How participatory design works as an approach for provoking system innovations towards sustainable pig production in the Netherlands

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Abstract: *Design is increasingly seen and tried as a vehicle for system innovative sustainable development. In a system innovative design project on pig production, called 'Porkunities', the authors tested the effect of a participatory and iterative approach. Does the approach serve the goal to provoke initiatives from stakeholders, without loosing innovative content of the designs necessary for system innovation? The results show that participation of stakeholders doesn't limit the innovative potential of the designs. Iterations help to find a growing number of solutions for a growing number of sustainability questions, from a growing number of stakes. The heterogeneity of a design team contributes to the formation of multi-perspective innovation consortia. And the participatory approach served as an important catalyst in provoking joined stakeholder action towards integrated sustainability in pork production. The iterative and participatory approach as executed in the Porkunities project is found to improve the effect of Reflexive Interactive Design processes.*

Keywords: *pig production, sustainability, system innovation, participatory research, structured design*

Introduction

In may 2009 The Dutch ministry of Agriculture and the important parties in the animal production chain signed a joined agenda on Sustainable Livestock Production (Ministry LNV, 2009). In this agenda the parties share the goal of an in all aspects sustainable Livestock farming in the Netherlands with broad support in the society. To reach this goal new designs for animal production systems are needed. The benchmark for new designs of livestock housing systems lies at substantial steps forward for animal welfare (natural behavior), environment (minimum emission), animal health and energy consumption and environmental integration. Progress on the entire set of issues must be in balance with the progress on individual aspects. The challenge in the Sustainable Livestock Production agenda is to achieve 5% integrally sustainable housing in 2011 and the prospect of large-scale application thereafter with the establishment of new concepts in practice.

System innovative research is indicated as an important instrument to achieve the indicated goals. Therefore the research project *Porkunities* (pork opportunities) was started as an assignment of the Dutch Ministry of Agriculture (LNV). *Porkunities* aims at the design of integrally sustainable pig production systems. And to do this in such a way that parties involved in the project are challenged to bring their innovative ideas for integral sustainability into practice. In the past eight years, we developed a design oriented approach to this governance issue, called RIO, a Dutch acronym for *Reflexive Interactive Design* described by Bos (2008) and Bos and Groot Koerkamp (2008).

The RIO approach is based on the idea that one can anticipate and facilitate system innovation in a desired direction by the introduction of novel concepts -such as farm designs- that are the intermediate between broad future visions on the one hand, and specific novelties on the other. The RIO projects have in common that they all try to tackle more than one issue of sustainability in animal production at the same time (for instance animal welfare and emissions of ammonia, or animal welfare and the creation of added value to the products) by rearranging functions or introducing new solutions for a combination of functions. A recurring question in the RIO approach, is to find the right balance between (radical or system innovative) future visions and specific practical

innovations. Future designs may be far away and theoretical, but they do reveal the actual 'structural rearrangements' crucial for the desired system innovation. Whereas specific practical designs tend to fit in the system as it is (with all its shortcomings), but are more likely to provoke actual initiatives. And thus present actors in the production chain do relate to them more easily.

Over the past years the RIO approach was used in several cases in livestock production: fattening pigs (Comfort Class), laying hens (Houden van Hennen) and dairy cows (Cow Power). In these projects the focus was on creating provocative designs. The researchers were the core group who translated the desired structural rearrangements of the present system into triggering designs of future housing systems. Stakeholders were consulted. Their participation in the actual design process was limited to front runners. The underlying assumption was that an involvement of every day practice in the process will reduce the system innovative content of the designs. This was thought to degrade the main trigger to provoke initiatives from the sector entrepreneurs (farmers, stable designers, food chain industries). This is in line with Leeuwis (2000) who stated that too much diversity of interests among the stakeholders can become an obstacle in reaching consensus in a project. The laying hen project shows that the time between presenting the designs, and the actual initiatives from industry and farmers can be rather long. Klerkx and Leeuwis (2008) also showed there can be a risk of losing some crucial rearrangements in the process of translating the innovative designs into practical innovations. Key question that arose was how to speed up the adoption, without loosing content.

