MSc Thesis

Consistent quality and market oriented pork production

A study of the supply strategy of the pork supply chain from the view of a pork processor.

MSc Thesis

Consistent quality and market oriented pork production

A study of the supply strategy of the pork supply chain from the view of a pork processor.

MSc Major Thesis:	MST-80433
Student:	Marc Biermann
Registration number:	871020-067-060
E-mail:	marc.biermann@wur.nl
Study:	Master Management, Economics and Consumer studies
Profile:	Management Studies
Supervisor:	Dr. Jacques Trienekens
Chair group:	Management Studies
E-mail:	jacques.trienekens@wur.nl
Co-reader:	Dr. Nel Wognum
Chair group:	Management Studies
E-mail:	nel.wognum@wur.nl
Company:	Meatfriends BV
Location:	Industrieweg 145 Best
Company supervisor:	Dhr. Stan Quinten

WAGENINGEN UR
For quality of life

Meat Friends
verrassende vleesverwerkers

Preface

This report is written for as a MSc. Thesis at the management studies group at Wageningen university. The report is the result of a research done for Meatfriends, located in Best. Because of my personal background I was interested in doing a research in the Meat sector. Therefore I want to thank Meatfriends for giving me the opportunity to do the research. I want to thank all the employees who helped me during my research. I want to especially thank Stan Quinten my company supervisor, who gave me the chance to do the research.

Also I would like to thank Dr. Jacques Trienekens and Dr. Nel Wognum for their guidance, support and feedback during my research. I also want to thank all the people who were willing to participate in the research through interviews.

Marc Biermann,

September, 2012

Executive summary

Introduction

Meatfriends is a meat processing company producing consumer package meat products for retail organisations in the Netherlands. The difficulty Meatfriends currently has is the consistency of their supplied pork. The reason for this problem is the quality attributes used to buy their supplied pork, which are based on carcass quality. The most important quality attributes Meatfriends has for their supplied pork are meat quality attributes. These are different from the carcass quality attributes. The difference between meat quality and carcass quality is that carcass quality focusses on meat percentage and carcass composition and meat quality attributes focus on WHC, pH 24h value and tenderness. Meatfriends now only buys their supplied pork based on carcass quality, resulting in a high fluctuation in meat quality. The goal of the research is to give an advice to Meatfriends how they can influence their supplied pork to make the meat quality of the delivered pork more consistent and market orientated.

The main quality attributes of importance to Meatfriends are: colour of the meat, water holding capacity, pH 24 h value, intra muscular fat and tenderness. Generally four different areas within the pork supply chain influence the quality attributes through nine different actions. These four areas are: genotype, feeding, productions systems and slaughter procedure. Based on the configuration of the different actions a particular meat quality can be reached. The description of the desired quality of Meatfriends is as follows:

'' More tender pork with a high WHC and optimal pH 24 h value, with no high need for lean meat. ''

The configuration used for the chain should be based on this description. Next to the configuration the building and coordination of the supply chain is important to reach more consistent and market orientated pork production. The coordination and building of the chain should be done based on a quality management system containing three different areas: the quality standard, quality signals and the coordination of the chain. Based on the choices made for the quality management system the governance structure and the coordination mechanisms used are determined. The usable coordination mechanism are: contracts, information sharing, information technology and joint decision making. The research was performed to see how Meatfriends should make use of all these points and answer the general research question:

''What strategy and methods would be suited to Meatfriends BV to make their supplied pork market orientated and of consistent quality?''

Research methods

The used research method were interviews with the different chain actors. The goal of these interviews was to find out which conditions Meatfriends should take into account to make sure the configuration of the actions within the chain will be adapted and coordinated throughout the chain. Based upon the research different conditions for pork quality,

configuration of the actions taken within the chain and the coordination of the chain are set. Within the analysis these general conditions are being transformed into nine different criteria that Meatfriends should adapt to in order to reach the desired quality, introduce the configuration to the chain and the coordination of the chain.

Conclusions

The results of the research are the different conditions that Meatfriends should be aware of when starting to build the chain. The conditions are divided into the three different areas namely conditions for the quality, configuration of the actions taken within chain and the coordination of the chain. The conditions show the interests and views of all the different chain partners. Based upon these conditions the analyses comes up with the conclusions of the research. The conclusions consists of nine different criteria that Meatfriends should take into account when building their own chain. These criteria are:

Quality of pork:

1. **To make sure that farmers take meat quality into account as a driver for production, meat quality needs to be adapted into the pay-out system.**

Configuration of the chain:

2. **The genotype should be the leading action for choosing farmers, with the production system being dependable (on the chosen farmers) in the short term and the diet used changeable at farm level in the short term.**
3. **The preferable stunning method, CO2 stunning with automatic driving to the stunner should be the leading action for choosing the slaughterhouse.**

Coordination of the chain:

4. **Meatfriends needs to become the leader of the chain and determine the quality standard**
5. **Meatfriends needs to fill in the configuration of the chain to reach the desired quality based upon the views and interests of all the chain partners, to make sure the configuration is reachable and acceptable for the chain partners**
6. **The scale of the quality management system should be small (selected group of partners) and the scope (all the different chain actors should be involved) should be chain wide because all chain actor should be involved**
7. **The governance structure needs to make sure the farmers keep the freedom of choice about how much of the configuration they want to implement within their company**
8. **The coordination mechanisms Meatfriends should use are: pay-out system (instead of contracts), information sharing, information technology and joint decision making**
9. **The level of organization integration should be low**

Recommendations

Following the conclusions recommendations can be made for Meatfriends. The recommendations answers the general research question. It is a strategy that Meatfriends

can implement. Based on the different criteria set for Meatfriends following the conclusions. The strategy consist of a plan that Meatfriends can implement in different steps.

The first step for Meatfriends is to define the desired quality and to determine the configuration of the chain that fits with this quality. In table 1 the actions, preferred configuration, how this should be reached and which quality attribute is being influenced are shown.

Table 1: Desired quality configuration

Action	Preferred choice	Reached by	Influence on
genotype	Duroc breed	Search for farmer using Duroc	WHC, pH and tenderness
Diet	Low protein level	Changing the diet at farm level	Tenderness
Vitamin E	Supplementation yes		Colour
Magnesium	Supplementation yes		WHC
Production system	Conventional 0,7m2 or 1m2	Depended on the farmer in the short term	WHC, pH
Fasting	16 h > 24 h fasting (low acceptability)	Setting clear guidelines and arrangements for the different actors	WHC, pH
Pre-slaughter handling	Low stress levels are preferred		Colour, WHC and pH
Stunning	CO2 preferred above electrical stunning	Search for slaughterhouse using this method	Colour, WHC, pH and tenderness
Chilling	Usage of accelerated chilling	Depended on slaughter house	Colour positively, risk for cold shortening

The second step is to build the frame of the chain. The frame of the chain consist of a genetics company, feed company and slaughterhouse. These three chain partners will be responsible for carrying out and coordinate the genotype, diet used and the slaughter procedure. By the usage of these chain partners a frame of the chain is conducted that should secure consistency and coordination of these actions.

The third step is to find and bind farmers to the supply chain. The farmers should be searched based on the genotype they are currently using. This should be done in collaboration with the genetics company who is aware of the genotype the farmers are using. The genotype is not changeable on the short term, because it takes a lot of effort for the farmers to change the genotype in combination with a very low acceptance to change the genotype. Therefore the genotype should be the leading action for searching farmers, because the diet is changeable on the short term and the production system which is dependable on the chosen farmers has less influence on the meat quality. The binding of

the farmers should be done through the pay-out system. Meatfriends should introduce a flexible pay-out system in various stages of implementation of the configuration. The pay-out system should start with a pay-out based on the normal pay-out and the usage of the desired genotype. The further implementation of the configuration should be stimulated to the farmers by giving an extra pay-out for taken efforts in accordance with configuration, for example by changing the diet. This way the farmers can choose which effort they want to take and influence their pay-out based on the efforts they to take.

The fourth step will be the coordination of the chain. The coordination will be done by using coordination mechanisms. The first used coordination mechanism is the pay-out system. The pay-out system replaces the usage of contracts and will define the terms and conditions like actions demanded and the rewards for taking these actions. The second and third coordination mechanisms are information sharing and technologies. In table 2 an overview is given of the information necessary to share and the information technology to enable sharing. The incentive for sharing the information by the farmer is given through the pay-out system. In order to get an extra pay-out they need to show they have worked into accordance with the configuration.

Table 2: Linkage between information shared and technologies

Quality signal	**Information shared**	**Information technology**	**communicate to Meatfriends**
Genotype	Which genotype the pig has	Farm management system/ IKB	Email before delivery
Diet	Diet fed to the pig/ composition of the diet	Farm management system/ IKB	Email before delivery
Production system	Used production system	Certificate/ audit	Visit
Fasting	Fasting time	IKB/audit	Email before delivery
Lair age	Lair age time	IKB/audit	Email before delivery
Stunning	Used stunning method	Certificate/audit	Visit
Chilling	Used chilling method	Certificate/audit	Visit

The last coordination mechanism usable is joint decision making. The joint decision making should be used for the evaluation within the chain. There should be made use of two types of evaluations, individual and chain wide evaluations. The individual evaluation should be done based on the delivery and the quality of the delivered pigs by the farmers. This way Meatfriends can help the farmers to improve the quality and the pay-out he is receiving. When specific knowledge is needed other chain partners can be asked to help to improve quality. Next to the individual evaluation there should be an annual meeting with all the chain partners to tell about the functioning of the chain. This way general points coming forward from the individual evaluations and suggestions for improvements, interests and possible adjustments can be discussed. This should create better understanding and collaboration between the different chain partners. h

Table of Contents

1. Introduction

The pork sector has to deal with differentiated and changing consumer demands. There are many reasons why: consumer food habits change, the concept of food quality is under transition, consumers' attitudes to meat are becoming more differentiated and family structures change. The idea that the supply chains and their governance should be aligned with the demands of end users is not new. Despite this general agreement, consumer research and chain research have not joined forces in analysing how chains can become most competitive in serving customers (Grunert, et al., 2011). However, the level and type of quality demanded by consumers, along with an analysis of where and how in the chain these desired qualities are best shaped and certified, will lead to more competitive pork chains in the future (Grunert, et al., 2011).

Meatfriends BV is a meat processing company located in Best, the Netherlands. They produce meat products for retail organisations in the Netherlands. The company is one of the biggest Dutch meat processing companies. At the moment they have very little insight in and influence on the quality of the pork supplied to them. The biggest problem that Meatfriends has is the big fluctuation in quality of supplied pork. Quality as perceived by Meatfriends is low variation, so the supplied products should have a consistent quality without many fluctuations (Quinten , 2011).

1.1 Pork quality

When looking at the different articles written in the scientific literature about the quality attributes there are different sets named by the different researchers: Water holding capacity, colour, fat content, composition, oxidative stability and uniformity (Rosenvold & Andersen, 2003), while other researchers include other attributes : Tenderness, juiciness, flavour and odour with their associated physical parameters pH, shear force, water holding capacity and fat content (Bonneau & Lebret, 2010) and colour, firmness, water holding capacity/drip loss, ultimate pH, marbling/inter muscular fat, tenderness and palatability trait such as taste, flavour and juiciness (Kalathas, 2007). All these researchers name a lot of corresponding quality attributes that decide the quality of pork meat. The attributes have been discussed with Mr. Quinten the director of Meatfriends. Who told that the following attributes are the most important to Meatfriends for the pork quality.

- Colour
- Water holding capacity / drip loss
- Inter muscular fat content
- pH value
- Tenderness / Shear force

Therefore these attributes will be used during the research. The relation between the different attributes will be presented in the following part of the introduction.

1.1.1 Colour

Colour is an important quality attribute for pork meat, because consumers relate the colour of meat to the overall quality and freshness. Therefore colour and colour stability is important. During retail display, discoloration of pork takes place and the colour changes from bright cherry-red to greyish-brown (Tikk, et al., 2008). Different studies show that there are

correlations between the colour of pork and early post-mortem temperature, pH decline and storage time (Lindahl, et al., 2006) (Tikk, et al., 2008). High post-mortem temperature and low pH value early post mortem increases lightness and yellowness. While a higher redness of the meat is being obtained if the post mortem pH value falls below 6.0 and the muscle still produces heat above approximately 38 degrees (Lindahl, et al., 2006). Storage time has a positive influence on the colour of meat. Ageing for 8 days shows superior colour characteristics (Lindahl, et al., 2006).

1.1.2 Water holding capacity

There are two reasons for water holding capacity being an important quality attribute for pork meat. First it has an influence on product yield, which has economic implications. Second the eating quality is affected by the water holding capacity, because this is connected with the juiciness of the pork (Kalathas, 2007). Low water holding capacity results in lower yield and higher drip loss which results in a loss of weight and value. Low water holding capacity also has a high impact on the juiciness and tenderness of the pork meat. Consequently, severe loss of water will reduce product acceptability for consumers and decreases sales value (Rosenvold & Andersen, 2003) (Cheng & Sun, 2008).

1.1.3 Inter muscular fat content

Inter muscular fat content (IMF) or marbling of pork has a positive influence on the tenderness of pork. The higher the IMF the more flavour and tenderness is being noticed. There is also a downside with this reasoning because consumers want to see a minimal amount of fat in pork. (Jeleninkova, et al., 2008) (Ngapo & Gariepy, 2008). There are correlations between the IMF of pork and the drip loss, when the marbling increase the drip loss decreases. Other correlations are that the tenderness increases when the IMF is higher and that higher IMF values are correlated to higher pH value (Cannata, et al., 2010). Inter muscular fat is different from intramuscular fat content. The inter muscular fat is the fat content between cells and visible while intramuscular fat is the fat content within a cell and not visible. For the research the inter muscular fat is of importance, because of the negative impact of visible fat on consumers .

1.1.4 pH value

The ultimate pH value at 24h post mortem is the best predictor for meat quality attributes like colour, water holding capacity and tenderness (Boler, et al., 2010). Different researchers find correlations between the pH value and colour (Lindahl, et al., 2006), Tenderness (Jeleninkova, et al., 2008) (Ngapo & Gariepy, 2008)and water holding capacity (Cheng & Sun, 2008) (Ngapo & Gariepy, 2008) . A pH 24h value of 5.8-6 gives the most acceptable flavour of pork. While low pH values can result in pale soft and exudative (PSE) meat, which is low quality and not accepted pork meat (Ngapo & Gariepy, 2008) (Boler, et al., 2010). High pH 24 h values above 6.0 result in dark, firm and dry (DFD) meat which (because of its high WHC) has high chance of bacteriological contamination (Guardia, et al., 2005).

1.1.5 Tenderness

The eating satisfaction of pork is highly depending on the tenderness, juiciness and flavour of the pork. Where the tenderness is the most crucial factor (Lee, et al., 2012). The main determinants of the tenderness of meat are the intramuscular fat content and the myofibrillar protein structure. The protein structure is being affected by the post mortem ageing process. Intramuscular fat content has a positive correlation to tenderness. The higher the percentage intramuscular fat the higher the tenderness (Jeleninkova, et al., 2008). Other correlations are

that the tenderness increases when the IMF is higher and that higher IMF values are correlated to higher pH value (Cannata, et al., 2010)

1.1.6 Classification of carcasses

The five quality attributes are important for Meatfriends in order to have constant pork quality. However, they buy there supplied pork based upon the classification of the pig carcasses. There is a difference between the pork quality attributes and the attributes determining the classification of the pig carcasses. The classification is based upon the carcass quality which differs from the pork quality.

