Agro-food in search of sustainability: a study of reframing processes

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Abstract
The agro-food sector is under pressure to move towards sustainability. Given the complex value chain, not only technical, but also socio-institutional changes are needed. The innovation processes aiming at a sustainable agro-food chain involve many actors, such as knowledge institutes, governments, farmers, businesses, intermediary organizations and societal organizations. Such encompassing innovation processes, concerning the whole agro-food chain, entail questions about the alignment of perspectives and about the reframing of issues, identities and processes in interaction between actors. Moreover, while sustainable development is an open-ended term which may circulate in discourse it will be articulated more precisely in concrete actions and interactions. Accordingly, the research question addressed in this paper is: What reframing processes are taking place within and between actors of the agro-food value chains and how can these reframing processes be understood? We will first investigate the concept of 'reframing' and relate it to current theories of framing. We suggest including 'material frame' as a third category next to 'cognitive' and 'interactional' frames. Subsequently, we will empirically investigate different types of reframing. We compare and contrast several cases of reframing that we draw from a study of a Dutch project aimed at sustainable agro-food chains. On the basis of in-depth interviews and document analysis we gain more insight into reframing, and the way they influence the outcome of innovation processes
We conclude with a reflection and present insights in reframing processes, in relation to innovation processes, in which different types of reframing can be distinguished and different contextual factors influencing reframing can be found.

Keywords: reframing, interaction, sustainable development, agro-food value chains

1. Dutch agricultural innovations towards sustainability

Since the 1950s the Dutch agricultural sector has been growing. Increasingly, this growth has been challenged by environmental problems and societal concerns about nature conservation, animal well-being and quality and safety of food (Bekke & De Vries, 2001). The economic conditions for the sector have changed as well. Due to globalization, for example, consumers now choose between many products from all over the world (Ruben et al., 2006). Consumers have higher demands regarding quality, traceability and environmental friendliness of products and processes (Ruben

et al., 2006). The food safety and quality rules and regulations for food producers and processors are becoming more stringent (Ruben et al., 2006). As the agricultural sector is facing a lot of economical, technical, ecological, societal and political changes, innovations are seen as inevitable (De Groot, 2003; Werrij, 2007). Given the concerns related to animal welfare, biodiversity and environmental problems (Beers et al., 2010), the interest in sustainable practices is increasing. Innovations in the agricultural sector are needed to maintain the 'license to produce' (social problem), 'license to operate' (policy problem) and 'license to deliver (market problem) (Veldkamp et al., 2008).

Two conditions hinder the agricultural sector to move to a sustainable direction. First, there is no precise definition of what sustainable agriculture will comprise, despite the plethora of studies about the future of the planet in relation to food production (Kloppenburg Jr. et al., 2000; Nousiainen et al., 2009) As Francis and Hildebrand in (in 1989 p 8 cited by Pretty, 1995) state: "everyone assumes that agriculture must be sustainable. But we differ in the interpretations of conditions and assumptions under which this can be made to occur." The term is ambiguous in the sense that there is no agreement about how to operationalize and how to measure it (Nousiainen et al., 2009). Sustainable development is an umbrella term covering many aspects, and is filled in by activities and practices (van Lente & van Til, 2008). So, there are many interpretations but not a consensual view on how a sustainable agricultural sector should look like.

Second, and more importantly, the agro-food sector is complex and involves different kinds of actors who produce, process or distribute food and agricultural products. As the agro-food sector consists of complex chains, coordinating change is a daunting task. The actors are interdependent, so if something changes in one part of the chain, it will affect the other parts as well. This condition makes it difficult to innovate, as interests and ideas are quite diverse.

Given these two conditions, innovations in the agro-food sector can no longer be considered as linear, i.e. starting at research and development sections and via the extension officers the innovation brought to the farmers. While this linear mode of innovation has led to growth during decades, it is now seen as flawed. It has changed towards more involvement of actors during the development of new knowledge and technologies (Pretty, 1995). So, depicting innovations as a linear process is no longer suitable, as the innovations are complex and involve many stakes. Instead, we need to look at innovations from a systems level perspective, in which an innovation is no longer seen as an autonomous process, but as part of a "game" with heterogeneous actors involved (Dosi, 1982; Smits & Kuhlmann, 2004). A system innovation is defined by Geels (2004) as "large-scale transformations in the way societal functions such as transportation, communication, housing and feeding, are fulfilled". In system innovations technology and society are developing simultaneously, what is also called co-evolution (Smit & Van Oost, 1999). As Schot et al (1994) state: "The content and form are given to technological developments simultaneously with the construction of their context" (Schot et al., 1994).

Inspired by the systems perspective, many innovation experiments are being conducted in the Dutch agro-food context, in which different actors are involved in the innovation trajectory such as knowledge institutes, governments, farmers,

businesses, intermediary organizations and societal organizations. The experiences thus far are mixed: the experiments are promising in principle, but also encounter many pitfalls and clashes of interests and perspectives (Klerkx & Leeuwis, 2009). In interaction actors with different institutional backgrounds are confronted with each others perspective.