The ultimate system innovative design project should combine both aspects: be innovative enough to unveil system innovative *structural rearrangements* and provoke initiatives which serve the general goal (integral sustainability). *Porkunities* aimed at combining both goals through adding a process of participatory design to the existing RIO approach. Its first hypothesis was that, apart from the design results, participating in the design process itself is an important factor to provoke initiatives from stakeholders and will contribute to a deeper understanding of the necessary structural rearrangements. This fits in the social systems theory of Luhmann (Luhmann, 1995). According to this theory, organizations – in this case a project team – can be interpreted as a 'social system' with their own unique code of communication which can be observed by other social systems (for example groups of stakeholders) but which can never be fully understood. A social system namely reproduces itself in a 'autopoietic' way using exclusively their own elements and structures (During et al., 2009). So a deeper understanding of necessary structural rearrangements aimed at in Porkunities only is possible if the relevant stakeholders play a role in the social system and in a part of the systems environment. Only in that case, they will be able to fully understand what is 'going on' in the design process.

A second hypothesis was that designs made by a trans disciplinary design team will lead to more plausible designs (less theoretical) for entrepreneurial parties. Following these hypotheses the *Porkunities* project was set up and executed. This paper describes the setup and the results of the project in the light of the key issues of innovative potential, and stakeholder ownership / initiatives.

Materials & Methods

The *Porkunities* project is set up according to the approach of Reflexive Interactive Design which is described in more detail in Bos and Groot Koerkamp 2009 and Bos et al. 2009. Figure 1 shows the consecutive steps in this approach.

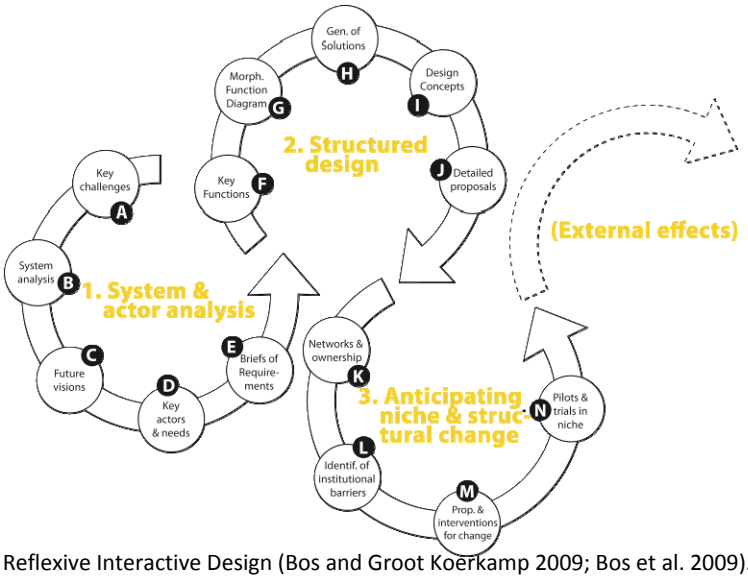

Figure 1: The process of Reflexive Interactive Design (Bos and Groot Koerkamp 2009; Bos et al. 2009).

The four phases are 1) a process of system and actor analysis 2) a process of structured design 3) a phase of anticipating niche and structural change to finally reach 4) the external effects. In the figure it looks like this is a linear process. In practice it is a process of several iterations, jumps en steps backward.

A second crucial choice for the project was the used working definition for sustainability. The Dutch policy goal of integral sustainability of livestock systems is not clearly defined. Aspects of animal welfare, return on investments, environmental impact and social acceptance were mentioned as relevant, but were not defined. The design method that we followed in step 2 starts from the needs of the pre-defined main actors in a system. Therefore our work definition of sustainability starts from that same point of view. We consider a pig production system integrally sustainable when it is able to meet the needs of four principle actors in the system: the pig, the farmer, the environment / ecosystem, the citizen-consumer. This fits in a definition of McGlone: 'If our systems of production are in harmony with the environment, the animals, the workers and the community and if they are efficient and economically competitive then the system may be said to be sustainable'. This refers to the multi-dimensional character of the sustainability concept (people, planet, profit).