In the Netherlands the classification of pig carcasses is done by Classificatie bureau slachterijen (CBS). The classification system currently used is the SEUROP system. The SEUROP system measures the meat percentage of carcasses together with the muscle structure that has to be examined by the CBS employee who is responsible for the classification at the slaughter houses. The classification is recorded in a document that is used to pay farmers (PVE, 2009).

The first part of the classification is measuring the meat percentage of carcasses. This has to be done with the Hennessy grading probe. The measuring has to be done between the third and the fourth rib at the back side of the carcass. The measurement of the meat percentage is transferred to a classification following the SEUROP as shown in table 3 (PVE, 2009).

Table 3: SEUROP system (PVE, 2009)

Classification	Explanation	Meat percentage
S	Superior	60% or more
E	Excellent	55 - 60%
U	Very good	50 - 55%
R	Good	45 - 50%
O	Fair	40 - 45%
P	Poor	Less than 40%

The second part of the classification is done by an CBS employee who examines the muscle structure of the carcass. They have to take into account the most valuable parts of the carcass which are the hams, loin, shoulder and belly. The examination can result in one of the following muscle structures shown in table 4. In the type column the corresponding classification is mentioned.

Table 4: Muscle structure classification (PVE, 2009)

Type	Muscle structure
AA	Excellent muscle structure
A	Good till very good muscle structure
B	Average muscle structure
C	Very thin muscle structure.

Combining these different classifications gives the final carcass classification used in the Netherlands. Examples of possible classifications are SAA, EAA, EA, UA, RB etc. These are the so-called trade classes that are used for selling the carcasses. So buyers of carcasses can choose from these different ratings. (PVE, 2009)

1.1.7 Conclusion

For answering the research question the different relations between the different quality factor will be shown with respect to their natural influence. The quality attributes included are colour, WHC, IMF, pH, tenderness. The relations are shown in table 5.

Table 5: Relations between different quality attributes

	Colour	WHC	IMF	pH	Tenderness
Colour				+/-	
WHC			+	+	+
IMF		+			+
pH	+/-	+	+		+
Tenderness		+	+	+	

The results in table 3 show that there are positive correlations between WHC, pH value, IMF and tenderness. So this means that if one of these attributes is increased the other ones also increase. There is a limit to this because of two reasons: consumers demand less visible fat in meat, so the IMF cannot be too high and high pH values result in DFD meat which is not accepted. Therefore the optimal pH value is between 5.6-6.0 24 hours after slaughter. Considering these finding the challenge for the current pork supply chain is that WHC and tenderness should be high while the IMF should be low.

It is not possible for Meatfriends to buy carcasses based on the pork quality attributes. Meatfriends has to buy the carcasses based upon the SEUROP classification system. The system is based upon the carcass quality and not on pork quality. This is the reason there is a variation in the quality of the products produced at Meatfriends. Therefore the insight in the pork quality of the supplied pork is low and this result in a higher variation in quality of the supplied pork.

Meatfriends want to deliver a more constant and market oriented product. Therefore they want to do a research to look for a way how they can lower the fluctuations in quality attributes that are not taken into account with carcass classification. Therefore the research should cover their entire supply chain starting with feed and genetics, pig farming and meat processing. The main focus should be on the feed, genetics and pig farming because Meatfriends has the least knowledge about these areas. The aim of the research is to be able to produce pork satisfying current market demands for the different quality attributes. So consumers can buy a consistent product as much as possible (Quinten , 2011).

1.2 Research objective

The research objective is the motivation to do the research and what one hopes to achieve through the research (De Vaus, 2001). The objective of this research is to make recommendations to Meatfriends BV about how they can design their supply chain, so that their product quality is more constant and market oriented. The recommendations should cover the total supply chain of Meatfriends BV, focussing on the feed companies and the pig farming. (Quinten , 2011) This will be a practice orientated research, with the goal to design a supply strategy that can be adapted by Meatfriends. By using this strategy they can instruct their suppliers throughout the entire supply chain about their wishes. This will be a single case study based on the issues that affect the supplies of Meatfriends.

1.3 Research issues

In the research issues the research questions are being formulated. These questions have to concern the knowledge that is useful or necessary to achieve the research objective. The most effective way is by formulating a set of research questions, which has at least one central question. (Verschuren & Doorewaard, 2010)

The central research question is:

'What strategy and methods would be suited to Meatfriends BV to make their supplied pork market orientated and of consistent quality"

Literature study

This central research question will be answered in two different stages. A literature study and an empirical research. The literature study will be based on scientific literature. The following three sub research questions can be answered by the literature study.

1. What attributes determine the quality of pork?

In this sub research question all attributes determining the quality of pork meat are being addressed. These are the attributes that are of importance during this research. These attributes will be named and specified why they are important for quality.

2. Which actions influence the quality attributes and in what stage of the supply chain?

In the second sub research question the attributes found for the first research question will be connected with actions that influence these quality attributes throughout the entire supply chain. This is done to see what attributes can be influenced and by which actor within the supply chain.

3. What coordination mechanisms are most applicable to achieve consistent quality of the pork supplied?

The last sub research question answered in the literature study will be about what coordination mechanisms can be used to bind different partners within the pork supply chain together with Meatfriends BV so that consistent quality can be secured.

The literature search will be completed with three different scenarios based on the literature search. These scenarios are possibilities for Meatfriends BV to reach the consistent and market orientated quality based on literature.

Empirical research

After the literature study an empirical study follows. The empirical study is based on a specific case. In this research the Meatfriends BV case will be used. The empirical study will take place in the field and will be based on interviews with experts and actors within the pork supply chain. There will be five different sub research questions that will be answered in the empirical research.

4. What is the desired quality of Meatfriends BV?

After the literature study it is important that the desired pork quality of Meatfriends BV will be stated. The desired quality pork of Meatfriends BV needs to be made specific for the different pork quality attributes. The desired quality gives an insight in which quality attributes are the most important for the empirical research and show the quality issues that Meatfriends BV has.

With the following four different sub research questions the aim is to look at what actions can be taken by the different actors within the supply chain to meet the desired quality that Meatfriends BV wants to reach. The aim of these research questions is to see what is realistic en which actions are needed throughout the supply chain to reach the desired quality. There will be four different areas investigated are pork quality, chain actions, coordination and the view on new initiatives in the chain.

5. *What are the drivers for pork quality in the current pork supply chain?*
6. *What is the acceptability and effectiveness of working following a particular pork chain configuration?*
7. *What coordination is needed to get the supply chain organised?*
8. *Suggestions for value-adding in pork supply chain?*

With the answers to these different research questions we expect to know what Meatfriends BV needs to ask from the different actors in the pork supply chain to reach their desired pork quality. This will give insight in which of the three scenarios written is the best fit for Meatfriends BV. The analyses will use the findings out of the empirical research to find the best fitting scenario and to name the adjustments needed to the scenario.

Conclusions and recommendations
After answering all the different sub research questions the central research question will be answered. The answers to the different sub research questions will result in the conclusions of the research. The conclusions will consist out of different statements that should be taken into account for answering the general research question. These statements will be used as the bases for answering the central research question.

'What strategy and methods would be suited to Meatfriends BV to make their supplied pork market orientated and of consistent quality"

The answer on the general research question will be which strategy is the best fit for Meatfriends to make their supplied pork market orientated and of consistent quality. This strategy will be based on the findings of the analysis and the conclusions. The recommendations will be presented as a possible strategy for Meatfriends.

1.4 Research strategy

The research strategy consists of the most significant decision when constructing the technical research design: the approach that will be taken. Research strategy means the coherent body of decisions concerning the way in which the research is going to be carried out. (Verschuren & Doorewaard, 2010)

The research is a case study of the pork chain. The start of the research will be the literature study followed by the empirical research. These two researches will make use of different research strategies.

The literature study will be based on a broad desk research. The desk research will be done with different sources that are used. These sources will mainly consist of scientific and professional literature about the pork chain. Other sources that are used within the desk research will be internet and newspapers when interesting articles are found. Besides the desk research also some interviews with experts in the field of pork can be used to discuss the literature study. The information gathered with the literature study will be used to answer the first three research questions.

The empirical research strategy will be different from the literature study. The empirical research study will be mainly based on interviews with different actors within the pork supply chain. It starts with interviewing Meatfriends BV to answer the fourth research question about the desired quality. For answering the fifth to eight research question, the goal is to interview different actors at every level of the pork supply chain, namely slaughter houses, pig farmers, genetics and feed companies. The main focus of the research lays on feed companies and pig farmers. The interviews with these different actors should give insight on the view of the different actors about the pork chain in general and to the initiative of Meatfriends to build their own supply chain.

The results from the interviews will be used to do the analysis to see what are the possibilities within the pork supply chain for having more insight and influence on the pork quality of the supplied pork. The analyses will be used to make conclusions and recommendations. The recommendations will be a strategy how Meatfriends can build their own supply chain based on different steps that are needed to take.

2. Actions influencing the quality attributes in the pork supply chain

The second chapter shows the influence of the actions taken in the pork supply chain on the quality attributes. These actions will be connected with the different actors active within the supply chain. The pork quality is being influenced by a lot of different actions throughout the supply chain, according to The following actions/choices have an influence on the quality attributes in the pork supply chain: genotype, feeding, production systems and slaughter procedure (Rosenvold & Andersen, 2003). In this chapter these actions/choices will be explained and connected with the influence they have on the different quality attributes.

2.1 Genotype

The first step in the pig supply chain is the choice of genotype the pigs have. There are different breeds and crossbreeds that can be used for pig production. The different genotypes all have specific influences on the quality attributes. Genotype has a high influence on all the five different quality attributes (Garcia-Rey, et al., 2005). There is chosen to examine only the most used breeds in the Netherlands. The most used breeds in the Netherlands are for bears the Duroc, Large white (Yorkshire) and Pietrain breed. For the sows the most used breeds are the large white (Yorkshire) and Dutch landrace (Overvarkens, 2012) (Varkensenzo, 2012). The four breeds most used in the Netherlands are Duroc, Large white, Pietrain and landrace. The chain actors that are involved with the choice of the breed is the farmer who chosen his used genotype together with the genetics company who sells and advises about the genotype.

2.1.1 Duroc

The Duroc pig is a red breed that is originally from the USA. The Duroc breed is notable for having a high marbling fat content compared with other breeds (Wood, et al., 2008). As a result of the higher marbling the Duroc breed is juicier, more tender and more palatable compared to other races (Ngapo & Gariepy, 2008). In comparison to the Pietrain race the Duroc has a significantly better WHC. There is no difference in colour in comparison with the Pietrain (Edwards, et al., 2003). When looking at the carcass composition of the Duroc breed, the breed has a higher percentage of the carcass as loin and belly meat in comparison to the Pietrain. The percentage of loin is also higher in comparison with the Large White. In comparison to the Landrace the Duroc has significantly more shoulder meat. Also the fat percentage of the Duroc is significantly higher than that of the Pietrain and Large White (Gispert, et al., 2007)

2.1.2 Pietrain

The Pietrain is a Belgium pig breed that has a white colour with black spots. The Pietrain breed is known for its high meat percentage and thus a low IMF content (Edwards, et al., 2003). The Pietrain on the other side scores low on pH 24 h and WHC values. These attributes also result in a lower score on tenderness compared to the Duroc breed and higher scores compared with the Large White breed (Ngapo & Gariepy, 2008). The carcass composition of the Pietrain breed in comparison to the other breeds named shows that the Pietrain has significantly more ham meat and lower percentage of loin, Belly and fat. (Gispert, et al., 2007)

2.1.3 Large white (Yorkshire)

The Large White breed finds its origin in the Yorkshire race and has a white colour. The Large white has a low IMF content in comparison to the Duroc breed but still manages to

have high WHC and pH 24 h value that doesn't significantly differ from the Duroc (Lee, et al., 2012) Although these values are good the Large White scores low on tenderness in comparison to other breeds. While the meat colour of the Large White scores lower than the Duroc breed (Ngapo & Gariepy, 2008) (Lee, et al., 2012) The carcass composition of the Large White has in comparison to other races more shoulder meat and the loin meat percentage is lower. The Large White also has a low fat percentage. (Gispert, et al., 2007)

2.1.4 Landrace

The landrace pig is also a white colour pig. The Landrace pig like the Pietrain and the Large White has a low IMF content. In comparison with the other races the Landrace has a low WHC score, the colour score of the Landrace meat is lower in comparison with Duroc (Lee, et al., 2012). The carcass composition of the Landrace breed shows that the belly and loin percentage is higher in compare to the Pietrain and Large White breed. The fat percentage of the Landrace breed is higher than the Pietrain and Large White. (Gispert, et al., 2007)

2.1.5 Currently used genetics in the Netherlands

To give an indication of the currently used genetics figure 1 shows the usage in the Netherlands. The data is from Varkens KI, who sells genetics in the Netherlands. There can be assumed it is reliable because they are the selling organisation operating everywhere in the Netherlands. In 2011 they have sold 3.35 million doses in total (Loenen, 2012).

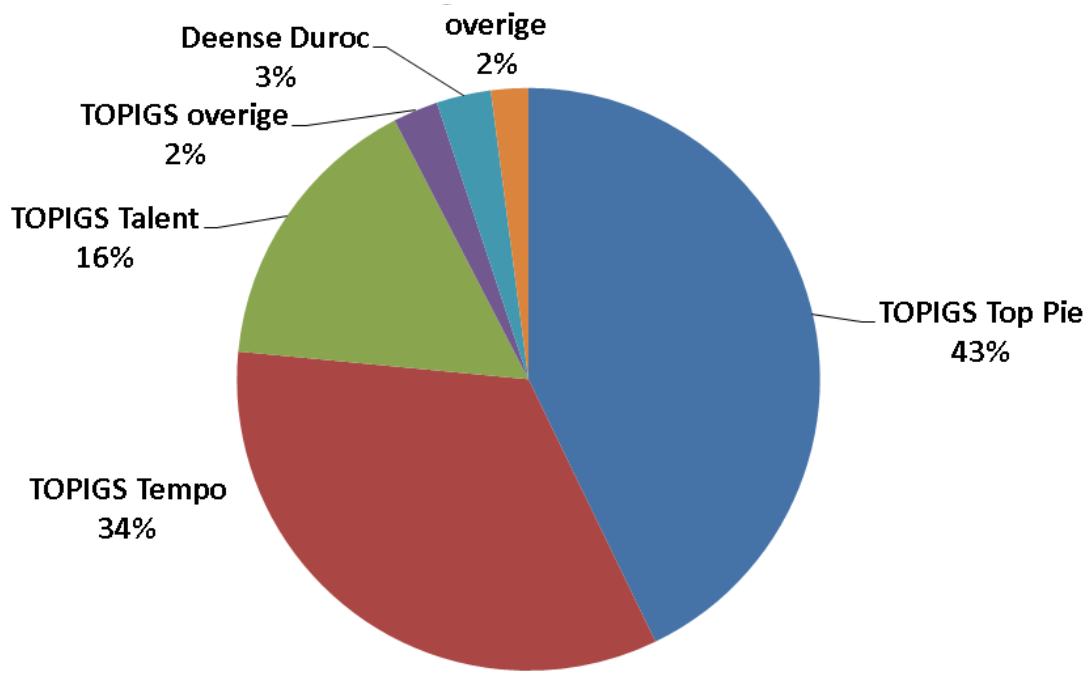

Figure1: Usage of boars 2011 in The Netherlands (Loenen, 2012)

Remark: Top Pie = Pietrain breed
Tempo = Large White breed
Talent = Duroc breed

The current size of pig farming in the Netherlands is that approximately 12,4 million pigs are held within the Netherlands (Bont, et al., 2011). The usage of the different pigs in the Netherlands is shown in table 6 based on the percentage time the pigs in the Netherlands:

Table 6: Number of pigs in The Netherlands per breed

Used Breed	% of the pigs	Number of pigs
Pietrain	43	5.332.000
Duroc	16+3	2.356.000
Large White	34	4.216.000
Other	2+2	496.000

This shows the most used breeds are Pietrain, Duroc and Large White as a boar.

