The development of the Dutch broiler sector

What are the critical success factors of its innovations?

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Preface

This report is written as MSc thesis for the master study Management, Innovation and Life Sciences. It was my own interest to learn more about the ins and outs of the development of the agricultural sector and how innovation can be managed in order to foster this development. This desire led to some research idea paper that I presented to several companies. FME, in the person of Marcel van Haren, showed to be enthusiastic to cooperate and to help make the research possible. I was very pleased with this and happy to start with it. At the end of the research period, I can say that the choice for FME has helped me a lot in increasing understanding about the dynamics of interacting organisations. This has been of great importance in doing this study, since development is not in the least about the dynamics of the interactions between organisations. Therefore, I would like to thank the FME and Marcel van Haren first because of this important role in the research and my personal development. I also want to specially thank Marcel van Haren, and Jacqueline van Oosten as second contact person within the FME, for their enthusiasm, flexibility and trust.

The outcome of this research would not have been possible without the very inviting openness of all of the interviewees and other people who have helped by making the research possible: Jeroen van den Hurk, Arnoud Leerling, Bram Bos, Erik Helmink, Kees Lokhorst, Theo Bruinsma, Wilbert Hilkens, Peter Vesseur, Marleen Boerjan, Jan Wolleswinkel, Gertjan Fonk, Hans de Haan, Jouke Kardolus, Ruud Duijghuisen, Jan Odink, Cor van de Ven, John van Rens, André van Straaten, Robert Nijkamp, Marijke de Jong and Marcel Kuijpers. They all were very cooperative in interview planning, question answering, and besides, they showed genuine interest in my research. I would like to thank them all for this very pleasant hospitality. I have learned a lot from them.

Lastly, but certainly not in the least, I would like to express my gratitude to the staff of the Management Studies chair group at the Wageningen University, in the persons of dr. Kim Poldner as first reader and dr. Thomas Long as second reader. Their commentary on my written parts and their further advice was indispensable in improving my work.

Personally, I have learned a lot while conducting this study. At the beginning of the period, I had a clear picture of what I wanted to learn, while at the end I feel like I did not know where I started with. I must admit that my approach was too ambitious and, as a consequence, the perspective too broad. However, this has certainly not impeded my learning about the topic and research methodology, on the contrary.

I hope this report will offer the reader new insight on the development of the Dutch broiler sector and I hope it will provide new leads on how the sector can be further developed, meeting Dutch requirements, improving quality of life of our fellow world citizens.

Corstian Prosman

Wageningen, 30 July 2016
Abstract

This research seeks to explore the critical success factors of innovation in the Dutch broiler sector by a consideration of its development. The sector has had a period of decades of specialisation and appropriation, resulting in high-standard and efficient production. However, the sector has increasingly faced societal discussions, mainly regarding animal welfare, which has led to adapted market concepts and adapted production systems. During the research, about twenty people from different perspectives have been interviewed about their view on the development of the sector and on what is blocking real progress. The different perspectives include farming equipment manufacturers, researchers, policy makers and representative organisations. By the method of grounded theory, conclusive results have been developed from the interview data. These refer firstly to a better balanced guidance of the development by widely shared interpretation of developments, and a clear articulation, alignment and integration of interests. This would lead to a better representation of interests on national level and, hence, better decision making. Secondly, results include that different social processes towards innovation are needed, which include greater external orientation and cooperation of organisations on innovation. In parallel to this, an integrative approach to innovation would be a determinant of success. Lastly, the results include a description of problems related to research and funding structures, through which the question arises whether the broiler sector is appropriately organised to work with a liberalising public sector. Further research is required for validation in more specific contexts.
Management summary

The objective of this research is to increase knowledge about how innovation functions in the Dutch broiler sector and how it enables the sector to keep addressing the major challenges that they are facing. The research question is therefore formulated as follows: “What are the critical success factors of innovation in the Dutch broiler sector?” The research includes literature review, aiming at finding a framework for sectoral innovation, or preliminary results on research question. It turned out that the approach involves quite a lot of literature because of the broad perspective of the research’s objective and research question. Besides the literature review, the research includes a qualitative study to innovation in the broiler sector, by an inductive approach based on roughly twenty interviews with people from, or related to, the broiler sector. These interviewees are from some very different perspectives, allowing for greater reliability despite limited resources.

The broiler sector has had a period of extensive specialisation which allowed for production that meets high standards and high efficiency. However, societal discussions about the negative production externalities have become more prevalent. Therefore, the sector needs to adjust its way of working and innovating in order to address these discussions. This is not easy to organise, since the relatively high degree of specialisation make that firms have appropriated institutions and besides, competitive concerns. Aligning and integrating the interests of competitive firms and societal actors (e.g. NGOs), in order to orchestrate the required change, is therefore difficult. This needs attention.

From the analysis of the research data, 15 issues have been identified. These 15 issues are further synthesised in order to find a more comprehensive picture of the critical success factors of innovation in the broiler sector. Three dimensions of the success factors of innovation in the broiler sector have been identified. These three are (1) a clear guidance of the development, (2) presence of sectoral dynamics, and (3) facilitation of the innovation process by appropriate structures of funding and knowledge development. The ‘guidance’ dimension refers to the need for an overall consideration of major developments and based on that, a clear articulation, alignment and integration of interests of different stakeholders. These interests need to be well-balanced, in avoiding sub optimisation. This is essential for the future of the prominence of the Dutch technological poultry sector.

The ‘dynamics’ dimension refers to the need for companies to be externally oriented; cooperation within sectoral actors as well as cross-sectoral cooperation is important in making real progress. Because of the considerable degree of specialisation of competitive firms in the Dutch sector, the issue of connections and networks requires attention. Because of the fact that integral solutions are becoming more important, companies need to be externally oriented instead of optimising their own products and processes only. The ‘facilitation’ dimension refers to the need for risk capital because of innovation outcome uncertainty. Subsidies are not in any case suitable for this. Besides, the connection of (SME) companies with the Dutch top sector policy is being considered as problematic, because of structure problems as well as a difference in research agendas. The latter issue can be caused by a lack of ‘guidance’, see above. Furthermore, innovation can be constrained by a lack of room for experimentation, which can partly be caused by stringent regulation.
Based on these findings, the report concludes that an increased focus of the sector on decision making in the public domain is necessary, to make sure that there is a well-balanced representation of interests and, hence, better ‘guidance’. The report also concludes that, because of the nature of today’s challenges, there is need for different social dynamics, specifically in increasing connections and network approaches.
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1. Introduction

The title of this report ("The development of the Dutch broiler sector; what are the critical success factors of its innovations") has been established during the research period. The prior aim was to investigate the factors that are responsible for success of innovation, besides the factors that are responsible for constraining innovation in the Dutch agricultural sector. This was a personal interest of the author. The reason that research to innovation constraints is important, is that by innovation the sector can enable itself to address the major challenges that they are facing. These are, first of all, that in 2050 there will be some 9 billion people that need to be fed, which requires more food production in the upcoming 40 years than the amount of production that was needed for over the last 4000 years. Next to the need for higher production, available cropland is decreasing and commodities such as water and energy are becoming scarcer. At the same time, consumers and society are becoming more demanding regarding food quality and production methods. Because of these issues, the sector needs to innovate to address the issues and to transform itself to a different set of standards. These issues are to be addressed by the broiler sector as well, as a lot of social debate that had been going on about its production.

The next chapter (chapter 2) will describe how the research has been delineated, by providing the research objectives and research questions. Before the research period started, cooperation with some organisations on this research idea was sought, for practical reasons. The organisation that showed enthusiasm was the employer’s organisation FME, which has proven to be a very valuable ecosystem. See chapter 3 for an introduction of this organisation, besides an introduction of the broiler sector and the context it provides for the research. In short: the technological potential is perceived to be high, however, because of societal discussion, it is tough to determine what is and what is not legitimate in doing technological development. It is important to address this issue in some way, uncertainty about what could work can constrain innovation.

Because of the wide perspective of this enquiry (i.e. the entire broiler sector), the approach to investigating the success factors and constraining factors of innovation is sector wide. There is no such thing as a perspective from one single organisation. Therefore, anything that concerns the development and innovation in the sector needs to be considered. Chapter 4 includes insight from literature that fit this perspective, which is the system approach to innovation. This system approach considers the action of multiple organisations in innovation, rather than the innovating activities of just one organisation. Interaction is key word in this matter; it is all about the interaction between organisations. Therefore, this report does not include study to any in-house, technology-driven innovations, but rather innovations driven by problems that concern multiple actors. To increase insight on how such innovation is functioning in the broiler sector, data has been gathered. This has been done by conducting interviews amongst various people related to the sector. The methodology is described in chapter 5 and the interview data is described in chapter 6. In chapter 0 the interview data is discussed with inclusion of the theoretical insights from chapter 4. Chapter 0 provides the conclusions and recommendations following from this study.
2. Research delineation

This chapter consists of research objectives (2.1) and research questions (2.2).

2.1. Research objectives

There has been a lot of change in the broiler sector, for instance regarding the transformation of the demand of the retail from the traditionally produced chicken (“plofkippen”) to the so-called ‘Better Life’-standard chicken; there are in The Netherlands no supermarkets anymore that are willing to purchase the regular chicken. In the future, the requirements regarding the sustainability and animal-friendliness of the broiler sector will be further tightened, forcing the sector to adopt these tighter requirements. This increases the need for innovation, because the sector has to remain competitive to foreign production. The assumption in this research is that innovation is key to the sector’s competitiveness and continuity. This research therefore aims to increase knowledge about how innovation in the broiler sector functions and how it enables individual companies to increase their competitiveness. It is intended to increase awareness about the importance of innovation for the sector. The research will meet the objective by investigating the critical success factors of innovation in the Dutch broiler sector.

2.2. Research questions

This paragraph contains the research question, the sub research questions and the explanation on the sub research questions, respectively.

2.2.1. Research question

The main research question, derived from the research objective, is formulated as follows:

“What are the critical success factors of innovation in the Dutch broiler sector?”

It is assumed that the ‘critical success factors’ are the counterpart of the constraining factors. As described in the research objective, this research is descriptive and subsequently meant to provide a lead on how the broiler sector can be strengthened by innovation.

2.2.2. Sub research questions

To guide the answering of the main research question, the below sub questions are formulated. These sub-questions are established by having a closer look on the concepts ‘critical success factors’ and ‘innovation’. The second sub question is related to existing literature, the questions 1 and 3 to 7 are related to knowledge that will mostly be generated during ‘field research’, i.e. in interviews with different persons of the broiler sector. Question 8 is formulated on demand of the commissioner and seeks to generalize the results from the study to the Dutch agri-food sector as a whole.

1. What does the Dutch value chain of chicken meat production look like?
2. What is the most appropriate and hence successful mode of innovation / R&D management?
3. What is the type of innovation / R&D management which is mostly applied in the broiler sector? (e.g. technological innovation, business model innovation, open innovation)
4. To what extent is innovation in the broiler sector successful?
5. What factors contribute to successful innovation?
6. What factors contribute to unsuccessful innovation?
7. What are the constraining factors regarding innovation?
8. What can other ‘agri-food’-related sectors learn from innovation in the broiler sector?

2.2.3. Explanation on the sub research questions

In order to be able to answer the main research questions, the above eight sub research questions have been formulated. Sub question 8 is not needed to answer the main research question, it is included because innovation is important in the entire agri-food sector. It is not unthinkable that the agri-food sector as a whole can learn from how the broiler sector copes with innovation. Therefore, the results of the first seven sub questions can be of interest to other agri-food sectors as well, and can be a source of new research questions.

In sub question 1 the most important characteristics of the broiler sector will be investigated, such as how the sector is developing and what kind of innovation it currently pursues. In sub question 2 there will be a more extensive research to how innovation works on which existing literature on innovation will be used. Besides this, literature on ‘innovation systems’ and ‘transition management’ will be consulted. The intention is to list the most relevant scientific work, which can provide hypotheses on the research question.

The sub questions 3 to 7 provide a guideline for ‘field research’ part of this research. In sub question 3, there is descriptive research about the way in which innovation is currently being performed, in sub question 4 the value of the innovation will be examined by the opinion of people concerned with innovation and acquainted to the broiler sector. In the sub questions 5 and 6, the factors that make innovation to succeed or not to succeed will be investigated. This will be done by qualitative research with different persons. The same applies to sub question 7 in which the constraining factors of innovation will be investigated.

Since the sub research questions have the function to guide the start-up phase of the research, they will not be answered in the conclusions section explicitly, especially when it is not relevant to the answering of the main research question.
3. Research context

The context in which the research has taken place will in this chapter be described by an introduction of the commissioner in paragraph 3.1 and by an introduction of the sector in paragraph 3.2.

3.1. Introduction of the commissioner

The FME is the Netherland’s number one employers’ organisation in the technological industry. It has 2,200 affiliated companies for whose the FME is aiming to boost earning capacity. It is doing that for the companies individually, for instance by business support, and industry-wide by lobby and promotion of interests. The FME is affiliated to a number of branch organisations, such as, in the case of the agri & food sector, the Dutch Manufacturers of Machines for Food Processing and Packaging (GMV). The GMV promotes the Dutch food processing industry and organises activities to stimulate accessibility and diffusion of knowledge and to facilitate innovation and networking. Within the FME, these activities are organised in the form of ‘clusters’, of which the FME Cluster Agri&Food is one of them. In 2015, the FME Cluster Agri&Food has initiated a roadmap for the agri&food technology sector, named High Tech to Feed the World (HT2FtW, see Figure 1). Besides, the cluster is co-initiator of the AgriFoodTech Platform, which aims to increase and broaden involvement of society regarding the use of technology in food production. The commissioner, Marcel van Haren, is manager of the FME Cluster Agri&Food, as well as director of GMV. The interest of the commissioner in this research is in understanding how the position of the member companies can be strengthened. This can be either by learning how technology can be better employed in the sector, or how innovation can be better managed.

3.2. Introduction of the sector

The Dutch broiler sector has, just like other agricultural sectors, an innovative history. Halfway the 20th century, the broiler sector emerged, when breeders started to make a distinction between breeding chickens for meat production (i.e. broilers) and chicken for egg production (i.e. layers). Since then, broiler farming has become more efficient by the development of efficient technology. The farmers have become more professional, which has increased their productivity. Also innovation has professionalised; different firms (equipment/machinery manufacturers) have specialised themselves in developing different technologies. Besides equipment manufacturers, feed producers have specialised as well. Today, besides delivery of their product, they also take care of the so-called extension services. The reason for doing this is that it creates loyalty. So, these input providers do not just deliver their product, but also, embedded in the product or explicit, knowledge. See Figure 2 for an overview of the broiler sector and its relatively high degree of specialisation. The downside of this specialisation and integration of knowledge into their products is that it makes competition possible, alongside with reluctance in sharing knowledge. Interaction between in order to make knowledge and idea exchange and innovation possible requires attention.
The research’s main focus is on the broiler farming. The place of the sector in society is changing as there is increasingly societal discussion going on. These discussions are not limited to the broiler sector; they are present agriculture-wide. Food, in contrast to halfway the 20th century, is plentiful and cheap, while these societal discussions address the negative externalities that are a result of this efficient way of production (OECD 2012). Although no evidence from literature can be found specifically for the broiler sector, I assume that in the broiler sector the same is going on. An indication that supports this assumption is the commotion about the “plofkip” (which is a very efficiently produced chicken). This had led to a development of the sector from mainstream regular chicken towards different market concepts. The most important ones are the following two:

- The ‘Better Life’ (translated from “Beter Leven”) trademark. This concept is based on the criteria of the Animal Protection Agency. This organisation has developed the criteria and decides on whether a certain farmer meets the standards. The ‘Better Life’ trademark encompasses three levels of standards; each level adds or tightens some criteria. For instance, a three-star rating equals organic farming standards.

