

# Instrumentalization Theory and Reflexive Design in Animal Husbandry

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*In animal husbandry in The Netherlands, as in a wide variety of other societal areas, we see an increased awareness of the fact that progress cannot be attained anymore by simply repeating the way we modernized this sector in the decades before, due to the multiplicity of the problems to be dealt with. The theory of reflexive modernization articulates this macro-social phenomenon, and at the same time serves as a prescriptive master-narrative. In this paper, I analyse the relationship between Feenberg's instrumentalization theory and reflexive design; that is, the approach of doing reflexive modernization. Feenberg's analytical distinction between primary and secondary instrumentalization is useful in highlighting the way social and political values are inscribed into technological arrangements, but is not meant as a method. Reflexive design, on the other hand, is meant to be a reflective and deliberative method that aims to articulate, assess and reintegrate hitherto unquestioned values and presuppositions into new designs of production systems. Reflexive design thus may be seen as a conscious strategy of making explicit the separate stages of instrumentalization in advance, instead of criticizing the implicit embedding of dominant values in technological artefacts once they have been realized. The approach is illustrated with a case from animal husbandry.*

*Keywords:* Reflexive Modernization; Instrumentalization Theory; Reflexive Design; Animal Husbandry; Interactive Technology Development

## Introduction

How might critical philosophical approaches to technology have an impact on technology development? Especially in the earlier-20th-century tradition of philosophy of technology, its predominant role seems to consist primarily of interpretation, analysis

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and critique of technology in general or in specific cases *after* it is realized. However, such efforts remain unsatisfactory, while once realized and embedded in practices and institutions (or, in general, an established socio-technical regime; see Rip and Kemp 1998, 340; Geels 2002; Hoogma et al. 2002), technology is not easily changed in the face of criticism. One may only hope that the critique will be adopted and applied to future and comparable instances. How could philosophy of technology be more effective in contributing to more satisfying types of technology, which incorporate and sustain a broader range of societal goals – or, as Andrew Feenberg would put it, to contribute to *a fuller realization of technology*?

One of the areas in society where this fuller realization is actually needed is modern western – including Dutch – livestock production. Currently, several diverse research & development (R&D) programmes in The Netherlands are being carried out, which are oriented towards the transition of livestock production to more sustainable forms. As a consultant and researcher, I am involved in a number of them. These R&D programmes – ranging from new production and housing systems for cows, chicken and pigs to new institutional arrangements for land property and land use – have in common that they take place against the background of contested values, problem perceptions and visions of feasible future directions for agriculture. Therefore, development of technology in this area has to deal actively and consciously with the way current technologies are coded, and how we should recode new ones in an acceptable way.

Agriculture in The Netherlands faces a variety of problems created by its own modernization process – problems regarding ecology, economy and animal welfare. Pressure from society, politics, and a globalizing market force the sector and its periphery to reflect on a number of basic tenets and presuppositions, which have laid the basis for its enormous success of the past three or four decades. Success, that is: the success of a continuous increase in production volume against continuously decreasing costs. This *modernization* reaches its limits in the field, and actors are actively pursuing other ways for development, while retaining the idea of progress. In the words of Beck (1997), there is a need for a second modernity: *reflexive modernization*.

As Feenberg already noted in *Questioning Technology* (1999, 109), there is a relationship between his critical theory of technology on the one hand, and this idea of reflexive modernization on the other. In his view, his plea for *democratic rationalization* can be compared with Beck's idea of *subpolitics*, in the sense that both strive for change by challenging the established order (or "hegemony") from outside (the "subordinates"). In this interpretation, reflexive modernization is primarily characterized as a countermovement ("counter-hegemony") against the established technical rationality. However, according to Beck (1994a), reflexive modernization may also very well originate within current institutions, because they are reflexively (i.e. by self-confrontation, not by reflection) confronted with increasing difficulties progressing the way they have done in first modernity. Subpolitics is the phenomenon of politics occurring "outside and beyond the representative institutions of the political system of nation-states" (Brey 2008, 72), which is enhanced in reflexive modernity. As Beck writes:

Those decision-making areas which had been protected by the political in industrial capitalism – the private sector, business, science, towns, everyday life and so on – are caught in the storms of political conflicts in reflexive modernity. (1994a, 18)

According to Beck, reflexive modernization primarily means that “modernization *undercuts* modernization, unintended and unseen, and therefore also reflection-free, with the force of autonomized modernization” (Beck 1994b, 176). Thus, reflexive modernization affects any subject in society, indiscriminate of her relative power. Despite its autonomous character, its ultimate effect is uncertain. Beck is not proclaiming that a new society is necessarily emerging according to some sort of Marxian historical necessity (Beck 1994a, 12). Only secondarily may subjects within society become aware of this, and reflect on its implications and the way we can deal with, or anticipate, undesired side effects, but this is not a necessary condition for reflexive modernization to occur. This second-order reflection may arise within established institutions as well as outside, although Beck stresses the importance of individuals, who “have become ever more free of structure ... (and) have to redefine structure” (1994b, 177).

Dutch animal husbandry is a case in point. In recent years, this sector has become the object of significant pressure for change. Until around 1997 it was generally thought that these problems could be solved through adaptation by technological innovation accompanied with and induced by strict regulative policies (*ecological modernization*; Hajer 1995).

However, the classical swine fever epidemic between February and September 1997 gave rise to the suspicion that something was more fundamentally wrong with the existing socio-technical regime of intensive husbandry, not only in the pig sector but also in other sectors. Subsequent crises have been going on: the bovine spongiform encephalopathy (BSE) outbreak in The Netherlands (peaking there in 2000, following a peak in 1996 in the United Kingdom); foot and mouth disease (2001); the affair with polluted animal feed containing the illegal hormone MPA touching the pig and calf sectors in 2002; and, more recently, the avian influenza epidemic of 2003. These developments, together with a number of other societal considerations casting doubt on the legitimacy and long-term viability of livestock production at large, created a sense of urgency for the need to reform it: within government (for example, Denkgroep Wijffels 2001), societal organizations (Dierenbescherming et al. 1997) as well as – although reluctantly and hesitatingly – in the sector itself (LTO Nederland 1999, 2001).

Thus, in this case the urge for more structural reform can be located not only at the periphery, but also within the institutions that are part and parcel of the socio-technical regime itself, which is characteristic for the claim of Beck regarding the locus of reflexive modernization. The R&D programmes mentioned before – subsidized by government – are an expression of this. In this paper I would like to address the relationship between Feenberg’s instrumentalization theory and reflexive design (i.e. the approach of *doing* reflexive modernization), using an example from one of these programmes: a project on the development of new husbandry systems for laying hens (Project Team Houden van Hennen 2004). As I will show, critical approaches to technology, such as the one Feenberg has developed in the past 15 years, might play a useful role in reflexive

design, both in understanding how reflexive design differentiates itself from more traditional design practices, as well as in practically contributing to this method by its analytical instrumentarium.