2.1.6 Conclusion

To see what is the influence of the most used breeds in the Netherlands: Duroc, Pietrain, Large White and the Landrace (Varkensenzo, 2012) (Overvarkens, 2012) on the quality attributes an overview has been given in Table 7. Table 7 shows the quality attributes of the four different breeds based upon the literature mentioned in the section above. Where the Duroc breed clearly has a different focus compared to the Pietrain and the Landrace. Where the Duroc focuses on the WHC and palatability. The Pietrain focuses on lean meat and meat percentage. The Large white race is positioned between the Pietrain and Duroc breeds. The Large White has a higher WHC and pH value compared to the Pietrain although not as good as the Duroc. The same is shown with the IMF where the IMF is lower than with the Duroc and Higher than the Pietrain.

Table 7: Influence of genotype on the quality attributes.

	Duroc	Pietrain	Large White	Landrace
Colour	**0**	**0**	**-**	**-**
WHC	**+**	**-**	**+**	**-**
pH 24 h	**+**	**-**	**+**	**-**
IMF	**+**	**--**	**-**	**-**
Tenderness	**+**	**0**	**-**	**0**

+ = Higher value compared to other breeds
0 = Average value compared to other breeds
- = Lower value compared to other breeds

Table 8 shows that the different genotypes all have their specific carcass composition compared to the other genotypes. The Duroc has a bigger loin meat percentage, Pietrain has a higher percentage of ham meat, Large White has a higher Shoulder percentage and the Landrace has a higher percentage of belly meat.

Table 8: Carcass composition of different genotypes

	Duroc	Pietrain	Large White	Landrace
Ham	**0**	**+**	**0**	**0**
Loin	**+**	**-**	**-**	**0**
Belly	**0**	**-**	**0**	**+**
Shoulder	**0**	**0**	**+**	**-**
Fat	**+**	**-**	**-**	**+**

+ = Higher value compared to other breeds
0 = Average value compared to other breeds
- = Lower value compared to other breeds

2.2 Feeding

The second action that influences the quality attributes of pork is feeding. The feeding of pork can be separated in different aspects that influence the quality attributes. These are the composition of the diet in combination with the addition of specific vitamins and minerals influencing the quality attributes. Another important issue that is connected to feed is the impact of the exhaust of ammonia and other gasses on the environment.

2.2.1 Diet

The composition of the diet used for producing pigs consist mainly out of three sources, namely proteins, fats and carbohydrates. The composition of the diet has influence on the meat quality and structure. Therefore the effect of the three sources on the quality of the meat. The influence of feed on the quality attributes of pork meat is said to be lower then other actions/choices like genotype and slaughter procedure. The reason for this is that quality attributes like pH 24 h, WHC and colour are generally not affected with the level of protein (energy) in feed (Lebret, 2008). The only quality factor that is influenced through feeding with proteins is the IMF content. Which is depending on the amount of protein that is being fed. Pigs with high protein levels in their diet have low IMF content. Where pigs with low protein levels in the diets show a higher level of IMF content. (Ngapo & Gariepy, 2008) (Apple, 2007)

Next to proteins another important feeding aspect of the diet is the dietary fats used. The dietary fats are being split in to the saturated fats and unsaturated fats. The result of feeding more unsaturated is that the firmness of the fat declines and increases the susceptibility for oxidation and thus reduces the shelf life of the products and has a negative influence on colour stability. In efforts to obtain more lean carcasses the concentration of unsaturated fats in diets has increased (Rosenvold & Andersen, 2003). This leads to enhanced oxidative instability. The firmness of the fat in carcasses is depending on the type of fat used within diets with unsaturated fats causing softer fat and more saturated dietary fats results in more firm and oxidative stable fat. This results in more colour stability. The ratio of saturated/unsaturated fats in the diet will reflect in the ratio of saturated/unsaturated of the carcass. In recent years there has been a development to have more unsaturated fat in meat products to produce healthier meat (Lebret, 2008) (Wood, et al., 2008).

The third main source of pig diets are carbohydrates. Carbohydrates in feed can be split into enzymatic digestible carbohydrates and fermentable carbohydrates. The enzymatic digestible carbohydrates mainly consist out of starch and sugars. These are being absorbed in the form of glucose and transformed into glycogen or fat. Glucose and glycogen levels have an important role in the decline of the pH value after slaughter (Rosenvold & Andersen, 2003). Fermentable carbohydrates have a contribution to the energy intake of pigs. Mostly between 15 to 20% of the total energy intake. The addition of fermentable carbohydrates in the form of sugar beet pulp leads to a lower fat percentage in carcasses. Also the addition of sugar beet pulp result in a better ratio of intra-muscular fat and inter-muscular fat. This results in more tender meat (Lambooij, 2007).

The manipulation of the muscle glycogen level through diet in the weeks before slaughter can affect the WHC of carcasses. When the diet in the three weeks prior to slaughter is adapted with diets high in protein (22-24 %) and fat (17-18%) in combination with a lower content of digestible carbohydrate (sugars) (< 5%) results in a lower muscle glycogen content without affecting the overall performance which improves the WHC in the loin meat part (*m. longissimus dorsi*) (Rosenvold & Andersen, 2003). This finding is been confirmed under the condition that the glycogen reserves where below 53 µmol/g of wet tissue immediately prior to slaughter. (Apple, 2007) On the other hand too high levels can result in a higher chance for PSE pork.

2.2.2 Vitamins and minerals

The addition of vitamin E to the diet of pigs improves meat quality, especially colour stability during retail display (Apple, 2007). The supplementation of vitamin E has an positive influence on the colour stability through the reduction of the lipid oxidation which results in a longer shelf life for pork. The other quality attributes are not affected with the supplementation of vitamin E (Boler, et al., 2009).
The supplementation of magnesium (Mg) into diets was traditionally used to prevent metabolic disorders with Mg deficiency. Recent research has shown that the supplementation of Mg for only 1-7 days before slaughter results in a better WHC regardless of the Mg source (Apple, 2007) (Hamilton, et al., 2003) (D'Souza, et al., 1999).

2.2.3 Environmental effect

The pork chain has a high influence on the greenhouse effect through the emission of ammonia. Nutrition is a key factor in reducing the emission of ammonia in pig farming. Research shows that there are three different ways to reduce emission through feeding (Aarnink & Verstegen, 2007).The first strategy that can be used is lowering the crude protein intake in combination with the supplementation of limiting amino acids. The second strategy is including digestible carbohydrates in the diet (Aarnink & Verstegen, 2007) (Philippe, et al., 2011). Following these two strategies the next step is to see what effect these actions have on the quality attributes of pork. Lowering the level of crude protein in combination with the supplementation of amino acids leads to an increased level of IMF content and higher tenderness (Apple, 2007) (Ngapo & Gariepy, 2008). This action leads to more marbling and therefore affects the appearance. The second action that reduces ammonia emission is the addition of digestible carbohydrates into diets. The effect of this action on the meat quality is that the feeding of digestible carbohydrates (sucrose) results in a decrease in pH 24 h and WHC value (Camp, et al., 2003) (Apple, 2007).

2.2.4 Conclusion

Looking at the influence of feeding on the quality attributes of pork research shows that feeding proteins only influences the IMF content of the pork meat. High levels of protein in diets results in low IMF content and inverse when the protein levels in the diet are low the IMF is higher. Also the composition of the fat can be steered through the diet composition of saturated and unsaturated fats. This composition in fats will reflect in the carcass. More unsaturated fat makes pork more healthy, but results in higher oxidation and less shelf life and colour stability. Also the finishing strategy in the last three weeks before slaughter through a high fat and protein diet together with low digestive carbohydrates results in a lower glycogen level which results in a better WHC of the loin meat. The supplementation of vitamin E has a positive effect on the colour and colour stability during retail display. The supplementation of Mg results in a higher WHC of pork meat. The result already occurs when supplementation only happens in the last week prior to slaughter. Reducing emission of ammonia through diet on the pork quality attributes results in higher IMF content through lowering the crude protein level together with the supplementation of amino acids. This leads to better tenderness score and higher marbling. The supplementation of digestible carbohydrates leads to a decrease of pH 24 h value and WHC. An overview is given in table 9.

Table 9: Effect of ammonia reduction feeding strategies

	lowering crude protein and Amino acid supplementation	Including digestible carbohydrates
Colour	**0**	**0**
pH 24 h	**0**	**-**
WHC	**0**	**-**
IMF	**-**	**0**
Tenderness	**+**	**0**

+ = Positive effect on the pork quality attribute
0 = No effect on the pork quality attribute
- = Negative effect on the pork quality attribute

2.3 Production systems

In pig farming different production systems can be used to hold pigs. The different types of housing used in pig farming are conventional, animal welfare based systems and organic systems (Rosenvold & Andersen, 2003) (Lebret, 2008). Also the systems are being compared to the ‘’Beter Leven kenmerk’’ of the Dutch animal protection organization. The system works with the classification of four different certifications namely: conventional, 1 star, 2 stars and 3 stars. Where the more stars the higher the animal welfare level of the pigs is.

2.3.1 Conventional farming

In the conventional system pigs are held inside. The allowance space of pigs held in the conventional system is the lowest of all three systems. The space a pig has is commonly between 0.65-0.75 m2 in this system. The floor used to hold the pigs on is slatted (Lebret, 2008) (Lebret, et al., 2011) (Morrison, et al., 2007). When the quality attributes are being

taken into account there are two quality attributes who score higher in the conventional system, the WHC and pH 24h value. The reason for this difference could be the behaviour of the outdoor access pigs who are more explorative because of the outdoor access (Morrison, et al., 2007). The other quality attributes do not show differences (Lebret, 2008) (Lebret, et al., 2011). When the space is being upgraded to around 1 m2 so the pig has got the 1 star classification of the ''Beter Leven kenmerk'' (Dierenbescherming, 2011) no differences in the quality attributes is shown (Lebret, 2008).

2.3.2 Animal welfare

In the animal welfare system the pigs have got more space allowance, deep litter bedding and outdoor access. The space that a pig has is 1.1 m2 allowed with outdoor access. The floors inside need to be covered with straw our sawdust. This system results in a two star certification according to the ''Beter Leven kenmerk'' . When the allowance space for pigs is being upgraded to 1.3 m2 this results in a three star certification of the ''Beter Leven kenmerk'' (Dierenbescherming, 2011). When the quality attributes of this system are compared to the conventional system the WHC and the pH value is lower (Lebret, 2008) (Lebret, et al., 2011) (Morrison, et al., 2007). The IMF content shows no clear finding, some report a higher IMF and others a lower IMF value. This can be explained by the outdoor climate condition (Bonneau & Lebret, 2010). Another aspect that is significantly different is daily food intake. Pigs with outdoor access have higher daily food intake than conventionally held pig. This results in a higher daily growth, although the feed conversion rate stays equal because of a higher feed intake and higher daily growth (Lebret, 2008) (Lebret, et al., 2011) (Morrison, et al., 2007).

2.3.3 Organic farming

In organic pig farming space allowance for pigs has been increased to at least 1.9 m2 inside for sows with outdoor access. The bedding inside is like with the animal welfare system covered with straw or sawdust. This correspondents with three stars in the ''Beter Leven kenmerk'' (Dierenbescherming, 2011). Another aspect of organic farming is that the feeding needs to be in accordance with the European community standards for organic livestock and livestock production. This means the pigs receive an organic diet which consists out of at least 90% organic feed ingredients and roughage is provided into the diet. The supplementation of synthetic amino acids, antibiotic growth promoters and products from GMO is prohibited (Lebret, 2008). Research has shown that organic pigs have a reduced daily gain compared with the other production systems due to feeding. This did not influence the WHC or pH value in comparison to the animal welfare system. The organic pork meat has lower tenderness scores. The reason for this is that the lipid content of organic pigs is lower. (Hansen, et al., 2006). Organic pigs have a lower lean meat content (Rosenvold & Andersen, 2003) (Lebret, et al., 2011). Organic pig farming has little effect on the quality of pork (Bonneau & Lebret, 2010). The daily feed intake and feed conversion ratio of organic pigs has a higher variance because of the limited availability of resources for the diets and thus a high variance in diet composition (Lebret, 2008) (Bonneau & Lebret, 2010).

2.3.4 Conclusion

Based on the finding of the different production systems that are used within the pork chain. The production systems mainly differ on allowance space, outdoor access and floor type. There can be said that the main difference does not occur in the quality attributes. The only effect on the quality attributes found in literature is that the WHC and pH 24 h value of

conventionally held pigs is higher than in the more animal friendly and organic system. In table 10 the differences are shown.

Table 10: Differences between housing systems

	Conventional		**Animal welfare**		**Organic**
Allowance space per pig	0,7 m2	1 m2	1,1 m2	1.3 m2	1,9 m2
Floor	Slatted	Slatted	Straw/ sawdust	Straw/ sawdust	Straw/ sawdust
Outdoor access	No	No	Yes	Yes	Yes
''Beter Leven kenmerk''	**0**	*	**	***	***
Daily feed intake	**0**	**0**	+	+	variable
Feed conversion ratio	**0**	**0**	**0**	**0**	variable
Daily gain	**0**	**0**	+	+	-
Diet	Normal	Normal	Normal	Normal	Organic
Colour	**0**	**0**	**0**	**0**	**0**
pH 24 h	+	+	**0**	**0**	**0**
WHC	+	+	**0**	**0**	**0**
IMF	**0**	**0**	Affected by climate		
Tenderness	**0**	**0**	**0**	**0**	-

+ = Positive effect on the pork quality attribute
0 = No effect on the pork quality attribute
- = Negative effect on the pork quality attribute

The main differences between the different housing systems are found in the animal welfare aspect which can add value through the certification with the ''Beter Leven kenmerk'' in the Netherlands.

2.4 Slaughter

The slaughter procedure of pigs can be divided into four different stages that influence the pork quality. These four steps are fasting, pre-slaughter handling, stunning method and chilling process (Rosenvold & Andersen, 2003).

2.4.1 Fasting

The aim of fasting before slaughter is to reduce the risk of microbiological cross contamination during slaughter. Also it is known that pigs should not be fed immediately before transportation because pig with full guts show higher mortality during transportation (Sterten, et al., 2010). Fasting is also been investigated as a way to reduce the muscle glycogen stores in pigs at the time of slaughter to increase the pH 24 h and hereby improve the WHC and colour. Different researchers see that there is an effect but only after 24 h fasting period before slaughter. The longer fasting period has also some negatives like the welfare of pigs due to extended fasting and the decreased yield of the carcasses (Rosenvold & Andersen, 2003). It is found that the effect of fasting on the glycogen stores in pigs is also dependent on other attributes like lair age and pre-slaughter handling activities (Sterten, et al., 2010). There is a difference between the fasting time of 24 h and 16 h. A 24 h fasting period has a positive effect on the pH ultimate value which is higher than non-fasting. Other positive effects that come with the fasting is that the pigs are less stressful during transportation and easier to handle which results in a lower usage of aids like electric prods. Also fasted pigs have a significantly lower loss of weight through chill (Eikelenboom, et al., 1991).