- The ‘Chicken of Tomorrow’ (translated from “Kip van Morgen”) concept. This was introduced by the Dutch retail in reaction to the ‘Better Life’ trademark. The retailers found the lowest rating of the ‘Better Life’ trademark (i.e. 1 star) a too large difference compared to regular chicken. This large difference could cause competitive problems and therefore, retailers chose to collaborate on a concept of something between regular and ‘Better Life’, which is ‘Chicken of Tomorrow’. The Authority of Consumers and Markets (ACM) eventually forbade such arrangements and therefore, different retailers came up with different variations of a chicken standard between ‘regular’ chicken and ‘Better Life’ one-star chicken.

Parallel to these market-related developments, production systems are in development as well. This is not limited to the broiler sector only: the poultry sector in the Netherlands is roughly divided into two ‘sub sectors’: the layer sector and the broiler sector. These two ‘sub sectors’ have communalities in terms of tech companies that supply to both kinds of production sectors and in terms of
comparable regulations and public policy. In 2004, a re-design research project for the layer sector, commissioned and funded by the Ministry of Economic Affairs, delivered two new designs for the layer industry (e.g. Bijleveld, 2004). One of those (the Rondeel) has been adopted by private parties for market introduction purposes. The market introduction was a system innovation and the process towards achieving that has been quite extensive (see Klerkx et al., 2010 for a study on this). Later, in 2011, a re-design research project for the broiler sector was completed (Janssen et al., 2011) which also proposed two different designs: the ‘Cardinal Point’ and the ‘Sum of Parts’. One of these, the ‘Cardinal Point’ (see Figure 4), was built in 2015 and is producing chicken and subsequently generating test results. Because of the low energy consumption of the ‘Cardinal Point’ compared to regular sheds, there could be potential for a separate market concept on this as well. This could also compensate the higher investment costs. However, comparable with the Rondeel-case, the process towards achieving a new market concept for chicken from the ‘Cardinal Point’ will be extensive.

Besides the above-mentioned publically funded research programmes, established tech companies are doing developments as well. A clear example is the Patio production system (see Figure 5), which is both intensive and efficient. This system is more successful than the ‘Cardinal Point’ because it has proven itself already on production characteristics. Since 2012, over 100 of them have been sold of which a few in the Netherlands as well.

Figure 4: Artist’s impression of the Cardinal Point, a broiler shed design from the research programme ‘Broilers with Taste’. Source of the picture: Janssen et al., (2012)

Figure 5: The intensive production system ‘Patio’, a 6-layer production system, which is also used in the ‘New Mixed Farm’ concept. The ‘New Mixed Farm’ concept involves more innovations than just the Patio system. The illustration shows the technology-intensive nature of the production system. Source of the picture: Vencomatic (2014)
4. Theoretical background

This chapter represents the results from the literature search on finding theoretical insights that can help answer the research question, or that can provide a theoretical framework for this enquiry. The found theoretical insights will be presented with as starting point the main research question (provided in chapter 2: “What are the critical success factors of innovation in the broiler sector?”) The next paragraphs will introduce a system approach to innovation. This will start in paragraph 4.1 with an introduction from an organisational perspective on why a system approach to innovation is appropriate. Paragraph 4.2 will introduce the system approach, provided in a context of a historical development towards this system approach. The paragraphs 4.3 and 4.4 will elaborate on the dynamics of innovation systems and their relation to established economic systems, respectively. Paragraph 4.5 will make this more explicit, by providing the multi-level perspective of socio-technical transitions. In paragraph 4.6 I will elaborate on what extensiveness of change is to be expected, or: the importance of radical innovation above sustaining innovations. Paragraph 4.7 is about the matter of path dependency, since organisations that are leading in innovation can strongly favour path dependent, sustaining innovations above radical innovations. Paragraph 4.8 will draw the consequences of the first seven paragraphs of this chapter and the implications for innovation management in the sector.

4.1. An introduction from organisational perspective

This paragraph will approach the main research question from the perspective of organisations, and, by doing so introduce the fields of literature to which this study is relating to.

The ultimate reason for organisations to innovate is to adapt themselves to the environment; when an environment is subject to change, organisations can remain competitive by innovation (e.g. Crossan & Apaydin, 2010; Tushman & O'Reilly, 1996; Lane et al., 2006). A firm's innovation capability is even its most important determinant of performance (Mone et al., 1998; Montobbio, 2004). This emphasises the importance of innovation to companies in competitive industries with an environment that is subject to change. An organisation’s capability to innovate depends on a lot of its characteristics, such as its ability to learn and absorb information (absorptive capacity, Cohen & Levinthal, 1990) and its resilience and ability to strategically adapt (dynamic capabilities, e.g. Teece et al., 1997; Nelson et al., 2007; Vlaar et al., 2005; Gilbert, 2005).

Besides studying organisational characteristics, there are other constructs as well by which one can study the “critical success factors of innovation” in a sector. Because the study addresses an entire sector, it would be interesting to see what determinants of innovation success are on a sectoral level. In other words: what environmental characteristics are the ultimate determinants of innovation success? This theoretical construct on the main research question is supported by the fact that the impact of a single innovation is broader than an organisation itself: it impacts its related organisations as well. This is the business model perspective that emphasises that value creation is embedded in a larger system (Boons et al., 2012). Therefore, the ability of the system (which is the broiler sector in the present study) to effectively innovate determines the success of single innovations. The theoretical perspective will therefore be on sectoral level, looking for the determinants of that sector and its environment that affect innovation success. These determinants
can for instance lie in market/industry factors, economic developments, global factors and socio-cultural factors and the ability of the sector to successfully address these by innovation.

This challenge/opportunity/problem based thinking addresses the question: “To what extent do the actors involved in innovation react effectively to the challenges/opportunities they face?”, or, more specifically: “To what extent is the broiler sector able to effectively respond by innovation to the challenges/opportunities that they are facing?”. The determinants of the sector’s ability to effectively address the challenges/opportunities by innovation are the success factors of innovation where I am looking for.

The next paragraphs provide theoretical insights related to a sector’s ability to effectively address challenges/opportunities by innovation. The paragraphs will build on each other’s findings and hence increase theoretical thoroughness, comprehensiveness and complexity. This will be done by using the overview of Klerkx et al. (2012) on system approaches to agricultural innovation. This overview will be introduced in the next paragraph.

4.2. System approaches to agricultural innovation

The research of innovation in agricultural sectors knows different approaches. Leeuwis & Aarts (2011) pointed out that the linear model of innovation, which has been present from the 1950’s onwards, has made place to more complex ways of thinking from the 1990’s until now. Innovation has long been seen as a linear process, which starts with research and continues with development, prototyping, market introduction and diffusion. The initiative for the development of something new, an innovation, did not always come from the side of the researchers; also the consumer and the society started to “pull” on innovation. The result of this is that the view on innovation as a linear process has been changed to an integrated model. A good example is the model of Kline and Rosenberg (1986), where they still view innovation as a linear process, but with knowledge streams between the distinct chains and, moreover, ‘research’ as an overarching concept in which the complex dynamics of the various feedback-loops is embodied. This view on innovation has also changed the view on technology diffusion: in the diffusion of technology re-invention is important, which is the continuous adjustment of the technology to the needs and wants of new groups of users, which takes place during the course of innovation diffusion.

Related to this is the description of different generations of R&D management (see Rothwell, 1994; Nobelius, 2004). R&D has been changing from the 1950’s until now, from R&D as ivory tower (in the 1950’s) to R&D as business, R&D as portfolio, and R&D as integrative activity, towards R&D as network (from the mid 1990’s onwards, Nobelius, 2004). This theory of the evolution of R&D management clearly shows the increasing involvement of (external) stakeholders in the innovation process, increasing complexity from the linear model of innovation towards the more complex models of innovation presented at the very start of this paragraph. See Table 1 for an overview of system approaches to agricultural innovation.
Table 1: System approaches to agricultural innovation. Adapted (reduced) from Hall, 2007; Klerkx et al., 2012

<table>
<thead>
<tr>
<th>Characteristics of the perspective</th>
<th>Diffusion of innovation/transfer of technology (TT)</th>
<th>Early Farming Systems Research (FSR)</th>
<th>Agricultural knowledge and information systems (AKIS)</th>
<th>Interactive learning for change / agricultural innovation systems (AIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Era</td>
<td>Central since 1960s</td>
<td>1970s and 1980s</td>
<td>From 1990s</td>
<td>2000s</td>
</tr>
<tr>
<td>Mental model and activities</td>
<td>Supply technologies through pipeline</td>
<td>Learn farmers’ constraints through surveys</td>
<td>Collaborate in research (participatory research) and extension</td>
<td>Co-develop innovation involving multi-actor processes and partnerships</td>
</tr>
<tr>
<td>Drivers</td>
<td>Supply-push from research</td>
<td>Diagnose farmers’ constraints and needs</td>
<td>Demand-pull from farmers</td>
<td>Responsiveness to changing contexts, patterns of interaction</td>
</tr>
<tr>
<td>Intended outcomes</td>
<td>Technology adoption and uptake</td>
<td>Farming system fit</td>
<td>Co-evolved technologies better fit to livelihood systems</td>
<td>Capacities to innovate, learn and change</td>
</tr>
</tbody>
</table>

From Table 1 can be learned that the evolution of system approaches to agricultural evolution involved the involvement of multiple actors. Innovation success does not merely come from inventions that are being diffused in the sector (which is the linear approach to innovation), but is rather a complex process in interaction with multiple actors (Klerkx et al., 2012). Along with this, Koster (2016) pointed out that many innovation theories are focussing on the characteristics of organisations rather than the characteristics of the relationship between organisations. This distinction is important, because competitive advantage comes for a substantial part from relations and routines between organisations, instead of originating from within the organisation (Koster, 2016). This relates to the systemic nature of innovation (i.e. innovation in the context of a system), as presented in paragraph 4.1. Although much of the AIS work has been carried out in developing countries, criteria for a successful functioning in industrialized countries are similar (Klerkx et al., 2012). AIS is defined as: “a network of organisations, enterprises and individuals focused on bring new products, new processes, and new forms of organisation into economic use, together with the institutions and policies that affect the way different agents affect, share, access, exchange and use knowledge” (Leeuwis and Ban, 2004). From this definition can be concluded that agricultural innovation systems are not just concerned about developing a new product, process, or form of organisation, but also how it can be implemented and how the required dynamics for change can be organised.

The next paragraph will deal with the question on what views can be adopted when researching systemic innovation.
4.3. Dynamics of innovation systems

Taking the theory into account, one can conclude that innovation is a collective effort rather than an individual one. When looking at innovations in the past, it is true that often (large) single organisations have played an important role in innovation. However, they have been dependent on other parties, such as suppliers, customers, banks, universities, intermediaries, and so forth. The consideration of all these parties acting together, giving room for innovations and facilitating it on the one hand and being a constraining factor for innovation on the other, results in three possible approaches (Negro et al., 2010): the organisational view (building up new infrastructures), the innovation systems literature (building up a new innovation system), technological transition literature (a technological niche needs to grow in order to become part of the regime). From all three perspectives it becomes clear that the success of an innovation depends on the system that surrounds it during its development. This is confirmed by Christensen & Raynor (2003) when they say that it is often the circumstances of the innovation that determine whether incumbent industry or upstart companies (with new technologies) win a competitive fight. Another confirmation comes from Negro et al. (2010) as they state that failures of innovation systems are often not because of malfunctioning or undesirable technology, but rather system problems or lack of build-up processes. A large part of the answer on why a certain innovation is not successful can therefore be found by an analysis of the innovation system.

The term ‘innovation system’ has been developed in the nineties and has had its influence on policy makers. The initial description of an innovation system was the National Innovation System (NIS) (Lundvall, 1992 & Nelson, 1993). The interest was derived from national industry and technology policy, in order to determine differences in innovativeness between countries. The focus of a National Innovation System is broad: there is no technological focus. Innovation systems can also be delineated by a region (e.g. Silicon Valley) or a cluster (e.g. a biotechnology cluster). Another innovation system definition is the Technological Innovation System (TIS). TISs do not necessarily have a geographical boundary, and there are multiple innovation systems within one country or region. The focus of a TIS is more narrow than of a NIS and relates to the development of a certain technology. Because of the fact that in this research an entire sector is subject of research, TIS is not comprehensive enough because there is possibly more than just one technological innovation and there is more going on than development of technology. Therefore, the type of innovation system then will be used is the Sectoral Innovation System, or, in the words of Malerba (2002): “sectoral systems of innovation and production”. The latter one, the one of Malerba (2002) covers the chosen perspective best, because it is not just about innovation but also about production, and, there may be multiple systems of innovation and production. The systems are networks of actors that within a specific institutional infrastructure influence the development and adoption of a new technology (Carlsson & Stankiewicz, 1991). A sectoral system of innovation and production is therefore a theoretical construct; it helps to understand the reality by providing a view on the working and the dynamics of the sectoral system, involving new and established technologies and products.

An innovation system starts when a person or company decides to start to develop an idea of a new technology. In this phase, expansion of the innovation system with more actors is important to create enough input from third parties in order to be able to develop it. This starts with exploration of the possibilities of the new technologies, so the diversity of technologies is high. Once there are externals who see opportunities, they link up with the idea and become part of the innovation system. According to Hekkert & Ossebaard (2010), the magnitude of an innovation system takes
place in the form of a S-curve. In the take-off phase the number of technologies will decline and a dominant one will become more prevalent. The innovation will be introduced on the market and will have to compete with existing technologies (Hekkert & Ossebaard, 2010). In protecting the new technology from too much competition, a niche market is useful, in which the innovation system can do the needed learning and development on the technology (Markard et al., 2012), but also market formation and the creation of legitimacy. The next stage is the one of acceleration in which the innovation system expands rapidly. The establishing of the new technology become irreversible, it is becoming embedded in the concerned community. Once the s-curve is in the stabilisation phase, the newly introduced technology becomes ‘old’ and the system is no longer ‘innovative’, but rather a system of production and consumption (Hekkert & Ossebaard, 2010). The course of the innovation system is not a linear as just outlined, it is “rather chaotic, in the sense of an unsteady, faltering course with cleavages from other innovation processes” (Van de Ven et al., 1999).