By assessing the affinity between Feenberg's instrumentalization theory and the reflexive modernization thesis of Beck, Giddens and Lash (1994), I will show that the theoretical work of the latter may be elaborated into a practical programme of doing reflexive modernization, by applying concepts from the former. At the same time, I will argue that reflexive modernization may imply that conscious "strategies of concretization" (Feenberg 1999) to reach a fuller realization of technology do not have to be limited to subversive action of subordinate groups.

### **Reflexive Modernization**

The concept of reflexive modernization (Beck 1997; Beck, Giddens and Lash 1994) stems from the idea that traditional modernization processes, characteristic for "first modernity", have been aiming at knowledge-driven progress, based on increasing opportunities for controlling nature and society. In the case of agriculture, this modernization process has led to one dominant developmental path, oriented to a continuous increase of control over inputs, outputs and animals involved, unprecedented increases in production volume, and a remarkable decrease of costs. So remarkable that, for instance, the consumer price of an egg in The Netherlands is the same in absolute terms as it was 30 years ago, despite inflation and increased labour costs, and so on (Bieleman 2000).

This was made possible by a combination of technological changes, a structural alignment of institutions and a consumption culture that values cheap food rather than the quality of this food. Exemplary for the case I will discuss in this paper are cage systems for laying hens, where typically five hens are confined to an area, which leaves a space per hen as small as an A4 piece of paper, fed by conveyer belts, living and laying their eggs on netted wire to get rid of the manure, and eggs rolling off to a second set of conveyer belts. After approximately one year, their productive life ends in the slaughterhouse, often with a negative economical value: the farmer has to pay the slaughterhouse for accepting these hens, rather than be paid.

In recent years, realization has spread that these processes bring with them risks and side effects that society does not, or will no longer, tolerate. In the case of animal husbandry: a series of serious outbreaks of animal diseases like swine fever, mad cow disease (BSE), and, more recently, avian influenza; growing societal concern about animal welfare; and serious troubles to mitigate the environmental effects of mineral deposition originating from manure – to name the most important.

Combined with the continuous pressure on prices farmers get in the market, a fundamental reorientation is deemed necessary – not only by government or societal groups, but by a lot of actors in the field itself as well. However, this reorientation cannot simply be a continuation of the modernization process that led to these problems in the first place. Simply trying to solve this complex web of problems by further increasing control and lowering costs will not be sufficient to address the basic

issues at hand, since they are side effects of this strategy in the first place. We need another approach.

As said, the idea of reflexive modernization starts from the claim that modernity is increasingly confronted with its own undesired effects. But this descriptive claim is followed by the assumption that another approach to modernization is possible and occurring (Beck 1997; Beck, Bonns and Lau 2003; Grin 2006): a re-orientation of socio-technological development so as to pre-empt these undesired effects without throwing away the baby of socio-economic benefits with the bathwater of modernization. Modern institutions have co-evolved with the development towards progress through control, and thus have developed blind spots for risks and side effects and lack capacities for designing and pursuing strategies that are able to deal with them effectively. Therefore, reflexive modernization involves not only a re-orientation of socio-technological development, but also an institutional transformation – more precisely, a transformation of the institutions of state, market and society and a re-alignment of these institutions. If this is done deliberately, a *reflective* stance is required in order to systematically question elements of classical modernist institutions that are dominant cultural assumptions, routinized modes of working, identities, network rules, “self-evident” knowledge claims, and so on. Subsequently, new institutional arrangements need be created to enable the design beyond such standard assumptions, routines and rules.

In the case of agriculture, this institutional transformation has been defined as an explicit goal of the national government in The Netherlands, which is tightly coupled to an explicit normative idea about the direction of this transformation, namely *sustainability*. The policy idea is as follows: if agriculture is to survive, it should be sustainable in a threefold way – ecological, economical and social. Although one can legitimately criticize this normative goal for its apparent underdetermination, it does its job in aligning actors within and outside the production sector to strive for more than just economic survival, and does nonetheless represent an ambitious, and quite unusual public goal: to actively pursue a fundamental restructuring of an important part of society, in which a multitude of actors participate. In The Netherlands, this has led to the emergence of an interdisciplinary academic network structured around bold terms such as *system innovation* and *transition* ([www.ksinetwork.com](http://www.ksinetwork.com); Grin 2006; Rotmans 2003).

### **Instrumentalization Theory and Reflexive Modernization**

Reflexive modernization thus is the attempt to save the idea of progress, the idea that we can do better, without falling back on standard routines, norms and arrangements that are formed in the first stage of modernization and entrenched in our institutional structures. This corresponds with Feenberg’s ideal of democratic rationalization of technology (1999, 75–76), or – as he puts it in this volume – strategies for undermining the formal bias of (institutionalized) social rationality (Feenberg 2008).

Feenberg’s *instrumentalization theory* is an attempt to understand the phenomenon of technology both in its premodern (non-rationalized) and modern form, by applying

an analytical distinction between primary and secondary instrumentalization. Both forms of instrumentalization are necessary steps in the realization of (new) technology, but they purport to fundamentally different activities that may take place in a more or less conscious way. Primary instrumentalization is the act of decontextualization, in which objects are taken out of their context in the life world, and reduced to things with a specific function and a limited set of useful properties. Secondary instrumentalization is the act of recontextualizing a new technical arrangement into the life world, where it gets integrated into specific practices, is connected to other devices, and is enriched by specific meaning and use. Meaning, ethical and aesthetical values, and societal goals are attached or literally built into the device during secondary instrumentalization. They become *coded* into the artefact, normally invisible to the average observer or user. These *technical codes* explain why technological artefacts can be said “to have politics”. One of the tasks of philosophy of technology is to analyse existing technology and identify these technical codes, which seem self-evident or even non-existent after recontextualization has taken place or closure has been reached.

These two instrumentalizations are analytically distinguished, and should not be taken as subsequent phases in time. Engineers themselves already take societal goals or values into account during their work – implicitly and sometimes even explicitly. Nevertheless, Feenberg notes that technological development in modernity distinguishes itself from premodern technology by a much stronger differentiation of these two processes: a much sharper distinction between technical and social ends (Feenberg 1999, 209), or between function and meaning (Feenberg 2008). Sometimes this can take institutional form; for instance, if the engineering and design departments of a firm are separated.

Societal goals are integrated into technological design during secondary instrumentalization. According to Feenberg, this can take place at the strategic and the tactical level. In general, this *strategic level* is the level at which dominant institutional powers are able to operate. Here, considerations of control and efficiency are privileged, according to Feenberg (2005, 6). On the other hand, there is a second level where influence can be exercised over recontextualization, and that is the *tactical level*, the level of the subordinates. Their influence remains small, as long as those subordinated act individually, but coagulated into masses of individuals (or users) they can significantly influence future designs of technology and technological systems. Feenberg calls this “democratic rationalization”.

Both democratic rationalization and reflexive modernization have in common that the primary way to improve technological development in order to fulfil broader societal goals is to open up basic norms and values that have become self-evident, either in technology itself (“*technical codes*”) or in the surrounding social structure and institutions.