2.4.2 Pre-slaughter handling

Pre-slaughter handling has a high influence on pork quality. The reason for this is that pre-slaughter handling causes stress. The quality attributes are negatively affected when pigs have a high stress level before slaughter. Actions such as handling on farm, loading, transportation, unloading, lair age and driving to the stunner cause stress. Stress affects the pH pre-slaughter value. The pH value drops which has a negative effect on the WHC and can result in PSE meat (Perre, et al., 2010) (Cheng & Sun, 2008) (Hambrecht, et al., 2003). According to research the most significant risk factor for causing stress are noise level during unloading and the number of panting pigs during unloading (Perre, et al., 2010). In addition to this it is generally accepted that loading at the farm and offloading at the slaughterhouse are the most stressful parts of transportation (Rosenvold & Andersen, 2003). This stress prior to the stunning results in a lower pH value and higher temperatures post mortem. These two factor normally result in a decrease of WHC (Cheng & Sun, 2008). Another factor influencing the quality of pork is seasonality. In summer pigs have less stress compared to spring and autumn, which results in better pork quality (Perre, et al., 2010).

2.4.3 Stunning method

Before pigs get slaughtered they must be rendered unconscious and insensible to pain prior to slaughter. The two most commonly used methods for stunning in commercial pig slaughter are carbon dioxide (CO_2) and electrical stunning (Channon, et al., 2001). CO_2 stunning means that the pigs are being stunned with the usage of CO_2 gas. Electrical stunning is done by using electric tongs that are being put on the head of the pigs. There have been shown differences in the quality of pork because of the stunning method that is used in slaughterhouses. The main quality differences due to the stunning method is that electrical stunning results generally in more pail pork and CO_2 stunning result in more pinker meat (Channon, et al., 2001). There were no differences in WHC and pH 24 h. The only difference

found was in the tenderness where CO2 stunned pigs had a better score when they are not carrier of the halothane gen (Channon, et al., 2001).

2.4.4 Chilling

After slaughter the last action that affects pork quality is the chilling of carcasses. The chilling of carcasses can be done by conventional chilling or accelerated chilling. The difference is the rate of temperature decline which is larger with accelerated chilling (Rosenvold & Andersen, 2003). The difference between the two types of chilling for meat quality is that the colour is positively affected with accelerated chilling. Other traits that are being improved with accelerated chilling are that texture and firmness of the loin is improved. For the other quality attributes no differences are found (Springer, et al., 2003). This is confirmed in other research that shows that accelerated chilling improves the colour of pork which is less pale. Also no differences were found in other quality aspects (Holmer, et al., 2008). Accelerated chilling can have cold shortening as a negative effect, cold shortening causes a fall in WHC and tenderness. Cold shortening is being caused when carcasses are exposed to extreme cold or hot temperature pre-rigor. With rigor meaning the point that all the activity is out of the carcass (Savell, et al., 2005) (Kalathas, 2007).

2.4.5 Conclusion

Looking at the slaughter procedure and the effect on pork quality the highest risk factor is stress in the pigs prior to slaughter. With high stress levels prior to slaughter results in higher post-mortem muscle temperatures and higher pH decline, this reflects in a lower WHC, lightness and yellowness in colour. There are some actions that can be done to lower stress levels in pigs prior to slaughter. First the fasting of pigs is done to lower the risk of microbial cross contamination during slaughter, because of faeces within the intestines of the pigs. Other effects of fasting are lower stress levels and easier handling of pigs during transportation. The most important part of the slaughter procedure is the pre-slaughter handling during loading, unloading, lair age and driving to the stunner. Because the handling is responsible for the stress level of pigs prior to slaughter. It is generally accepted that loading and unloading at transportation are the most stressful parts of the transportation. The stunning method of pigs is only effecting the pigs with high stress levels. Low stress pigs stunned with CO2 show better WHC and lower drip loss compared to electrically stunned pigs. Other points that are being influenced with the stunning method is the colour, CO2 stunned pigs have more pink meat and electrical stunned pigs have more pale meat. Looking at the influencing actions on the quality it is show that the quality of pork is highly dependent on the stress level prior to slaughter. After slaughter accelerated chilling reflects in better meat colour. With the risk of accelerated chilling compared to conventional chilling can cause cold shortening. Cold shortening leads to lower WHC and tenderness of pork.

2.5 Conclusion

The different actors that are active in the supply chain are the genetics companies, feed companies, pig farming and slaughterhouse. The connection of the different actors with the different actions is as follow: genotype is done by the genetics companies who advice and supply the pig farmers, feeding is done by feed companies who advice and supply pig farmers, production systems are being utilized by pig farmers within their company, the slaughter procedure is being done by the slaughter house. Connecting the different actions to the supply chain actors in table 11.

Based upon the second chapter it can be said that the actions of the different actors within the chain all influence pork quality. A distinction can be made between the influence of the genetics companies, feed companies and pig farmers. These actors all can influence the quality attributes in a way that they can chose for different actions to deliver their desired product. For example breed, diets and production systems. The influence of the slaughterhouses on the pork quality is different. They may influence the pork quality negatively through insufficient pre-slaughter treatment resulting in higher stress-levels of pigs.

Table 11: Overview of the actions affecting quality attributes

Chain actor	Actions		Influence on pork quality attributes				
			Colour	WHC	pH 24 h	IMF	Tenderness
Genetics company	Genotype	Duroc	0	+	+	+	+
		Pietrain	0	-	-	-	0
		Large White	-	+	+	-	-
		Landrace	-	-	-	-	0
		Berkshire	0	++	++	+	+
		Hampshire	0	-	+	-	0
			Ham	Loin	Belly	Shoulder	Fat
	Carcass composition	Duroc	0	+	0	0	+
		Pietrain	+	-	-	0	-
		Large White	0	-	0	+	-
		Landrace	0	0	+	-	+
			Colour	WHC	pH 24 h	IMF	Tenderness
Feed company	Diet	High protein	0	0	0	-	-
		low protein	0	0	0	+	+
		High protein low fat low carbohydrates	0	+ (loin)	0	0	0
	Vitamins	Vitamin E	+	0	0	0	0
	minerals	Mg	0	+	0	0	0
	NH3 reduction	lowering crude protein adding amino acids	0	0	0	+	+
		Including digestible carbohydrates	0	-	-	0	0

			Colour	WHC	pH 24 h	IMF	Tenderness		
Pig Farming	Production system	Conventional 0,7 m2	**0**	**+**	**+**	**0**	**0**		
		Conventional 1 m2	**0**	**+**	**+**	**0**	**0**		
		Animal welfare 1,1 m2	**0**	**0**	**0**	affected by climate	**0**		
		Organic 1,9 m2	**0**	**0**	**0**		**-**		
	Other aspects		Floor type	Outdoor	BLK	Daily feed	Conversion	Daily gain	Diet
		Conventional 0,7 m2	Slatted	No	**0**	**0**	**0**	**0**	normal
		Conventional 1 m2	Slatted	No	*****	**0**	**0**	**0**	normal
		Animal welfare 1,1 m2 / 1,3 m2	Straw/sawdust	Yes	** / ***	**-**	**0**	**+**	normal
		Organic 1,9 m2	Straw/sawdust	Yes	***	variable		**-**	organic
			Colour	WHC	pH 24 h	IMF	Tenderness	Remarks	
Slaughter house	Fasting	24h	**0**	**+**	**+**	**0**	**0**	Decreased yield, animal welfare	
		16h	**0**	**0**	**0**	**0**	**0**		
	Pre-slaughter handling	low stress	**0**	**0**	**0**	**0**	**0**	In summer pigs have less stress because of the warmer climate	
		High stress	**-**	**-**	**-**	**0**	**0**	Can result in PSE pork	
	Stunning	CO2	**+**	**0**	**0**	**0**	**+**	Tenderness score only with Halothane non carrier pigs.	
		Electrical	**0**	**0**	**0**	**0**	**0**	CO2 has more pink meat and Electrical result in more pale meat colour	
	Chilling	conventional	**0**	**0**	**0**	**0**	**0**		
		accelerated	**+**	**0**	**0**	**0**	**0**	can result in cold shortening	

3. Coordination of quality in the pork supply chain

The coordination of quality within the pork supply chain is reached through a combination of quality management systems and governance structures (Wever, et al., 2010). Quality management systems coordinate by setting the standards, monitoring the compliance with these standards and signalling the compliance of the different actors within the pork supply chain. Governance structures may facilitate the reduction of the transaction uncertainties and opportunism related to the coordination of quality. The introduction of coordination mechanisms is used to monitor the compliance of the different actors with the standards. The coordination mechanisms are necessary to motivate or force actors to achieve coordination (Brinkmann, et al., 2011).

3.1 Quality management systems in the pork supply chain

For the coordination of the quality in a supply chain there is the need to use quality management systems. Quality management systems consist of three different areas: quality signals, quality standard and quality monitoring mechanisms. Quality signals are to indicate product and process quality to their buyers. The signal owner sets the quality standards. Standard setting and monitoring those standards can be split between different actors responsible for each activity (Wever, et al., 2010).

Within the quality management systems three different dimensions can be distinguished. These are the owner of the system, the scope of the system and the scale of the system. There are two different types of owners, public and private owners. Public owners can be governmental institutions or organizations. Private owners can be companies. The owner of the system is the actor who sets the standards of the system. The owner can be one specific actor or a set of actors. The scope of the system means how wide the system is organized. This means is it from company to company or chain wide. Chain wide systems cover the entire chain and company to company only cover one specific transaction within the chain. The scale of the system refers to in which extent the system is been adopted horizontally within the chain across one or more stages within the chain. The quality management systems can have a chain wide scope or a small scale reflecting to a couple of companies. The typical pork chain quality management system in companies in the Netherlands consist of three layers of quality management systems (Wever, et al., 2010). The baseline level consists of public quality management systems like EU regulations and country regulations on top of the of the EU requirements. The second layer consists out of large scale private systems like IKB in the Netherlands which is a chain-wide integrated quality control system and company to company systems like British Retail Consortium or the International Food Standard. The third layer consists out of small scale systems, this can be private company to company systems such as buyer specifications, and public chain wide systems owned by farmer cooperatives. In figure 2 the different layers are shown.

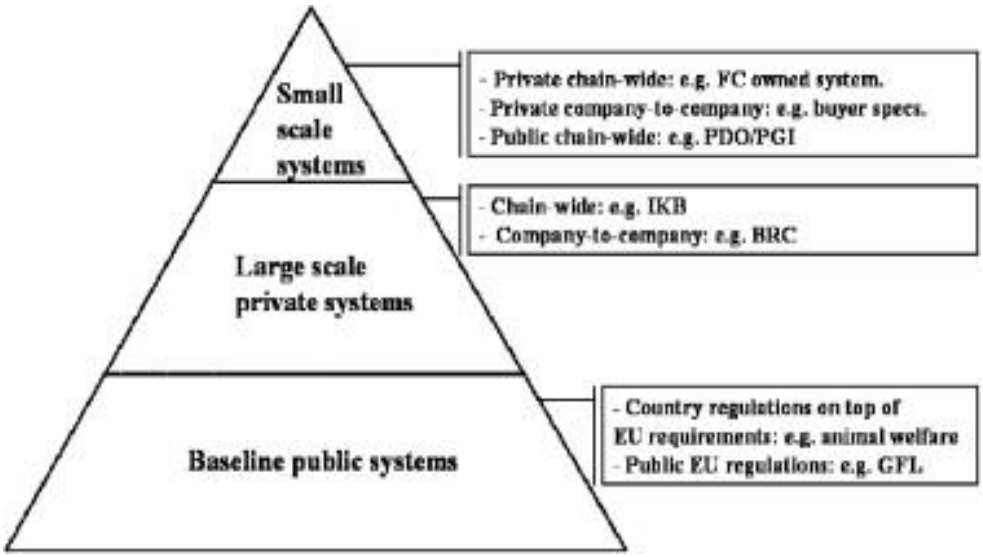

Figure 2: Type of quality management systems (Wever, et al., 2010)

3.2 Governance structures

Governance structures refer to the manner in which the transactions in the chain are organized. The different governance structures can be divided in five different types distinguished by the level of in which actors coordinate or control various phases in the production process. Governance structures are ranging from the market-based form of coordination to the hierarchy types of coordination. In figure 3 the types of governance structures are shown.

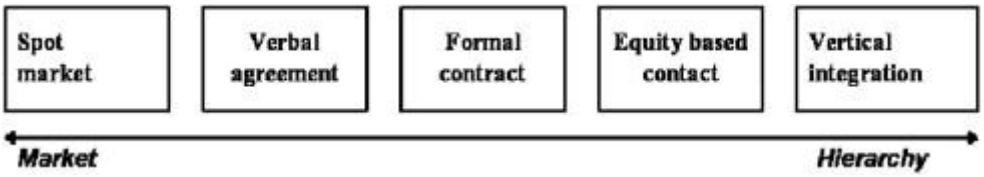

Figure 3: Governance structures (Wever, et al., 2010)

Market types of governance structures mainly rely on price and competition for the coordination of the governance structures. While the hierarchy types of governance structures mainly rely on administrative control of the coordination of the transaction. The characteristics of the different types of governance structures is shown in table 12:

Table 12: Governance structures (Grunert, et al., 2011)

GS	Rule
Spot market contract	A contract (invoice) for instant exchange of goods or services
Verbal agreement	Exchanges not formalized into written, legally enforceable contracts. Performance or behavioural standards are unlikely to be specified, but if so, they are not formalized
Formal contract	Legal enforceable, written contracts are used to govern the transaction. Performance and behavioural standards are specified in the contract
Equity-based contract	A chain actor owns stock (and has the accompanying shareholder voting rights), but less than 50%, of (one of) its suppliers/buyers
Vertical integration	A chain actor owns more than 50% of the stock (and has the accompanying shareholder voting rights) of (one of) its suppliers/buyers

3.3 Coordination mechanisms for the pork supply chain

Coordination mechanisms are necessary to motivate or force actors to achieve coordination. Organizations seek to implement coordination mechanisms that increase benefits and reduce risks (Brinkmann, et al., 2011). The dependency between the members of the supply chain can be managed by coordination mechanisms. Four different types of coordination mechanisms can be used together (Arshinder, et al., 2008). These four different types of coordination mechanisms are:

- Contracts
- Information technology
- Information sharing
- Joint decision making

Using the four types of coordination mechanisms mentioned above many parameters can be covered within the pork supply chain to guarantee a well-coordinated supply chain. The coordination mechanism can cover general quality requirements, animal health or welfare, food safety, certification and supply chain performance (Brinkmann, et al., 2011). Taking in account the four types of coordination mechanisms different tools can be used within the pork supply chain. The tools will be named together with the different coordination mechanisms.

3.3.1 Contracts

Contracts are used to lay down the general principles for the product and process, this is done by quality requirements and specifications. The quality requirements and specifications make sure that the desired product is delivered. The next aspects in contracts with the supply chain partners is quantity, capacities and flexibility. By appointing these aspects the contract gives insight in the possibilities about the availability of the product, but also an indication for response and lead time (Arshinder, et al., 2008). In the pork chain it is

important that there is a health protection clause that specifies the actions taken to avoid hazards for animals and consumers. The monitoring of the actions need to be specified within the contracts. One of the most important issues within the contract are the incentives/ discounts within these contracts to motivate the producers to work according to the contract. Reasons for this is that storage capacity for growing pigs is limited and stock keeping of pork often increases cost and reduces quality. The last aspects that need to be covered in today's contracts are the certificates that are valid for the production, examples are IKB, Beter Leven keurmerk, etc. (Brinkmann, et al., 2011). Specifications and quality requirements are important in the chain to specify the configuration of actions like genotype, diet, supplementation of vitamins and minerals.