In a well-functioning innovation system, there are a number of processes going on. These processes are responsible for successful innovations and are therefore the functions on innovation systems. Seven functions have been described. These are the following (Hekkert et al., 2007; Johnson, 2001):

1. Entrepreneurial activities, the transformation of the potential of knowledge, networks and markets into concrete actions in order to exploit this potential
2. Knowledge development, both fundamental knowledge and practical knowledge. Good knowledge development results in more variety (McKelvey, 1997) of available technologies as well as application possibilities
3. Knowledge diffusion through networks, a network is important to enhance flow of information between the actors working on the innovation within the innovation system. There are different forms to facilitate this and, besides, there are existing links between actors.
4. Guidance of the search, the explicit making of wants, needs and expectations of the new technology among actors. An issue is the ‘peak of inflated expectations’
5. Market formation, includes activities on the creation of market demand, for instance by commercial or protected niches
6. Resources mobilisation, relates to financial resources, facilities and skilled researchers. Issues are the ‘valley of death’ (capital requirement during scaling up/take-off) and education of specialists
7. Creation of legitimacy/counteract resistance to change, convincing politics and governmental institutions and counteracting resistance of lobby organisations, NGOs and society.

However, this does not mean that, in order to develop a new technology, all seven functions need to be in place from the beginning, simultaneously. Rather, a system will build up during the innovation process, adding one function after the other, reinforcing each other’s functioning (Hekkert et al., 2007; Suurs, 2009; Hekkert & Ossebaard, 2010). Typically, as Hekkert & Negro (2009) concluded, an innovation system typically begins with the fourth function (i.e. guidance of the search), in the sense of articulation of the need for innovation. This is then followed up by function 6 (i.e. resources mobilisation) and function 2 (i.e. knowledge development). This will reinforce function 4 (i.e. better guidance, based on the developed knowledge). In later stages of the innovation process, other system functions will be added. Such an innovation system build-up develops through various
virtuous and vicious cycles, dependent on how promising the new technology seems at that specific moment (Hekkert & Negro, 2009).

Therefore, alongside the previous, the seven system functions need to be considered as descriptive, rather than normative (Klerkx et al., 2012); an innovation system is not really a hard system, but rather a dynamic process of self-organising, growing network of actors, which develops a new technology and which tries to configure it so, that it can become part of the regime (Hall & Clark, 2010; Klerkx et al., 2010).

The next paragraph deals with the question on how the dynamics are regarding the competition of a newly developing technology with the regime. This competition is still part of ‘innovation’, since the definition of innovation includes a successful market introduction.

4.4. Innovation and the established economic system

When the innovation system has been analysed, the question can arise on why a certain innovation does not succeed within that innovation system, or why it does. A large part of the explanation can follow from the fact that, besides the fact that innovations create opportunities, innovations eliminate other opportunities. These opportunities can be in other innovations (i.e. competing innovations), but also, and more importantly, in the established structures. In other words: innovation creates benefits, which comes at the cost of the benefits of incumbent businesses. An example to illustrate this, is the development of renewable energy, which comes at the cost of the fossil fuel industry. When the relative advantage of a new technology is high, i.e. the benefits of the new technology are high in comparison with the established technology, other innovation system actors, such as financial ones, are likely to support the development of the new technology (Hekkert & Ossebaard, 2010). A lot however, the second reason, depends on the complexity of the technology; the more complex the technology, the more knowledge is needed amidst actors about the effects will have.

A third reason for innovation to be successfully implemented or not, is the integration dimension. This involves the degree in which adjustments are necessary in the socio-economic context in incorporating the new technology (Hekkert & Ossebaard, 2010). There is more literature on the success of innovation diffusion: for instance, Rogers (1983) mentioned, besides the previous mentioned three factors, triablility and observability. Whatever the exact factors of innovation diffusion are in the broiler sector, old technologies are generally speaking in favour of current circumstances, because they are embedded in a framework of regulations, infrastructure, habits and so forth. Implementing a new technology requires therefore adjustment of the established context. The degree of in which adjustment of the established socio-economic context is needed affects the attractiveness of the technology. Innovations with a low need for adjustments is called a ‘modular innovations’, whereas innovations with a high need for adjustments are called ‘system innovations’ (Hekkert & Ossebaard, 2010). In system innovation there is a high need for adjustments, requiring the commitment of multiple parties.

Ten Have et al. (2012) have described the need for beta-gamma integration regarding innovation as they mention that besides the need to focus on knowledge creation, valorisation and implementation, it is necessary to consider development and investment on human capital as well. This followed from their analyses of three knowledge valorisation barriers, which are: (1) between knowledge development and actual successful application, (2) between technological and social
innovation and (3) a restrained attitude of humans (e.g. consumer, citizen, producer) regarding change and improvement. These barriers are in the present study seen as the social factors, which are part of the boundary conditions regarding innovation. The before mentioned three reasons of successfully implemented innovations (i.e. relative advantage, technology complexity and the integration dimension) are the so-called rational considerations, which are dependent on the human factors.

Human factors also play an important role in the lock-in of existing technologies. Related to that, lock-in results in path-dependency; new technologies build on proven technologies. Solutions for problems are being sought in new technologies, but within the direction of the proven technologies ("bounded rationality"). When taking this theory into account, it becomes obvious that a new technology has to have to possibility to be adjusted (to certain extent) to existing socio-economic structures. Another social factor is the fact that new, arising technologies are being criticized based on their current performance, instead of on their potential (Ossebaard & Hekkert, 2010). Governmental subsidy is therefore a useful tool to increase their performance. Resistance from the established industry is very likely.

The next paragraph will provide insights from transition theory, in order to understand the dynamics of the competition of innovation systems with the regime better.

4.5. The multi-level perspective

In this chapter, the framework of Markard & Truffer (2008) is used, because it not only addresses innovations itself, but also their relation with the macro and meso environment. This is important, as the success of an innovation is not only determined by the characteristics of the innovation itself, but also its relation with the status quo. The framework is based on the multi-level perspective (MLP) from Geels (2002) and has ‘systems of innovation’ as an extra aspect, as literature of innovation systems has not been unimportant in innovation research. The framework includes the landscape (macro environment), the regime (meso environment), niches (innovations\(^1\)) and innovation systems\(^2\).

First I will elaborate on the MLP framework, see Figure 6, and next on what the ‘landscape development’ could be for the broiler sector.

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\(^1\) In this review, the concept ‘innovation’ does not relate to some technology in a pre-market phase, but it relates to a technology that already has some sort of commercial application (a “niche” market)

\(^2\) Please note that ‘innovation systems’ is not some sort of extra level added to the multi-level perspective, it is rather something of a different dimension.
The framework was developed based on the model of Geels (2002), see Figure 7, which addresses the same dynamics but without the visualisation of innovation systems that the above shown framework has (Figure 6).

Both models visualise the pressure that is being exerted by (a) landscape development and (b) technological niches on regimes. Regimes can have different ways to act upon these pressures, for
either protecting themselves from that pressure of by transforming according to that pressure. Geels and Schot (2007) propose four different transition pathways: (1) transformation (i.e. regime adjusts their way of working), (2) technological substitution (i.e. newcomers develop novelties which compete with regime technologies), (3) reconfiguration (i.e. regime actors adopt component innovations; its suppliers compete) and (4) de-alignment and re-alignment (i.e. incumbents lose legitimacy; multiple novelties compete in becoming the new regime).

By means of these four transition pathways landscape developments will determine the direction of changes within an industry (Rotmans, 2006). Transition is conceptually considered to be a number of system innovations, which in turn consists of process innovations and product innovations. A transition is a long-term process, in which different developments are acting against each other or reinforcing each other. Transitions require system innovations; system innovations are trans boundary renewals, which take place in and beyond organisational boundaries. The connections between business, organisations and individuals undergo thorough change in a system innovation. Such innovation takes shape within an innovation (eco)system, which is the flow of technology and information among people, enterprises and institutions within an innovative process.

Wortmann & Krusemann (2008) argue that industrial progress causes large environmental problems and planning, large-scale production and centralisation are at the root of the problem. It would therefore not be logical to look for solutions in even more planning and consolidation of industries. This implies for the Dutch agri-food industry that on-going consolidation would not be going to last long, in the favour of (according to this theory) decentralised and diversified systems. This will put the consumer in his/her ecosystem again, breaking the tendency of linear processes (which creates waste) to cycles. Hoek (2015) confirms this development and adds that cooperation is essential in transforming from linear processes (i.e. supply chain) to cycles (i.e. value cycle). Three rules of thumb are proposed by Hoek (2015): cooperation with chain partners generates more value than enforced performance (1), long term partnerships create more value than single transactions (2) and (3) created value can also be non-financial. When combining the findings, it becomes visible that there will be a macro-level change from supply chains towards value cycles, which requires more and stronger cooperation between actors. Consolidation in itself is not an answer to problems, local production is, as it suits the modern consumer to know where and how the product has been made. This stimulates formation of local ecosystems and symbioses through collaboration (Hoek, 2015). Paragraph 4.8 will elaborate more on this.

The implication of the proposed macro-level development for the Dutch agri-food industry is that large-scale food production becomes less relevant in the favour of production in local ecosystems where consumers are concerned. Another confirmation comes from Folkerts & Maijers (2014). They argue that chain cooperation has always been present, although it historically has only been market driven, whereas nowadays society is becoming a driver for chain cooperation as well. Alkemade et al. (2010) pointed out that process innovation in a mature market leads to a reduced value of the product. The innovation system should therefore when aiming at creating value focus on product innovation (i.e. starting a new product life cycle) or marketing innovation (i.e. product differentiation) instead of solely process innovation.
4.6. Transition versus stability

What determines whether the competition between niches and regimes (as provided in 4.5) is a hot issue (i.e. is explaining most of the innovation change that is going on in the sector)? It is obvious (from the MLP framework) that this is the case when either technological solutions provided by niches are very promising, or when there is important pressure from landscape developments. Geels (2002) argued that landscape developments can open up “windows of opportunity” by exerting pressure on regimes. So, the larger the pressure from landscape developments, the more windows of opportunity and the more competition from niches is likely. This has been described as periods of stability that are being alternated with periods of change (Schumpeter, 1934; Anderson & Tushman, 1990). In periods of change, there is so-called ‘creative destruction’: technological ease of entry and a major role for entrepreneurs and new firms in innovative activities. Periods of stability, on the contrary, are characterised by creative accumulation (i.e. path dependency; sustaining innovations), prevalence of large established firms and the presence of relevant barriers to entry for new innovators (Malerba, 2004). The timing of going from a period of relative stability to a period of change is, in the theory of Schumpeter (1934), determined by “long waves” of technological opportunity (Kondratiev, 1925). These waves are the industrial revolutions, in which new technological possibilities provide opportunities to economic sectors, such as the broiler sector. Whether the broiler sector is in a period of relative stability, or such a period of change, has to become apparent from field research.

It needs to be mentioned, however, that sectors can be characterised by high complexity (Malerba, 2004). If this is the case, advanced integration capabilities are required (Cohen & Levinthal, 1990). As a result, following from transaction cost theory, if the relative advantage (Hekkert & Ossebaard, 2010) of a new potential technology is not perceived as high enough, the industry may be concentrated and formed by large established firms, instead of many new entrants/niches (Malerba, 2004). This seems to be the case in the broiler sector, as farmers have to comply to quite a lot of regulation, alongside the specificity of required knowledge. This needs however to be validated by further consideration of the sector. It would mean for studying innovation in the broiler sector, that the main innovations are being done by large established firms and a minority, if any, by technological niches. However, technological innovation systems could still be distinguished, if cooperation between different actors is important to innovation in the broiler sector. This also has to become apparent from the field research; is innovation in the broiler sector being pursued by large established firms and is their innovation process rather linear, or more holistic, AIS-like (see paragraph 4.2)?

According to Brunori et al. (2012) the pace and intensity of changes in agriculture and rural areas “challenges widely shared assumptions”, which implies a radical change for agriculture. More attention in public policy for the externalities of the production, instead of only on the production itself, will be increasingly required (Lowe et al., 2010). How such a paradigm shift specifically for the broiler sector is, needs to be investigated. However, developments such as about food scares, animal welfare, amongst other publicly uttered concerns about production externalities, could be indications.

In parallel to the previous, the question arises how important path dependency is characterising innovation, since large established companies would be in the lead and large established companies tend to favour path-dependent innovations in allocating resources (Christensen & Bower, 1996).
Such path-dependency could be challenging the sector’s adaptation towards the addressed changing role of the consumer. The next paragraph will go into more detail on path dependency.

4.7. Path dependency

A firm can foster different innovation trajectories, which will be determined by the firm’s strategic choices. As mentioned before, firms can pursue sustaining innovation, aimed at making the current product offering better, by either improving product performance or by improving the production process. From the S-curve concept (Foster, 1986; Sood & Tellis, 2005) can be derived that new technologies that are currently underperforming, might going to outperform in the future. Because of this threat, companies need to, if they want to survive, focus on possible new technologies too. However, incumbents tend to allocate resources to favour sustaining innovations (Christensen and Bower, 1996) and as a result they are too late in being able to replace the product based on the outdated technology by a product based on new technology (Christensen, 2000). Willingness to cannibalize prior investments is a key success factor (Chandy & Tellis, 1998) for such radical product innovation. Gilbert (2005) named resource rigidity (failure to change investment patterns) and routine rigidity (failure to change organizational processes) as constraining factors to an adequate response. Vlaar, de Vries & Willenborg (2005) suggested five factors for inertia: cannibalization, conventional wisdom, corporate inflexibility, incompetence/overconfidence, access to resources. The latter factor is positively related, whereas the other four are negatively related to the incumbent’s ability to extract value from new strategic options (from Viellechner & Wulf, 2010).

Why do incumbent firms favour sustaining innovation? Because those investments have advantages over newly developing technologies. This has several reasons. First, existing technologies are embedded in a well-functioning system that is very difficult to change, which is called lock-in (Hughes, 1987; Unruh, 2000; Arthur, 1998; David, 1985). Furthermore, Negro et al. (2010) names three other advantages that favour existing technologies, namely: technological advantages (technologies are optimised due to economies of scale through a long period of learning), institutional advantages (due to co-evolution, surrounding institutional structures have become perfectly aligned, Unruh, 2000), and relational advantages (because of strong established interests, incumbents will be reluctant to favour technologies that might threaten the status quo). Also, besides technological lock-in, incumbents can postpone change by demand lock-in (i.e. customers do not switch to alternatives, but rather stick to the offering of the incumbent firm, Malerba, 2004). Such strong lock-in (either technological and demand lock-in) may even cause a sector to stick to inferior technologies (Malerba, 2004).

Lock-in of existing technologies and the related path dependency can be overcome by processes of variety creation. From the previous paragraphs, however, can be concluded that a precondition is that new, potential technologies offers sufficient relative advantage (see paragraph 4.4), good prospects on the competition with existing technologies and no lack of innovation system build-up (see paragraph 4.3 and Negro et al., 2010). Variety creation refers to products, technologies, firms and institutions (Nelson, 1995; Metcalfe, 1998, Malerba, 2004). When relating to firms, processes of variety creation is, as mentioned before, harder when the need for advanced integrative capabilities is high, which is likely to be the case in the broiler sector. In this case, few niches (which provide such variation) are to be expected. Although processes of variety creation can also be done by established firms on the other ones (i.e. products, technologies and institutions), the creation of new organisations is important for the dynamics of a sector (Malerba, 2004).
4.8. Knowledge generation, networking and system failures

When taking the findings from the literature study, provided in the previous paragraphs, into account, the question arises how innovation on sectoral level would need to be organised. In this paragraph, answers to this question will be provided. Field research in the broiler sector, however, will be needed to see to what extent these answers are relevant.