The *Porkunities* project was set up as a form of action research, fully acknowledging the fact that iterations and interaction with stakeholders within the process of Reflexive Interactive Design are both valuable. The iterations were planned as three consecutive design rounds: three structured sessions on the design of sustainable pig production, with different design teams, at different times, each starting from scratch (Table 1). Focus in these design rounds was on the structured design (RIO phase 2) with parts of the actor and system analysis (RIO phase 1). The premise was that by involving stakeholders in the design process, the niche initiatives and structural changes would follow faster, with less effort from research and/or policy makers. And to transfer the tractive force from the researchers to the people who put the gained knowledge into practice

Interaction was arranged by actual participation of parties from the pig industry in the design rounds. To judge the effect of different degrees of interaction, the heterogeneity of participants increased in each design team (Table 1). According to the social networks theory of Granovetter (1973) a balance is needed between strong ties – people engaged in stable, frequent and intimate interactions (the Porkunities project team) – and weak ties – people engaged in tenuous or random relationships (the participants of the pig industry) – in a network as strong ties are useful in the transfer of complex knowledge, whereas weak ties are more useful in the dissemination of new knowledge, and allow learning and imitation between actors in different networks (Reinders, 2010, in preparation).

In the first round a multi disciplinary team of researchers formed the design team. In the second round the design team was formed by innovative pig farmers and researchers. In the third and last

round the design team consisted of: pig farmers, partners from the farm equipment industry, pig farm advisor, policy makers and researchers. The number of perspectives present grew with every round. A theoretical perspective in round one, was combined with a user perspective in round two. In round three these perspectives were combined with those of suppliers and government/society.

Table 1: participants and time frame of three design rounds

Design round	Participants in the design team	Time
1.	7 Livestock researchers	Jan 2009 3 weeks, 2.5 days /week
2.	5 Pig farmers 4 Livestock researchers	May 2009 3 weeks, 1 day /week
3.	3 Pig Farmers 4 Farm Equipment manufacturers 1 Pig Farm Advisor 2 Policy makers (local governments) 2 Livestock researchers	Oct 2009 3 weeks, 1 day /week

The design process for the sessions was set up and guided by members of the *Porkunities* project team. The program was based on the process of structured design described by van den Kroonenberg and Siers (1999) and fine tuned on the base of earlier experiences in RIO-projects. In the first round the theoretical process of structured design was followed. The experiences of this round were used to further develop the process into a practical tailor made program for round two. After round two the program was evaluated and some improvements were made for round three.

According to Duineveld et al., (2009) who based their theories partly on Foucault, it is important that researchers should not determine the strategies of transitions processes according to an univocal list or framework, but that they should analyze each case as unbiased as possible to prevent that they too much create their own 'reality' or discourse (defined by Foucault as practices or strategic games in which realities are constructed) with the risk that they overlook other realities. In the design rounds we prevented a growing bias by starting from scratch in every design round. Each design team was asked to deliver innovative designs based on the collective analysis of needs and generation of solutions performed by the design team itself. The researchers involved were the only ones who participated in more than one design round. They introduced suggestions based on earlier design rounds. But every design team decided by itself which suggestions were incorporated in their process. This is important because in that way it could be prevented that the project team became too biased and developed a tunnel vision. And the approach was expected to help create ownership for the designs from the participants. The focus was on designs in which the participants themselves believed, and not on designs which they made "for the sake of the research project".

The design process itself was set up in such a manner that jumping to (known) solutions was minimized. Minimum 2/3 of the program focused on underlying questions for a design. Respectively the needs of key-actors, sustainability goals, brief of requirements and the formulation of essential functions of the system to design. These steps were essential to be let go existing preferred solutions and to focus on the "why" and the "goals" of a design rather than the "how to" questions. All these steps were performed as a group. The actual combination of solutions in technical designs were done in groups with a shared future vision. This was done since the fulfilment of the goals can differ greatly between people with different future visions of sustainable pork production.