In this paper we will investigate a particular phenomenon that seems to hinder innovation processes: the notion that actors in their perception and interactions are limited by 'frames'. Due to different frames, actors will perceive the world and its exigencies differently, and respond differently. Due to different frames, therefore, the required alignment between the many parties can be thwarted. Correspondingly, changing frames, or reframing, may help to establish new forms of alignment. Therefore, our research question is: What reframing processes are taking place within and between actors of the agro-food value chains and how can these reframing processes be understood.

We will first discuss the notions of 'frame', 'framing' and 'reframing' based on our reading of the literature. Our main argument is that in socio-technical changes like in agro-food not only the well-known categories of cognitive and interactional frames are important, but also a category of what we label as 'material frames'. Then we will delineate our method to study reframing in innovation processes and introduce our case study. In the results section we compare and analyse instances of reframing. The paper concludes with a reflection on the importance of reframing for systemic innovations in agro-food.

2. Framing and reframing in agricultural innovations

The concept of framing already has a long tradition. It originates from cognitive psychology (Bartlett, 1932) and anthropology (Bateson, 1972). Starting with Bartlett's schema theory of memory (Bartlett, 1932) cognitive psychologists define frames as cognitive structures in our memory that can help to organize and interpret new experiences. In the work of Bateson (1972) on meta-communication (communication that means something different on different levels) framing is "about exchanging cues that indicate how ongoing interaction should be understood". A well-known example is the play between two boys, which becomes rougher and ends as a fight. According to Bateson, the ambiguity of how to interpret ongoing interactions creates the need for framing.

In later studies, framing has also been used in sociology (Benford & Snow, 2000; Goffman, 1974), artificial intelligence (Minsky, 1975), psychology (Levin et al., 1998), policy studies (Hajer & Versteeg, 2005; Schön & Rein, 1994), communication studies (Bryant & Miron, 2004; Tannen, 1993), management studies (Creed et al., 2002) and conflict studies (Lewicki et al., 2003).

Tannen and Wallat (1987) explained the distinction between 'interactive frames' and 'knowledge schemas'. Interactive frames refer to what is going on in interaction and knowledge schemas refer to participants' expectations about people, objects, events and settings in the world. The same distinction was presented in a review by Dewulf et al. (Dewulf et al., 2009). They made an ontological distinction between 'cognitive

frames' and 'interactional framing'. Interactional framing is defined here as "the dynamic enactment and shaping of meaning in ongoing interaction" (Dewulf et al., 2009).

Besides the distinction between cognitive frames and interactional framing, Dewulf et al. (2009) also make distinctions between what it is that gets framed (see also table 1). They distinguish between:

- Issues, which refers to meanings about agenda items, events or problems,
- Identities and relationships, which refers to meanings about oneself and relationships with counterparts, or
- Interaction processes, which relates to interpretations that actors assign to their interaction process.

Table 1. An overview of framing concepts (Dewulf et al., 2009)

	What is it that gets framed?		
Nature of frames	*Issues*	*Identities and relationships*	*Process*
Cognitive representations	1. Cognitive issue frames	2. Cognitive identity and relationship frames	3. Cognitive process frames
Interactional co-construction	4. Interactional issue framing	5. Interactional identity and relationship framing	6. Interactional process framing

Cognitive frames are relatively static structures or categories in one's mind. Cognitive *issue* frames are cognitive heuristics that people use to interpret an issue, meaning of an agenda item, problem or event. Cognitive *identity and relationship* frames are frames about self, others and relationships. Cognitive *process* frames are cognitive representations of interaction processes. One could also see these as 'behavioural scripts' for diverse social processes. An example is the expectations that people have when they visit a general practitioner with a medical complaint; you know the 'rules' of visiting a general practitioner.

The interactional approach investigates the co-construction of issues, identities and processes as they are negotiated in the talk. The focus is on how participants (try to) influence the ongoing definition of issues, identities and interactions through (meta-) communication; how participants propose specific issue definitions and how other participants receive or challenge those interpretations. Interactional *process* framing centres on the communication itself and how parties make sense of their interaction. The actors are interactively co-constructing the meaning of the ongoing process.

These categories are not mutually exclusive (Dewulf et al., 2009). As Aarts and Van Woerkum (2006) state, "interactional framing en cognitive frames both emphasize different aspects of the framing process". According to Tannen and Wallat (1987), there is a relationship between interactive frames and knowledge schemas. In case of a mismatch in knowledge schemas (cognitive frames) between people, a shift of frames is triggered.

Technological innovation processes are not only shaped by the perspectives of people (cognitive frames) and by what is discussed in interaction (interactional framing), but

these processes are also dependent on the possibilities and impossibilities inscribed in materials and technologies. The sustainable innovation processes in the agro-food chain that we study can be seen as socio-technical reconfigurations in which technology plays an important role. We want to observe the frames and interactional framing in relation to the technical possibilities as they are developed in the innovation trajectory.