3.3.2 Information technology

The second coordination mechanism that can be used in the pork supply chain is information technology. Information technology is useful to facilitate the communication along the pork supply chain. The implementation of a chain information system can be used to generate information about the intermediary products, classification for the value determination and animal health monitoring. ERP can be integrated into the chain information technology to achieve a high alignment of supply and demand within the pork chain. This will especially be a challenge at farm level (Brinkmann, et al., 2011). Logistics IT used in combination with ERP is an important coordination mechanism to deliver intermediary products at proper time to meet demand. Other information technologies that can be used in the pig chain are audit- and risk management. The audit management should ensure that compliance with the certifications that are used within the chain. An example, the supply chain meat inspection integrates quality and risk management, enforcing collaboration at the farming level (initiated by the EU hygiene package) (Brinkmann, et al., 2011). Information technology is needed throughout the chain to make information sharing possible. The most used information technology systems are: chain information systems and health and food safety monitoring. These information technologies are used to communicate about all the different actions taken in the chain.

3.3.3 Information sharing

Information sharing between the different actors within the supply chain is very useful for the coordination of the product quality within the supply chain. Possible information that can be shared between the different actors in the supply chain are animal diseases and treatments, demand, pig inventory, lead times/ production cycles, stable- and meat plant capacity. The use of critical control points (CCP) and key performance indicators (KPI) allow the controlling of the product and process specifications (Brinkmann, et al., 2011). With good usage of information sharing the process and quality of the product can be controlled and adjusted during the production process. Therefore information sharing about used production cycles, feed regimes, used production technologies, CCP's and KPI's is necessary.

3.3.4 Joint decision making

Good collaboration within the supply chain is done on the base of joint decision making. The importance of joint decision making is that all the parties together can achieve a better value for their products (Arshinder, et al., 2008). An important issue for joint decision making in the pork chain is the participation in certification schemes (e.g. GlobalGAP, IFS, BRC etc.), which need to be decided together in order to get a chain wide certification. Ordering and pricing schemes are the main interests of the different supply chain members. Therefore the choice of certification should be taken together. Another aspect that need joint decision

making is the increase of animal health. Also there should be a taken a decision about the costs distributions and investment risks taken (Brinkmann, et al., 2011). The usage of joint decision making during the production period is difficult because the configuration is fixed.

3.4 Combination of quality management systems, governance structures and coordination mechanisms

Combining the quality management systems and the governance structures results in four different types of quality management systems with their governance structure within the EU. These four different types of quality management systems are: public baseline quality management systems, private chain wide quality management systems as an industry standard, private chain wide quality management systems on top of the industry standard and public chain wide quality management systems (Wever, et al., 2010) (Grunert, et al., 2011). The last two systems generally have a quality label indicating the source of the product or quality strategy that is adopted in the supply chain. The first two types of systems are commodity products generally. The usage of the coordination mechanism is dependable on the governance structures. The more integration within the chain the more there is the need to use coordination mechanisms.

Public baseline quality management systems

Chains with this systems have not got a chain wide quality management system covering the whole vertical supply chain. The actors in this type of quality management systems only adhere to the public baseline quality standards. More hierarchical governance structures are most commonly used within this type of quality management systems. Examples in Spain and Hungary show that there are contracts used in all the stages of the supply chain. The public baseline quality management system lacks a chain wide approach in forcing actors to take measures to safeguard quality (Grunert, et al., 2011).

Private chain wide quality management systems as industry standard

The private chain wide quality management systems are set as an industry standard. The chains working with this type of system have set a private chain wide quality management system on top of the public baseline standards. Because of the wide scope and scale these systems have, they can be seen as the industry standard. Examples of this type of supply chains can be seen in the Netherlands (IKB), Germany (QS) and Denmark (QSG) (Grunert, et al., 2011). In the Netherlands with the IKB systems more market relationships can be found. The vertical integration is achieved through the chain wide quality management system (IKB), which makes it unnecessary for more hierarchical coordination of transactions.

Private chain wide quality management systems on top of the industry standard

The supply chains using this system have set a private chain wide quality management system on top of the industry standard. This type of quality management system has a large scope and small scale (Wever, et al., 2010). The systems are often smaller and regional systems. Two examples are found in Germany where one particular chain is owned by a farmer cooperative and one coordinated by a retailer. In both chains long-term relationships exist and coordination is formalized into contracts and hierarchical types of governance structures (Grunert, et al., 2011).

Public chain wide quality management systems

This type of supply chain have adopted a public chain wide quality management system on top of the baseline quality standards on EU or national level. Examples of this types of chains are found in Spain (Iberian Ham) and France (Ham of Bayonne) (Grunert, et al., 2011). These systems have a small scale , but the governance structures of this chains are not hierarchical, but mostly informal, with verbal agreements or market like governance structures. The explanation for this is that a public actor provide resources necessary for safeguarding the investments made by the different supply chain actors. This results in less-hierarchical governance structures (Wever, et al., 2010).

3.4.1 Coordination mechanisms within a quality management system

Coordination mechanisms are used for the coordination of the quality management system and governance structure on the operative level. The coordination mechanisms are necessary to motivate or force actors to achieve coordination (Arshinder, et al., 2008). The coordination mechanisms are the tools used to enable the coordination within the supply chain. The usage of coordination mechanisms is not only depending on the quality standard, key processes and the strategic quality objective. Also the type of governance structure can be of importance for the use of coordination mechanisms due to the chance of opportunism. Where the chance on opportunism, when someone does not work in accordance to the arrangements is higher in market type of governance structures in compare to the more hierarchical types. Because of the level of vertical integration within the chain. Based on these criteria the final choice for the used coordination mechanisms on the operative level should be made.

3.4.2 Conclusion

The type of quality management system used for a particular chain is leading for the choice of governance structure that the chain should have. While the used coordination mechanisms are depending on the quality standard, key processes and the strategic quality objective of the chain. This means that both the governance structure and the coordination mechanism used should be determined after the quality management system is designed. Based on the decisions taken for the design of the quality management system the coordination of the chain is determined. The result is that the quality management system sets the standards used for both the governance structure and coordination mechanisms used within the chain.

4. Meatfriends

The main strategy of Meatfriends is based on the customer intimacy strategy. This means that Meatfriends want to be a reliable partner for their customers, the retailers in the Netherlands. This means they have a lot of interaction with the retailers and are well aware of the wishes and demands retailers set. Therefore their supply strategy needs to change to give them more insight in the quality of their supplies and the possibility to coordinate their supplies better, based upon the wishes of the retailers.

Currently the organization of the supplies at Meatfriends is as followed. Meatfriends has a couple of different farmers where they buy there pigs. This certain group of farmers that sell their pigs to Meatfriends make use of different breeds of pigs and production systems. The only general demand that Meatfriends has set to the different farmers is that they make use of feed produced by one specific feed producer. This the feed company is a partner of Meatfriends. All the pigs Meatfriends buys are fed with feed that is been produced by this company.

There are no other conditions set by Meatfriends to the farmers. There is a deviation between the farmers. For example some are certified for the ''Beter Leven Keurmerk'' and some use the conventional farming system. So there is no clear quality standard set for the different farmers in order to supply Meatfriends. Currently Meatfriends is buying in a market situation. With low levels of integration, only the collaboration with the feed company. This means that the current quality management systems that Meatfriends uses is the chain wide public quality management system as the industry standard. In case of Meatfriends in the Netherlands this means that the current system used is the IKB system. With the exception for the part currently working following the IKB together with the ''Beter leven Keurmerk'' which is a private chain wide quality management system on top of the industry standard.

The pigs bought by Meatfriends are currently slaughtered at a Belgium slaughterhouse. This slaughterhouse focuses on the meat quality during the slaughter procedure. Their goal is to slaughter pigs with low stress levels. They do this by regulating all steps in the slaughter procedure together with the usage of CO2 stunning with automatic driving. Currently all the pigs Meatfriends buys are slaughtered at this facility.

Meatfriends does not make use of their own quality management system. This means they do not set the quality standard, because they are not the owner of the system they work with. They have verbal agreements with the farmers where they buy the pigs. This means that they work with a market orientated governance structure. This situation also results in Meatfriends not using any type of coordination mechanisms to secure the quality. Therefore they have little insight in the quality of the pork supplied to them.

4.1 Desired pork quality Meatfriends

The different quality attributes determine the desired quality of Meatfriends BV. The following insight about the quality Meatfriends desires is based on information obtained from Mr. Quinten director of Meatfriends BV. The paragraph contains the first two steps of the three different scenarios. In this two steps the quality standard and quality signals that Meatfriends needs to use are mentioned. The chapter starts with the quality standard that Meatfriends want to have followed with the corresponding quality signals which are the different actions taken during the supply chain. Filling in these actions in the right way should result in the desired pork quality of Meatfriends which is the quality standard.

The different quality attributes are colour, WHC, pH 24h value, IMF and tenderness. For Meatfriends the following description of their desired meat quality has been given (Quinten, 2012):

'' More tender pork with a high WHC and optimal pH 24 h value, with no high need for lean meat. ''

Based upon this description a preferable configuration of the different actions influencing the quality attributes can be made. The correlation between the different quality attributes show that WHC, pH 24h value and tenderness are positively correlated. This means that if one of these values improves it positively influences the other two. A second positive point in the description is that the IMF is not a determining factor, the other three are the most important. This means that the need for lean meat is low. The result of this is that there should be looked for a configuration that maximises the positive effect on the WHC, pH 24h value and Tenderness under the condition that the IMF and colour stay on acceptable levels.

4.1.1 Water holding capacity and pH 24h value

The findings within the literature search show that the following actions have an influence on the WHC: genotype, supplementation of Mg, type of production system, fasting, pre-slaughter handling and stunning. The only difference with the actions influencing the pH 24h value is that the supplementation of Mg doesn't have influence on the pH 24 h value. The optimal value for the pH 24h is between 5.8-6. Starting with the genotype the most acceptable genotypes are Duroc, Large White and Berkshire pigs for both WHC and pH 24 h value. The following actions that should be used to positively influence the WHC is the supplementation of Mg to the diet of the pigs prior to slaughter. The next point is the production system used. The findings show that the conventional production system has a positive influence on the WHC and pH 24 h value of pigs. This means that the choice for production system should be the conventional system. The slaughter of the pigs is an important determinant for the WHC and pH 24h value of pigs. The most important factor with this is the stress pigs have before slaughter. The usage of 24h fasting shows a positive influence on the WHC and pH 24h value. The only downside of the long-time fasting is the decreased yield and animal welfare is bad. High stress levels have a negative influence on the WHC and pH 24h value. The WHC shows no differences when the stress level is low between CO2 and electrical stunning. When the stress levels are higher the CO2 stunning has a lower negative influence as electrical stunning so CO2 stunning is preferable above electrical stunning as a precaution when it is difficult to secure low stress levels.

4.1.2 Tenderness

The literature search shows that tenderness is influenced by the following actions within the pork supply chain: genotype, diet, production system and stunning. Starting with the genotype the following two genotypes most acceptable are Duroc and Berkshire pigs. The influence of the diet on the tenderness shows that diets with lower protein levels result in more tender pork. This also results in more IMF in the pigs. Production systems show no big differences in tenderness only that the organic farming system results in less tender meat. At the slaughter of pigs the stunning of pigs show that the CO2 stunning results in more tender pork compared to electrical stunning. Also high stress levels have a negative influence on tenderness with both stunning methods.

4.1.3 IMF and colour

The two less important quality attributes for Meatfriends can also be influenced without negatively influencing the other attributes. Three actions influence the colour of the pork directly: the genotype, supplementation of vitamin E and accelerated chilling after slaughter. The genotype shows that the Large White and Landrace score lower on colour in comparison to the other genotypes. These breeds are not the preferred breeds based upon the other quality attributes. The supplementation of vitamin E should only positively influence colour without influencing the other quality attributes. This is an action that can be taken. The last action positively influence the colour is the usage of accelerated chilling. When applied properly accelerated chilling does not affect the other quality attributes, but when it is not applied properly accelerated chilling can result in cold shortening which negatively influences WHC and tenderness. So that is a risk that should be taken into account with the choice for this action. IMF is of lower interest to Meatfriends BV. Although the IMF should not be too high. This occurs mostly with the choice for the Berkshire breed and with the feeding of low levels of protein. So there is a limit to ignoring the IMF value.

4.1.4 The configuration

Based upon the desired pork quality of meat friends the following configuration should according to the literature search be the best to reach the desired quality. For the choice of genotype the best choice is the use of the Duroc breed. Looking at the feeding the preferred action are to use a diet lower in proteins. Together with the supplementation of vitamin E and Mg to improve the colour and WHC. For the preferred production system the conventional system is the best choice because they positively influence the WHC and pH 24 h value. During the slaughter procedure the stress levels of the pigs should be kept as low as possible. The fasting time used show a positive influence when the 24h fasting time is used. The acceptability of this is low because of decreased carcass yield and animal welfare. Looking at the choice for a stunning method the CO2 method is preferred above the electrical method because of its influence on tenderness and the more pink colour resulting from CO2 stunning. The last choice is if there should be chosen for accelerated chilling this is depending on the risk of cold shortening. An overview of the configuration is been given in table 15:

Table 15: Configuration of action for Meatfriends BV

Action	Preferred choice	Influence on
genotype	Duroc breed	WHC, pH and tenderness
Diet	Low protein level	Tenderness
Vitamin E	Supplementation yes	Colour
Magnesium	Supplementation yes	WHC
Production system	Conventional 0,7m2 or 1m2	WHC, pH
Fasting	16 h > 24 h fasting (low acceptability)	WHC, pH
Pre-slaughter handling	Low stress levels are preferred	Colour, WHC and pH
Stunning	CO2 preferred above electrical stunning	Colour, WHC, pH and tenderness
Chilling	Usage of accelerated chilling	Colour positively, risk for cold shortening

The determination of the configuration of the actions taken in the pork supply chain in order to reach for the desired quality of Meatfriends is the first step of all three different scenarios following the literature search. This is the base for the Meatfriends to get there supplied pork. The next step will be the empirical research which will be to determine which scenario gives Meatfriends the best opportunity for successfully adapting the configuration into their supply chain.

4.2 Scenarios

In order for Meatfriends to reach their goal for more consistent and market orientated pork they need to change their supply strategy. The goal can be reached through different scenarios that fit within the strategy of Meatfriends to be a reliable partner for the retailers with customer intimacy as their main strategy. Based upon the literature review three different scenarios for Meatfriends can be distinguished. These scenarios have different quality management systems based upon the structure of the quality management systems and governance structures. With the quality management systems containing the quality standards, quality signals and the monitoring mechanisms used to coordinate.

4.2.1 Scenario 1: Private chain wide quality management system as an industry standard

The first scenario for Meatfriends to make their supplied pork of more consistent and market orientated quality is to make use of a quality management system based upon the currently used IKB system. This means that in the first scenario Meatfriends does not use any coordination or integration with the different chain partners and buys pigs in the current market having produced in accordance with the configuration to reach the desired quality.

The actions Meatfriends need to take in this scenario are that they start with setting their own quality standard. The quality standard needs to be set based upon the desired pork quality that Meatfriends has. This means they start with determining the desired colour, pH 24 value, WHC, IMF and tenderness they want their supplied pork to have. The second step they need to take is to set the quality signals. The quality signals will be the actions taken within the pork supply chain to influence the quality. By determining the actions in accordance with the

desired quality the quality signals are filled in. With this the actions taken will be the quality signals for Meatfriends. This means that based upon the actions taken the desired quality is reached.

Meatfriends now has its quality standards and signals worked out. In the first scenario Meatfriends is going to search into the market to find pigs that are produced in accordance with the desired quality. The pigs can be found together with the feeding company who has insight in the pigs farmers production. When the pigs are found these pigs can be bought from the farmers.

When Meatfriends has bought the pigs they will be slaughtered. This will be done at the slaughterhouse they currently use in Belgium. So Meatfriends does not need to adapt the slaughter procedure. They currently are satisfied about the slaughterhouse.