The overall process can be defined as a process of forced progression. The design teams had to go through every step of the process. Within a strict timeframe the design teams were forced towards a new step, even when they thought the previous step was not finalised yet. Priority was given to experiencing a complete design process, over performing perfect individual steps.

With the described approach the authors addressed the key issues of the defined dilemma of innovative content versus stakeholder ownership/initiative.

Results

The *Porkunities* project delivered multiple results. Each of which has its own specific contribution towards the general goal to provoke system innovative initiatives towards sustainability. We distinguished four types of results: the designs, structural rearrangements, design workshop process and actual innovative initiatives. An in depth analysis of the structural rearrangements deserves to be described in a separate papers. In this paper we focus on comparing the designs produced in the three design rounds, and the initiatives that arose from them. Each design round produced several sets of designs for sustainable pig production. The designs differed in their focus, in their degree of detail, and in the practical use. Up till the writing of the paper only the last design round resulted in a joined initiative of participants to actually develop designs towards prototypes.

Results design round 1

Round one (with the design team of researchers) revealed seven functions that should be taken into account to reach the goal of integral sustainability. For each of those functions concrete solutions were designed. The coherence between the seven types of sub-systems was not very strong yet. Result was a set of seven sub-system designs with some links between them. An overall farm design was given, but acted mainly as “artist impression”of the seven key-functions. An impression of the results is given in figure 2. The pictures illustrate three different levels of ‘design’: an abstract design of key-functions, a very practical design of subsystems, and a artist design of the total farm.

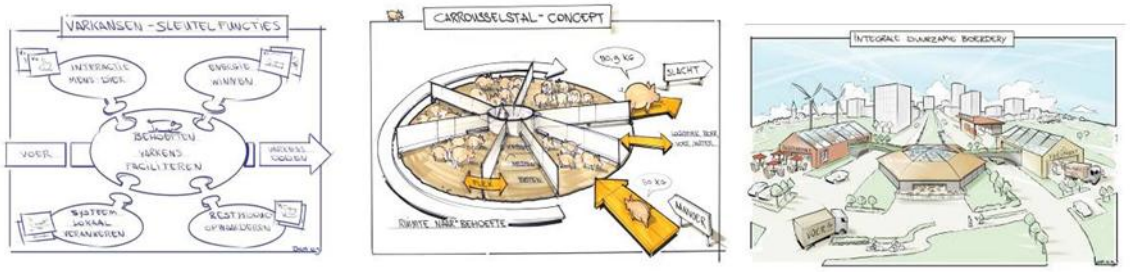

Figure 2: impression of design results round 1.

Important rearrangements in the designs were multiple: Solutions for a transition towards using local feedstuffs, which do not compete with human food needs. Housing solutions in which animals will not be force-moved during their lives, and where pigs have sufficient choice to cover their behavioural needs. Solutions for on-farm production of energy, for closing nutrient cycles, for connection towards society. And a search for solutions which reduced the dependency of the farmer on large meat industry parties.

The first design Round delivered new insights and experience on how the design process itself works. And insights in how (and in which fields) the pork production can innovate towards a new level of sustainability. The design team developed a strong and reflective vision on the present form of pork production. And reflected on this from a theoretical view on sustainability. The designs showed strong innovative ideas and disclosed the focus points for innovating towards sustainability. The designs lacked practical focus. Presentation of the designs for a steering committee, resulted in strong agreements on focus points, and little belief in the actual solutions

Result design round 2

Round two (with a design team of farmers and researchers) produced three overall farm designs. Each design was build on specific farmer visions, like regional vs international focus, commodity vs specialty products and other special characteristics (high health status of pigs). An impression of the results is given in figure 3. The pictures illustrate the focus on overall farm designs, and the fact that designs were tailor made to the specific visions of individual farmers. From the same goals and

requirements for sustainability, different combinations of solutions were chosen to fit the individual farmers needs.