In science and Technology Studies (STS) Bijker (1989; 1997) introduced the concept of 'technological frame' where he defines a technological frame as "the set of practices and the material and social infrastructure built around an artefact or collection of similar artefacts (Bijker, 1997 p 123). It does not only involve cognitive elements, but also social and material elements (such as technological artefacts) and therefore has an overlap with the cognitive frames and interactional framing of Dewulf (2009). We choose to only add the technical or material part of Bijker's technological frame to the cognitive and interactive framing concepts. The material frame brings in the technological artefact, which is important in the innovation processes that we study. The material frame refers to the artefact(s) that enable and constrain the developments in the innovation process. We can compare the influence of the material frame with the 'script' of technical objects. Script refers to the action program inscribed in the material dimension of technological artefacts that influences the behaviour of actors. As Akrich (1992 p 208) puts it: "Technical objects define a framework of action, together with the actors and the space in which they are supposed to act". An example is the round conference table that makes the actors around the table more equal because nobody is sitting at the head of the table. In this way the material, technology or object can influence the roles of the actors involved. We define the *material frame* as "the characteristics of artefacts that guide (enable and constrain) the interpretation of issues, identities and relationships or processes".

Both the cognitive frames and material frames are relatively stable. However, Tannen and Wallat (1987) emphasize that all types of structures of expectations are dynamic. Cognitive frames can change because of new experiences. Material frames are inscribed in artefacts and are therefore not very easy to change. On the other hand, interactional framing is less stable, and changes continuously in interaction; it is shaped in interaction.

Frames, thus, may change and this is of interest to our research. According to Tannen and Wallat (1987) a mismatch in knowledge schemas can cause a change in frames. In parallel, cognitive frames can change when people are confronted with other frames in interaction. Different cognitive frames are the basis for interactional framing. And because of interactional framing, cognitive frames can shift. The material frame influences the framing of an issue, identity or relationship or process. However, the material frame may also lead to unintended effects, when implicit or unconscious schemas/heuristics used in the design turn out to affect the actors' interpretations in a specific way.

The phenomenon of 'reframing' that we seek to investigate in this paper may occur in several ways. For instance, when people with different cognitive frames (about an issue, identities or the interaction) meet, an interactive process may be triggered in which these (cognitive) frames are confronted with each other (interactive framing). During the interactive framing process people may sharpen, change or abandon their

cognitive frame(s), which can be understood as *reframing* (of issues, identities or the process). This process in which frames are interactively challenged and/or changed can be observed by critically examining the (meta-) communication during that interaction. The effects of interactive framing on the (reframing of) cognitive frames can be observed by examining people's perceptions before and after the interaction. Reading the material frame from artefacts may be derived from interviews and other expressions by actors.

3. Methodology of analyzing frames

In order to find how and when reframing is taking place one needs to determine how frames and framing change over time. Cognitive, interactional and material frames, however, cannot be observed directly, as they are not present in an isolated, abstract form. Frames can only be inferred by considering what gets framed, as we discussed above. So, one way to study this phenomenon is to follow the way topics are discussed in the projects over time. We define a topic as a problem or a goal, relevant to one or more participants in the interactions. Topics are explicitly or implicitly introduced into the interactions by the actors themselves, and can be traced afterwards by analyzing documents and interviews. In interviews actors tend to reproduce the same list of topics.
During innovation projects topics may emerge, become salient and dominant, or may leave the scene silently. It is possible to reconstruct the vicissitudes of a topic, or, how we propose to call it, a 'biography of the topic', on the basis of quotes of interviewees, traces of interaction processes and project materials
Following topics is helpful, as that is what the interactions were about. The topics are not invented by the analyst but brought into existence by the actors themselves: they discussed them, expressed their perspective on them and stressed their importance. When following topics we also encounter discussions about the roles of actors in the discussion and the processes around it. When some actors, for example, are talking about building permits, they implicitly seek to convince the local authorities to give a permit.

The biography of a topic allows a further analysis of the framing and reframing around that topic. By making a thick description, by describing besides the behaviour also the context, in such a way that behaviour becomes meaningful to an outsider (Geertz, 1973), the biography of the topic is reconstructed.
We consequentially follow four basic questions to get a complete description of the topic.

1. When, how and why was the topic introduced?
2. How did actors cope with the situation; what were their strategies?
3. What was the effect of the strategies and interactions on the fate of the topic?
4. How did cognitive, interactional or material frames change in due course?

The answers to these questions will produce a complete biography, describing the moments a topic became important, faded away or became an important topic after a while.

How can we distil the frames from the data? First of all we interviewed the actors involved in the project. The semi-structured in depth interviews are transcribed

verbatim with the help of the program F4[1]. Besides the interviews also project material and other documents were studied. Project material includes notes of meetings, project plans, evaluations and end reports. In addition, interaction moments such as workshops have been recorded. These are transcribed verbatim as well with F4. All the material has been coded and organized with the qualitative data analysis program Atlas.ti[2]. The transcripts are coded with words as close as possible to the words the actors use. Once the quotations are categorized, the quotes can be organized per topic. The biographies of topics allow studying how the frames changed and why they changed.