Whereas Feenberg’s instrumentalization theory is meant as a *description* of how political and social conditions “provide the decision rules that resolve underdetermined design choices” (Feenberg 2008, 15), Beck’s notion of reflexive modernization is inherently ambiguous, as Latour (2003, 46) has pointed out. It is *prescriptive*, as a master-narrative on how modernization could be done better. But Beck also claims

that it provides an adequate *description* of what is actually going on. Latour casts doubts on the possibilities to prove the adequacy of this description: how can we possibly prove something like *re-modernization* (in Latour's rephrasing of reflexive modernization) is actually going on? Latour's conclusion is "that the data to be gathered in order to prove the advent of a substantial phenomenon called re-modernization are not easy to come by and, so far, are not thoroughly convincing" (2003, 45). Thus, Latour concludes that *re-modernization* should be seen as a prescriptive master-narrative that is powerful enough to shift the "attention from the mainstream to the discrepancies, failures and side-effects", in that way fulfilling its own prophecy.

I think we lose an important characteristic of the concept of reflexive modernization if we try to resolve its inherent ambiguity, like Latour does. On the one hand, reflexive modernization might very well be a form of modernization actually occurring in parallel with other attempts at modernization, like ecological modernization, making it much more difficult to discern and empirically identify it as a meta-change. On the other hand, Latour seems to be too optimistic about the power such a master-narrative or vision might have in shielding actors involved in projects of reflexive modernization from the influences of the dominant socio-technical regime. If we take this into account, reflexive modernization is neither to be seen solely as a prescriptive master-narrative, nor as a, more or less smoothly, ongoing process of societal change, but as a concept that primarily refers to a programme of *doing* reflexive modernization inspired by a particular vision on how progress might take a new form without disregarding the lessons of the past. I stress the "doing" because of the "duality of structure" – structure is both the medium and the outcome of action (cf. Giddens 1984). Acting upon structure, which influences action at the same time, implies hard work. In the field of animal husbandry, one can see actors *trying* to realize structural changes in order to accommodate a much more heterogeneous set of challenges than they were used to before, inspired by a guiding vision of a transition towards sustainability, while at the same time being confronted with inhibitions and resistance from the established structure they have to work in.

Reflexive modernization thus implies the claim that within society the need for a different approach towards modernization is felt, both by those with a high inclusion and a low inclusion in the dominant socio-technical regime. However, in attempting to realize this different approach in practice, they will be confronted with the resistance of that regime at the same time. Beck's subpolitics thus may also originate from within the institutions that constitute the regime, as a consequence of their inability to proceed as they did before. In this sense Feenberg's democratic rationalization differs from reflexive modernization, since Feenberg locates the driving forces behind it exclusively in the aggregated action of subordinates (i.e. those that lack the power to influence on the strategic level).

As can be observed in Dutch agriculture, the driving forces for reflexive modernization do not exclusively originate from resistance of subordinate groups, and resistance to change is not limited to the dominant powers that be. Because of the accumulation of risks and side-effects resulting from the first modernization of agriculture, basic presuppositions of the system at large are put under scrutiny by a variety of dominant

actors, including government and large corporations like the meat industry and dairy cooperatives. At the same time, subordinate actors, as for instance many farmers, are actively resisting change, and refuse to revise their basic ideas of what agriculture is, and what their role should be.

Therefore, at least in agriculture, reflexive modernization is more than a beautiful master-narrative, and has become something of a necessity – felt by (some) dominant and (some) subordinate actors alike, while resisted by others, both dominant and subordinate.

### Reflexive Design

By its ambiguous nature, *doing* reflexive modernization is not self-evident and straightforward, but its promise reaches further than the effect of an outsider's critique, or the collective action of subordinates, because it originates from, and works on the self-doubt emerging within dominant structures that arose from first modernity. Projects of reflexive modernization, such as the one discussed here, aim to realize system innovations – new technologies and practices that break with existing patterns of thinking and doing. These system innovations involve changes in action as well as structure. The duality of structure indicates that, in principle, such a “system innovation” is possible. However, *doing* this requires an elaborate methodology, currently missing in the more theoretical contributions of Beck and Giddens on reflexive modernization.

Within the Dutch KSI network ([www.ksinetwork.com](http://www.ksinetwork.com)) we are elaborating such a methodology in theory and practice under the heading of *Reflexive Design* (Grin et al. 2004). Reflexive design is the deliberative design of strategies for reflexive modernization, and is a specific form of deliberative or participatory technology assessment (Bellucci and Bellucci 2002; Grin, Van de Graaf and Hoppe 1997; Gutmann and Thompson 1996), oriented towards the definition of both the problem and the solution in a reciprocal argumentative exchange between the actors involved in the problem. Those actors may be the actual stakeholders, but also those people needed for implementation of the solution. As Grin and Van de Graaf (1996) point out, the intended outcome 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 modernization in a specific instance should proceed, which makes sense for each of the actors involved. This should be distinguished from consensus: the idea of congruency holds that each actor considers the outcome sensible in terms of his or her own interpretive frame, shaped in the type of professional or social practice(s) in which the actor is normally engaged.

Deliberation therefore has an important place in reflexive design, but this should transcend the more common involvement of stakeholders and co-producers in design. 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. Additionally, this deliberation – or, as Fox and Miller (1996, 91) put it, “discursive will formation [in recursive systems]” – requires that institutionally

and technologically embedded assumptions, norms, knowledge claims, distinctions, roles and identities that are normally taken for granted must now be critically scrutinized.

Reflexive design is thus an interactive, deliberative undertaking, in which a critical approach to embedded self-evidences plays a vital role, such as the one Feenberg proposes in his instrumentalization theory. But the challenge for reflexive design is that these approaches should be applied beforehand, and in a deliberative context. Ideally, they are done by participants themselves, not (only) by a dedicated philosopher, removing the blinds of the unknowing others. We otherwise would relegate the reflective work to dedicated personnel, not only repeating the classical division of labour of modernity, but also risking a highly biased critique, detached from the context in which any technology has to function (cf. Radder 2008).

### **Houden van Hennen**

A recent research project aimed at the design of new and sustainable husbandry systems for laying hens may serve as a case of, or at least an attempt at reflexive design. The project is called “Houden van Hennen” – a Dutch title that cannot be easily translated without losing its meaningful twist: at the same time, it means both “the keeping of hens” as well as “loving hens”.

Houden van Hennen (Project Team Houden van Hennen 2004) took place in a rather turbulent period of time for the egg-producing sector in agriculture in The Netherlands. Of the major livestock production sectors (dairy, pigs and poultry), only the last had been spared of large-scale crises until 2003, when a massive outbreak of avian influenza spread over areas where chicken farms are concentrated, such as the area around *Barneveld*.

Just prior to that, the Ministry of Agriculture of the Dutch Government had asked the agricultural research institute Wageningen UR to develop new ways of keeping laying hens for egg production, in order to give an impulse towards sustainability of this sector. This impulse was considered necessary, since a number of autonomous and legal developments in the coming years would impose serious inhibitions to the continuity of a large number of farms. Most notably, two European regulations would take effect in 2006 and 2012 that would stop the practice of trimming the beaks of chickens and would forbid the use of cages, respectively. Two measures with a big impact, which nonetheless did not lead to much initiative in the sector itself. The trimming of beaks was considered an unavoidable necessity – politics was expected to eventually acknowledge this and withdraw or postpone the measure, which actually happened in 2006. The ban on cages was interpreted in a similar vein.