The first scenario that Meatfriends can adapt to is rather simple and makes no use of integration. The only coordination mechanism used within this scenario is information sharing, based on the information gained for partners and farmers within the chain to find out which farmers produce in accordance to the quality signals. This means that this scenario does not ask any actions or changes made by farmers. The result of this is that there is no need for more integration within the chain. This means that the governance structure will be market orientated. The first scenario therefore works with the view that the responsibility for finding the right pigs is taken by Meatfriends. The scenario has different advantages:

- No integration or coordination needed
- Independency for Meatfriends and farmers (No formal agreements).
- No need for changes at farmers
- Low cost for all parties
- Current pay-out system usable

The scenario also has some disadvantages for Meatfriends:

- No certainty about the availability of pigs
- Always needing to search for the right pigs
- Little influence on pork quality
- Depended on the market
- No influence on the production
- No possibilities for labelling

4.2.2 Scenario 2: Private chain wide quality management system on top of the industry standard

The second scenario possible to reach more consistent market orientated pork is based on the principle for Meatfriends to make their own quality management system above the IKB system. This means that Meatfriends sets extra standards for farmers and chain partners. This means that in the second scenario Meatfriends makes use of higher levels of coordination resulting in more influence on the pork quality within the chain. Which means that Meatfriends becomes owner of the quality management system.

The first steps that Meatfriends needs to take in the second scenario is the same step as in the first scenario. They need to set the quality standards based upon the quality attributes. These attributes are: colour of the pork, WHC, pH 24h value, IMF and tenderness. Based on this quality standard they need to fill in the quality signals in accordance with this quality

standard with the quality signals being the different actions taken within the chain. When they have filled in these two steps they have founded the base of their quality management system. So they now have the configuration of how the actions within the chain need to be taken in order to reach the Meatfriends quality. This is basically the same as in the first scenario.

The third step will be different from the first scenario. Now Meatfriends needs to make sure that besides the quality standard and the quality signals, they use coordination mechanisms to coordinate the chain. The different coordination mechanisms that are useful for the system are contracts, information sharing, information technology and joint decision making. The contract should be used to specify the quality requirements, meaning the quality standard and signals used within the quality management system. Next the contracts need to have the terms and conditions for other issues occurring in the pork supply chain like: Health prevention, incentives and discounts, certificates and revenue sharing. The contract needs to make sure that the farmer now the terms and conditions for the working with the quality management system of Meatfriends. The information sharing should be used to see if the quality requirements are met. The information should be share about the following points: production cycles used, stable capacity, production costs, animal diseases treatments and retailer demand. Different information technologies can be used to obtain this information: chain information systems, animal health monitoring, audit management and classification systems. Joint decision making is useful to determine the agreements about: participation in certification schemes, production planning and forecasting, risks, diseases and zoonosis reduction and pricing schemes. By giving farmers the freedom to choose their own chain partners as long as they work in accordance with the quality management system. This means that the farmers are not pushed too particular partners or suppliers by Meatfriends.

The fourth step is to find farmers who want to adapt to the quality management system of Meatfriends. The farmers get the choice to work in accordance with the quality management system of Meatfriends. The way how they want to do this is free of choice to them. So they are free to choose their own partners as genetics and feeding company. The slaughter in this scenario like in the first scenario will be done by their current partner the Belgium slaughterhouse.

The result of this scenario is that the governance structure of the chain will change for the market situation currently used to a more hierarchical structure with formal contracts and verbal agreements. The advantages of the second scenario are:

- Coordination of the supply chain through the coordination mechanisms
- Certainty about the pigs supplied
- Collaboration with the farmers resulting in a bound
- Freedom of choice for farmers
- Possibility for labelling

The disadvantages of the second scenario are:

- Loss of flexibility
- changes asked from farmers
- Higher costs
- Need for new pay-out system to give incentives to farmers

4.2.3 Scenario 3: Private chain wide quality management system on top of the industry standard and integration

In the third scenario that Meatfriends can adapt to reach more consistent and market orientated pork quality Meatfriends like with the second scenario develops their own quality management system, but also strives for more integration within the chain. This means that Meatfriends takes away more freedom of choice from the farmers and sets more demands to the farmers about the chain and partners they use.

The start of the third scenario is equal with the first two scenarios and starts with the steps to determine the quality standard and quality signals based on the desired quality of Meatfriends. Based upon this steps the configuration of the different actions taken within the supply chain is being reached.

The third step is different from the other two scenarios, now Meatfriends starts with finding the chain partners to build a frame for the chain. The frame of the chain consists out of fixed chain partners supplying the genetics and feed used within the chain. This way Meatfriends get more influence on the chain and the chosen partners. So in this step Meatfriends looks for a genetic company who will be responsible for the genetics used within the supply chain. Also they have to appoint there current feed partner as the fixed supplier for the feed within the chain. Based upon this the entire frame of the supply chain that need to be adapted by the farmer is fixed. This gives Meatfriends a lot of influence in the entire chain.

The fourth step will be finding the farmers the same way as in the second scenario. They also make use of coordination mechanisms to coordinate the pork supply chain to make sure that all chain actors work in accordance with the configuration that is demanded by Meatfriends to reach the desired quality. The coordination mechanisms useable will be the same as in scenario two, namely: contracts, information sharing, information technology and joint decision making. The difference with the second scenario will be the integration of the chain. In the second scenario the farmer gets the freedom to choose his own partners for genetics and feed. In the third scenario they need to make use of a appointed genetics and feed company. This means that the integration of the chain is higher because the only flexible partner will be the farmer, because the rest of the chain is fixed. Because of this situation the coordination within this scenario is higher.

The slaughter procedure like in the first two scenarios will still be done by the currently used slaughter house in Belgium.

The higher level of integration and coordination means that in scenario three the governance structure that is used will be more hierarchical in compare to the second scenario. This means that there needs to be formal contracts at least. Perhaps the possibility of shared equity or vertical integration as a governance structure can be an option in the future with the third scenario. The advantages of the third scenario are:

- Coordination and integration throughout the supply chain
- Collaboration throughout the entire supply chain
- Certainty about the quality and consistency of the pigs
- Possibility for labelling

The disadvantages of the third scenario are:

- High demands set to all chain partners
- Loss of freedom for the farmers
- Higher cost for coordination
- Dependency between the different chain partners

4.3 Comparison between the different scenarios

In table 14. the three different scenarios will be compared in an overview. The comparison will contain the quality management areas used, quality management element occurring, the governance structure, the integration of the chain, usage of coordination mechanisms, the demands asked of the chain partners and the possibility of labelling.

Table 14: Comparison of the scenarios

	Scenario 1	**Scenario 2**	**Scenario 3**
Owner of the system	IKB	Meatfriends	Meatfriends
Scale of the system	Large	Small	Small
Scope of the system	Chain wide	Company to company	Chain wide
Governance structure	market/verbal agreements	Formal contracts	Formal contracts
Coordination mechanisms used	IS	Contracts, IS, IT and JDM	Contracts, IS, IT and JDM
Level of integration	No integration	Low level of integration	High level of integration
Level of demand set for the chain partners	Farmers stay free	Low level of demands set	High level of demands set
Possibility for labelling	No	Yes	Yes

The main difference between the three scenarios is the level of coordination and integration within the supply chain of Meatfriends. The higher the level of integration the higher the effectiveness of the chain. The downside is the higher the coordination and integration within the chain is the more efforts are demanded from all chain partners and the higher the dependency on each other becomes. The first step in all three scenarios is the same, the determination of the quality standard that Meatfriends desires from their supplied pork. In the second step the determination of the actions taken throughout the pork chain to reach the desired quality therefore will also be the same. Therefore the main difference between the three scenarios is the way how Meatfriends can reach the desired quality and how they can coordinate the pork chain in order to not only reach this quality but also to maintain it.

5 Methodology for the empirical research

The previous chapters contained the literature study that was conducted to find the theory useful to start the empirical research. Based upon the theory the empirical research can be designed. The goal of the empirical research is to gather data that is used to answer the general research question. The methodology chapter focuses on the empirical research and the way it was conducted. The chapter starts with the case study design which consist out of data collection, data analysis and reliability and validity. These factors together make the methodology used to do the empirical research.

5.1 Case study design

The case study design is to organize the empirical research which will be conducted about the pork supply chain. The goal of the case study is to find out what the possibilities and needs of the pork supply chain actors are to build a supply chain focusing on consistent quality and market orientated pork production. The specific case will be the pork supply chain and the needs and possibilities of the different supply chain actors for building a supply chain.

5.1.1 Data collection

There are three types of data collection sources that can be used during an empirical study namely documents, media and people (Verschuren & Doorewaard, 2010). The source for collecting data during this empirical research will be people. The reason that only people will be used as source for the empirical research is because they are active within the chain and aware of the latest developments within the supply chain as part of their profession. Therefore they can give the best information to answer the research questions that are part of the empirical research. These research questions are:

- *What are the drivers for pork quality in the current pork supply chain?*
- *What is the acceptability and effectiveness of working following a particular pork chain configuration?*
- *What coordination is needed to get the supply chain organised?*
- *What can be suggestions for value-adding in pork supply chain?*

There are different way to get information from people during a research. There are two ways of accessing individual people to gather data. These are questioning and observing (Verschuren & Doorewaard, 2010). In the research the way of collecting data is to question the different experts/actors that are active within the supply chain. There are different methods to do question people. There can be chosen between a poll and an interview (Verschuren & Doorewaard, 2010). In this research there will be chosen for interviews because of the limited interaction that takes place within a poll which is more pre-structured and contains mostly closed questions. While in an interview there is more interaction. There are different ways of interviewing that can be used. The interview can be done through face-to-face interviews or by telephone (Verschuren & Doorewaard, 2010). The research there will use face-to-face interviews. Because in a face-to-face interview the researcher has the advantage of observing the expressions on the face and the body language of the interviewee, these may be of particular interest to make sure that there is a correct interpretation of the answers by the researcher (Verschuren & Doorewaard, 2010). The interviews will be done individually with the different interviewees.

The interviews will be semi-structured. The reason for this is when the same questions are being used for all the interviewees there can be made a good comparison of the answers given by the different interviewees. In addition asking open questions gives every interviewee the chance to answer in his own way and opinion without limitations of particular answering possibilities. The structure of the interviews will be the same in every interview.

The interviewees need to have expertise about the pork supply chain. There will be made a distinction between two types of interviewees. The first group of interviewees are the chain actors. These group are people who work at a company directly active within the pork supply chain. The companies they work for can be farms, feed companies, genetic companies or slaughter houses. These groups can give a clear view on the needs and possibilities that there are within the pork supply chain. The second group of interviewees are experts within the pork supply chain. The difference between experts and the first group is that the expert are not active in a company active within the supply chain. They are mostly researchers active within the pork supply chain. The reason this group is interviewed is because they can give a representative view on the pork chain without having a particular economic dependence in the chain. Both groups will be interviewed with the same method. The reason for this is to have comparable interviews through the usage of the same method and questions.

The interview starts with an introduction of the research and the goals of this research. This is done to give the interviewee a clear understanding about the goal of the interview and to make sure he or she understands the case. When the introduction is finished the interview will start with asking the different questions. These questions will be fixed and used in every interview with the different interviewees. In this way the answers will all be comparable.

Fourteen questions are prepared for the interviews. These are all open questions. Open questions have been chosen to make sure that the interviewee answers the questions based upon their personal views and not to let them choose between different answer possibilities, using closed questions lets the particular views of the interviewees will come out less clear. The following fourteen questions have been asked during the particular interviews:

1. What are the most important drivers/values for the production/sales of pigs?

The reason the question is asked is to find what are the drivers/values of production used by the different actors within the chain to control their production process. The answers given can be very wide and reflect on the growth of animals, quality of meat, pay-out systems etc.

2. Is meat quality taken into account with the buying/selling of pigs/feed/genetics and in which way?

With the second question there is especially asked for the meat quality attributes that are taken into account with the buying/selling of products in the production chain. This is done to find out in what way meat quality is taken into account within the pork chain.

3. Is there a clear view on demanded meat quality of the meat processors and how is this demand being translated to pig farming?

The third question is used to get a view in what is being communicated throughout the pork chain about the demanded quality and if the pork chain is aware of the demand.

4. Is their feedback about the meat quality throughout the pork chain and between which chain actors?
The fourth question needs to give an insight in the feedback currently given though out the pork chain about the meat quality and between which chain actors.

5. Does pig farming have a need for more feedback on meat quality focussing on aspects like: colour of the meat, water holding capacity, pH values, inter muscular fat and tenderness?

The reason for asking this fifth question is to see if pig farming has a need to gain more feedback about the pigs they deliver. So can it be useful to give more feedback too the pig farming.

6. Is it possible to set the particular actions/choices within the production chain (genotype, diets, stress reduction policies etc) influencing the different quality attributes pre-hand and use this configuration as a production plan? If yes which actions can and cannot?

The sixth question is asked to see if it is possible to make a clear production plan and if possible to produce pigs according to this configuration and which actions are able to be fixed or not. So is it technologically possible to produce according to a configuration and does this result in a desired product quality.

7. Would more communication and reflection about the different choices/actions within the pork chain help to improve the predictability and consistency of the pork quality? And why or why not?

The difference between the sixth and seventh question is to see if more communication and reflection about the different actions and choices in the chain make sure that the predictability and consistency of the meat quality is improved. This question more focuses on the possibility to make sure the quality becomes more predictable and consistent. So in question six is asked if a particular desired quality can be reached and in question seven if this quality also can be made predicable and consistent.

8. About which actions/choices (breed, feeding, stress reduction, classification, meat quality, consumer information) within the pork chain would more information be useful?

The reason of this question is to find out which information that different chain actors would find useful if they could receive this information from other chain actors.

9. About which actions/choices in the production chain would you be prepared to share information with other chain actors? And in which way?

The reason for asking this question is to see about which points the different actors are prepared to share information and in which way should this be arranged. So what should be done in return for sharing these information.

10. How should a fixed chain be designed en coordinated? Think about points like contracts, information sharing, information technologies and joint decision making.

The tenth question is asked to see what methods and tools are acceptable and feasible for designing and coordinating a closed supply chain with one end-user in this case Meatfriends.

11. What does pig farming ask in return for participating in a supply chain? (profit, image, collaboration, branding, continuity etc)

The eleventh question is asked to see what does pig farming ask in return for binding themselves with other chain actors. This is to see how different actors in the pork chain can be bounded to a particular chain.

12. How do you think should a better value for pigs be created?

The reason for asking this question is to see what ideas the different chain actors have about how the value of the pigs should be increased. With the views perhaps new idea or insides can be find.

13. Do you see a clear value added trough the different labels in the pork chain for example: milieukeur, organic or animal welfare (Beter Leven Keurmerk)?

The idea behind asking this question is to find out the view on different labels and the effect of the labels. This can be used to see what pitfalls or chances a label gives. This then can be taken into account with building a chain and bind partners.

14. Do you know other initiatives for quality improvements or different aspect in the pork chain for example sustainability?

The last question is asked to see if there are other initiatives in the chain for improving quality that then also can be taken into account, especially for sustainability and quality.

In general the question are connected with the different aspects of the literature search. Question 1 until 4 are connected with the first part of the literature search about the quality attributes and the view the different chain actors have on them. The questions 5 until 8 are more connected with the different actions influencing the different quality attributes within the pork chain. This is to find out what are the possibilities to reach the desired quality by working into accordance with a configuration. The questions 9 until 11 are connected more on the design and coordination of the supply chain and are connected with the different coordination mechanisms. The last three question focus more on the views and ideas the different chain actors have about the chances and initiatives there are possible in the pork chain. Regarding the answers on this question possible views can be used for value-adding after the Meatfriends chain is realized.