Cognitive and material frames can be found in interviews and interactional framing can be found in the transcripts of the workshops. Actors reconstruct interactional framing in their answers to the interview questions. Interactional framing does only take place in interaction and is an ongoing process.

From this description, with the help of the scheme below, we analysed the description and looked for the different types of frames. The cues that point to frames can be found in the scheme below (table 2).

Table 2: Cues that point to frames

	Issue	**Relationship/ Identity**	**Process (time sequences)**
Cognitive frame	Statements about 'what does this mean?'	Statements about 'I am x and you are y "Who am I, who are they?"	'This is a conflict and therefore…'
Interactional framing	We are doing x now	These are our roles now	This should happen now
Material frame	The way an artefact limits the range of topics	The way an artefact distributes roles	The way an artefact determines/ shapes process

In the next section we will provide some case material of the Roundel project in order to illustrate our ideas. We will start with a short general case description.

4. General case description

The project we studied is about the realization of a novel laying hen husbandry system in the Netherlands, called Roundel (see Bos & Groot Koerkamp, 2009; Groot Koerkamp & Bos, 2008) which aimed to surpass current sustainability standards. In the Netherlands different ways of keeping hens co-exist, namely in cages, in barns, free range and organic.

In 2003 and 2004 the Dutch government initiated and financed a project called 'Caring for Hens' (in Dutch: 'Houden van Hennen'). In this project a visioning experiment was done in which two animal husbandry systems for hens were

[1] http://www.audiotranskription.de/english/transcription/
[2] Atlas.ti version 6. source: www.atlasti.com

envisioned with the involvement of heterogeneous actors, such as people from knowledge institutes, poultry farmers, egg and system building businesses, animal welfare organization, government officials, communication people, journalists, sector organizations, consultancy organizations and advisory organizations.
The actors discussed what the system according to them should look like. They came up with a lot of demands that should be met. The ideas where drawn up and the first visionary ideas appeared (see figure 1 below) and were laid down in a Brief of Requirements.

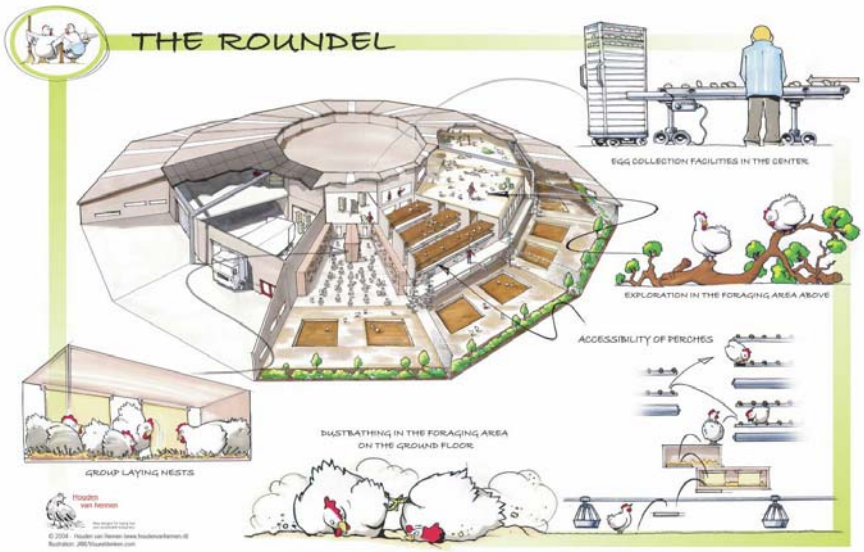

Figure 1. Design of the Roundel system and typical aspects. Source: Brochure loving and keeping hens (Project team Houden van Hennen, 2005)

Based on the 'brief of requirements' developed in 2004, a consortium was formed in 2005 with a large egg packer and a husbandry systems developing firm, with the goal to redesign one of the two developed designs into a system to be used in practice. This system was called the Roundel after its typical round form.
The aim of the project was to realize a system innovation by developing and introducing a new socially responsible table egg to the market, with a sustainable production system and chain (Internal communication, 2009). In the first part of the project (2007-2008) the focus was mainly on the technical development of the new laying hen husbandry system (see Klerkx et al., 2010 for details). In the second part (2008-2010) the focus was on realization, development and marketing of a socially responsible table egg, based on a production system that leads to "happy poultry, proud farmers and satisfied citizens" (Project team Houden van Hennen, 2005).

Various actors started working on the implementation of the design, and thinking of how to sell the eggs. Core participants in the project team were: the husbandry system builder, a research institute (ASG Animal Science Group, part of Wageningen University and Research Centre), TransForum[3] as intermediary organization and project funder (since 2006), and a consultant in the field of animal welfare and social corporate responsibility. Besides these core participants, other actors were also

[3] TransForum is a Dutch program which hosts many innovation projects in the agro-food sector with the aim to improve upon ecological, economic and social sustainability, and in which heterogeneous actors, such as the government, societal organizations, businesses and knowledge institutes are involved (Veldkamp et al. 2008).

involved, namely the Society for Protection of Animals, farmers interested in building and exploiting a Roundel system, municipalities in which the Roundel would be built, architects, building contractors, and other consultants and process facilitators. The project team met every six weeks to discuss the progress of the activities. In addition, workshops were organized by the project team. In these workshops experts in the field were invited and topics such as how to position the egg in the market and how to organize the product chain were discussed together with the project team. In spring 2008 Roundel Ltd was formed as a daughter company of the husbandry system building firm. In the timeline below (figure 2) some important events in the Roundel project are described.