This paragraph will add literature and, at the same time, derive implications from findings from the previous paragraphs. This will be done by two different subparagraphs, which are: the nature of innovations (paragraph 4.8.1) and how innovation may be organised (paragraph 4.8.2). In 4.8.1 the consequences of the first seven paragraphs of this chapter will be presented, while in 4.8.2 there will be elaborated on implications of these for innovation management and research.

4.8.1. The nature of innovations

First of all, the finding that innovations are not merely technological, but are socially embedded as well, needs to be considered. From the paragraphs 4.1 and 4.2 became apparent that an organisation is not acting on its own, when innovation is concerned. Rather, they are in contact with their environment in order to determine what innovations could be relevant, and, besides, they seek interaction with other organisations in pursuing the innovation. The importance of the latter (i.e. interaction between organisations in making innovation happen) has become apparent from the paragraphs 4.3 and 4.4, from where can be concluded that, especially when it concerns a radical innovation, the build-up of an innovation system is important to success. The underlying reason for this is the need for institutional change, alongside technological change (paragraph 4.4 and 4.5).

Because of the existence of a system within a sector (i.e. different economic actions have interdependencies, such as the interdependency of retail purchase and primary production), the required change for innovations can be extensive. Therefore, according to Smits et al. (2010), leading innovation systems are based on good relationships of exchange among the institutions of science and technology, industry and political systems. Klein Woolthuis et al. (2005) show confirmation of the importance of this institutional infrastructure and mention funding mechanisms, network characteristics and market structure as important characteristics of innovation systems. These findings build on the proposition provided in paragraph 4.2 that the linear model to innovation (i.e. Technology Transfer, TT) is out dated. In place of that, innovation approaches are/should be more interactive in terms of an innovation network/system that integrates the generation of knowledge, the adaptation of existing systems and the demand for innovation from exogenous factors. The alignment of actors within the innovation system/network and the consolidation of their interactions is therefore essential (Rip and Kemp, 1998; Rotmans et al., 2001; Geels, 2005).

4.8.2. The organisation of innovation

From the previous paragraph, 4.8.1, became apparent that innovation does not occur in isolation; it rather requires a lot of interaction between actors, making sure that the ‘push’ (i.e. knowledge/science/technology) matches the ‘pull’ (i.e. socially desirable change). This implicates a change from the linear model of a science-driven approach (“top-down”) towards an innovation-driven approach (“bottom-up”). The latter approach requires multi-stakeholder involvement. To make sure that their interests are being addressed in an integral way and to really involve them in the process, the interaction among them is important. When such a bottom-up approach is not
working, it indicates consequently the presence of systemic problems in the network or a lack of creation of new innovation systems. Such an innovation-driven approach implies that policy will co-evolve with the innovation, through a process of multi-stakeholder learning (Moulaert et al., 2005; Smits et al., 2010). This approach is partially embodied by the ‘Triple Helix’ (Etzkowitz & Leydesdorff, 1995), which is the collaboration between universities, government and industrial parties on various topics. The triple helix approach facilitates the generation and renewal of their institutional and social arrangements regarding the application of new knowledge. Although this approach has shown advantages, there is no involvement of non-traditional actors, such as societal. Therefore, a quadruple helix approach could be advocated instead, in innovation practice policy.

This includes, besides the interaction of firms with other firms, a broader interaction with their socio-cultural context, which is the complete institutional framework. Collaborative learning networks for exchanging innovations and for learning processes needs to stimulated in order for this approach to work. Innovation brokers can help by facilitating this process, by filling the gap between the “pull” and the “push”. The result would be effective processes of learning among farmers, other rural actors and entrepreneurs.

The implication for this for large cooperatives and retailers, who often pursue a linear, top-down approach of innovation, will be that they will experience competition from bottom-up approaches. The advantage of large cooperatives and retailers is economies of scale, however the advantage of bottom-up approaches is the institutional factor: consumer/citizens as well as NGOs are involved, can take initiative and can address the societal interests that are currently being inadequately addressed by large cooperatives and retailers.

In such bottom-up innovation networks, there is a need for leading personalities, vibrant networks and novel project groups. According to Geels & Schot (2007), there can be interpretive inflexibility (Bijker, 1995) by social groups that have different problem definitions and interpretations, which would lead them to different solutions to the problem. A process of negotiations and coalition building is needed to get one leading solution. Such processes of collective learning help developing knowledge in managing competing interests. Besides, the shift from linear processes of learning towards shared and circular ones can generate entirely new things, by combinations of different sources and types of knowledge (Oreszczyn et al., 2010).

As mentioned before, there needs to be some holistic and bottom-up approach of innovation in order to provide a solution to problems. Such an approach includes an inter-disciplinary approach to research (Smits et al., 2010; Darnhofer et al., 2012; Gibbon, 2012). The implication of this is that research becomes less centralised and more context specific and adapted to certain conditions. This requires cooperation between academic research and practice, by networking. As mentioned in paragraph 3.2), due to the privatization of extension services, there is competition and reluctance in sharing knowledge, which can impede such ‘collective intelligence’-like network structures. Because of this, the aspect of networking, trust between different parties, commitment of these parties to the network, and their culture and institutional capacity will need attention (Röling & Jiggins, 1998; Ostrom, 2009, 2010). The process of such social learning includes social change, cultural transformation and institutional development, which is needed in innovation (Woodhill & Röling, 1998); technological and institutional change are inseparable (Smith et al., 2010).
5. Research methodology

The research is an exploratory case study. Because the case involves a rather large case of innovation in the broiler sector, it involves many social objects, such as companies, networks (both formal and informal) and so on. Any of these social units is viewed as a whole (following Goode and Hatt, 1952). Because of the exploratory character of this research, it is important to analyse any of these social units to get a complete picture of how they relate to each other. That complete picture might yield some insight on what a theory could be of explaining innovation in the broiler sector and extracting the critical success factors of that. Important to consider is the extensiveness of this research in combination with the limited resources (e.g. just one researcher and just a few months of time) and the implication of that on the thoroughness; this research will not yield a theory that possibly explains all variation, but rather some indication of what parts of it could be. Therefore, this research is called exploratory: it has the intention to explore the broiler sector in order to find the explanation for the success of innovation in that sector. The idea is that there is on a conceptual level an explanation for the success of innovation. Initial talks, before the choice was made to start this research, indicated the existence of problems when it comes to innovation success in the sector.

The approach in starting this research was to identify the factors that contribute to success of innovation and, subsequently, the factors which presence is not there or is not prevalent enough. These factors are in this research called the ‘critical success factors for innovation’. The underlying assumption is that, despite the fact that innovation can be unpredictable, there are critical success factors that need to be present. These ‘critical success factors’ do in this study not merely relate to organisational characteristics, but rather to the broader system of interacting firm and non-firm organisations. Therefore, I chose to aim at conducting a considerable number of interviews with people from different firm and non-firm organisations, with different perspectives. The implication of this is that the study has a qualitative nature and that the results from the interviews will need to be interpreted. This is done by a grounded theory approach (see paragraph 5.2). This qualitative approach allows for a dynamic view on the innovations of the sector. A quantitative approach was not possible, since my prior research did not provide solid groundwork in doing so.

This remainder of this chapter elaborates on the methodology of data collection in paragraph 5.1 and the methodology of the data analysis in paragraph 5.2.

5.1. Data collection

In this chapter, interviewee selection (paragraph 5.1.1) and interview strategy (paragraph 5.1.2) will be discussed.

5.1.1. Interviewee selection

In order to be able to obtain insight on what those success factors could be, I had to explore the dynamics of innovation in the sector by consulting the sectors’ key actors related to research and innovation. Because of the fact that I did at that time not have an overview of the sector and its major players, I decided to just start interviewing relevant people and expand my network along the way. The choice to do so would be justified by the indication that the sector was not too large to investigate and, besides, access to the network of FME which would make quick access to contact details possible if needed. I did this by pro-actively asking people after the interview if he/she could
provide contact details of relevant people they thought should be interviewed. This is way of sampling is called the snow-balling method.

Besides the process of reaching informants by networking expansion while doing the interviews, a publication about the research was placed on the website of FME (see Figure 8) and, besides, of GMV. This has increased awareness about the research in the sector, as people have responded to it. As a third way of reaching informants was my participation in various network groups. I had the opportunity to talk to people about the research and ask for contact details of possible relevant informants. These ‘network groups’ are the following:

- A joint initiative of a number of tech companies, related to the broiler sector, and WUR Livestock Research. This was facilitated by FME/GMV and was aimed at exploring PPP opportunities for research on optimisation in the supply chain by using big data.
- A meeting of GMV members with Canadian food processors trade mission in the Netherlands for trade facilitation purposes.

A fourth way was by web search about interesting innovation projects that have been going on or that were still going on.

From the previous four ways of reaching informants has become apparent that ‘interviewee selection’ was partly unstructured and based on luck of getting relevant informants and partly based on earlier interviewed people’s opinion about who relevant people should be. The implication of this method of interviewee selection is that some relevant people might have been missed and subsequently interesting information as well. The reliability of the method may therefore be reduced, when a different starting point results in a different set of interviewees. The selection of the by the earlier described process handed names of people has roughly been according to the following criteria:

- The person is well introduced into the broiler sector, knowing about how things regarding innovation practically work and what related forces are
- The person has a broad view on the broiler sector, so that he/she has the ability to place the own work activities into a broader perspective
- The person has an ability to nuance the own interests from that broader perspective, reducing possible bias from the person’s own perspective / interests
- Because of the previous point, a rough estimation about if such a person (usually with a well-filled agenda) would be willing to spend time on an interview with the researcher

Since these criteria are not really quantifiable, prudence of the researcher is key to the quality of the selection.

One interviewee does not meet the above-mentioned criteria. That person was interviewed because of his work field related to the broiler sector, having a more general view on innovation.
5.1.2. Interview strategy
The interviews have been conducted from the 7th of March until 24th of May 2016. See Table 2 (in Appendix II) for an overview of details of the interviewees. During these eighteen interviews knowledge has been gained on the view of the interviewees on innovation in the broiler sector. The interviews were therefore unstructured; I have put the initiative on the side of the interviewee for explaining their view on innovation, both the success factors and the constraining factors. My role was to ask those questions needed to encourage the interviewee to go into depth on the topics they have knowledge or experience on.

I naturally have gained insights along the way, as well as increasing understanding of innovation in general and of the broiler sector in general. This will have increased the quality of my understanding of the things mentioned during the interviews. Also, the specificity and effectiveness of the my questions will have increased subsequently. The research question however has remained the same during conducting the eighteen interviews, so my interest has been uniform over the different interviews.

5.2. Data analysis
The data analysis is done based on the transcribed interviews. There has been a first order coding that is informant centric and, based on these first order codes, second order coding that is researcher centric (following Gioia et al., 2013). The first order coding is used to get structure in the raw data, while at the same time remaining reliable. The second order coding is used to ‘translate’ the terminology used by the informant to terminology that is more commonly used by researchers and hence better interpretable for research purposes. Based on this, theory can be developed. This theory is called grounded theory, because it was inductively developed from the raw interview data. The reliability of grounded theory is supposed to be high, as the developed theory would logically follow from the data (Glaser & Strauss, 1967). In this paragraph, I will elaborate on the processes of: coding (paragraph 5.2.1), going from first to second order codes (paragraph 5.2.2), and categorising codes (paragraph 5.2.3).

5.2.1. Coding the data
The process of going from the interview data towards the coded transcripts has been as follows. I first wrote, before any form of analysis had been done, all the transcripts. These are approximately over 200 standard text pages, which is on average 12.5 pages per interview (the transcripts of two interviews are missing, because of a lack of recording due to technical failure). Because of the extensive work of transcribing, most of the topics that had been talked about had to a certain extent become embedded in my mind. This has been useful for starting the coding and deciding upon which codes could be relevant. Once the coding process had started, the number of codes increased quite rapidly, but along the way the re-use of codes increased, which shows saturation in the diversity of data. The relatively high number of first order codes shows the high diversity of topics and concepts that have been discussed. This could be a result from the fact of the high degree of data triangulation in the form of interviewing people with quite different perspectives. Also the non-standardised questions have facilitated the high diversity of topics and concepts that have been discussed. When I posed a suggestive question, the confirmation of that suggestion by the interviewee has not been coded because of possible subjectivity. After the coding had been completed, a process of extensive re-checking has taken place to check for coherence on code-level (i.e. is there coherence between
codes on concept). There have been some changes and combination of codes, however on a small scale.

5.2.2. Developing second order codes
The 61 first order (informant centric) codes are relating to each other to a certain extent. The codes that have most in common, or are believed to have a relationship of considerable importance, have been combined under the so-called second order codes. 15 second order codes have been developed. Putting the first order codes together towards the second order codes involves the researcher’s interpretation. In order to make explicit the nature of this interpretation and to make the process transparent, there will be for each theme quotes given with the corresponding code. The quotes are selected by reading all the paraphrases coded with that code and, as a next step, by deciding whether those paraphrases are consistently addressing the same thing. If so: the most clear and context comprehensive code will be picked. If not: multiple quotes will be given to make sure that no information is lost.

As an illustration on this, I will provide now an example of how I developed second order code ‘alignment of interests’. Please refer to paragraph 6.1.1 for the full description of the result of this second order code.

Example second order code 1: Alignment of interests:
This second order involves the paraphrases with one of the following five first order codes:

1. “chain wide optimisation/innovation is needed”
2. “different interests with regard to animal welfare and environmental issues”
3. “different interpretations on the concept ‘sustainability’”
4. “different possible optimisations on sustainability”
5. “sub optimisation/ non-integral optimisation”

These five codes are here numbered 1 to 5; these numbers will be used to refer to when introducing the quotes.

“10, 20, 30 years ago, it was all aimed at the primary sector, primary sector is around that cattle farmer, and now, and that is all that development of chain thinking and networking thinking” (Informant 1, code 1)

“So, where do I see chances for innovation in the broiler sector? Surely the chain integration. And yes, also cooperating throughout the entire chain” (Informant 2, code 1)

“It can be that for one group in the society carbon footprint is most important and for others: the welfare of the animals that are held in captivity. For one, the animal in nature, for the other animals in the stable, so to speak, to place the one against the other” (Informant 3, code 2)

“When looking at the world, it is questionable whether the slower-growing chicken is an answer to the world feeding dilemma. That’s a question. The second thing is: the slower-growing chicken, is it sustainable? That’s the question” (Informant 4, code 2)

“Sustainability is a word that can have many meanings. Some parties find something sustainable and if you go and look at that, there are considerations that make it not sustainable” (Informant 3, code 3)
“Sustainability is of course a comprehensive concept on which one can foster different optimisations. TerraSea, Patio, New Mixed Farm, Cardinal Point, these are four different ways to optimise on different dimensions of sustainability. And there is no reason to claim that one is by definition more sustainable than the other” (Informant 5, code 4)

“...and thus there is a different kind of innovation on those chains before it” (Informant 6, code 4)

“That is being considered as sustainable, and that is from animal welfare perspective. But if one considers efficiency and use of resources, use of arable land, carbon footprint, than it is not sustainable but a deterioration” (Informant 3, code 5)

The above quotes show all that interests of different parties can clash, in the sense that each party can have their own optimisation. Second, there might be lack of discussion between those parties, as it becomes apparent from the quotes that there is no consensus on what would be sustainable. Third, integration of interests would avoid sub optimisation and can be achieved by chain integration. These three propositions, extracted from the interview data, are here put under the header ‘alignment of interests’ because it is about alignment of interests and the proposed lacking of it.