In total there where held ten different interview with chain partners, within these ten interviews all different chain actors where at least interviewed once. In total the composition of the interviews looked as followed:

- 2 Farmers

- 1 Genetic company
- 2 Feeding companies
- 1 Pig trader
- 1 Slaughterhouse
- 3 Chain experts

5.1.2 Data analysis

The information gathered through the different interviews with the chain actors is analysed by comparing the different answers given. Based upon the similarity in the answers there can be seen which points are of importance with the design and coordination of the pork chain that Meatfriends wants to start. These generally can be spilt into two points the quality and reaching this desired quality as close as possible. And on the other hand the analysis will be used to see how the organisation, binding and coordination of the different actors within the chain can be realized. Generally said this means the technological possibilities and on the other side the organizational possibilities.

For the quality in the analysis is looked at the quality attributes and which actions are easier or more difficult to implement into the pork chain. With the answers on the questions 1 until 8 there can be given a clear view about the possibilities to reach a desired and consistent quality and what needs to be taken into account to make sure that it can be reached.

For the chain building aspect of the analysis the research questions 9 until 14 are used. The goal of this questions is to see what is needed to organize and bind the different chain actors to a chain. The data analysis will result in a list of point that are of importance for the different chain actors. These points need to be taken into account to build good relationships with other chain actors and gives key points to make the chain last.

Based upon the answers given during the interviews there will be looked for the similarities between the answers. The similarities are used as the bases for the different needs that the chain partners have. Based upon the similarities there can be made statements that Meatfriends should take into account when designing to develop a scenario.

5.1.3 Reliability and validity

The reliability and validity of the interviews need to make sure that the researcher measures what he want to measure (validity) and the results following the research are similar (reliability). The reliability and validity needs to make sure that the accuracy of the results is secured.

Reliability

To make sure that the results are reliable there will be used semi-structured interviews. The interviews will consist out of open questions. In order to reach a high reliability the questions asked during all the interviews will be the same. By asking the same question to all the interviewees there can be made a proper comparison between the answers given. By interviewing chain actors active in all stages within the chain and experts active throughout the entire chain. The interests and views represent all stages and interest throughout the supply chain.

Validity
To reach high validity during the research it is important that the researcher asks the right questions during the interview. This means that all questions need to be relevant for the research. In order to reach the high validity all questions are based upon the same areas as the literature review. These areas are: the quality of pork, the actions taken within the chain influencing the quality and the coordination needed to reach the quality. The questions are used to find the view of the interviewees on these issues in the chain. The validity is secured because this way the findings are useful to give an advice based upon the view of the different chain actors on the research areas.

5.2 Limitations

The limitations to the research, affect the research and the results. During a research there are four types of limitations that can occur: the available time and people, variables are already fixed, the theoretical framework is incomplete and the skills of the researchers (Verschuren & Doorewaard, 2010). These four types of limitations all occurred in the research. In this paragraph the different limitations affecting the research are mentioned.

Available time and people
The available time and people during the research gave no limitations. The time available for the research was sufficient and the people who were asked to participate all made time in their schedule.

Variables that are already fixed
Within this research no variables can be seen as already determined. The outcome of the empirical research can possible result in the dependent or fixed variables. Pre-hand there are no variables within the research already fixed.

The incomplete theoretical review
With the configuration only the attributes affecting the five different quality attributes colour, WHC, pH, IMF and tenderness are taken into account. Other issues of importance like carbon footprint, antibiotics, health etc. are not taken into account. Also with the coordination mechanisms and especially important contract issues in the chain like price and costs, risks, etc. are not taken into account with the theoretical review. When designing the supply chain these issues should be taken into account and therefore also affects the configuration. Based upon these points the configuration can be different for the focussing only on the quality attributes and coordination in the literature review.

Skills of the researchers
The different skills of the researcher that can be a limitation to the research can be the interviewing skills of the researcher. These skills are not on top level because the interviewer has got no specific training and a limited knowledge about interviewing techniques. This can limit the information obtained during the empirical research and interviews. This can affect the effectiveness of the analysis because the of the limited information obtained from interviews.

6. Results

During the empirical research ten different interviews were held to find the needs of the different actors within the pork supply chain to build a specific pork chain. The interviews will be analysed to see the similarities between the different actors and the needs that have to be covered in order to build a good working supply chain to reach consistent and market orientated pork production. The answers given within the different interviews can be divided into three different area's starting with the quality of pork, the configuration of the actions in the supply chain and the coordination of these actions. The different answers given will be connected with these three areas. The results will be used to answer the four different research questions of the empirical research.

6.1 Quality in the chain

The first part of the results is about the questions that were asked about the quality of pork and the current communication about the quality of pork between the different chain actors. The text refers to the first five questions asked in the interviews. The answers of this questions will be used to answer the following research question:

- *What are the drivers for pork quality in the current pork supply chain?*

6.1.1 Drivers for production

About the quality of pork different questions were asked to see what currently are the most important drivers in the production of pork. All different actors in the chain mentioned that the most important drivers for farmers during the production of pork are the fat/muscle composition of the carcass and the weight. Those are the two most important drivers because they are the bases for the pay-out system used within the Netherlands. Other important drivers are the growth rate, feed conversion and health of the animals, stated by farmers and genetics company. The overlap between all these factors is that they are economically driven. Al the drivers have a direct influence on the economics of the farmers. The general impression is that the pork supply chain is a cost driven chain with the objective to minimize costs as mentioned by farmers, genetics and feeding companies.

The genetics companies most important driver is improvement of efficiency at farm level through genetics every year. This means that better growth rate, health or feed conversion through better selection of genetics, results in lower production costs for the farmers.

For feeding companies the most important drivers for selling feed are the technical and economical results the farmers reaches through feeding. The most important drivers connected with this are feed conversion, daily growth, feed cost per kg growth and health. The goal of the feeding companies is to make sure that the farmers produce as cost efficient as possible.

For the traders their most important handling is to make sure that he arranges the demand of the slaughterhouses with the supply of the farmers. With the goal to make sure that the farmers get the best possible price for their pigs, based upon historical data about their pigs. By using this production data, the trader looks for the highest pay-out with that type of pig. Where the genetics of the pigs is an important indicator. This is the action performed by a trader.

Based upon these drivers used in the pork chain meat, quality is not used as a driver for production. The quality aspects used for the production of pork all relate to the carcass quality of the pigs. It is awkward to see that the quality of the end-product (pork) is not used as a driver for production. The reason why the slaughterhouse does not include pork quality in the pay-out system is that because of the high number of slaughtered pigs per day, there deviation in quality is constant so they divide pigs at the end of the day based on the deviation they had that day, as stated by the slaughterhouse. Another reason why meat quality aspects like WHC and pH are not taken into account with the pay-out systems is because these point are affected by the stress level the pigs have before slaughter. It is nearly impossible to allocate the responsibility for the higher stress level in pigs with low WHC and pH values to the chain actor who is responsible for the higher stress level. It can be the farmer, transporters or slaughterhouse. So there will always be discussion about who should suffer the costs connected to the lower quality, as stated by a chain expert.

6.1.2 Genotype and diet

The pay-out system of pigs is based upon the carcass quality. The current pay-out system takes into account the fat/muscle composition and the weight, as mentioned by trader, genetics and expert. The genotype and diet are the most influencing attributes for the composition of the carcass. The general statement is that the farmers all chose their own genotype and stick to this genotype, as mentioned by farmers and genetics. On the other hand the farmers are more flexible with the feeding of pigs, as stated by trader and farmers. With the combination of genotype and feeding the carcass quality is been determined. So there can be said that the acceptability of changing the feed is there, changing the genotype is for farmers not acceptable without high rewards, because the genotype generally is been used within the company for many years. The choices for genotype and diet are always based upon the economic benefits. These can be reached by high pay-out through a good fat/muscle composition on the one side, as stated by genetics, traders and experts. On the other side efficient production based upon feed conversion, growth rate and health are also drivers for the choice of genetics and diet as mentioned by farmers and genetics company. The choice for genotype and diet does not take meat quality in account ,as stated by respondents throughout the chain.

6.1.3 Insight in demand

The insight in the demand for meat quality of the slaughterhouses that the farmers have is very little to nothing. The only insight they currently got in the demand of the slaughterhouses is the pay-out system that is also leading for the production of pigs as stated by trader, farmers, feeding company and expert. It is not necessary for slaughterhouses to give insight in their demand for meat quality, because they divide the carcasses themselves between their customers. The high number of slaughtered pig results in a common standard deviation in quality and therefore they know the quality of the carcasses they need to divide between their costumers, as stated by trader and slaughterhouse. This results in the farmer having a clear insight in the demand for carcass quality through the pay-out system based upon the fat/muscle composition. There is no insight in the meat quality. The slaughterhouse mentioned that they were very active in instructing the transporters and farmers how they can lower the stress levels resulting in a higher meat quality. These instructions were not mentioned by any other interviewee.

6.1.4 Need for feedback

Farmers say they have little knowledge about meat quality and how to influence the meat quality with their production method. There is clear feedback about meat quality from retailers to processors and from processors to slaughterhouses as mentioned by the slaughterhouse and experienced at Meatfriends where retailers set high demands to processors. The slaughterhouse does not give feedback on the meat quality to the farmers. There is a need to get feedback on the meat quality, the reason given for this is that the insight in meat quality should result in a better understanding between each other within the supply chain as stated by farmers, trader and feeding company. By better instructing why particular actions should be taken to improve the meat quality, surely affect the meat quality and can result in a better product an expert mentioned. With the condition that all feedback should have a purpose. When additional information is not usable, the need for feedback is not there. Only when the feedback about meat quality can result in a better product that gives an added value to the farmers, as stated by an expert, feeding and genetic company.

6.1.5 Conclusion

In this paragraph the first research question about the pork quality has been answered based upon both the theoretical and empirical research. The research question is:

- *What are the drivers for pork quality in the current pork supply chain?*

In the theoretical research the first part was about the quality of the meat and what the most important quality attributes are for the meat processor. The most important quality attributes are colour of the meat, WHC, IMF, pH 24 h and tenderness. These are the most important for Meatfriends. Looking at the findings in the empirical research the drivers for production of other chain actors are different from the meat processors. The most important drivers for pig farmers are the fat/muscle composition of the carcasses, the weight of the carcasses, the growth rate, feed conversion and the health of the pigs. Looking at these drivers they are all different from each other. There can be said that the pay-out system used by the slaughterhouses and the efficiency of the production are the most important drivers for pig farming. Also the genetics and feeding companies work with these drivers because they are there for their costumers and the interests they have. This means that the quality standard for all the different actors within the pork supply chain are based on the carcass quality and efficiency.

Looking deeper into the quality attributes and asking if pig farming has insight in the meat quality. The insight in the demand for meat quality is non-existing. The slaughter houses only give insight in the demand for carcass quality. The information about the carcass quality is mainly given through the pay-out system. With the pay-out the slaughterhouses give feedback about the fat/muscle composition, the weight and the health of the carcasses. This is also the base for the pay-out. The reason why meat quality is not taken in consideration during pig production is because there is no pay-out system based upon meat quality.

To make sure that pig farming takes meat quality into account it is necessary to give incentives to pig farmers to take actions based upon the meat quality. Besides giving incentives to take the meat quality into account during production, there need to be made clear to pig farming what is demanded on the base of meat quality. When it is not clear to pig farming what is demanded there will be no actions. So there need to be made a combination

between the demanded meat quality and incentives given too farmers to take these into account. Incentives need to give the pig farmers a direct or indirect profit or advantage.

Based on the result the following conditions can be made about the drivers for pork quality in the current pork supply chain:

- **The farmers determine their choices on the base of economics**
- **Take meat quality into account in the pay-out for farmers, so farmers get the incentive to take meat quality into account.**
- **Inform farmers more about meat quality and the actions they can take to improve it**
- **Give feedback about meat quality and the effect of the actions taken**

6.2 Influencing actions for quality

The second part of the results is about the possibility to produce consistent pork throughout the entire supply chain in accordance with a specific configuration. The result are based upon the answers during the interviews. The specific questions reflecting to the actions and the possibility to regulate the different actions taken within the supply chain are the sixth until the eighth question. The different actions taken are the quality signals that are important for Meatfriends and need to be the base for the configuration used for the chain. The answers of this questions will be used to answer the second research question of the empirical research:

- *What is the acceptability and effectiveness of working following a particular pork chain configuration?*

6.2.1 Configuration of the supply chain

All the respondents agree that it is possible to regulate all the different actions taken throughout the chain to produce more consistent quality pork. There are different remarks about the plan to produce in accordance with a configuration. There needs to be made clear how the specific actions should be taken and these action should be controlled, as stated by farmers, feeding company and a chain expert.

The different actions taken within the pork chain start with the genotype. The desired genotype should be searched for because farmers are not willing to change their genotype within their production. This means that when a specific breed is asked it is a lot easier to find farmers who work with this breed instead of looking for farmers willing to change their genotype in accordance with the specific breed, as mention by farmers. There can be said in general that for genotype it is preferable to search for farmers already working with the genotype, as stated by a trader. This can be done together with the genetics company that knows which boars are used by which farmers.

The diet composition should be made in accordance with a feeding company who make a specific recipe that focuses on the most important wishes from the chain, as mentioned by the feeding companies. The acceptance of farmers to change the diet they use for the production of pigs is higher, when it is made clear why the diet is used and what the purpose of the specific diet is, as stated by farmers and trader. Another remark made is that the quality can be made more consistent by fixing the genotype and using a constant diet, but the biological diversity between the pigs will always affect the consistency and cannot be regulated, as mentioned by experts.

Looking at the slaughter procedure it is important that the pre-slaughter handling of the pigs starting with the transportation until the stunning of the pigs is been regulated and controlled to make sure stress levels stay low, stated by the slaughterhouse and experts. This has a high need because the stress level has a high influence on the meat quality especially on the WHC and pH value. The biggest issues are the driving of the pigs and the stunning. Experts mentioned that when CO2 stunning is used it is not acceptable to use an electric prod, because then the pigs suffer the negative effect of both CO2 and electrical stunning. The best way to reach consistent quality is CO2 stunning with automatic driving to the stunner. The reason is that CO2 stunning results in more pink meat with better colour and better pH values, as mentioned by experts. The need to control the stress level is high because this will make sure that the pork quality is consistent. Because high variation in stress levels also result in high variation in quality. Therefore it is important to use the same slaughter procedure every time. This needs to be arranged with the slaughterhouse. Therefore the more automatic method, where the handling is done the same every time is preferable, as mentioned by the slaughterhouse and experts.

In order to have good consistent quality pork it is important that the configuration arranged between the different chain partners is clear and not changed overtime. The chain needs to stick to their arranged plan in order to reach more consistent pork, according to the farmers. There is a need to control the production method to make all the participants work in accordance with this configuration. When a chain is been made it is important that all the participants deliver what they agreed on. There needs to be a control method within the chain to make sure all participants stick to the appointments, as mentioned by experts and feeding companies.

6.2.2 Starting the chain

In accordance with determining the different actions the communication about the different actions can surely improve the predictability and the consistency of the pork quality. Where the shared information makes sure that the predictability and consistency is improved, as mentioned by all the different respondents.