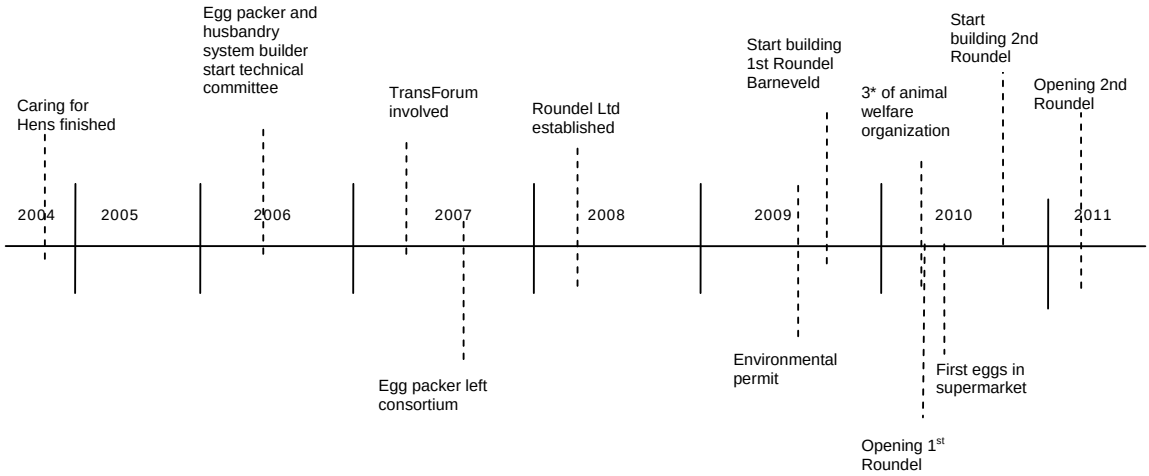

Figure 2. Timeline of the Roundel case.

Deliberate interactions and reflection between different actors on the course to be followed in the innovation trajectory have played an important role in the Roundel project, which makes it interesting to study in the light of the framing of sustainability in innovations.

5. Results and analysis: Reframing the fit in the landscape

In order to analyse the case, we start with a thick description of the biography of the topic under study. The topic we studied for this paper is “fitting the landscape” of the Roundel system. Fitting the landscape was mentioned by the actors involves as an important sustainable characteristic of the system. We used this topic to study the framing and reframing.

Biography of the fit of the system in the landscape

One of the needs in the brief of requirements for the farmer was an open and transparent laying hen system. There should be a possibility for the chickens to go outside, but at the same time it should not take too much space as that makes it difficult to get a permit to build the system. The chickens should be protected against risks from the environment (such as migrating birds, which via their excrements can

‘distribute’ avian influenza). The system should be accessible for visitors, people have to be able to see the chickens, but at the same the public health should be guaranteed.

In 2006 the first talks with the municipality of Barneveld were conducted. They were enthusiastic about the idea. The drawings had to be checked by the commission that regulates the external appearance of buildings, in order to get a permit for building the system. Because the Roundel system has a typical round form, it does not fit the existing rules for building in the rural area. The zoning plans of a municipality are divided in rectangular blocks. The system has to fit these blocks. So some changes to the shape were needed. Because of the round shape and the design in which there is a day, night and outside facility it is still possible for chickens to go outside, while the space needed is not more than 1,5 hectare, which is the size of the building blocks. If the system would need more space than 1,5 hectare, one would need a longer and more intensive procedure in order to get a building permit.
Besides that the system should fit the building blocks of the zoning plan, it should also ‘fit the landscape’ in order to get a permit. The actors did cope with that situation by changing some of the characteristics of the initial design in order to make it fit to the landscape, as the quote below illustrates.

> “The model is slightly changed, there were some concessions made to make the Roundel fit the landscape, such as grass roofs[4], trees and plants accompanying the shape of the system, in order to do not make it rise as a circus tent in the landscape. Some concessions were made to make it fit to the landscape.” (Municipality)

By planting trees around the system, the system would fit the landscape better. That makes a change in the framing of the Roundel as a circus tent into a hill, fitting the landscape, as the quote bellow demonstrates.

> “The Roundel actually has an impact on the environment; it is a gigantic construction that is build. It is a circus tent, that was our first thought: what a huge circus tent in the landscape. It is a completely different design than we are used to. But it is good to change that. I am curious.” (Advisory company)

According to the people involved in the project a natural appearance was needed as well, although it will be nice if the system is visible for the public from a distance. Already in an early stage of the discussions the project team talked about the possibilities of a “sight location” near the highway.