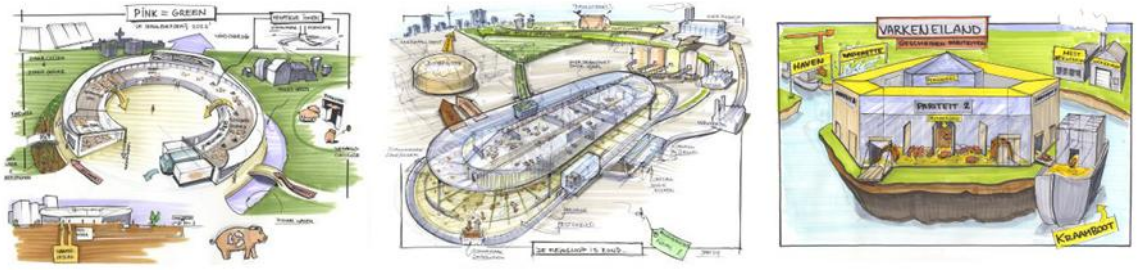

Figure 3: impression of design results round 2.

Compared to round one the designs shared a much stronger focus on closing mineral cycles, and feeding by-products of human food industry. The designs shared a focus in solutions which concentrate on individual management of sows and slaughter pigs, housing systems in larger groups (40-250) of animals, no mixing of groups, and more freedom of behavioural choice for the individual pig. The designs also shared their search for solutions connecting the farm to its environment through local social, economical or ecological functions.

Compared to round one, round two added a clear user perspective to the designs. Solutions for on-farm and off-farm logistics were added, working pleasure and light work conditions got extra focus. Also the economical goals were specified in more detail, although this did not result in purely economical focussed designs.

The search for on-farm solutions to reduce dependency on large market parties was rather limited, compared to round one. Farmers shared the analysis that market forces put strong limitations on innovation as a whole. Unlike the researchers in the first round they stated that there was little that can be done on-farm to change this.

In evaluation interviews the participating farmers stated that inspiration was the main result they valued in the process. They valued the setup of the process and were surprised by results they produced themselves. “We produced very plausible solutions which I have never thought of before”. One of the farmers stated that the designs were not innovative enough. While others valued the fact that the designs were practical. The farmers felt themselves as owners of the designs. They used the designs in their own negotiations with local authorities and defended the designs towards a steering committee. The farmers praised the fact that they could co-operate in the design process itself, rather then be able to reflect on research made designs. They stated that their thinking about sustainability in pork production had changed in the process. One of them explained that: “I never looked at sustainability from this point of view. We always start from our own perspective. *Porkunities* forced me to see sustainability from an outsider perspective as well”. Most of the participants thought that the design round changed their future choices as well.

Result design round 3

Round three was performed by a design team of farm equipment suppliers, farmers, local government, farm advisor and researchers. It resulted in two overall farm designs each with one or more detailed designs of subsystems (porker housing, pig toilet and transportable delivery crates). There was a good coherence between the whole farm designs and the highlighted sub-systems. The two whole farm designs differed in farmer vision of the future (international market versus local market orientation) An impression of the results is given in figure 4. The pictures illustrate the technical focus on both overall designs and design of subsystems.

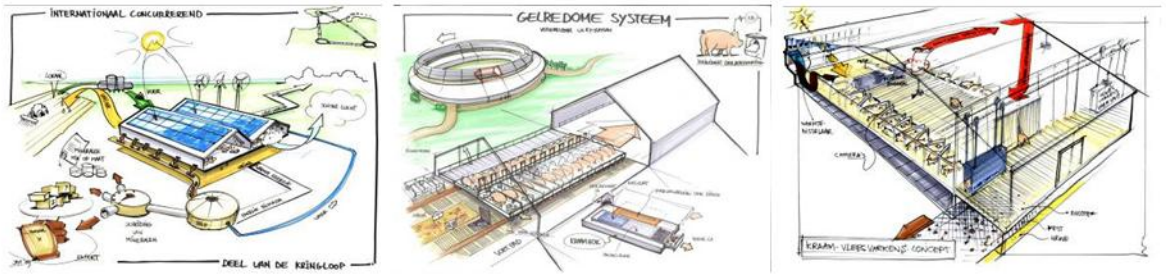

Figure 4: impression of design results round 3.