This process, of finding complementarities between first order codes, follows from the researcher’s interpretation of the data. However, through an iterative process of re-checking whether the first-order codes are indeed consistent with the chosen second order code and by checking if they could be more consistent within another second order code, maximal cohesion within second order codes is being pursued.

5.2.3. Categorising second order codes

The 15 second order codes have been placed under three categories. This has provided a better overview on the results from the data analysis, although interconnections between second order codes might have been lost. For this reason, the process of going from those results towards conclusions has been iterative to increase reliability. I created the categories by writing down the main points of each second order code and I compared these continuously with each other in order to find similar concepts. During this process, I set up different sets of categories in order to find the most suiting set of concepts. This turned out to be quite unambiguous and was therefore no hard job. See Figure 9 for an overview of the process.

1. Write down the main points of each second order code
2. Compare the main points and find communalities. Put the codes that show communalities in one category
3. Review the categories on conclusiveness and start the process over, until there is saturation

Figure 9. The process of going from second order codes towards the dimension/categories
6. Results

This chapter consists of two paragraphs. Please refer to paragraph 3.2 for some context of the results. This context has been defined during the interviews and is needed in order to understand certain concepts that are used in the other parts of this chapter. The interview data, which is related to the research question will be presented in two paragraphs: the insights (6.1) and their categorisation (6.2).

6.1. Insights

From the data analysis I derived 15 codes, based on the 61 first-order informant-centric codes (see Appendix I for all codes and their frequency of use\(^3\)). These 15 codes do not directly provide an answer to the research question, but are rather ‘insights’ that need to be interpreted. This interpretation will be done next paragraph, and, more importantly, in the discussion (chapter 0). The fifteen insights are named as follows (alphabetically ordered):

1. “Alignment of interests”
2. “Effectiveness regulation”
3. “Finance difficulties and risk/uncertainty”
4. “Flexibility regulation”
5. “Importance of networks/connections”
6. “Knowledge development”
7. “Leadership and innovation practice”
8. “Level of knowledge among actors”
9. “Market dependence”
10. “Path dependency”
11. “Social acceptance”
12. “Social context”
13. “System rigidity”
14. “The social component of innovation”
15. “The ‘why’ of innovation”

For any of these fifteen insights, I will now elaborate on what is meant with their names and what the relevant information is that has been mentioned by the respondents. I will do that in a separate paragraph for each of the fifteen insights. Each paragraph contains illustrative quotes that originate from the transcribed interviews.

6.1.1. Alignment of interests

From the data within this code can be learned that the respondents perceive differences in optimisations, and they find that an important issue. Differences in optimisations involved the concept of sustainability, on which different optimisations are possible. For instance, optimisations of animal welfare is by some powerful parties called ‘sustainable’, whereas according to many

\(^3\) The frequency of use of first order codes provides an indication of what topics have been mentioned most often during the interviews.
respondents it has either nothing to do with sustainability, or it is just an aspect of it. As one respondent mentioned:

“That is being considered as sustainable, and that is from animal welfare perspective. But if one considers efficiency and use of resources, use of arable land, carbon footprint, than it is not sustainable but a deterioration” (Anonymous, quote 1)

Optimisation on solely animal welfare would therefore threaten performance on other aspects of sustainability, such as use of resources, carbon footprint and use of farmland. To be specific: NGOs (like the Animal Protection Agency) pursue optimisation on animal welfare, whereas other parties (e.g. companies, knowledge institutions) emphasise the importance of use of resources and use of farmland. The influence NGOs have is perceived as problematic because it would lead to sub-optimisation by too much focus on animal welfare, since there are other sustainability issues that need to be addressed as well. Better alignment of interests would therefore be valuable to the performance of the whole sector. Also, in addition, better integration of the supply chain would also lead to better performance of the sector, since the chain is in the current situation very long and each chain-link is optimising for its own benefit; integration of the interests of the different chain-links would lead to better performance for all of them. Integration of interests would logically be preceded by alignment of interests, hence the name of this code: ‘alignment of interests’.

![Figure 10. Illustration on suboptimisation. If no chain-link feels responsibility for the most limiting stave, the total performance would be limited as well, although there is no evidence for such a static minimum. Source of the picture: Wikipedia (n.d.)](image)

Liebig’s law of minimum (Sprengel, 1828) doesn’t necessarily apply here (see Figure 10) as it does not follow from the data. Therefore, optimisation on other ‘staves’ could still work for increasing overall chain performance.

See for further data background on this topic (i.e. ‘alignment of interests’) the quotes provided in paragraph 5.2.2.

6.1.2. Effectiveness regulation

According to the interview data, regulation/legislation concerning the growing and processing of chicken in the Netherlands is in some cases ineffective or inconsistent. Three issues have been mentioned. The first issue concerns whether the market for chicken can be considered a level playing field: chicken production in the Netherlands is subject to strict and high-level regulation, whereas the production standard of imported chicken is of a lower level. Different interviewees perceived this fact as problematic for the sector, because it competes with Dutch production as the following three quotes illustrate:
“...the free market is a threat. That, with the TTIP and from Ukraine, we will get very cheap products that have been produced under different norms, I find that a threat” (Marijke de Jong, quote 2)

“This is a risk to the further development of the sector in the Netherlands, if, over there, they may do such developments and produce cheaply, while here these things are being constrained. The market will then do its work” (Anonymous, quote 3)

“There is no level playing field” (Anonymous, quote 4).

From the perspective of the researcher it can be both a stimulus to innovation (because of the need to produce even more efficient) as a constraint to innovation (when the sector slips into survival mode because of deteriorating sales and profits).

The second issue is about market formation on more sustainably produced chicken meat. The Dutch Authority Consumer and Market (ACM) forbade arrangements between retail chains to replace the least sustainable chicken meat by a higher standard. This impeded market formation of chicken produced under new standards and will impede and slow market formation of new products on the retailers’ side in the future. Besides, a free international market would constrain market formation of more sustainable chicken as well as it would mean that cheap chicken (and produced under lower standards) from Ukraine would mean a very tough competitive position of Dutch chicken. These types of regulation would be ineffective because on the one hand the government wants more sustainability, while on the other hand there is no level playing field and no market protection (see quotes 2, 3 and 4).

The third issue is related to local governments. Local governments have their own way of working in the form of programming and making plans. Because of the fact that innovation often requires a different procedure because regulation is still not in place or because current regulation does not comply with the needs of the innovation. As one respondent mentioned:

“As a government, we will need to some different role, by which we can become more flexible. If we want to cooperate with knowledge institutions and companies, we will also need to respond to what occupies them. Their rhythm is way different from ours” (Arnoud Leerling, quote 5).

When innovation becomes more prevalent, local governments should become more flexible and adjust their way of working so that it corresponds with activities of entrepreneurs and with the pace of change. This would make regulation more effective.

6.1.3. Finance difficulties and risk/uncertainty

There are a number of things that have been mentioned by the respondents regarding finance difficulties and regarding risk of innovation market uncertainty. First, there is the chicken-egg paradox on market development: because of the negative comparative advantage of the Dutch primary companies, they need to differentiate from the world market. However, introducing a new market concept brings market risk along, which is perceived as a major constraint for market formation for those new concepts. An uncertain market situation deteriorates this constraint, as the following quote indicates:
“…[one can] develop those ideas into a coherent whole, but still, there is a R&D phase of years that cannot be sustained by individual companies alone, because of market uncertainty. That is where it fails” (Bram Bos, quote 6)

Another issue that has been mentioned is the unpredictability of innovation; the outcome is most often unclear, as the following quote illustrates:

“Often, there is a lot of thinking about in how much time revenues will start to develop. That is often hard, because one lacks that insight. It is hard because it is not easy to predict when certain steps really can be done, since processes are often not linear” (Anonymous, quote 7)

Hedging is therefore necessary, especially for the more radical innovations once in the experimental stage. It has been suggested that companies have relatively low knowledge on finance structures to cover the risks on innovation. Besides, from the Cardinal Point project (see Figure 4, paragraph 3.2) can be learned that subsidy is a difficult finance structure, because of the uncertain outcome of a certain innovation. On the contrary, the SBIR (Small Business Innovation Research) is a rather good one, because it provides the time needed to make the new technology ready for entrepreneurs.

A third issue is related to the subsidy policy of the government. Large(r) companies in the broiler sector know how to apply for subsidies, however it has been suggested that the connection of subsidy programmes (Dutch top sector policy) with SMEs is problematic, for example in the following two quotes:

“…difficult to also find SMEs in starting the right projects in the right way. I think that is difficult, because from the perspective of the university, they are hard to find. And, large companies are wealthier, in order to do the real R&D” (Anonymous, quote 8),

“…those large companies, we can find them. They also have the resources for research investments, so that works quite well in PPPs, I think that this model works quite well. Serving SMEs however is way more complex. (…). There is also a difference in dynamics, like short-term versus long-term, ad hoc versus more programmatically (…)” (Ruud Duijghuisen, quote 9)

A part of the explanation would be the fact that SMEs lack budget for long-term research programmes, while the public sector needs long-term programmes. The number of companies that can participate in long-term programmes is relatively low.

Besides lack of subsidy options for SME tech companies, the primary sector is short on budget for R&D too. The structure for collective research (‘Productschap Pluimvee en Eieren’) has been abolished, leaving the primary sector with no structure for collective research. For the sake of completeness, I need to mention that a new structure for such collective research is being set up and will be launched this year.

Some respondents have said that the dependence of a company on subsidy slows the innovation process down, leaving the suggestion that other financing possibilities (i.e. private) would be more appropriate for innovation. The reason of this would be that the procedure of applying for subsidy is more time-consuming.
6.1.4. Flexibility regulation

This code, flexibility of regulation/legislation, is related to the code ‘effectiveness regulation’. A major issue here is the fact that legislation can be constraining innovation, because it takes time to adjust regulation to the new situation shaped by the innovation. Besides, in some cases there is no regulation for the new technology and therefore it needs to be defined, as the following quote indicates:

“Regulation can be a constraint to innovation, because adjusting it to the new situation takes time. In some cases, regulation needs to be set up in making clear how a certain technology may be used” (Gertjan Fonk, quote 10).

Other issues are the non-specificity of regulation on certain matters and the low ability to be flexible when it comes to granting environmental permits by local governments. Lastly, the cooperation of the sector’s regulation supervisor would be too low in giving companies room for experimenting with new technologies, see for instance this quote:

“There is need for some room to initiate this kind of development and research. At this moment, the room to do so becomes increasingly limited. Therefore, these developments move to other countries. There is the same regulation, but there are possibilities for experimentation” (Anonymous, quote 11).

From this can be concluded that, in doing innovations, room for experimentation is important, as well as co-developing regulations.

6.1.5. Importance of networks/connections

The respondents have mentioned the importance of networks and connections for innovation. It has been suggested that companies often are doing research on the same research topics separately and thus are developing similar things. Better networking and connections between companies would increase efficiency of R&D efforts and also increase outcomes as people know together more than they do each on their own. Besides, companies could cooperate more with suppliers to make use of their R&D capacity. This, however, is hard because there are many different parties, which have different interests. The following quote illustrates this partially:

“We have had a very strong specialisation. So we got better in an increasingly smaller part of the chain or a certain technology [...]. The more specialisation, the more important the connection becomes [...]. There will be no progress if the exchange of ideas stops in some way.” (Anonymous, quote 12).

In addition to the previous, revenues generated by partnerships need to be divided over the participant, which is tough to organise. Trust, allowance, good management of expectations, like-mindedness and a strong leader are helpful, if not necessary.

Connections and cooperation are perceived as crucial for innovation because it features exchange of ideas. The exchange of ideas and the arising of new ideas would be a ground for innovation and this can be achieved through networking and making sure to be present at relevant occasions. In the words of the next quote:
“connecting and encounter is often a setting generating so much dynamics” (Arnoud Leerling, quote 13).

Another dimension is connections between different knowledge domains. Is has been suggested that connections between two different things can create synergy, see the following quote:

“It is much harder to innovate in a certain domain, to come up with something new. If you really want to make big leaps, you will have to [put several things together]” (Anonymous; quote 14).

One respondent also mentioned the cluster effect on innovation. In clusters, there is a concentration of knowledge and because of low physical distance it is easier to make connections. Cooperation on the basis of trust, facility sharing and attracting R&D of other companies would all be features of clusters.

6.1.6. Knowledge development

It is assumed that knowledge development is an extremely important precondition for innovation; no new knowledge, no innovation. The respondents have mentioned many things that relate to knowledge development. First, there is the changing role of the government in the knowledge system: there has been a shift from a government-funded knowledge system towards a knowledge system in which there is more funding from the side of business. The combination of businesses with the public sector is tough when it comes to setting up research programmes, because the research agendas of business and government are different. In addition, public research programmes are often long-term, while companies are not always willing to participate in long-term research. This is especially the case with SMEs, so SMEs often cannot find the fit with the research institutions although the connection could be very interesting (this is related to SME finance difficulties, see above).

Another issue is the one of a holistic approach when it comes to solving social problems. Universities have a disciplinary way of working; each discipline is doing research mostly based on what is of scientific interest. When it concerns applied research or when the research question has been brought forward by a social problem, it then is often based on a not well enough articulated idea about what the solution is for a certain social problem. An interdisciplinary approach on such problems would help, however inter-disciplinarity is problematic from an academic perspective because it is so different from traditional research. An interdisciplinary approach could help to address a certain social problem in a more holistic way (“assembling knowledge”, this could help avoid suboptimisation, see paragraph 1) and this could also give directions to fundamental research. The following quote illustrates all this:

“We developed an approach to connect existing knowledge, together with people from practice, to create and elaborate new concepts (....). We do not discover facts, but assemble existing knowledge (...) ... if ones considers the problem from a more integral perspective, one will formulate different research questions” (Bram Bos, quote 15)

There is however no systemic way for doing this. However, the campus development fostered better connections between university departments as the following quote states:
“…knowing that the agri-food sector faces major challenges, there is a lot of opportunity in mutual connections between knowledge institutions. That has luckily been enforced with the campus development, by which domains within the university can find each other” (Arnoud Leerling, quote 16)

These better connections could solve the above sketched problem partially. However, the above sketched problem is broader than the university only. Since this problem is quite extensive, more research will be needed in being conclusive.

For companies, in order to implement generated knowledge (i.e. to innovate), it is important to have the presence of a large enough sector in the Netherlands. The following features of this have been mentioned:

1. The larger the sector, the more presence of innovating entrepreneurs
2. Strong market forces to have international meaning
3. Prestige of the Dutch sector
4. Presence of technological sophistication in the Netherlands to show it to potential foreign investors and
5. Experimentation possibilities and an innovative pilot area.