Besides meeting the demands of the building inspector of the municipality, the idea is that when you fit a system in the landscape, the public is willing to accept it better than in the case the system is raising from the environment. As the image the public has about the animal production sector is partly based on the current systems, which are big and closed (for public), it is even more important to think about the way the system is fit into the landscape. By opening up the system visitors can see the way the animals are kept. A system in which visitors can see the chickens was already part of the design in 2004. In the end report of the project they state:

> “The perspective the public has on livestock farming is partly depended on the current big and closed systems in the landscape.” (End report)

In order to show the openness of the system, there is a visitor’s corridor through the day facility. The corridor is integrated in order to make it possible for the visitor to see the system from the same views as the chicken does and experience the system the

[4] In the final design the grass roofs are no longer present, but the colors of the gaze changed.

way the animal experiences it. According to the project team: “By designing the corridor like this, the visitor is equalled to the animal.”

While the discussion was about how to fit such a system in the landscape, at the same time it was realized that it is difficult to measure when something fits the environment. According to the end report “It is a personal opinion and it depends on the landscape and the environment of the system. So the way one Roundel fits the environment can differ from another one.
As the architect said: “Every Roundel will be build on another spot, so here it will be build like this, with the plan for the plants and trees surrounding it. And at another spot, that is besides a creek, that has to be fit in that landscape.”

> “My advice is: go with these types of projects in an early stage to the commission of the municipality involved in building inspection, as it will differ per municipality. They have an independent status”.

In 2008, when the design of the system was adapted to the technical, practical and regulatory requirements, the environmental permits did come across. A system should be proved to meet the environmental requirements before it can be build. That made the people in the project realise that they had to go through the whole procedure of testing and measuring for example the emissions. Instead of developing a new system, the project team decided to make use of existing systems for laying hens. Available techniques are combined in every compartment of the system. For example the interior of the system was an existing system of the system builder, although it had to be adapted to the new design.

> “That has to do with whether you build a real new laying hen system, or do you try to make use of existing systems.”(System builder)

By changing the way of looking at the system from one new, round system into five existing systems placed in a circle shortened the procedures, as these existing systems were already proven to meet the rules. In the middle of the circle for example the egg packing machines were placed and between and surrounding the systems an outdoor run was created.

> “I think in the first instance the concept was a Roundel with a tree in the outdoor run and a really open system. In the final design there are 5 systems. Systems with a common design, build in a circle. That is different than the first concept.” (Researcher)

In 2009 the permit was given by the municipality of Barneveld and at the end of 2009 the started with building the first system, which was finished in spring 2010.

Reframing the topic

What type of framing and reframing did we see in this topic? When looking at the description above we see reframing of topics related to fitting the landscape.

In first instance the laying hen system was framed as a circus tent by the civil servants. Later on, by planting trees around the system it became more integrated in the landscape and it was framed as a “hill in the landscape”. Fitting the landscape is framed according to the municipality as “planting trees around it” and so makes it integrated in the landscape, as the quote below demonstrates:

> “At the commission of the municipality employed to enforce the regulations regarding the external appearance of buildings it first was a circus tent, and in

the end it became a Teletubbie hill in the landscape. It fits within the rolling of the hills, and that created a basis at the municipality."

The openness of the system, so the technological feature, did reframe the role of the public as well. The fact that the system is literally open for public makes the public not only a consumer, but a spectator. It can change the idea people have on closed systems and the way animals are kept. According to one of the designers the building is "… a place to which excursions are planned". In this way it also informs people in society about the way of keeping hens. So the system becomes not only a production side, but an information centre as well, by welcoming visitors. This is framing of the identity and relationship, as it is about the role of the public. The design of the system made this reframing possible, what makes this an example of material identity framing, in which the corridor makes the visitor equal to the laying hen.

An example of cognitive reframing is the change in perceiving the system as one round system into five systems. That helped by getting through the procedure for the environmental permit.

In the design phase the system was developed as an isolated object. That changed into an object that is part of the landscape, what differs per region. The system can only be build if it fits the landscape, and what fitting the landscape means differs per situation, so that has to be defined in interaction with the municipality involved.
In table 3 below the results are summarised.

Table 3. Summary of reframing of topics.

Topic	**Before reframing**	**After reframing**	**Nature of frames**
Fitting the Roundel in a rectangular building block	A new building in the landscape has a rectangular form that cannot exceed 1.5 ha	A new building can have other (e.g. round) forms, as long as it does not exceed 1.5 ha	Cognitive frame (rules) and material frame (building blocks on a map)
Fitting in the landscape	The Roundel actors had designed a new system that could be *visible* because of its shape like a giant circus tent, e.g. at a sight location to promote the product	The municipality reframed 'fitting in the landscape' as making the system *less visible*. E.g. by changing the colors and by planting trees around the system, the system could become a natural element (like a hill)	Cognitive frame (different ideas about fitting the landscape) and material frame (changed appearance to make system less visible)
Location specific	Roundel is a complete design	Roundel is adapted to specific environment	Interactional framing (in interaction with specific municipality and environment is determined what fitting the landscape means)
Consumer-spectator	The public consists of consumers eating eggs	Consumers can witness the living / production circumstances of the chickens	Material (identity) frame (visitors' corridor makes public spectator and equals visitor to animal)