Both measures were taken because of societal concerns about animal welfare. At the same time, the outbreak of avian influenza was a welcome opportunity for significant parts of the sector to criticize welfare measures: the probability of an avian influenza outbreak had been increased by a development driven by the market to let chickens out of their animal houses, into an outdoor area. This was adopted reluctantly by many farmers: they did not like it for a variety of more and less valid reasons, varying from

management problems to health risks and food quality, but at the time there simply was more money to be made with eggs from hens with outdoor access.

The Houden van Hennen project thus had to operate on highly contested ground, in which even the need for change was not shared by all participants. At the same time, it was clear to others that a fundamental shift was needed in the way we produce eggs in The Netherlands: because of animal diseases related to high concentrations, because of growing problems of meeting with animal welfare standards and effective resistance of the non-governmental animal protection movement, and because of the very thin margins on the product itself. It was very questionable whether a further optimization for cost-reduction, control and efficiency – the modernization route already taken for decades – would solve this multiplicity of challenges.

Houden van Hennen adopted a design strategy in which a small team of young researchers from a variety of disciplinary backgrounds alternated between research and analysis, on the one hand, and a variety of close interaction with a diverse group of actors from within and around the sector, on the other. In this way, it was tried to maximize 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 further than their immediate short-term needs to prevent a repetition of current practice in laying hen husbandry.

The central elements of this design strategy were:

- the definition of a set of key challenges to be met by the project;
- the identification of the needs of the trinity of main actors involved in a husbandry system for laying hens: the hen herself, the farmer and the consumer/citizen;
- the definition of an elaborate programme of demands based on these needs (Project Team Houden van Hennen 2005);
- a series of creativity sessions to generate solutions for pesky problems;
- a methodical design approach, strictly reasoning from needs to demands to solutions (Siers 2004);
- intensive communication about the project and its intermediate results in a dedicated and widely read weekly bulletin for chicken farmers and surrounding professionals; and
- professional communication about the end results.

Almost all of these elements were carried out in interaction with, checked by or discussed with a rather large group of stakeholders, such as farmers, other actors from the production sector such as egg traders, governmental officials, non-governmental organizations and consumers. At the same time scientific expertise was tapped from a network of scientists around the team – ethologists (scientists of animal behaviour), economists, social scientists and agricultural engineers. These various stages of interaction were important for the end results, since their content took shape and was adapted substantially under the influence of prospective users and consumers. Moreover, by the interactive definition of an elaborate list of demands, starting from the explicated needs of actors, a permanent entry point for future designs was created, which would allow actors previously not involved to make their own basic design choices, instead of being

limited to adapting a complete design that already presupposes a specific interpretation of – for instance – sustainability.

The first phase of Houden van Hennen was finished in mid-2004 with the presentation of two new concepts for a husbandry system for laying hens, called the Roundel and the Plantation (see the Appendix for more information), which departed from the current standards in the laying hen sector in several ways, but were judged to be potentially technically and economically feasible in most respects. With their uncommon design, they attracted a lot of attention in the Dutch agrarian media, and got a lot of recognition from government, societal organizations and agrarian engineering firms. Initially however, they also met with scepticism amongst poultry farmers. First and foremost because they presumed the concepts would have very high building costs. Additionally, the concepts were interpreted by farmers as blueprints on how laying-hen husbandry “should” be done in the future. This was exactly according to the pattern of how animal husbandry in The Netherlands had worked for decades: knowledge institutes prescribing the way to go in the sector, in alignment with the dominant policy regime and the ideas of sector representatives. This time, however, the concepts were not meant as a prescription, but presented as examples of “how it could be done”. This was also the reason that *two* concepts were presented that differed in key respects (for instance the availability of outdoor access), which was meant to exclude the normative effect one blueprint would have.

Therefore, in a subsequent phase, a lot of effort was put into communicating the basic principles behind these concepts, next to the concepts themselves. These principles include a much lower density of animals per square metre, spatial differentiation of functions in the system, and the possibilities of differentiation of these systems according to different sets of (ethical, esthetical and economical) values for different groups of consumers and farmers, and promise solutions for technical and managerial as well as marketing challenges of current systems. Laid down in an elaborate programme of demands (Project Team Houden van Hennen 2005), the message was that a multiplicity of different husbandry systems for laying hens was realizable (cf. Radder 2007), without violating these principles. This resulted in a small but significant network of farmers, which at the moment of writing are in several preparatory stages to invest in new buildings on their farm, based on these principles. The way the project got there and its follow-up are as meaningful to reflexive design as is the first phase, but will be subject for a separate publication elsewhere (Groot Koerkamp and Bos forthcoming). In the remaining sections I shall focus on two characteristics of the first phase of this project that are especially meaningful for the reflective nature of the process, and at the same time concretize the claimed relationship between instrumentalization theory, on the one hand, and reflexive modernization, on the other.

### **Reflexivity in Houden van Hennen**

As said, reflexive design tries to attain a synthesized judgement on how modernization should proceed, by transcending existing differentiations and distinctions. In order to do this, participants need to take a reflective stance: without questioning the

presuppositions and basic values that guide their judgement and action, such a synthesized judgement is out of reach. Their reflectivity should, however, also apply to the structural arrangements in which participants and others have to act.

In the Houden van Hennen project, reflectivity was systematically introduced in the design process by way of two basic and coherent elements. Firstly, the so-called “methodical design” approach of Kroonenberg (Siers 2004) was adopted; an approach derived from architecture that emphasizes the articulation, analysis and abstraction of the needs of the prospective users, over the intuitive and creative process of an individual architect synthesizing needs and solutions in his or her own head. Secondly, this analysis was fed back to, and partly done together with, a range of stakeholders several times during the project; not only to check whether this analysis was right, but also to stimulate reflectivity of the stakeholders themselves on what they really believed was needed for them, and was needed for others – including the laying hen.

Houden van Hennen discerned three main actors having a stake in the design of new husbandry systems: the farmer, the laying hen and the citizen/consumer. For those three, the exercise was done to highlight their needs on a more fundamental level, before thinking towards solutions. Using interviews and group discussions, the needs of farmers were investigated and analysed. Of course, in the case of the laying hen, seeking interaction was more problematic. Instead, a large body of ethological data was used, especially experimental preference studies, as well as experiential knowledge of farmers and other practitioners. Finally, three different groups of citizens/consumers, grouped by the *Mentality* typology (Dekker, Lampert and Spangenberg 2003, 9; Lampert et al. 2002; Motivaction 2006), participated in sessions taking a day, to assess their cognitive ideas on, and their values and emotional attitude towards, an ideal husbandry system for laying hens.