The trajectory from knowledge to implementation can be tough. Certain preconditions need to be in place to take knowledge to the market, for instance a “healthy” sector where creativity and entrepreneurship thrive, as one respondent mentioned:

“There will be more movement when there is healthy sector development” (Kees Lokhorst, quote 17)

Sometimes, insights need time and sometimes insights need to wait for other developments before they can be implemented.

6.1.7. Leadership and innovation practice
A number of propositions have been brought forward by respondents, see below. There are no directly visible contradictions.

Multiple respondents have mentioned that the supply businesses have the lead in innovation. They also have the needed financial capital in order to do investments. However, before they do investments, the decision maker (i.e. CEO, founder) needs to believe in the feasibility of the idea and needs to believe in the future cash flows generated from that idea. In some cases, there are smaller companies hooked in for specific knowledge and to speed up the innovation process. The supplying business also collaborates with progressive farmers in experimenting with technologies. The following quotes illustrate the above:

“In the broiler sector I think it is mainly the exporting equipment businesses [that take the initiative in innovative farming concepts]; SMEs, who live from the export (...) of machinery” (Bram Bos, quote 18),

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“I think it is often necessary that large companies take the lead. Smaller companies can join for their specific knowledge (...). ...but without larger companies it is difficult to succeed, anyway there needs to be a strong leader” (Ruud Duijghuisen, quote 19)

There are also progressive farmers who have innovative ideas, but they are lacking investment capital.

In the market introduction phase, a powerful party is crucial, however the Dutch sector lacks such powerful parties, see the following quote:

“There are opportunities, (...) a strong party should intervene. We do not have such strong parties in the Netherlands anymore. We had them in the past, but we do not have them now, currently” (Cor van de Ven, quote 20)

The government is reluctant taking up this role, see paragraph 6.1.9.

6.1.8. Level of knowledge among actors

An important topic that has been mentioned quite a lot in many interviews is the perception many people have of livestock production. This perception is not really based on proven knowledge, but is rather emotional. The issue here is animal welfare; people have a perception of how animals are feeling, while this would be contradictory with our proven knowledge of animal welfare, see the following two quotes:

“we may think we have a coherent narrative, but it still may clash with something that has not been articulated and evokes [...] resistance. Take for instance the perception of happiness of animals by citizens, some of whom will not be convinced animals are happy even in a well-designed barn.” (Bram Bos, quote 21)

“I think that if I were chicken, I would definitely not want to be part of those new concepts. But if the consumer likes it, we do it.” (Jan Odink, quote 22)

The emotional perception of animal welfare would be strongly embedded in people’s minds, that it would not be possible to falsify it with knowledge and that companies have to take it into account when designing production systems. Besides the way in which animals are being held, scale is also considered to be important. Efficient, large-scale production could per definition not be in harmony with people’s emotional perception of it.

Besides the issue concerning emotional perception, there is the issue of limited knowledge of actors in the public sector. Actors in the public sector have relatively limited feeling with the sector and limited knowledge of it as the following quote indicates:

“They know those new systems not well enough, too little knowledge at municipalities” (Marijke de Jong, quote 24)

The ‘Productschap Pluimvee en Eieren’ was a sort of interface between the public sector and the broiler sector, but is now because of a political decision gone, leaving the sector with lesser presence on national executive level. Insights regarding needed decisions on national level, based on knowledge from the sector, becomes, because of this, more difficult to address.
6.1.9. Market dependence

Dutch chicken-producing companies can change their products and production methods, but market demand is a prerequisite for such developments. This is a chicken-egg story, of retailers’ market demand and production. As one respondent mentioned:

“That’s the positive thing of the concepts that are being developed now: the retail is committing themselves to it, so there’s quickly large volume, the slaughterers can adjust themselves to it, there can be organisation of various things related to it. But large volume is necessary” (Jeroen van den Hurk; quote 25).

The government is not willing to interfere and wants to leave such developments to the as one respondent mentioned:

“That’s up to the market, we as government are not going to stimulate on that. That’s also close to discussions around [illegal] government support” (Anonymous; quote 26).

Such market developments take time and that can be problematic for the following reason. The sector could become less likely to be able to compete with the world market and therefore product differentiation is important to distinguish the sector’s produce from the world market. Chain management is important in this case, see the following illustrative quote:

“A chain manager: if there is none, there is no possibility for rapid change. That’s extremely important for innovation” (Jan Odink; quote 27).

The firms who had the ability to organize and control the supply chain of chicken, have because of the fragmentation of the supply chain become less powerful. Therefore, they are less likely to be able to do the needed chain management in organising the change that is needed in making some innovations an success.

Besides the issue of market dependence of chicken-production companies, there is also the issue of the dependence of tech companies on the export market. The shift of the Dutch sector towards more animal-friendly production methods has therefore implications for innovation as well. This is perceived as problematic, because the export demand is different: abroad, there is not such development on animal welfare, but rather on increasing production efficiency and on food safety, see the next quote:

“We have in the Netherlands a very high standard of living, which allows us attention for many aspects of quality of life. We should however always remember that there is still a very large part of mankind fighting for survival for whom it is a luxury situation to be able to think about these aspects [animal welfare]” (Theo Bruinsma; quote 28).

So the direction of the development of the Dutch sector does not correspond with the nature of export demand. This is a threat to the Dutch exporting tech companies, as the developments they must do for the Dutch context will not deliver the revenues from abroad that are necessary for remaining prominent innovating companies.
6.1.10. Path dependence

It has been mentioned that the Dutch sector is quite traditional, and that their innovations are building on what has been achieved, as the next quotes indicate:

“So everything that is available in standard solutions is a strong determinant of where companies are innovating on. They have a strong tendency to continue a certain technological trajectory, because they have invested in that already.” (Bram Bos; quote 29).

“It [innovation] is nearly always a fine-tuning of what companies have been working on” (Jan Wolleswinkel; quote 30).

Such standardisation is strongly determining whether tech companies find a certain radical innovation interesting and if they want to invest in it. However, despite the path dependency of innovation of established firms, there has been introduction of radical new innovations, such as the Cardinal Point from Wageningen University. See the next quote:

“...such a development has led to innovation networks...” (Kees Lokhorst; quote 31).

This really looks like the establishment of a new innovation system (see literature review for definitions) that can foster innovations different from those of established companies.

6.1.11. Social acceptance

The social acceptance of the broiler sector in the Netherlands seems to be under pressure. This is because of “area pressure, ambient pressure and societal pressure” (Jeroen van den Hurk; quote 32). Scaling is therefore hard to achieve. Also important in this discussion is the use of tech in agrifood production (this refers to the emotional perception mentioned in ‘lack of knowledge among actors’). See the next quote:

“But, it is, the technology we have, we know, we find that poultry farming scary. We actually want to just see the chickens walking outside” (Arnoud Leerling; quote 33).

There is discussion going on at this issue, because the use of technology in food production is important, as the following quote states:

“The combination of high tech with agro provides us with opportunities. There is being investigated to what extent NGOs are ok with this and what they think is interesting and legitimate” (Gertjan Fonk; quote 34).

The sector will possibly have to adjust on certain matters, see the next quote:

“...there has to been done something to get that link with society back. (...) There’s a lot to be done: getting trust, transparency, perceptibility, connection. So also on that social connection there will need to be a lot of innovation”. (Kees Lokhorst quote 35)

Besides innovation, ‘story telling’ is a measure too, as the next quote indicates:

“we’ll need to tell from our perspective why we do things” (Anonymous; quote 36).
Social media and its low-threshold for users plays a role in this case, as information flows very easily, which can help spread negative aspects of chicken production really quickly. The discussion seems to continue regardless of the legitimacy of the previous mentioned things, see the next two quotes:

“...the importance of the intensive [livestock] sector decreases. That's also the case in surrounding countries” (Cor van de Ven; quote 37)

“...gradually, an increasing portion of the House [of Parliament] is very critical about intensive livestock farming” (André van Straaten; quote 38).

These quotes indicate that the position of the broiler sector in society has changed and that the different informants are struggling to interpret this development.

6.1.12. Social context

Entrenched thought patterns are a constraint for innovation. Some respondents have mentioned that actors in the sector are conservative and unwilling to change, while when change has been enforced, either by market of regulation, it turns out to be working really well. In other words: actors can learn from the past. In contrast, some respondents say the sector is not conservative, just like the next quote

“In the sixties, there wasn’t real specialisation in broilers and production chicken. And to, so to say, establish such a huge industry in two generations of time, that’s not realisable with conservatism” (Kees Lokhorst; quote 39)

Thus, the social context cannot be qualified with the use of just one concept.

6.1.13. System rigidity

Respondents have mentioned their concerns about the negative impact of the fragmentation and specialisation of the supply chain on the sector’s ability to adapt, the ability to be responsive to changes, and the ability to innovate the system. Moreover, the more radical innovations require more extensive change (see also 6.1.7 and 6.1.9) and established forces will prevent such changes from happening in order to protect their current interests. Examples of such established forces, besides the incumbent firms, are branch-organisations that want to protect all their members, including the weaker ones, and retailers because they need to protect their competitive position.

Another issue is the carcase balance4; when introducing a new market concept, one must market any part of the chicken, which is more than just breast fillet. This issue is so important, that prices can quadruple when this is done badly. The attractiveness of proposing different market concepts based on different production standards is therefore low; introducing different production standards requires extensive system innovation (see 6.1.9).

Apart from the system’s complexity, the circulation speed in chicken farms is high (every 6-7 weeks there is a new batch of chickens), which provides possibilities for sudden changes on for instance genetics, feed, or shed management.

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4 ‘Carcase balance’ refers to efficiency in use of the different parts of the slaughtered broiler
6.1.14. The social component of innovation

Innovation does not just concern technologies and production processes there is a social component in it as well, as the following quote illustrates:

“It is not just about production and production processes, but not least importantly also about how organisations interact and how those social processes, how one can innovate in that” (Kees Lokhorst; quote 40).

This would make broader application of knowledge possible, for instance more use of technology in agriculture. Besides, different social processes (e.g. open source innovation) would help to foster cooperation between parties with different interests, see the next quote:

“Circulation of existing knowledge, the facilitating of all those different people talking with each other, and inspiring each other” (Anonymous, quote 41).

Another social component is the perceptibility of innovation, as this would help in creating legitimacy.

6.1.15. The ‘why’ of innovation

So, as the heading already suggested, why is the sector actually innovating? A number of reasons have been extracted from the transcripts. These can be formulated as follows:

- Innovation because of changing consumer demand: The consumer is changing its food consumption pattern (e.g. pays more attention to food and increasingly values small scale). These changes ask for a change in production.

- Innovation because of competition: Innovation is a way to keep ahead of competitors; to maintain the lead

- Innovation because of demanding customers/society, as one respondent mentioned:
  “I think innovation is driven the best and the most, when it happens in a challenging climate. Nothing is better for suppliers of technological solutions, than to have to serve a dominant industry which is demanding and progressive. There is no country in the world where high production, fast innovation, technological development and a demanding society are so closely concentrated as the Netherlands” (Theo Bruinsma; quote 42)

- Innovation because of large potential on the world market.

- Innovation because of critique: there has been quite a lot of critique on the sector regarding animal welfare. This has called for different innovation:
  “I think the critique on the system has been the reason they have been seeking this development” (Jan Wolleswinkel; quote 43).

These innovations are not just only for the Dutch sector as it turns out some of them are exportable as well.

- Related to the previous point: innovation because of problems related to production and willingness to solve these problems. In the past, innovation was mainly aimed at maximising production results while nowadays it is also aimed at boundary conditions such as the health of the environment.
- Innovation because of curiosity: some people have a desire for better understanding things, which generates new insights that can be implemented. This could be called “knowledge push”: there is knowledge available that can be applied.
- Innovation because of a desire for more sustainability. This is a clear, shared vision of many people. Vision leads to innovation. In the sector, vision is according to only one respondent lacking.
- Innovation because of pressure on margins. When margins stay intact, there would be no incentive for innovation.

Reasons to innovate are different from each perspective. This has not sufficiently been addressed in the above sum-up. This will be taken into consideration next paragraph by further synthesis of the data. Besides, there can be communalities in the above-mentioned reasons to innovate, which will also be addressed in the next paragraph.

### 6.2. Categorisation

In the previous paragraphs, 15 insights have been proposed by the researcher, based on the structured (i.e. first order coded) data. The data underlying these 15 insights have communalities and differences and therefore it would be interesting to further synthesise the structured data in order to find the interconnections between codes and underlying data. This will provide better overview. From this synthesis, the researcher has found three major categories of data that can provide leads to the success factors of innovation in the broiler sector. These categories do not represent things different from the 15 earlier mentioned insights, nor do I propose any causal relationship between the insights and the categories. Rather, the three categories are “aggregated dimensions” (see Gioia et al., 2013), developed from the 15 insights. See paragraph 5.2.3 for a description of this process. Therefore, the 15 insights can, in the context of this enquiry, be seen as aspects of the dimensions. The three dimensions are as follows:

1. Guidance
2. Dynamics
3. Facilitators

The above three points are the names I gave to the three different dimensions of the success factors of innovation. The first one (‘guidance’) is about the necessity of reaching consensus among stakeholders/actors on what the problems are that justify/demand innovation. If this (i.e. ‘guidance’) is not done properly, there may be innovation that is, at least on the longer term, going to be preempted by new developments. The second one (‘dynamics’) is about the social processes and dynamics that are necessary for the innovation process itself. The third one (‘facilitators’) is about the preconditions that need to be in place to facilitate and accelerate the innovation process.

I will now discuss the three dimensions, in the paragraphs 6.2.1, 6.2.2 and 6.2.3, respectively. Each of these paragraphs will start with what the second-order codes (or: ‘aspects’) are that belong to that specific dimension. The data where the text is based on can be found in the previous paragraph, paragraph 6.1.
6.2.1. Dimension 1: ‘Guidance’

This dimension originates from the following insights (see paragraph 6.1):

- Alignment of interests (see 6.1.1)
- Effectiveness regulation (see 6.1.2)
- Flexibility regulation (see 6.1.4)
- Level of knowledge among actors (see 6.1.8)
- Social acceptance (see 6.1.11)
- The ‘why’ of innovation (see 6.1.15).

The two codes regarding regulation (i.e. effectiveness and flexibility regulation) could have been placed under dimension #2 as well, but a major part of the data relates to the first category, as it turns out that regulation/legislation is related to guidance of the search to innovations. A minor part of this data relates to dynamics, which will be discussed next paragraph.