Production – visitors' centre	Roundel system as production facility	Roundel system as visitor centre	Cognitive frame (about what the Roundel system functions are)
Environmental permit	The Roundel system is seen as one large system	In order to fit in existing rules, the Roundel system is reframed as five rectangular systems positioned in a circle	Cognitive frame (about what the stable technically is)

6. Conclusion and discussion

In this study we have looked at what reframing processes are taking place between actors of the agro-food value chains and how these reframing processes can be understood. In sustainable innovation projects in the agro-food context heterogeneous actors are confronted with different frames and when they are 'locked in' in their own frames, change may be difficult. Reframing is necessary in such situations and can help to continue a project, while a lock-in in a certain frame can hinder the project.

We discussed three different dimensions of framing: cognitive, interactional and material framing. Our results show that besides cognitive framing and interactional framing also material frames can be observed to influence the innovation process. In, for instance, the reframing of the public from consumer to spectator, we see that this change is 'inscribed' in the material/technology. Opening the system to the public by making a corridor for visitors influences the way the system is perceived. Here the technology distributes roles and determines how the system is perceived.

In the socio-technical context of sustainable innovation projects, the technology itself plays an important role in arranging or prescribing the issues, identity and relationships and the process. Material frames are different from cognitive frames in the sense that is not in the head of people, but tangible. The shape or design is interpreted, not only the ideas in the minds of people or what is constructed in interaction. In order to change a material frame a new design has to be made, which makes material frames quite stable. The difference is that it is really the "material thing" that shapes how actors perceive something.

We observed that cognitive reframing can result in a change in the material/technology. This was the case with physically fitting the system in the landscape. In the municipality's cognitive frame this meant that the system should become less visible. This new idea was inscribed in the material by changing the colour of the system and by planting trees around it. However, we also saw dynamics in a reverse direction, where a material aspect leads to a change in the cognitive frames. For instance, after making a visitor's entry to the system (material frame), the cognitive idea of the system started to change from production facility to visitor centre (cognitive frame).

Looking at the material frame adds an important technological component to the analysis, which may frame roles, issues and processes, as can be learned from the STS literature on 'scripts' (e.g. Akrich, 1992). In the Roundel case, in which there is really a huge technological element involved, we see several material frames in just

analysing one topic. However, one can think of situations in which material frames are less present, because the technology is less concrete or still in the design phase.
We think that the material frame concept can yield added understanding of reframing processes in (sustainable) innovation processes. More research on especially the relation between these three types of framing can provide more insight in how reframing processes are happening.

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References

Aarts, M. N. C., & Van Woerkum, C. M. J. (2006). Frame construction in interaction. *Engagement. Proceedings of the 12th MOPAN International Conference.* 229-237.

Akrich, M. (1992). The de-scription of technical objects. In W. E. Bijker, & J. Law (Eds.), *Shaping Technology/Building society. Studies in sociotechnical change.* (pp. 205-224). Cambridge, Massachusetts: The MIT Press.

Bartlett, F. C. (1932). Remembering: A study in experimental and social psychology. *Remembering: A Study in Experimental and Social Psychology. Cambridge: Cambridge University Press.*

Bateson, G. (1972). Steps to an ecology of mind. New York: Ballantine.

Beers, P. J., Veldkamp, A., Hermans, F., van Apeldoorn, D., Vervoort, J. M., & Kok, K. (2010). Future sustainability and images. *Futures, 42*(7), 723-732.

Bekke, H., & De Vries, J. (2001). *De ontpoldering van de Nederlandse landbouw. Het Ministerie van Landbouw, Natuurbeheer en Visserij 1994-2000.* Leuven-Apeldoorn: Garant-Uitgevers n.v.

Benford, R. D., & Snow, D. A. (2000). *Framing processes and social movements: An overview and assessment. Annual Review of Sociology 26, 611-39.*

Bijker, W. E. (1997). *Of bicycles, bakelites, and bulbs. Toward a theory of sociotechnical change.* Cambridge, Massachusetts, London, England: MIT Press.

Bijker, W. E., Hughes, T. P., & Pinch, T. (Eds.). (1989). *The social construction of technological systems*. Cambridge, Massachusetts, Londen, England: MIT Press.

Bos, B., & Groot Koerkamp, P. (2009). Synthesising needs in system innovation through structured design: A methodical outline of the role of needs in reflexive interaction design (RIO). In K. J. Poppe, C. Termeer & M. Slingerland (Eds.), *Transitions towards sustainable agriculture and food chains in peri-urban areas* (pp. 219-237). Wageningen: Wageningen Academic Publishers.

Bryant, J., & Miron, D. (2004). Theory and research in mass communication. *Journal of Communication, 54*(4), 662-704.

Creed, W. E. D., Langstraat, J. A., & Scully, M. A. (2002). A picture of the frame: Frame analysis as technique and as politics. *Organizational Research Methods, 5*(1), 34-55.