In each case, an attempt was made to define the needs at a more fundamental level. For instance, most farmers would state they need *cost reduction*. But cost reduction is a solution within a specific context, not an intrinsic need. If questioned further, the real need turned out not to be cost reduction, but – more basic – values such as *continuity*, (*a reasonable income for*) *earning a living*, and *labour satisfaction*. For many, cost reduction was the only perceived option for survival in an increasingly competitive bulk market, which had been structured solely around price for decades. By questioning the self-evident assumption of cost reduction, other solutions become equally feasible, like a different distribution of the profits within the chain, or the creation of a separate market for eggs with an added value.

Something similar was found when investigating the need of the hens for nesting material. As a standard, most people would answer that hens prefer straw to make a nest, and that good conditions for animal welfare include straw. Straw, however, is seen as impractical for farmers, costly, and even damaging for the farmer’s health because of its dust. But actually, straw is more of a solution, not a need *per se*. By taking a closer look, and by abstracting from the concrete solution, one discovers that this need can be better defined as: material that is transformable by the hen itself, to make a comfortable seat for the laying of eggs.

Our third actor, the citizen/consumer, represents a special case. How could we say a consumer or a citizen actually *needs* something regarding animal husbandry systems, in which he or she will never be practically involved? At least, we can say most citizens cherish certain values and preferences on the way farming should be done, and animals are held properly (cf. Thompson 1998, chap. 10). But inclusion of this “actor” was also a strategic choice. One of the critical issues in animal husbandry in The Netherlands is how to market products that are produced differently at a higher price. One of the obstacles to do so is the established dichotomy within the sector between technical and economical issues – relegated to the production side – and societal and ethical considerations, which are relegated to the side of citizens and society. Within this perspective, issues such as animal welfare are seen as external requirements that have to be implemented on top of what is seen as technically or economically necessary. As a consequence, any of such external requirements will represent additional demands that will increase costs if realized as an add-on to what is technically and economically required.

Therefore, we chose to extend the range of actors involved in the husbandry system-to-be with citizens/consumers, in order to prevent a replication of this dichotomy in the designs. Their values and preferences with respect to laying-hen husbandry were investigated at the same level of elaboration, and were used at the same stages in the design process as were the needs of the other two main actors: the farmer and the laying hen.

During the sessions we held with three groups of citizens/consumers, the central question was how they would envision an ideal way of keeping laying hens. However, we did not specify in which respect this ideal should be interpreted: ideal for the laying hen, ideal for the farmer, or ideal for themselves. This was done deliberately, to prevent bias in their thought process towards a specific interpretation, for instance animal welfare.

An important result of these sessions was that much more differentiation between citizen/consumer groups could be identified than the established opinion within the sector allowed for. There, it is a common thought that citizens (i.e. people not involved directly in agriculture) generally cherish romantic ideals, with a few hens scraping happily around a small farm in a pastoralist neighbourhood, sharing important elements with the *agrarian ideal* that Thompson (1998, 159) claims to be the articulation of urban US citizens’ understanding of animal agriculture. However, in our citizen panels, a multiplicity of images turned out to exist. One of them was to some extent comparable with this romantic, traditional image, but it was only present in a subset of people attached to traditional values in general. Industrial, dynamic and wildly natural images were present as well, and correlated to different sets of values people held for their own lives.

Besides the identification of a greater level of differentiation among citizen/consumers, the approach of continued questioning and delving into the rational as well as the emotional levels of judgement on behalf of the citizen/consumers also resulted in a better understanding of what people mean exactly by their primary response to the question of what is an ideal husbandry system for laying hens. For instance, one group

stressed the importance of *nature*, or a natural environment for laying hens. If taken at face value, this could easily be interpreted as an environment that is close to the natural habitat of hens in the wild. This, however, turned out not to be the case: the reference to nature had rather to do with structural features such as self-sufficiency and the pursuit of (ecological) balance, which can be realized in a heterogeneous mixture of organic and technical elements.

As said, two central elements make up for the reflective character of this project: the adoption of a methodical design approach that emphasizes a thorough identification and analysis of needs, in combination with an interactive set-up to assess and adapt the intermediate results. As shown, with this approach reflectivity is introduced both at the level of substance –by analysis and abstraction of needs – as well as at the level of the actors involved. Individually, they are challenged to question their own presuppositions, through their active participation in this analysis. However, as a consequence of the interactive set-up, farmers, professionals surrounding them, animal rights activists and scientists are also confronted with a different perspective of each other, which may lead to a redefinition of their perceived roles and the creation of new alliances.

Reflectivity is not an end in itself: it should be a means to attain a synthesized judgement on how we should proceed with modernization. In the case of Houden van Hennen this occurred primarily by way of defining needs on a more fundamental, or abstract, level. Because of this, needs that initially appear to be in contradiction may turn out to be compatible with each other, enlarging the possibilities for what Simondon (1958) calls “functional compatibilities”. For example: one of the designs, the Roundel, has an almost round form factor, a central management unit and a terrace-like exploration area above a confined space for resting, feeding and laying eggs. In this form design, the (human) ethical value of safety and care for the hen, the aesthetical preference for round forms – both expressed by different groups of citizens – is combined with the need of the farmer for a central place to have overview, and for collecting eggs, and the need of a laying hen for a large semi-covered exploration space and a more protected resting area. If we, however, would have taken the directly uttered needs of actors as our starting point, these wishes could not be combined in one design.

Finally, defining the needs on a more fundamental level also enlarged the array of solutions to fulfil these needs. As long as we define straw as a need for laying hens (which is actually done), we neglect the possibility of using sand, wood chips, artificial turf, grass, and so forth.

### **Reflexive Design and Instrumentalization Theory**

The Houden van Hennen project has thus tried to articulate a diverse set of values, both ethical as well as aesthetical and social, for the actors involved, and subsequently has integrated these values into the design process at an early stage. In that way, we have actively sought to keep a close and explicit connection between primary and secondary instrumentalization, and to reassess this connection together with a range of actors involved in different stages of the design process. This is contrary to what is typical for modernity, where these two distinct moments of instrumentalization tend to be

differentiated into different spheres, but it is also different from premodern technology, because of the explication of the needs and values to be embedded.

The case of Houden van Hennen shows how primary and secondary instrumentalization can be knitted together more closely and more explicitly, by an assessment of the needs of the actors involved, which digs deeper than what seems obvious from the start (by way of reflection and abstraction). By doing this, Houden van Hennen can be interpreted as utilizing a “strategy of concretization” that, according to Feenberg (1999, 220), “can adapt technology to the environment, to vocational self-development of its human operators and to many other human needs.” Under modern conditions primary and secondary instrumentalization are increasingly differentiated, but Feenberg argues that a different type of social system is possible that restores the role of secondary instrumentalization, and would determine a different type of technical development (Feenberg 1999, 223). Although Houden van Hennen did not create a “new social system”, of course, the case does show that one can organize the design process in such a way that values can play an explicit role in an early stage, in the creation of technical configurations. Not only as a criterion for selection and evaluation (Radder, 2007), but as elements of a programme of demands on an equal footing with technical requirements.