Just like the preceding design rounds, round three showed a focus on the closing of nutrient cycles, on larger group housing, with individual precision management of pigs, and search for solutions that create a stability of pig groups. Within the design team the importance of connection with the (social, economical) environment differed. The local oriented design really valued this connection, the internationally oriented farm focused on the absence of negative effects on the local environment. The overall view was that an open and transparent form of production was needed regardless of the market orientation.

Compared to the preceding design rounds there was a stronger focus on problems where regulation already is in place (e.g. ammonia emission). Problems where little regulation is in place (e.g. climate change) caused clear differences within the design group. Some (mostly suppliers) found these issues less urgent, while others (government and farmers) stated that those problems had to be taken into account regardless of the regulations. The differences between participants in time horizon and urgency of issues resulted in more discussions, and a larger variety of design ambitions.

Compared to round one and two the program stimulated the participants towards a stronger focus on sub-systems. This had its effect on the outcome. This focus on more detail fitted the participants very well. Round three showed a stronger focus on technical (im)possibilities. The participation of suppliers contributed to this effect.

By the end of this design round, one of the farmers immediately stated that she would use the results for the development of the new farm she plans to build. She invited other participants to contribute to this development. Within three weeks one other pig farmer and three suppliers (all participating in the design session) joined this initiative. One supplier decided not to take part this development, because the innovations did not focus on his business. Another supplier was asked not to take part (because of personal reasons) and was replaced by an equipment supplier who didn't participate in the design round. The consortium now consists of three industrial partners working on climate systems, interior livestock equipment and animal recognition systems, two pig farmers and the association of agricultural entrepreneurs in the South of the Netherlands. This consortium opted for governmental innovation funding to further develop the chosen designs to a prototype pig farm. (at the writing of this paper there was no conclusion yet if the funding was granted)

Practical feasibility was a much stronger issue in this round compared to the earlier rounds. Nevertheless the groups searched for innovation; alternative strategies for the present practice in pork production. All participants stated that the process shifted their thoughts on what sustainability is, and in what way the sustainability questions can be met.

Discussion & Conclusions

The results of the *Porkunities* project look promising for serving the pre-defined goals of the project. Yet, as in all system innovations it takes time before one can actually measure the effect of the results. The project results are (going to be) made public in April 2010. And the first initiative partly depends on government funding. It is too early to tell if and how these results contribute to a desired system innovation towards more sustainable pig production. It might take more than ten years, before we can actually prove the contribution in hindsight. This is a general characteristic of

innovation processes (Duineveld et al.; 2009). Termeer and Van der Peet (2009) wrote: 'New realities, relationships or games are not mastered overnight. This requires time and patience. People need to be able to experiment in their own situation, to see how things work when done differently and share these experiences with colleagues (…).The challenge is to make sense of these small gains…'.

Nevertheless, the results of the three different design rounds give us indications about the value and risks of the chosen iterative and participatory approach. The three design rounds cannot be seen as independent experiments. In time there was a learning effect, especially from the researchers involved. Also the process itself evolved and was improved.

We can judge the different results against each other and analyse the agreements and differences between them. The agreements within the results can be seen as strong indications of issues that are crucial for innovation towards integral sustainable pig production. More so the agreements show where different stakeholders align in their search for solutions. The differences between the design round results give us indications about differences in perspective from different participants. It shows the effect off adding new perspectives in a design team. A deeper analysis of differences between the perspectives (theoretical, user, supplier, societal) might also give a greater understanding of where the energy for innovation occurs, and where it is hindered.

Looking at the agreements between the three design rounds we see four structural rearrangements recurring every round. Each of them indicates a point where a change in thinking is required to find sustainable solutions that meet the requirements. These structural rearrangements seem to be crucial in realising the goal of integral sustainability. The thus defined rearrangements are:

1) allow the pig space to fulfil its own needs, rather than applying techniques meant to do so;
2) Use the ability of the pig to recycle human food-waste, rather than feeding it foodstuffs that compete with human food.
3) Harvest minerals and energy as products of pig production, rather than treating these products as waste
4) Work on an active relationship with nature, society and consumer, rather than just reducing negative effects.