Davidson, E. J. (2002). Technology frames and framing: A socio-cognitive investigation of requirements determination. *MIS Quarterly, 26*(4), pp. 329-358.

De Groot, S. A. (2003). *Van OVO naar VOVI. nieuwe institutionele arrangementen voor kennisverwerving en -ontwikkeling van agrarische ondernemers* Rapport 7.03.06). Den Haag: LEI.

Dewulf, A., Gray, B., Putnam, L., Lewicki, R., Aarts, N., Bouwen, R., et al. (2009). Disentangling approaches to framing in conflict and negotiation research: A meta-paradigmatic perspective. *Human Relations, 62*(2), 155-193.

Dosi, G. (1982). Technological paradigms and technological trajectories : A suggested interpretation of the determinants and directions of technical change. *Research Policy, 11*(3), 147-162.

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy, 33*(6-7), 897-920.

Geertz, C. (1973). Thick description: Toward an interpretive theory of culture. In C. Geertz (Ed.), *The interpretation of cultures: Selected essays.* (pp. 3-30). New York: Basic Books.

Goffman, E. (1974). *Frame analysis: An essay on the organization of experience*. New York: Harper & Row, Publishers.

Groot Koerkamp, P. W. G., & Bos, A. P. (2008). Designing complex and sustainable agricultural production systems: An integrated and reflexive approach for the case of table egg production in the Netherlands. *NJAS - Wageningen Journal of Life Sciences, 55*(2), 113-138.

Hajer, M., & Versteeg, W. (2005). A decade of discourse analysis of environmental politics: Achievements, challenges, perspectives. *Journal of Environmental Policy and Planning, 7*(3), 175-184.

Klerkx, L., Aarts, N., & Leeuwis, C. (2010). Adaptive management in agricultural innovation systems: The interactions between innovation networks and their environment. *Agricultural Systems, 103*(6), 390-400.

Klerkx, L., & Leeuwis, C. (2009). Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological Forecasting and Social Change, 76*(6), 849-860.

Kloppenburg Jr., J., Lezberg, S., De Master, K., Stevenson, G. W., & Hendrickson, J. (2000). Tasting food, tasting sustainability: Defining the attributes of an alternative food system with competent, ordinary people. *Human Organization, 59*(2), 177-186.

Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All frames are not created equal: A typology and critical analysis of framing effects. *Organizational Behavior and Human Decision Processes, 76*(2), 149-188.

Lewicki, R. J., Gray, B., & Elliott, M. (Eds.). (2003). *Making sense of intractable environmental conflicts: Concepts and cases*. Washington: Island Press.

Minsky, M. (1975). *A framework for representing knowledge.*

Nousiainen, M., Pylkkänen, P., Saunders, F., Seppänen, L., & Vesala, K. M. (2009). Are alternative food systems socially sustainable? A case study from Finland. *Journal of Sustainable Agriculture, 33*(5), 566-594.

Pretty, J. N. (1995). Participatory learning for sustainable agriculture. *World Development, 23*(8), 1247-1263.

Project team Houden van Hennen. (2005). *Programme of demands. Based on the needs of poultry farmer, laying hen and citizen.* No. ASG/05/I00677)

Ruben, R., Slingerland, M., & Nijhoff, H. (2006). Chapter 1. agro-food chains and networks for development. issues, approaches and strategies. *Agro-Food Chains and Networks for Development.* Wageningen. 1-25.

Schön, D. A., & Rein, M. (1994). *Frame reflection : Toward the resolution of intractable policy controversies*. New York: New York BasicBooks.

Schot, J., Hoogma, R., & Elzen, B. (1994). Strategies for shifting technological systems : The case of the automobile system. *Futures, 26*(10), 1060-1076.

Smit, W. A., & Van Oost, E. C. J. (1999). De wederzijdse beïnvloeding van technologie en maatschappij. een technology assessment-benadering.

Smits, R. E. H. M., & Kuhlmann, S. (2004). The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy, 1*(1-2), 4-32.

Tannen, D. (Ed.). (1993). *Framing in discourse*. New York etc.: Oxford U.P.

Tannen, D., & Wallat, C. (1987). Interactive frames and knowledge schemas in interaction: Examples from a medical Examination/Interview. *Social Psychology Quarterly, 50*(2, Special Issue: Language and Social Interaction), pp. 205-216.

van Lente, H., & van Til, J. I. (2008). Articulation of sustainability in the emerging field of nanocoatings. *Journal of Cleaner Production, 16*(8-9), 967-976.

Veldkamp, A., Van Altvorst, A. C., Eweg, R., Jacobsen, E., Van Kleef, A., Van Latesteijn, H., et al. (2008). Triggering transitions towards sustainable development of the Dutch agricultural sector: TransForum's approach. *Agronomy for Sustainable Development, 29*(1), 87-96.

Werrij, F. (2007). The changing role of agriculture in Europe and how it affects poultry education and technology transfer. *World's Poultry Science Journal, 63*(2), 205-211.