Main points within dimension 1:

The food demand of the Dutch consumer has been changing. I assume here that the need for food security, food safety and food quality has largely been sufficiently met and that this explains people’s need for food ethics of ‘how’ the food has been produced (see Figure 11). This assumption is underpinned by data, as respondents have mentioned the difference between abroad (focus on food security and food safety) and the Netherlands (focus on animal welfare and sustainability, which is here considered to be ‘food ethics’), see for instance quote 28. ‘Food quality’ and ‘aesthetics’ have not explicitly been mentioned by respondents; it is based on logic. These two can be ignored, however, as it is not important for the remainder of the report. Later validation with some of the respondents learned that they agree upon the appropriateness of Figure 11, although they see, also in the Netherlands, different segments of consumers of which some care about food ethics, while others are not that wealthy to do so. The latter group would prefer cheap meat and would not care about food ethics. Besides the previous, the respondents also mentioned that the freedom of those lower segment consumers in choosing for cheaper meat is being restricted by an overall, segment-wide increase on animal welfare.

Figure 11. Researcher’s assumption in interpreting people’s desire for more animal welfare. Food security is here considered to be the most basic need, followed up by food safety and food quality. Once these have been met, people will begin to concern about the ethics and (assumed) aesthetics of food production. The picture is adjusted from Maslow’s hierarchy of needs (Maslow, 1943)
Because of people’s need for better food ethics, in which animal welfare is the most important issue, the sector needs to perform different innovations as well. From the interviews that have been held, it became apparent that the people (mainly from within the sector itself) criticise the tendency towards more animal welfare by calling the way in which it is done ‘emotional perception’ (ignorance of facts). This indicates the possibility of two possible situations: the interviewed people are for some reason unwilling to change towards more animal friendly production processes, or: the interviewed people indeed acknowledge the importance of more animal welfare to the consumer, however consensus on what “animal welfare” would mean is lacking. The interviewees mentioned that the discussion on animal welfare was carried out based on emotional perception, rather than fact-based discussions. Besides, there is more than just animal welfare where there can be progress, there is also issues such as feed conversion and carbon footprint. There are innovation in which animal welfare increases, but where there is deterioration on for instance feed conversion. Therefore, I believe that the interviewed people do indeed acknowledge the important of more animal welfare to the consumer, however they consider that in the larger picture (i.e. other factors that are also relevant, such as feed conversion).

The facilitators of discussions about animal welfare are the NGOs in this field (Animal Protection Agency and Alert Animal). These NGOs have brought this not-good-enough situation on animal welfare to discussion, both in the public field as well as in the sector. This has led to actions of various actors in order to take steps in improving animal welfare. One of these are the research programmes ‘Caring for Hens’ (completed in 2004) and ‘Broilers with Taste’ (completed in 2011). These research programmes have yielded new designs (for one of them, see Figure 4, paragraph 3.2), providing a solution to production methods with better animal welfare. Another measure to addressing this animal welfare issue was the introduction of the ‘Better Life’ trademark in the Dutch retail. Not everyone within the sector agrees upon the appropriateness of the criteria of this trademark, as a lot would be based on emotional perception of the welfare of production animals, rather than criteria based on facts. From this, the question arises whether the “facts” people from the sector (i.e. the interviewees) talk about are brought into the public debate. This is needed for a well-balanced decision making and innovation guidance.

The above is by the informants perceived as problematic, because there is more than just animal welfare, such as carbon footprint and use of resources (e.g. fuels, feed). This causes competition of legitimacy between different optimisations, such as the optimisations on animal welfare and optimisations on sustainability issues. Paragraph 3.2 shows two illustrative examples of such different optimisation trajectories. The role of the government in this discussion can be seen as reserved. The government wants to leave developments such as ‘Chicken of tomorrow’ and ‘Better-Life’ chicken to the market and even permits import of cheap chicken from abroad (e.g. US, Brazil, Ukraine). However, the government wants the sector to become more sustainable, but various parties in the sector dispute the direction of change towards the ‘Better-Life’ chicken because of worse carbon footprint and feed conversion. Competition from alternatives for the ‘Better-Life’ chicken is not, at least on a larger scale, present. There is an alternative, of regular, highly efficiently produced chicken, but it is not (yet) in the market. The customer has no choice, but to accept the, in

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5 The researcher assumes here that these sustainability issues are part of ‘food ethics’ as well, next to animal welfare.
some people’s view, less efficient, less sustainable chicken, even though it better scores on animal welfare. The question rises to what extent the government bases it decisions on independent, factual information regarding increasing sustainability. The reason for this question to arise is that the aspect of ‘animal welfare’ would be overly emphasised. Some respondents have said that the politician influence on increasing animal welfare is considerable, while sustainability-aspects would be of less importance. The Animal Protection Agency has mentioned that their advice is being well adopted by politicians, whose advice is strongly aimed at animal welfare. A conclusion from this could be that more representative streams of information would lead to better decision making and, consequently, a more well-balanced attention for sustainability.

Besides people’s desire for better food ethics and the exact interpretation of that, there is indication of issues regarding the relationships of the broiler sector with society. Different things have been mentioned. First, the role of meat in people’s every day diet would change and decrease in importance. Second, the extensive use of tech in the broiler sector is bad for the perceptibility of it, which would easily result in discussion on an emotional level, rather than on a factual level. Either, there has to be innovation on better perceptibility and transparency of the sector, or else trust would need to be restored by ‘story-telling’.

6.2.2. Dimension 2: ‘Dynamics’
The insights that led to this dimension are the following ones (see paragraph 6.1):

- Importance of networks and connections (see 6.1.5)
- Leadership and innovation practice (see 6.1.7)
- Path dependency (see 6.1.10)
- Social context (see 6.1.12)
- System rigidity (see 6.1.13)
- The social component of innovation (see 6.1.14).

These six codes have communalities that could be originating from the fact that, in general terms of speaking, change is difficult.

Main points within dimension 2:

Innovation in the broiler sector requires extensive dynamics for enforcing the required change in the implementation (i.e. market introduction) phase. The reason is the rigidity of the system caused by the need for carcase balance. If one does not take care of this properly when introducing a new concept, prices might quadruple. This makes radical innovations hard to achieve, because of the fragmentation and specialisation of the supply chain. The more firms specialise, the more important the connection becomes for idea exchange and an integrative approach. Besides, spill-over of knowledge between knowledge domain should not stall (see quote 14, in paragraph 6.1.5), which is another argument for the importance of dynamics and connections. This calls for focus on cooperation for innovation as well as a powerful chain manager that can enforce change. Different informants have mentioned the importance of chain-wide innovations, in which the various chain-links cooperate with each other in innovation. This would be needed in reaching further progress. This is hard to achieve, because there can be different interests and the division of revenues

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6 ‘Carcase balance’ refers to efficiency in use of the different parts of the slaughtered broiler (the carcase)
generated from that innovation can be tough to organise. This is the paradox of collective pie-growing versus pie-sharing; individual companies can fight each other to get a as largest market share as possible, while they could also allocate their resources to cooperative innovation. This would make the market larger, what would benefit all of them. It has been mentioned that trust, clarity and allowance would be facilitators of this cooperative process. Also, vision, a clear action perspective and leadership could help motivate people to take part in such collective efforts. An example of a clear action perspective is the ‘Better Life’ trademark, however this is not widely enough supported.

Large poultry equipment manufacturers often take the lead. They also possess the resources that are required for innovation. However, their resource allocation tends to be in favour of ‘path-dependent’ innovation. This has been mentioned, but not that specifically and verifiable. The desire to succeed and to innovate would be in place, though thought patterns can be entrenched. Projects such as the Cardinal Point (see paragraph 3.2) have proven to be able to interfere in such entrenched patterns of thought. However, if developments and the ‘what’s-in-it-for-me’ factor are clear, change can evolve real quick as this could be learned from the replacement of the lay battery (in the layer sector) and, in the broiler sector, the introduction of the ‘Chicken of tomorrow’-standard (see paragraph 3.2).

Many respondents have mentioned the social processes leading to innovation. Better connections between companies would lead to increased R&D potential. Besides, idea exchange between people would be important for innovation and for this, connections and cooperation would be useful. More focus on such social processes would be fruitful. This could address societal acceptance as well, by involvement of them in finding solutions together. Also the value of connections between different fields of knowledge has been mentioned, for instance the applications of various technologies in the broiler sector. This would require “social innovation”, which is new social processes in innovation. Key words regarding this topic are: connections, partnerships, cross-overs and clusters.

Lastly, poor adjustability / flexibility of regulation and regulators put a constraint on innovation.

### 6.2.3. Dimension 3: ‘Facilitators’

This category has been developed from the following insights (see paragraph 6.1):

- Finance difficulties and risk/uncertainty (see 6.1.3)
- Knowledge development (see 6.1.6).
- Market dependence (see 6.1.9)

These three, finance, market and knowledge development, are here considered to be facilitating the innovation process.

**Main points within dimension 3:**

The innovation process is unpredictable, leading to a unpredictable outcome. Therefore, there is need for funding of innovation processes, aimed at covering risk. Subsides are not appropriate for covering these risks, and therefore there is need for different structures, such as SBIR. Besides, when more extensive innovation are concerned, innovation that require system change, there can be a chicken chicken-egg situation, as the situation is with respect to market formation. In that case, there is need for a strong actor that can enforce change and that can ensure the retail that production will be as expected and that can ensure the producers that the retail will have demand for the product. In
this alignment of production and market demand, there is need for a stronger chain manager or intervention by the government. The latter one is not always an option because of legal issues.

Besides the previous, it has, because of the top-sector policy, become harder for companies, especially SMEs, to make use of public funding. The reason is difference in research agendas of the public and private sector and the long-term character of many of the public research topics. Since many problems demand an integrative approach, research needs to have such an integrative approach as well. This demands for connections between university departments and disciplines or research. As explained in the previous paragraph, paragraph 6.2.2, an integrative approach is, because of the strong specialisation, difficult to organise. Besides, many companies have considerable abroad and are also dependent on that for financing their innovation activities. This also explains the difference in research agendas of public and private sector, as the public sector seeks to address domestic issues, whereas the private sector, in very general terms of speaking, seeks to address issues that are important worldwide. Based on this, the question rises whether a better representation of their interests in the public domain would solve these problems.
7. Discussion

As shown in the previous paragraph, the results from the interview data analyses can be categorised in three major topics, i.e. ‘guidance’, ‘dynamics’ and ‘facilitation’. In this chapter, each of these categories will be discussed with the inclusion of findings from the literature review, see chapter 4. Lastly, in this paragraph the limitations of this study will be described and the implications of that for making up conclusions.

Guidance

The guidance of innovation refers to the ‘landscape developments’ (i.e. macro-level developments, see paragraph 4.5) that determine which innovations are needed and are therefore likely to happen. Major developments are societal interference because of more societal attention to negative production externalities of the broiler sector, of which animal welfare is an important issue. Besides animal welfare, there is concern about topics such as carbon emission, particulate matter emission and use of antibiotics. Influential NGOs, such as the Animal Protection Agency, have played an important role in making the sector address animal welfare more. This has led to new technologies, by which the zero use of antibiotics has become possible. However, not every actor agrees upon the legitimacy of these new production systems. Their major concerns are that it increases feed conversion (i.e. the broiler’s feed efficiency is lower) which is negative for feed import reduction.

As has become apparent from the results, the informants perceive differences in optimisations, i.e. some tend to optimise on sustainability (e.g. carbon emission and feed conversion), others have the focus on animal welfare (e.g. optimising for the Better Life trademark), while at the same time there are concerns about environmental issues that need to be addressed (e.g. particulate matter emission and use of antibiotics). These differences can lead to sub optimisation and therefore a better alignment and integration of interests would be fruitful to more effective development. From literature, a need for a more holistic approach by innovation has been advocated as well (system approaches to innovation, see paragraph 4.2). In this approach, innovation is being driven by demand-pull rather than technology-push and can be done by processes of multi-stakeholder involvement (see paragraph 4.8.2). However, from the results seems to have become apparent that such multi-stakeholder involvement needs to be well-organised, in terms of equal representation of each stakeholder group. In the case of the broiler sector, the animal welfare-lobby has a strong influence on innovation in the broiler sector, by which there is a lot of development on animal welfare, while sustainability issues and environmental issues are left behind. From this could be concluded that equal participation of the different stakeholder groups is important in order to get an unambiguous action perspective (or: roadmap) which is shared by every stakeholder.

Besides the previous, there seems to be a difference in interests as well. The economic interests of the broiler sector abroad are extensive; Dutch poultry equipment is being sold all over the world. Abroad, there is little attention to animal welfare, while technology development in the Netherlands is increasingly being aimed at adding more value on animal welfare performance. From this, the question rises whether the role of the Dutch sector abroad, in increasing the production standards in other countries, is sufficiently acknowledged by actors in the Netherlands that try to enforce more stringent production regulations. Because of the easy flow of state-of-the-art production technology and (embedded) knowledge, the sector needs to be able to innovate quickly in order to keep ahead
of international competition. This is becoming increasingly difficult in an economic situation in which the market tends to open up more and more to foreign produce. The presence of a considerable production sector in the Netherlands is as described a prerequisite to innovation, at least when innovation for the export market is concerned (see paragraph 6.1.5). As from the theory of the comparative advantage of nations (Porter, 1990) can be learned, an industry will become prominent in the nation where the most important market is located. This would mean for the Dutch technological sector that the societal developments that are going on would have as consequence that moving the development of the technology to some other country needs to be considered. On the other hand, from the same theory can be learned that in demanding markets there are the so-called “early warning indicators” for customer demand. This could also be the case in the Netherlands; the societal discussions that are going on in the Netherlands are according to that assumption a logic cause of the development of society and, therefore, such societal discussion will eventually going to be in other countries as well. More research is needed to draw unambiguous conclusions regarding this matter.

Dynamics

In order to get the interests of different parties aligned and integrated, there is need for certain social dynamics. Moreover, these dynamics are needed for the an appropriate innovation process that is demanded by the nature of the challenges. As described, the Dutch sector is fragmented and specialised onto numerous companies that are good at optimising their own activities. The integration of the interests of these companies, which is their common interest, needs attention because these companies have their competitive concerns, and, besides, they have a certain mental model which has been aligned with their way of working (see paragraph 4.4). This demands for so-called “social innovation”, in which different social processes are developed in order to foster generation and exchanging of ideas that can benefit all of them. The exact nature of this “social innovation” needs to be investigated; it has, besides the notion that better connections between separate companies are necessary, not been mentioned what this “social innovation” would include. From literature can be learned (see paragraph 4.8.2) that this can have something to do with a more bottom-up approach to innovation, through collective, multi-stakeholder learning processes. This could possibly allow for the generation of entirely new ideas for the sector, fostered by the exchange and combinations of knowledge and ideas of different types and from different sources. An example of such a thing is cross-sectoral innovation, just like the HT2FtW technology roadmap, in which food production innovation and technology development are integrated (see paragraph 3.1). In parallel to this, Malerba (2004) mentioned the importance of sectoral dynamics for the processes of generation of variety and selection (see paragraph 4.6). This ‘sectoral dynamics’ consists of new technologies and new processes, but also new firms. As Malerba (2004) mentioned, entrance of new firms can be constrained by the necessity of advanced integration capacities. This seems to be the case in the broiler sector, as there is a considerable amount of regulation and needed knowledge regarding production. Lowering the threshold to entrance, by lowering the need for advanced integration capacities can be done, in a logic way of reasoning, by increasing transparency and elimination of complex processes and procedures. By such ‘sectoral dynamics’, appropriated patterns of thought and action (see paragraph 4.7) can be opened up. This may result in more openness to new approaches and, if necessary, a new paradigm of production innovation, which is more multi-functional/circular. As from paragraph 4.8.2 became apparent, such a shift from linear processes of
learning towards more circular and shared ones can, through combination of different things, lead to new ideas.