The case not only shows how secondary instrumentalization can take place in parallel to primary instrumentalization, but also how the integration of values into these configurations may be enabled by exactly the same procedures that characterize primary instrumentalization: needs and values not only had to be made explicit, but they had to be made more abstract and decontextualized as well. This procedure is an important part of reflexive design, and as such a useful contribution to a methodical approach for reflexive modernization in general.

Moreover, by explicitly including a heterogeneous set of values in an early stage of the design process, one is able to prevent the economically suboptimal solutions that arise from the addition of societal criteria to a design after its technical structure is already finished. For instance, in the case of Houden van Hennen, adding demands such as space for exploration in an early stage made it possible to integrate this feature into the design concepts, without significantly increasing the costs.

Of course, this procedure will not automatically eliminate the power difference between dominant and subordinate groups. At least one actor with considerable power has to create the room for deliberation, which was what the Dutch Government did in the case of Houden van Hennen by financing the project, on the one hand, while defining the deliverables on a process-level (“concepts that help the sector to accelerate its transition towards sustainability”), on the other.

If Beck is right, and reflexive modernization is actually occurring – be it as a broad social phenomenon with a long time horizon and parallel to other types of modernization – we may expect other dominant actors to do likewise. Not inspired by some moral enlightenment *per se*, but by an increased consciousness that their existence in the longer run is served by systematically integrating values and needs of other actors in their modernization efforts, in order to prevent failure afterwards because of undesired side-effects or growing resistance from subpolitics afterwards. The growing interest in

corporate social responsibility is an indication of this development among private dominant actors.

Thus, critical approaches to technology may play a vital role in reflexive modernization. Concepts developed within philosophy of technology – like those of Feenberg – are instruments for a thorough empirical analysis of central concepts and values, which subsequently may structure design processes for production systems in such a way that their inherent risks and side effects are taken into account explicitly at an early stage. As is our personal experience, philosophers of technology can give a fruitful contribution to these reflexive design processes, by opening up fixed definitions and perspectives, and by structuring the design process in such a way that facts and values are constructed along with each other.

### Acknowledgements

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### References

- Beck, Ulrich. 1994a. The reinvention of politics: Towards a theory of reflexive modernization. In *Reflexive modernization – Politics, tradition and aesthetics in the modern social order*, edited by U. Beck, A. Giddens, and S. Lash. Cambridge: Polity Press.
- Beck, Ulrich. 1994b. Self-dissolution and self-endangerment of industrial society: What does this mean? In *Reflexive modernization – Politics, tradition and aesthetics in the modern social order*, edited by U. Beck, A. Giddens, and S. Lash. Cambridge: Polity Press.
- Beck, Ulrich. 1997. *The re-invention of politics. Rethinking modernity in the global social order*. Cambridge: Polity Press.
- Beck, Ulrich, Wolfgang Bonns, and Christoph Lau. 2003. The theory of reflexive modernization. Problematic, hypotheses and research programme. *Theory, Culture & Society* 20 (2): 1–33.
- Beck, Ulrich, Anthony Giddens, and Stephen Lash. 1994. *Reflexive modernization – Politics, tradition and aesthetics in the modern social order*. Cambridge: Polity Press.
- Bellucci, J., and S. Bellucci. 2002. *Participatory technology assessment: European perspectives*. London: Centre for the Study of Democracy.
- Bieleman, J. 2000. Landbouw. In *Techniek in Nederland in de twintigste eeuw: Landbouw & Voeding*. Part I. Zutphen: Walburg Pers.
- Brey, Philip. 2008. The technological construction of social power. *Social Epistemology* 22 (1): 71–96.
- Denkgroep Wijffels. 2001. Toekomst voor de veehouderij – agenda voor een herontwerp van de sector. Denkgroep onder leiding van de heer H.H.F. Wijffels, z.p., May. Den Haag, Ministerie van LNV.
- Dekker, Paul, Martijn Lampert, and Frits Spangenberg. 2003. Political disaffection: The Netherlands in 2002. Paper presented at the Annual WAPOR Conference, Prague, September.
- Dierenbescherming (Nederlandse vereniging tot bescherming van dieren), St Natuur, and Milieu, Voedingsbond FNV, de twaalf Milieufederaties. 1997. *Samen dit varkentje wassen – een gezamenlijke toekomstvisie voor de varkenssector*. Den Haag: Dierenbescherming.
- Feenberg, Andrew. 1999. *Questioning technology*. London, Routledge.

- Feenberg, Andrew. 2005. Critical theory of technology: an overview. *Tailoring Biotechnologies* 1 (1): 47–64.
- Feenberg, Andrew. 2008. From critical theory of technology to the rational critique of rationality. *Social Epistemology* 22 (1): 5–28.
- Fox, Ch. J., and H. T. Miller. 1996. *Post-modern public administration*. London: Sage.
- Geels, Frank W. 2002. *Understanding the dynamics of technological transitions: A co-evolutionary and socio-technical analysis*. Enschede: Twente University Press.
- Giddens, Anthony. 1984. *The constitution of society. Outline of the theory of structuration*. Cambridge: Polity Press.
- Grin, John. 2006. Reflexive modernisation as a governance issue, or: Designing and shaping re-structuration. In *Reflexive governance for sustainable development*, edited by J. P. Voß, D. Bauknecht, and R. Kemp. Cheltenham, UK: Edward Elgar.
- Grin, John, Francisca Felix, Bram Bos, and Sierk F. Spoelstra. 2004. Practices for reflexive design: Lessons from a Dutch programme on sustainable agriculture. *International Journal of Foresight and Innovation Policy* 1 (1–2): 126–49.
- Grin, John, and Henk van de Graaf. 1996. Technology assessment as learning. *Science, Technology and Human Values* 20 (1): 72–99.
- Grin, John, Henk van de Graaf, and Rob Hoppe. 1997. Technology assessment through interaction: A guide. Working document Rathenau Instituut W57, SDU, Den Haag.
- Groot Koerkamp, Peter W. G., and Bram Bos. forthcoming. A new method for design of complex and sustainable agricultural production systems applied to table egg production in the Netherlands. *Netherlands Journal for Agricultural Science*.
- Gutmann, A., and D. Thompson. 1996. *Democracy and disagreement. Why moral conflict cannot be avoided in politics, and what should be done about it*. Cambridge, MA and London: The Belknap Press of Harvard University Press.
- Hajer, Maarten A. 1995. *The politics of environmental discourse – Ecological modernization and the policy process*. Oxford and New York: Clarendon Press.
- Hoogma, Remco, René Kemp, Johan Schot, and Bernhard Truffer. 2002. *Experimenting for sustainable transport. The approach of strategic niche management*. London: SPON Press.
- Lampert, Martijn, Bram van der Lelij, L. Knoop, and W. Egberink. 2002. Awareness and attitudes with respect to genetic modification. In *Marketing for sustainability: Towards transactional policy-making*, edited by G. C. Bartels and W. J. A. Nelissen. Amsterdam: IOS Press.
- Latour, Bruno. 2003. Is re-modernization occurring – And if so, how to prove it? *Theory, Culture & Society* 20 (2): 35–48.
- LTO Nederland. 1999. *Kwaliteit en verantwoordelijkheid*. Den Haag: LTO Nederland, vakgroep varkenshouderij.
- LTO Nederland. 2001. *Toekomst van de veehouderij in maatschappij en markt*. Den Haag: LTO Nederland.
- Motivaction. 2006. Mentality – holistic research into norms and values for positioning, innovation and communication [cited 10 December 2007]. Available from <http://www.motivaction.nl/english/wat/modellen/mentality.html>; INTERNET.
- Project team Houden van Hennen. 2004. *Laying hen husbandry – towards a happy hen life, proud farmers and a satisfied society*. Wageningen and Lelystad: Wageningen UR.
- Project team Houden van Hennen. 2005. *Programme of demands – based on the needs of poultry farmer, laying hen and citizen*. Report number: ASG/05/100677. Wageningen: Wageningen UR.
- Radder, H. 2008. Critical philosophy of technology: The basic issues. *Social Epistemology* 22 (1): 51–70.
- Rip, Arie, and René Kemp. 1998. Technological change. In *Human choice and climate change: An international assessment*, edited by S. Rayner and E. L. Malone. Washington, DC: Batelle Press.
- Rotmans, Jan. 2003. *Transitiemanagement: Sleutel voor een duurzame samenleving*. Assen: Van Gorcum.

