional level. The more different issues are integrated into the design and into its message, the smaller the chances are that it will immediately appeal as an intermediate option to institutional players that, except for the government, mainly focus on single issues (like animal or farmers' interests). This effect is seen even more profoundly in subsequent projects on dairy husbandry (Bos et al., 2009a; Bos et al., 2009b) and pig husbandry (Van Eijk et al., 2010a; Van Eijk et al., 2010b), that added environmental issues as well. Yet, in the end, in the case of the Roundel it seems that the breadth of the innovation (animal welfare, environment, market) ultimately made it especially attractive to a range of institutional supporting stakeholders.

7. RIO AND THE FUNCTIONS OF DESIGN

Our basic claim in this chapter is that design (as a process and a visual description of a possible material end result) may work as an intermediate option between the niche level and the regime level. It can do so by facilitating the interplay between, and alignment within, these levels, and thereby serve as an effective instrument for dual-track governance of sustainable transitions.

In Section 4 we identified seven meaningful functions for design as an instrument, which work either on the regime level alone or simultaneously on the niche level, and demonstrated these functions in the two cases described. This regards our first research question. Our second question was to what extent the design *process* contributes to eventual success or failure in niche formation and/or regime transformation. The designs in the cases might have been effective as well without any methodical foundation, by chance, by artistic genius, or by normal professional engineering abilities. Although we cannot fully refute these alternative explanations, we can at least pinpoint the relation between (aspects of) RIO and apparent and important mediating functions of the designs.

- **Redefinition of central concepts:** by operationalising animal welfare within the structured design approach of RIO, by positioning the animal as a user with needs that have to be met, both cases introduced an alternative discourse on animal welfare. This in turn opened up new possibilities for dialogue between farmers, animal protectionists, engineers and regime players, and for the setting of a common agenda.

- **Question basic assumptions and rules:** an essential characteristic of RIO is the bracketing of current standards, practices and solutions, and the abstraction of solutions to functions, thereby opening up the solution space. Especially in *Houden van Hennen*, this led to an –at least partial- refutation of the common belief that any improvement in animal welfare will by definition be detrimental to financial returns, or the assumption that round form factors are inefficient by definition.

- **Suggest possible niche experiments and inspire niche players to action**: in the *Houden van Hennen* case, the farmers who attempted to apply the designs in practice were mostly those who actively participated in one or more stages of the design process itself, for instance in creative workshops or design workshops. This pattern is corroborated by lessons learnt from recent applications of the method in projects with dairy cows (Cow Power, (Bos *et al.*, 2009a, Bos *et al.*, 2009b), pigs (Varkansen, (Van Eijk *et al.*, 2010)) and broilers (Broilers with Taste, (Janssen *et al.*, 2011). The interactive character of RIO is an important factor in eliciting action by niche players. Of course, it is quite probable that these farmers would have taken an initiative anyway, but probably not with that level of ambition. The interactivity in RIO stimulates the mutual learning of professional experts and practising farmers, while its systematic and reflective character increases the probability that niche experiments will be radical leaps rather than adaptive steps. In addition, by promoting mutual vision formulation and collective learning by regime actors and practitioners at the same time, bottom-up initiatives that feed and fit these visions may increase their chances of being supported by regime actors, thus increasing their chances of becoming niche experiments themselves.

It can be concluded that the different steps in RIO stimulate second-order reflexivity by actors that become actively involved in the design process. In turn, this second-order reflexivity is a prerequisite for agency transcending the structuring force of the incumbent regime. In this way, applying design-oriented deliberative approaches like RIO may be seen as a form of knowledge production that transcends both the classical positivist and linear view of the generation of knowledge, and constructivist perspectives that perceive knowledge production as 'extending the laboratory' (Latour, 1987; Latour, 1983).

8. DESIGN, AGENCY AND LEGITIMISATION IN DUAL TRACK GOVERNANCE

The analytical focus on design in the preceding sections might obscure the important role of a range of actors that bring these interconnections about, and the role of power and landscape developments. Apparently, researchers played this intermediate role in both cases, not only in the first phase of design, but certainly also in the subsequent pilot phases. Yet a much more striking observation is of how, in both cases, actors with vested interests, engaged in practices shaped by the incumbent regime, embark on a learning process around

a design concept together with an non-governmental organisation whose raison d'être is to challenge that same regime. Thus, to a certain degree, regime actors themselves were actively engaged in intermediate work: on the one hand establishing a niche experiment, and on the other hand, and at the same time, re-evaluating important structuring assumptions (like the concept of animal welfare, or the importance of cost price)[5]. It was this heterogeneity of the actors involved and the fact that their viewpoints and concerns were (deliberatively) integrated in the designs, which lent the concepts legitimacy.