The importance of the network to organisations in doing innovations is not new. Batterink et al. (2005), although in a different agri-food sector, established the same conclusion. They could not establish a positive relationship between innovative output of companies and inter-organisational cooperation, but did find a positive relationship of innovative output with sourcing information from the network (from both competitors and suppliers). They conclude that, because of the typical interdependencies of agrifood companies on other chain partners and because of the potential advantages of cooperation, the network seems to be underutilized. In the present study, it relates to the integral approach in innovation (see paragraph 6.2.2). I want to add to this that, besides increasing cooperation within the chain, cooperation between companies within and outside the sector could yield interesting ideas for innovation as well (see paragraph 4.8.2 and 6.2.2). However, it needs to be mentioned that cooperation is certainly not the only determinant of innovation and that therefore the use of cooperation must not be overestimated as there are other determinants of innovative output of Dutch agrifood firms as well (Batterink et al., 2005).

As briefly mentioned in the results, regulation can put a constraint on innovation. From theoretical insights can be learned that “leading innovation networks are based on good relationships of exchange among the institutions of science and technology, industry and political systems” (Smits et al., 2010; paragraph 4.8.1). From the results (see the quotes 5 and 10, in 6.1.2 and 6.1.4, for illustrations) came apparent that regulation can be constraining innovation; from literature can be learned that better exchange relationships technology development and political systems could be helpful. There seems to be some connection with the dimension ‘guidance’, regarding this matter, as it seems that a lack of ‘guidance’, as described above, is at the root of the problem.

**Facilitation**

As already mentioned under the heading ‘guidance’ in this paragraph, export demand for poultry production technology is different from the home demand. As sketched out, this can be problematic since the large, exporting equipment manufacturers are having the lead in innovation. If they lose their export market, or if they move their production to abroad, there will be no corporate funding left for the developments needed for the Dutch situation. Without corporate funding, there cannot be innovation, since the Dutch top sector policy requires a minimum of 50 per cent funding from the private sector in PPPs. Therefore, it is, as described under the heading ‘guidance’ in this paragraph, important that the interests are wisely balanced, so that the Netherlands can remain doing the innovation which are needed, both for the export market as well as for the home market. A feature of this is room for experimentation. As mentioned in paragraph 6.1.5, the presence of a considerable large sector in the Netherlands is important in remaining innovative. This is important in keeping up with addressing the negative production externalities that are under societal discussion.

An alternative is the bottom-up approach to innovation as described in chapter 4 (in different paragraphs). This will allow for context-specific innovations, for instance innovation specific for the Dutch context. However, since this would mean a paradigm shift, it would require extensive institutional change from the sector. Features of such a different paradigm are short food supply chains, multifunctional agriculture, rural livelihoods, new institutional arrangements and economies of scope (Marsden 2003; Roep & Wiskerke, 2004). Research and related innovations will in this case,
generally speaking, no longer be centralised in the form of specialised research institutes, but will rather develop in networks of different actors.

**Limitations**

This paragraph will discuss the methodological implications on drawing conclusions from the results.

The grounded theory approach used in this study allows for great reliability; it is likely that any other researcher, when adopting the same research methodology, would eventually come up with the same theory. However, as mentioned in paragraph 5.1.1, the informant selection was done through a snow-balling method, by which the final selection is dependent on the researcher’s starting position and the course of the ‘snowball’. The selection I applied to potential informants (see also paragraph 5.1.1) has reduced this potential variance somewhat. The implication of the previous in making up conclusions is that the results may not be generalised to the whole broiler sector, but must remain limited to the part of it that is represented by the informants. Specifically, this observed part is exporting poultry equipment manufacturers and the Dutch primary poultry production sector from the perspective of representatives (see Appendix II). I interviewed representatives from different perspectives (e.g. a NGO, branch organisation), which is triangulation of data sources and which helped to reduce the influence of informants’ work field-related biases on the results. Secondly, because of potential variance in the used snow-balling method, by which different selections can be developed in case researchers with different starting positions and different personal characteristics would be employed, can lead to different results, though there is no clue about how strong these two are related. On the other hand, however, the extensive triangulation of data sources (the variety of interviewees, for instance equipment manufacturers versus policy makers versus researchers) allows for developing results that are widely shared within the sector. The downside of this is that the results can lack specificity. A more focussed case study on one innovation system could have provided a more specific and dynamic view, just like is done in the research to the Rondeel7 innovation system (by Klerkx et al., 2010). Because the researcher had only one perspective (i.e. the one of himself) he is not able to judge whether a different perspective would lead to different results. Some of the findings from the data analysis have been validated with the interviewed informants, which has increased the internal validity of the results. But still, the exploratory nature of this research calls for validation of the results in future studies. The findings for this research can provide a lead on what research questions for further research can be relevant.

Further indicators of the reliability of the data is that data saturation was reached early, and that validation of the in this report used quotes did not result in relevant changes. The reliability of the results may be negatively influenced by the fact that the data analysis was conducted by my person only, what may have resulted in developing confirmation biases (Gioia et al., 2013) along the way. Therefore, the definition of the conclusions has been done in a reflexive way, in consideration of the data, the insights from literature and results.

Besides considering the reliability of the results, validity issues need to be considered as well. Although some of these issues have indirectly been addressed above, I will elaborate now on these a bit more. Construct validity has been negatively affected by the interviewees’ interpretation of

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7 The Rondeel is a barn design similar to the ‘Cardinal Point’ in a very closely related sector (the layer sector). The case study on Rondeel could provide interesting insights for the broiler sector
interview questions. For example, when the researcher asked: “What do you think what the success factors of innovation are?” the interviewee might have interpreted this question as: “He wants to know from me what I think what needs to be improved for more innovation”. Such misinterpretations of interview questions are hard to detect. However, this has been present from the beginning, making it a consistent measurement error. Therefore, the data could relate to “what needs to be improved to make innovation better or more present”, rather than “what factors need to be in place for making innovation possible”, which was the actual research question. The process of going from transcribed interviews towards the results has been made as transparent as possible, by describing the process in paragraph 5.2 and by making the line of theory building explicit by the process of synthesising the 1st order codes in in the paragraphs 6.1 and 6.2. Furthermore, in this chapter it has been tried to triangulate the theory developed in this study with the theory that is described in chapter 4. The previous will have increased validity, although the fact that there was no investigator triangulation (I did it all on my own) needs to be considered. This results in the need for a prudent process in making up conclusions. This has been tried to accomplish.

Generalisation of research data, as demanded by sub research question 8 (see paragraph 2.2.2), is, when considering the limitations provided in this paragraph, not justifiable. Some findings however can be used as groundwork in formulating research questions, that seek to validate them in different contexts.
8. Conclusion & recommendations

The main research question in this study is “What are the critical success factors of innovation in the Dutch broiler sector?” From the data analysis (paragraph 6.1) and results/discussion (chapter 0), a number of success factors can be derived. The critical success factors will be provided next. For a full understanding of them it is necessary to refer to the results (chapter 6) and the discussion of the results (chapter 7).

First of all, there is distinction in the interests of different stakeholders. When freedom to act is limited, like in the Dutch situation where negative production externalities are widely discussed, there needs to be discussion and subsequently clear articulation, alignment and integration of interests. This needs to be well-balanced, in the sense of a balanced representation of major developments. These are for the Dutch broiler sector for instance rising awareness of the West-European customer on ‘food ethics’ and an increasing need for resource efficiency. This practically means that the current process of selection, which is possibly overly influenced by actors that care about animal welfare, needs to be balanced with sustainability aspects. Besides, the function of the Dutch sector in the gradual improvement of production standards abroad needs to be presented and considered. Fact-based decision making in the public domain needs to be facilitated with scientific research by some independent party. Still, the perception people have of the broiler sector, needs to be addressed. This can be done by unambiguous story-telling that the sector is taking care of the increased need for ‘food ethics’ and addressing negative production externalities. Alternatively, new production facilities should be transparent and meet the consumer/citizen’s perception of it. Because of indications that people’s requirements regarding food and food production is changing, there needs to be consideration of changed values as well. Based on that, consequences for production need to be formulated, in order to determine what the changing position this livestock sector has in society.

I would like to present the previous consideration, “consensus on what major developments are and a clear articulation, alignment and integration of interests”, as the main critical success factor of innovation. A second critical success factor relates to external orientation of companies. Both literature and interview data showed that companies need to be externally oriented in order to pursue innovations that will be successful. The reason for this is that societal actors are more concerned with production and need therefore to be part of the selection environment of technologies. Besides this, greater external orientation of companies will lead to a great process of variation, which is needed in addressing the challenges the sector faces. Processes of learning and innovation need to involve multiple actors in order to come with a holistic solution to some problems that satisfy every stakeholder. Alongside the previous, there is need for sectoral dynamics: processes of creation of variety and selection of new technologies need to be present, and continuous development in terms of new organisations, new ideas, and, new connections in order to exploit these ideas. The most important point in this, is that such sectoral dynamics contribute to overall learning and, subsequently, the required institutional change.

All this needs to be facilitated by appropriate structures of knowledge development and funding. One of the aspects of this is room for experimentation: the export market is important to Dutch poultry equipment manufacturers. In order to develop new technology for the export market, there
needs to be sufficient room for experimentation. Regulators and interfering societal groups need to have understanding and approval of this need. Otherwise, as a consequence, poultry equipment producers need to consider to replace their development to another major poultry market. Co-development of technology development and the political system is important regarding this matter, but is dependent on the main critical success factor presented above. Besides favourable research and development circumstances, there need to be appropriate funding structures as well. The connection between public and private sector, as demanded by the Dutch top sector policy, can be tough to make, especially the case of SMEs.

The recommendations that in my perspective follow from this study follow in the first place from the above-mentioned two critical success factors of innovation, which are firstly “consensus on what major developments are and a clear articulation, alignment and integration of interests”, and secondly “multi-actor processes of learning and innovation, developing new ideas and pursuing a holistic approach in finding solutions to challenges”. Further research will be necessary in interpreting these towards what needs to be done in more specific terms in more specific situations. For instance, competitive firms need to determine how they can organise such network approaches when considering their corporate structure. Representative organisations need to think about fact-based, independent information streams towards actors in the public domain, in order to find what the changed values are and what the implications of that would be for the development of the sector. An final recommendation is to do more research for validation purposes and to arrive at conclusive results and recommendations for the sector.
References


Negro, S., Hekkert, M., & Alkemade, F. (2010, June). Seven typical system failures that hamper the diffusion of sustainable energy technologies. In *Summer Conference* (pp. 16-18).


Ten Have et al. (2012), Roadmap versterken menselijk kapitaal en sociale innovatie; een gezamenlijk initiatief van NWO, TNO en Syntens


### Appendix I. First order codes and frequency of use

<table>
<thead>
<tr>
<th>Second order code</th>
<th>First order codes</th>
<th>Count</th>
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<td>alignment of interests</td>
<td>Chain wide optimisation/innovation is needed</td>
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<tr>
<td></td>
<td>Different interests with regard to animal welfare and environmental issues</td>
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<tr>
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<td>Different optimisations on sustainability</td>
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<tr>
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<td>Non-specificity regulation</td>
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<td>Restricted room for experimenting</td>
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<td>importance of networks/connections</td>
<td>Cluster effect</td>
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<td>Diversity in innovation increases</td>
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<tr>
<td></td>
<td>Importance of networks and connections between people</td>
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<td>leadership and the doing</td>
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<td>Importance of chain management</td>
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<td>Legitimacy of tech in agrifood</td>
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<td>Fragmentation and specialisation of the chain</td>
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**Frequency of use of first order codes**

![Frequency of use of first order codes](image_url)

*Figure 12. Frequency of use of first order codes. The 8 most used codes (of 60 codes in total) represent 36 percent of the total coded interview data. The frequency of use of first order codes provides just an indication of what topics have been mentioned most often during the interviews.*
Appendix II. Interview details
The interviews have been conducted in the period of 7th of March through 24th of May 2016. See Table for an overview of the interviewees.

Table 2. Details of the interviewees

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<th>Date of interview</th>
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<th>Company</th>
<th>Person</th>
<th>Function</th>
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<td>7-3-2016</td>
<td>Financial organisation</td>
<td>Rabobank</td>
<td>Jeroen van den Hurk</td>
<td>Sector manager poultry</td>
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<td>11-3-2016</td>
<td>Intermediary / knowledge broker</td>
<td>Food Valley Region</td>
<td>Arnoud Leerling</td>
<td>Communication, Marketing, Acquisition</td>
<td>On behalf of municipal government</td>
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<td>15-3-2016</td>
<td>Knowledge institution</td>
<td>Wageningen UR</td>
<td>Bram Bos</td>
<td>Senior researcher ASG</td>
<td>Project manager ‘Broilers with Taste’ and ‘Caring for Hens’</td>
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<td>17-3-2016</td>
<td>Company (SME)</td>
<td>Hatchtech</td>
<td>Erik Helmink</td>
<td>Director Marketing</td>
<td>Former CCO Vencomatic Group</td>
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<td>18-3-2016</td>
<td>Knowledge institution</td>
<td>Wageningen UR</td>
<td>Kees Lokhorst</td>
<td>Senior researcher ASG</td>
<td>Also lector at VHL</td>
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<tr>
<td>21-3-2016</td>
<td>Company (multinational)</td>
<td>Marel</td>
<td>Theo Bruinsma</td>
<td>Director special projects and former director on the board</td>
<td>Also chair GMV, chair NEN, chair BZW, chair Salm Partners LLC</td>
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<td>23-3-2016</td>
<td>Financial organisation</td>
<td>ABN AMRO</td>
<td>Wilbert Hilkens</td>
<td>Sector manager animal production</td>
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<td>1-4-2016</td>
<td>Branch organisation</td>
<td>NEPLUVI</td>
<td>Peter Vesseur</td>
<td>General Secretary</td>
<td>Branch organisation for poultry processing</td>
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<td>14-4-2016</td>
<td>Network organisation</td>
<td>Dutch Poultry Centre</td>
<td>Jan Wolleswinkel</td>
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<td>Former chair NOP, vice-chair PPE</td>
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<td>Government</td>
<td>Ministry of Economic Affairs</td>
<td>Gertjan Fonk</td>
<td>Programme manager</td>
<td>Former staff member InnovatieNetwerk</td>
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<td>18-4-2016</td>
<td>Regional development agency</td>
<td>OostNV</td>
<td>Hans de Haan</td>
<td>Senior business developer / projectmanager agrifood</td>
<td>Business consultant Ketensief, former senior consultant and policy specialist poultry at ZLTO</td>
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<td>Company or Institution</td>
<td>Name</td>
<td>Position/Role</td>
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<td>Jan Odink</td>
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<td>Director pig and poultry</td>
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<td>6-6-2016</td>
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<td>Dierenbescherming</td>
<td>Marijke de Jong</td>
<td>Manager ‘Better Life’ trademark and Head lobby</td>
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