Siers, F. J. 2004. *Methodisch ontwerpen volgens H.H. Kroonenberg*. Amsterdam: Wolters-Noordhoff.

Simondon, G. 1958/1989. *Du mode d'existence des objets technique*. Paris: Aubier.

Thompson, Paul B. 1998. *Agricultural ethics – research, teaching, and public policy*. Ames, IA: Iowa State University Press.

### **Appendix. Two Designs for Socially Responsible Laying-hen Husbandry Systems**

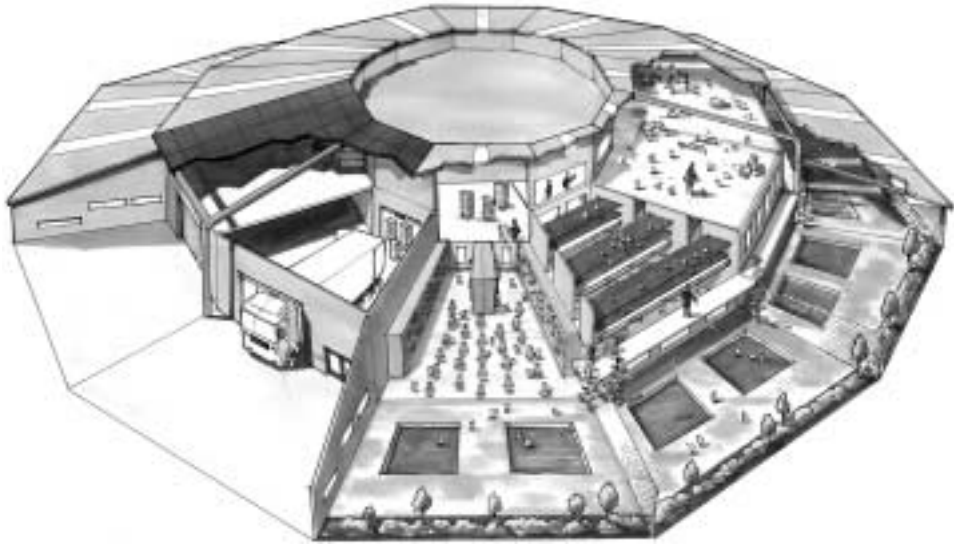
Houden van Hennen has combined the wishes of hens, poultry farmers and the public into two designs. Two designs because we do not believe in one single, ideal husbandry system. They both comply with the Programme of Demands the project formulated (Project Team Houden van Hennen 2005), but the main functional difference is the presence of an outdoor access. In our view, sustainable husbandry of laying hens might as well be realized with as without such an outdoor access. In both types, a distinct set of sustainable features can be combined, and both types will appeal to different classes of citizens/consumers, with different value sets. As our ethological data suggest, outdoor access is not an ethological need, as is dust-bathing or scraping. While outdoor access might be an important factor for public acceptance of the poultry industry, it does present risks for the health of the general public and the hens themselves.

More information on the project and its results can be found in the brochure of the project (Project Team Houden van Hennen 2004) or on the website (<http://www.houdenvanhennen.nl>).

#### *The Roundel*

The first concept resembles a large round cake with one piece missing. A central management area in the core is surrounded by a large two-stories-high loft covered by a roof, but open to the sides. Within that space, 10 smaller confined units are arranged around the core.

Its name, the Roundel, refers to the round towers in an old town wall, expresses characteristics such as visibility and overview, and conveys values like robustness and security. Space is used in a compact way: a central core area that gives access to all technical equipment, a ring around it with enclosed pens that house drinking, egg-laying and resting facilities, and around this a ring with an undercover foraging area, which also gives access to a foraging area on top of the pens. Functional areas are separated, making them easily accessible for the hens. At the same time, its radial form increases the accessibility and overview for the poultry farmer, while the round yet robust shape is chosen to appeal to the class of citizens (“Traditional Citizenry”, Motivaction 2006)



**Figure 1** The Roundel – the first of two concepts for laying-hen husbandry from the Houden van Hennen Project.

who stress the importance of safety and care. At the same time, the diversity of open and private space within, which includes a diversity of materials for exploration, scraping and dust-bathing, probably appeals to another class – that of the so-called *Cosmopolites*, who in our research tend to project their private view of a good life on the way hens should be kept, which is a combination of privacy and dynamism.

The central functional core area provides space for the egg collecting system, as well as storage of the eggs, feed and other items. There is a platform from which the whole husbandry system can be overviewed, by the farmer as well as the general public if paying a visit. Ten of 12 segments around this core are used for the housing of 3000 hens each. Each segment consists of a pen area and a foraging area. This segmentation helps in limiting the population size: each segment is used by its own group of hens.

The pens are partially separated from their surroundings, with closed walls left and right. Within their 5.5-metre height, they offer several functional levels: feeding pans and drinking nipples at the floor, laying nests above and on the side and above a series of perches for resting, which can be reached via “take-off” shelves in front of the laying nests. Conveyor belts underneath the perches enable removal of the droppings.