These rearrangements are mostly shared by the participants. Especially rearrangements 1 and 3 occur in all rounds. Rearrangements concerning the social environment, or the supply of feedstuffs were less shared in the design round three. Especially the equipment suppliers tend to look at the needed innovations from a narrower point of view.

The different design rounds showed the value of participation. In round one, designing from a theoretical perspective helped to identify crucial aspects of sustainability. It brought a deeper understanding of how external requirements of farmers, pigs, planet or the consuming citizen could be translated into sharp design focuses. For every point solutions were designed. But the coherence between solutions was problematic within the given timeframe.

In round two, introducing a user perspective clearly strengthened the on-farm logic of a chosen combination of solutions. It also showed that is important to make different designs for different users. Where researchers were triggered by one general design, the farmers got really focussed while choosing a combination of solutions fitting their own future vision and circumstances. Farmers clearly stated that the participation of researchers in the design round broadened their view on possible solutions. The design process itself helped them to gain a deeper understanding of crucial aspects and choices to consider while designing a new farm.

In design round three, the extra perspectives participating complicated the design process. Discussions about underlying goals and the relevance of several sustainability aspects took more time than in round one and two. Especially the equipment suppliers stated they broadened their view on which sustainability issues are relevant for the farmers. After the participants agreed on the sustainability goals, the suppliers had a specific value in designing sub-systems in more detail. The participation of policy makers contributed by keeping broader (societal) aspects of sustainability on the agenda. In the choice of solutions policy makers contributed by adding regulatory aspects.

The 'three-step' approach chosen by the project team seems to help to find the balance in multi-actor processes between a limited diversity between interests of stakeholders on the one hand (Leeuwis, 2000) and still an active participation of stakeholders on the other hand in order to adopt a more inclusive view on innovation (Klerkx and Leeuwis, 2008). Sumberg et al. (2003) wrote: '…to make most efficient use of limited formal research resources, as a general rule partially specified technologies should be released to farmers for final specification at as early stage as possible. Within this general rule, the basic characteristics of the technologies being developed must guide the timing, type and level of farmer participation.'

For realising the step from design towards initiative, the combination of suppliers and users seemed to be crucial. The farmers took the initiative, and guarded the broader picture of the desired innovation (an integral farm, instead of three technical sub-systems). The suppliers are the ones who are in the lead of actual development of sub systems. According to Lettl (2007), innovation processes require involvement of users that are in the position to play a role as inventors and co-developers. These are users with a high motivation towards new solutions, who are open to new technologies, possess diverse competencies and are embedded into a very supportive environment and have the invested power to implement the solution and make changes 'back home'. From that point of view the combination of farmers and equipment suppliers in one consortium looks promising.

It is important to mention the role of a governmental funding program for innovations towards integral sustainable livestock housing systems. The matching planning of the design round and the funding, created a clear opportunity to join the initiative at that moment.

Conclusions

Based on these results, and concerning the aspects mentioned in the discussion we can conclude that the iterative and participatory approach as executed in the *Porkunities* project can improve the effect of Reflexive Interactive Design processes.

- Results indicate that participation of stakeholders doesn't limit the innovative potential of the designs. Identification of the structural rearrangement needed for system innovation is possible.
- Results show that iterations help to find a growing number of solutions for a growing number of sustainability questions, from a growing number of stakes. Iteration serves as a important learning strategy which seems crucial for containing ambiguity in the design teams. Especially when the number of stakes involved in the design team increase.
- The complexity of a design process with heterogeneous groups doesn't reduce the willingness to bring designs into practice. More so, the heterogeneity contributes to the formation of multi-perspective consortia which can innovate from a broad view, and multiple stakes.
- The participatory approach served as an important catalyst in provoking joined stakeholder action towards integrated sustainability in pork production.

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