While design is a very real attractor and design processes are a good vehicle for these learning processes, they would not have come about without pressure and legitimisation from outside. Both cases were heavily influenced by a number of outside developments, including:

- The cultural and political landscape in the Netherlands at the beginning of the new millennium, which was increasingly characterised by criticism of livestock production and especially of the status of animal welfare, and which consequently put pressure on the incumbent regime and established practices;
- A continuing neoliberal perspective on the role of government and, consequently, substantial governmental resources that were diverted to research and animal-friendly initiatives by private actors (instead of enforcing legislation, for instance);
- Efforts and pressure by the Dutch government to align a multitude of actors to its future vision on integrally sustainable food production (e.g. the Covenant and the Implementation Agenda Sustainable Livestock Systems - *Uitvoeringsagenda Duurzame Veehouderij*).
- The rapidly increasing authority of the *Dierenbescherming* to grant their *Beter Leven Kenmerk* to animal products.

Thus, the experiments described in the case were enabled by outside pressures and subtly mobilised by them, and were legitimised by more all-encompassing political and cultural trends. At the same time, as we have shown, the design concepts themselves contributed to the formulation of a governmental vision of the need for system innovation. Years later, their actual materialisation in pilot experiments and new systems play important roles in aligning old and new actors (like the retail sector) to this governmental agenda. Their visual and material character should therefore not be underplayed in the establishment of linkages between the two tracks of governance.

[5] It should be noted that there are also important differences between these cases in this respect. In the case of Comfort Class, the pilot project was deliberately 'contained' on an experimental facility of Wageningen UR, instead of a real farm, in order to mitigate the risk that the farmers' organisation would lose its members' support by turning too fast away from the majority of farmers. By contrast, in the case of *Houden van Hennen*, it was a farmer and a private enterprise that took the lead.

9. CONCLUSION

System innovation requires a transformation at the level of practice and at the level of the socio-technological regime that structures people's actions in daily life. Although SNM literature originally presumed that it was primarily the interplay of niche experiments that would result in changes at the regime level, under the influence of developments at the landscape level awareness is growing in transition studies that this unidirectional perspective is too simplistic. Niches and regimes do interact in a much more multi-facetted way (see for instance Smith (2007)), and a more strategic approach to interlink the two tracks of system innovation governance is needed. From the results presented here, we draw three main conclusions.

- **Design may acquire legitimacy across agency and structure,** thereby strengthening the linkages between the two tracks of governance. The cases make apparent the fact that regime players in the animal production sector themselves increasingly express second-order reflexivity and become conscious of the fact that their ambitions for sustainability do have implications for the way they choose their (structuring) actions. In this chapter, one issue appeared particularly essential: legitimacy in the eyes of both established players and those interested in sustainable innovations. In fact, the designs derived much of their legitimacy from the fact that they reflected diverse interests. Nobody could claim that the designs reflected one single particular value bias. When even stronger, they manifestly reconcile interests that had hitherto seemed un-bridgeable, thereby solving a strong tension in the face of strong, undeniable signals that inaction was no longer a viable strategy.

- **Design as a process and design as a visual representation of a possible end result mediates between niche and regime**. Both cases show how they may inform and inspire appropriate niche experiments. They also provide a shared framework for multiple niche experiments for identification and mutual learning, while at the same time being instrumental in the alignment of institutional action, agenda setting and problem redefinition.

- **Design may precede and facilitate the generation of a more common agenda on the strategic level.** At least in the sector of animal husbandry, this might be a route with more chance of success, given the relatively large number of independent entrepreneurs that cannot possibly be involved in a process of shared agenda setting.

Support for a radical approach by one or more regime players is a prerequisite. The design strategy applied here runs the risk of being pushed back within the incumbent regime, since the approach is essentially deliberative and interactive. However, the cases show how this risk can be mitigated if a more radical approach by the project team is explicitly legitimised and supported by one or

more regime players, including the financiers. In the case of Comfort Class, this role was taken by the DB with support of the Ministry of Agriculture, in the case of *Houden van Hennen* it was provided primarily by the latter. Still, an independent, consciously and reflexively chosen role of researchers is essential.

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