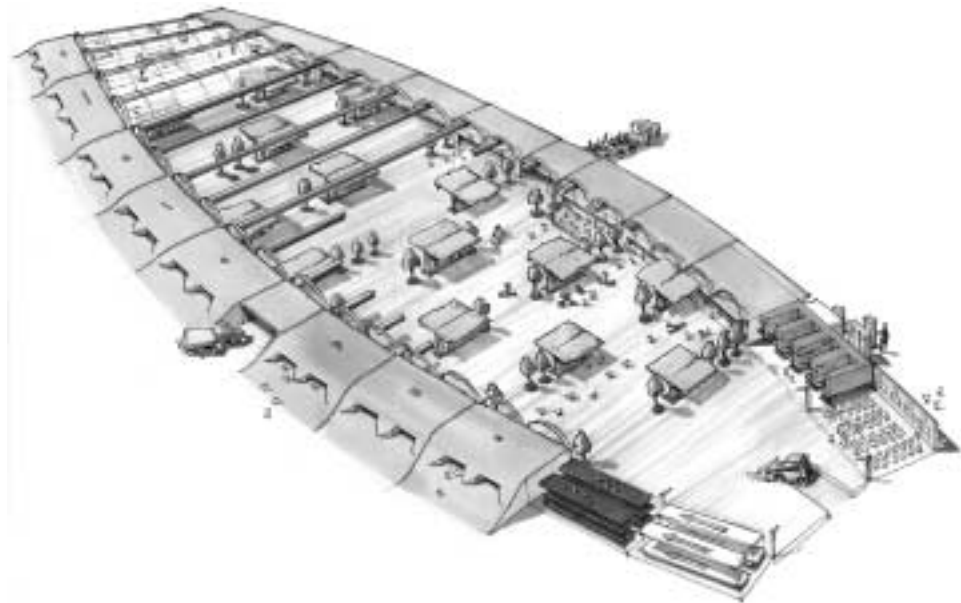
The foraging area has split levels for each segment: first there is a foraging area in the outer ring, separated from the neighbouring segments. Second, the area above the living unit can be utilized for foraging, dust-bathing, food searching and exploration. This area is not segmented. Both foraging areas are enriched with a thick layer of dry litter material and all sorts of planting, playing-material and grain seeds, which are automatically distributed. Daylight reaches the loft area and the ground segment through large windows in the ceilings, and through the sidewalls made of netting, that also allow for plenty of ventilation.

In the Roundel, two climatic zones are created, one in the living unit and the other in the foraging areas on the ground and in the loft. The hens can choose their preferred “climate”. There is a natural outdoor climate in the foraging areas, but the bedding cannot get wet, and solid blinds besides the netting walls can be lowered to keep out extreme cold and rain. The temperature in the living unit is regulated with help of ventilators to achieve a constant temperature of 20°C.

The Roundel is designed to give ample protection for the hen but also for the poultry farmer. Extreme temperatures do not occur. The hens have no contact with birds outside the system; foxes and vermin can be kept outside easily. Thus, as the hens are not exposed to extreme situations, they do not need to be prepared for them. They may therefore be a little more prone to diseases, be less alert for predators, and since there are no extreme seasonal and climatic differences, the hen must not have a need for a strong varying environment. In order to prevent feather pecking, they do have to be raised in an environment (up to the age of 17 weeks) within which they learn to use the space and bedding material available to them to the full. A type of laying hen that has a slightly lower requirement for foraging and exploring, but that prefers resting, continuity, and that prefers behaviours such as preening or dust-bathing is best suited to this system.

### *The Plantation*

The second concept is spatially characterized by two lightly bowed lines of buildings cut into the landscape, which enclose a large inner yard area. This ensemble is positioned



**Figure 2** The Plantation – the second concept for laying-hen husbandry from the Houden van Hennen Project.

between several hectares of land with fruit trees, willows and corn plants that are part of the system.

Its name, the Plantation, refers to the large colonial estates where living, working and recreation were combined. Characteristic for its design is the combination of natural and technical elements, and the emphasis on exploration and self-sufficiency. It is meant to appeal to a class of citizens ("Postmaterialists", Motivaction 2006) who value the potential of nature, while being open and interested towards creative connections between sophisticated technology, and organic and ecological processes. Another group of citizens, the *Cosmopolitans*, may be triggered as well, by the choice-freedom for the hen, the range of possible activities and the availability of privacy.

The inner yard of the Plantation is surrounded by two narrow long-stretching buildings, and forms the central area of the system. In case of rain it can be covered within minutes by a sliding roof in order to maintain it as a suitable foraging and exploration place for laying hens. The inner yard and the buildings together already satisfy all ethological needs of the hens.

The large outer areas, on the left and right sides, have a dual function. Trees and corn can be grown there, while it provides the hens with ample opportunity for exploration. Under the safe cover of the plants, the hens can move far away from the inner yard and buildings. In turn, they may be useful by picking out weeds and hunting after insects.

The two stretches of buildings are again divided into units of 3000 hens each. Both sides have their own function. On the one side there is a covered rest space, on the other each group has its own space to eat and drink as well as lay eggs. Since the hens arrived as eggs, they know their own area and nest from birth. This diversity of places is central to the design of the Plantation. Activities such as resting, eating, egg-laying, foraging and exploring all have their own spot, but are interconnected by logical routes according to the daily time budget of the hen.

The resting units have a simple design. There are adequate numbers of perches to allow laying hens to sleep or rest side by side in comfort. Conveyor belts underneath enable the removal of droppings. The resting unit has openings on each side, which can be shut. One side leads to the inner yard and the other to the outer area. In the morning the opening to the inner yard opens. Once the eggs are laid, access to the outer area is opened.

Egg-laying takes place on the other side of the courtyard, in the egg-laying units. Small trees and lamps providing light help the hens to cross over the yard safely. In the egg-laying unit, laying nests are available in large quantities above the ground. On the floor, under the nests, there is the feeding and drinking area. Also here, droppings and dirt are removed by conveyor belts.

The inner yard between the units is designed for foraging and exploration. This area is generally open air, but can be covered up within a few minutes if necessary; for example, if it rains or there is an increased risk of avian influenza. The yard can be cleaned up easily and new bedding material can be added, because it is accessible for machinery and has a concrete floor. The yard contains a lot of greenery and distraction for the hens, such as grains, green waste and cut wood from the outer area.

Two large areas can be found on the other side of the egg-laying and resting units. These outer areas are pieces of land of at least three acres (total of 2 m<sup>2</sup>/laying hen), which have a dual function. They are large enough to use for profitable crop production, and are designed in such a way that laying hens can enter them for exploration. There is no artificial roof, and the area offers even more variety than in the inner yard. Close to the buildings there are bushes, corn and maize plants and trees. The crop production is situated a little further away. The hen can look for her own food, but there is no protection against foxes or birds of prey. Cockerels might be useful here in protecting the hens against birds of prey. The two outer areas can be used alternately, so that the ground can recover and grass and weeds can re-grow. By growing different types of crops in the two outer areas, the need to have maintenance work carried out in both areas at the same time can be avoided.

The Plantation is very well suited for a type of hen that is more inquisitive and less easily frightened but remains alert. They may be a little heavier and will have a greater feed intake to compensate for the natural variation in their environment.

The brooding of eggs and raising of hens for future laying hens takes place on the farm. Inseminated eggs, rather than young chicks, arrive at the farm. The young animals will be separated from the adults and gradually get more space in the yard. The raising and keeping of chickens in one poultry farm has many advantages and makes this a very robust system. There is no transport stress for the hens, nor stress from a changing living environment. Teaching them how to use the yard at an early stage will concentrate their pecking behaviour on the ground rather than each other. Finally, these hens are gradually exposed to diseases that are inevitably around, and thus will build up a strong immunity at an early age.