Starting with the chain it is important that the interests of all the different partners are taken into account. These interests are prices, quality, costs, efficiency, goals and quantities. About all these issues clear appointments need to be made to make sure that the interest of the different actors are made clear and fulfilled in a way it is acceptable for them to participate, as stated by trader and feed company. This is done through joint decision making. In addition there are some conditions that need to be taken into account with making a configuration. First there need to be a strong actor who is the initiator and coordinator in the chain. On the other side the remark is being made that the farmers want to have the freedom to make their own decisions and can switch away from the concept if they see better opportunities with other partners, as mentioned by slaughterhouse, farmers, feed and genetics companies. Also the cost price for production may not increase or at least at a minimum level, because when cost price increases this means that switching between buyers becomes more difficult for farmers. Other farming aspects like growth rate and feed conversion are of high importance to farmers, as stated by feed en genetics companies. All these different issues should be taken into account and communicated with the different partners to jointly decide,

how this conditions are taken into account. Also their need to be made clear to all the participants why different actions are chosen and what the consequences are.

When the production chain is operative there should also be a permanent communication to make sure that every participant in the chain shares information about their products and the actions they have performed. By doing this the predictability and consistency of the product is easier and should improve, as mentioned by experts and trader. This means there needs to be an information system that distributes these information between the chain partners. This information should include: genotype, feeding, production system, slaughter age, transportation time, quality levels and product consistency. By sharing this information throughout the chain more insight will be given on the effect of the different actions, as stated by experts.

6.2.3 Building the supply chain

To reach a desired chain configuration it is important that it is made clear to all the participants in the chain what is expected from them. There needs to be a clear leader of the chain who designs the chain, as stated by feed and genetics companies. So on forehand all the terms and conditions need to be arranged together with all the different partners. All the participants need to have a contribution at the start to make sure that they agree with the chain and have had the chance to give their own input, as stated by experts, slaughterhouse and genetics company. The importance of pre-hand joint decision making is that participants will be more willing to bind themselves to the chain when they have the chance to give their own input.

6.2.4 Conclusion

In the second paragraph the answers have been given on the research question about the actions influencing the meat quality within the supply chain. The following research question has been answered:

- *What is the acceptability and effectiveness of working following a particular pork chain configuration?*

The second part of the research is about the actions within the supply chain that influence the meat quality. In the total supply chain there were found several actions that directly influence the five meat quality attributes. The choices can be divided into the four groups namely the genotype, feeding, production system and slaughter procedure. Where in every groups different choices can be made. All these choices are described in the second chapter. The goal is to influence the different actions in a way to make sure that the desired quality at the meat processor can be reached. By choosing the different actions in accordance with the desired quality a configuration of how to fill in the different actions is made. The interviewees confirmed that by filling in all actions in accordance with a configuration and doing this constantly there can be reached a specific meat quality. The remark given with this was that besides the biological diversity of the pigs also there needs to be controlled that the actions are performed the same every time.

General remarks made about the different actions that the genotype chosen by the farmers is fixed and they do not change the genotype. They generally stick with the choice they have made. Also when farmers want to change their genotype it takes time to do and it cannot be done on the short term. The diet that is being fed to the pigs is more flexible and changeable

in short term because of the high acceptability to change a diet if this gives an advantage. The change can be made when a new feed order has to be done. The production system a farmers has is fixed in the short term. Changing his production system is not possible in the short term and costs investments of the farmers. With the slaughter procedure the most important factor to control is the stress level of the different pigs. This needs to be done by controlling the pre-slaughter handling of the pigs. This starts with the transportation until the lairage time before stunning. During this period the WHC and pH 24 h value can be influenced badly when the stress levels are too high. Therefore stress levels need to be kept low. The stunning procedure that is the best to use is the CO2 stunning with automatic driving. This makes sure that it happens correctly and identically every time. There need to be chosen for a slaughterhouse that has its procedure managed properly and consistently every time.

In order to work following a configuration and to reach the desired quality it is important that there is control within the entire chain. The control needs to be done throughout the entire chain. The chain needs to have one strong leader who is the actor that controls the chain and sets the standards. With the condition that all the participants get the chance to tell the views and interest they have about participating within the chain. This needs to be done on the base of joint decision making. With this joint decision making a configuration needs to be made that benefits all chain partners, with one actor who is the initiator and leading actor within the chain. The results show the following conditions that are set for the configuration of the chain:

- **Producing in accordance with a fixed configuration of the chain will result in more consistent pork quality**
- **The genotype used by farmers is fixed with low acceptability to change**
- **The genotype and production system are linked at the farmer because both actions cannot be changed on the short term**
- **The acceptability to change feed is high**
- **The stress level is the most important factor to control during the entire slaughter procedure**
- **The CO2 stunning method with automatic driving of pigs is preferable for consistent quality**
- **Take into account the views and interests of all chain partners within the configuration**
- **There needs to be one strong chain leader**

6.3 Coordination

The third area in the interview was the coordination of the supply chain. When there is build a supply chain this chain needs to be coordinated to make sure the desired quality is reached and that the chain is made sustainable. Therefore in the interview the ninth until eleventh question were asked to see what are the biggest issues regarding the coordination. The answers will be used to see in what way the coordination of a quality management system needs to be done. The answers given on the questions will give an answer on the following research question:

- *What coordination is needed to get the supply chain organised?*

6.3.1 Acceptance

The acceptance to share information about the supply chain that can be used for the coordination of the chain to see if pork is being produced in accordance to the chain configuration is not very high. There are some clear conditions in order to create acceptance to share information. The first condition is that the information shared should have a purpose and results in profit through higher prices our production advantages, as stated by all type of respondents. So there needs to be a direct profit connected to the information sharing.

The second condition is that the information should be secured and not accessible for other parties not involved with the supply chain, as stated by farmers and genetic company. An example of a useful purpose for information sharing is that the comparison between different farmers works motivating for farmers to improve their production process and learn from each other, as stated by farmers. A third condition mentioned is that for all the arrangements made a clear explanation needs to be given to get better understanding why different actions need to be taken, as mentioned by farmers, traders and feed companies. Especially the first condition is widely recognized because there need to be incentives to share information.

The third point is that farmers want to stay free and flexible about their own company, they do not want to give away their company to a chain. The farmer always wants to be in control of its own company, as stated by all type of respondents. The way to make sure that the farmers still have a free choice is to give them the opportunity to choose between different alternatives that have a lot of similarities at the meat quality, think of two types of boar that may be used, or two different feed compositions with similar results etc., as mentioned by genetics company.

6.3.2 View on the coordination mechanisms

The view on the usage of the different coordination mechanisms useful within the chain differs for the four coordination mechanisms. The information sharing should be about pay-out system used, health status, satisfaction about the pigs, actions taken by the actors and performance. The sharing of information should be done through information sharing systems. All the information about the production on farm level is available so can be made sharable by giving each other access to this information, this gives insight in actions taken and performance during production, as stated by farmers. The pay-out system needs to be classified on the base of the current pay-out system together with extra rewards for working in accordance with the chain configuration. The pay-out system should make sure that there are incentives for the farmers to work in accordance with the chain demands. Together with information about the pay-out, the information about satisfaction of the pigs can be included or clarified in the pay-out system. So through an information system the coordination needs to be done and made accessible for all participants in the chain to see what happens with the products, as stated by farmers, trader and feed company.

There is a resistance within the chain against the usage of contracts. The reason is that contracts cost money, are limited through time and the farmers want to be flexible if somebody else can give a better price, as mentioned by all types of respondents. The best way to bind partners for working in accordance with the chain is that the chain is based on openness, trust and transparency within the chain and to make sure participants believe in the concept, as stated by farmers, genetics and feed companies.

Based upon all the conditions mentioned and quality demands Meatfriends needs to develop a clear concept/pay-out structure for the chain. This concept based upon all these conditions and quality demands makes sure that the participants know for-hand what is needed and what is been expected from the total chain. So the concept/pay-out structure needs to be leading not only based on the configuration of the chain, but also the terms and condition that are connected with the chain, as mentioned by experts.

6.3.3 Information needed to be shared within the chain

Information sharing is one of the most important factors to make the supply chain configuration work in order to reach consistent and market orientated pork production. Information sharing starts with the need for information. More information sharing within the supply chain about the genotype, diets, supplementation of vitamins and minerals, stress reduction policies, meat quality and consumers can be used to produce more consistent pork. Information sharing will lead to better understanding between the different chain partners, because they have better insights in the interest everybody has and to find better solutions through better understanding, as mentioned by trader, feed and genetics companies.

Information sharing should always be happening on the bases of trust, transparency and openness. When participants do not trust each other to be open and transparent, they will not be that themselves. Which means there will be no bases for information sharing. Therefore clearness why information is needed and what purpose this information has, is important, because then the participants know who gets inside in the information. A direct condition that should be taken into account is that all the information shared needs to have an added value and thus a purpose, as stated by farmers and trader. More information sharing about the supply chain and what all the actors do will have a positive influence on the collaboration within the supply chain and should result in a better product. The way to do this through information sharing is by connecting the supplier information about the production method used with the quality wished by the buyer, as mentioned by feed en genetics companies.

The information sharing should consist out of all the different actions that are specified within the total pork chain. Only the conditions about the detailed level should be arranged. This can be on different levels, for instance stable, batch or on pig level. The information sharing should at least consist the following four points quality, logistics, costs and profits, as stated by feed company. These are choices that come with the information sharing and the effectiveness of the shared information.

6.3.4 Binding partners

The binding of the partners within the chain is important and difficult. The base for the binding of the partners should be trust, openness and transparency between the partners. To make sure these points are there it is necessary that there are clear appointments made by all the different partners. When chain partners get influence they are more willing to accept and hold on to these appointments. The participants need to be confident and convinced of the concept, as stated by slaughterhouse and feed company.

To bind the participants within the chain they want to have something in return for the efforts they do in accordance with the chain. The most important reward that the participants want is that the financial results should be improved so they demand a profit for their efforts. This is

the first point the interviews show, as stated by all respondents. The second point important is that the effort needed to work in accordance with the chain do not result in a (high) raise of the cost price, as mentioned by feed and genetics companies. The participants want to keep the cost price on the normal market level. The reason is that the farmers want to stay flexible and do not want to take the risk that they are dependable on the chain, because of the increased cost price. These two points come together in the wish for continuality and certainty that the participants want to have, as stated by experts.

Next to the financial issues that are of high importance other points can also be used to bind partners. These points are improving the image of pig farming/meat production and collaboration between the chain partners, as mentioned by trader and feed company. Where the better collaboration and understanding between the different chain partners should result in improved efficiency and advantages in production. It is important that for all the efforts demanded from the chain incentives are given, as mentioned by feed and genetic companies.

6.3.5 General remarks

There were also some general remarks made about building a chain in the pork sector. The problem with a lot of former initiatives was that the pig farmer was seen as a producer and not as a partner which is unacceptable for the farmer, as stated by an expert.

The second important point is that the profit and cost fluctuations are being divided evenly throughout the entire supply chain. With fluctuations think about prices of raw materials used, transportation or promotions. These cases need to be covered pre-hand to avoid discussion. The last remark made was that there always need to be made sure that the costs do not rise, because there is a lot of doubt about the economic feasibility of a specific chain, as mentioned by feed company, slaughterhouse and experts.

6.3.6 Conclusion

The third paragraph of the analysis is about the coordination and building of the supply chain. The research question that will be answered is:

- *What coordination is needed to get the supply chain organised?*

The third part of the research is about the coordination of the supply chain. The need for coordination is there to not only reach the desired quality, but also to contain this quality consistently. According to the theoretical findings there are four types of coordination mechanisms that can be used within supply chains. These four are contracts, information technology, information sharing and joint decision making. These four mechanisms use different tools to coordinate a supply chain. The contracts are used to specify parameters and actions need to be taken. Contracts are useful to resolve conflicts and risk-related problems. Information technology is the second coordination mechanism. Information technology helps to link actors by using real time data about products. Information technology is used to make information sharing possible. Information sharing is used to tell what information in the supply chain needs to be shared. So with information sharing different actions of the supply chain actors that influence the quality should be shared within the chain. The goal of information sharing is to give insight in the efforts every actors within the chain needs to take to reach the desired quality. The joint decision making helps to resolve conflicts among the supply chain members and to anticipate on future uncertainty.

Joint decision making is used to make sure all the actors get the chance to tell their interests and to jointly plan the different supply chain activities by using the different skills, technologies and market knowledge of the different actors.

The empirical research shows that most of the farmers are not happy about contracts. They do not want to work with contracts because of the loss of flexibility and freedom because then they are bound to the arrangements. Therefore they react averse from contracts. There is a low acceptance for information sharing with other chain partners. The results show that information sharing only is accepted when there is a clear purpose for information sharing. So there needs to be made clear why there is the need to share particular information. Another condition set to information sharing is that the information is secured. The information about the production is available through farm management systems and chain information systems like IKB. So the information technologies to share information are available. Therefore it is important to convince partners to share this information. The joint decision making was an important issue coming forward from the interviews. Farmers do not want to be only a producer for a chain, they also want to have the chance to tell their point of view and interests. Therefore joint decision making needs to be done pre-hand to make sure all terms and conditions are clear for all chain partners and also that everyone had the chance to tell his interests. This will make it easier to bind farmers because they had the chance to tell their interests.

Besides the coordination mechanisms other important issues coming forward from the interviewees are that there needs to be a clear leader within the chain that gives clear guidelines to the chain. This leader should be available and reachable for the other chain partners. The chain should always be built upon trust, openness and transparency. In order to have a well-functioning chain there needs to be made sure the right partners are found. This means that partners need to believe in the concept. These points are important for the certainty of the chain.

The coordination of the supply chain is the most important factor to make their supplied pork of consistent quality. With the coordination of the supply chain Meatfriends needs to take into account different conditions. The chain actors give clear guidelines about what is acceptable for them. During the start of the chain it is important to give all the different participants the chance to tell their views, interests and possibilities before entering the chain. This way there can be made clear to the participants what the goals and conditions to participate within the chain are. The acceptance of participants to work in accordance to a chain is generally low. The farmers do not want to lose their freedom to decide about the activities of their own company. They want to be in control of their own company. So in order for farmers to accept working in accordance to the configuration they have some conditions that Meatfriends needs to meet before farmers are willing to participate. The farmers need to be made clear why different actions are asked and what the purposes of performing an action in a way is. For all actions asked from farmers that purpose needs to be made clear. Second there needs to be a reward for all the different actions a farmer needs to take. The reward generally best working is to give the farmer a direct profit for taking this action. The best way for Meatfriends to do this is to connect the pay-out system directly to the actions asked from the farmers. This way it is made clear to them what is asked and it offers a direct reward. This way the farmers can choose what actions they find acceptable or not. Therefore they keep their freedom. Based on acceptability arrangements can be made if the farmer is going to participate.

The following statements can be made about the configuration of the supply chain based on the results.

- **Give all the participants the chance to tell their views and interests**
- **Farmers do not want to lose the freedom to make their own choices**
- **There needs to be made clear why an action is asked to perform and what the purpose of this action is**
- **There needs to be a reward for all the actions asked, generally profit is the best reward**
- **The used pay-out system needs to give farmers freedom to choose how they want to participate**
- **The farmers are opposed to the usage of contracts**
- **Information sharing is only accepted if there is a clear purpose and reward for it**
- **Information technology to share information about genotype, feeding patterns and health status is available through the chain information system and farm management systems**
- **Joint decision making needs to be done through evaluating the configuration, with giving all chain partners the opportunity to give their views and interests for improvements or adjustments.**

7. Criteria for Meatfriends

Based on the conditions from the research different criteria that Meatfriends should take into account for their chain can be determined. First the configuration based upon the desired quality will be tested with the different conditions set following the results of the empirical research to see what the possibilities are for Meatfriends to reach the desired quality. The second part will be the testing of the different scenarios with the conditions out of the empirical research. This will show which scenario will be the best fit and where possible adjustments need to be made.

7.1 The desired quality and configuration of the chain

The desired quality that Meatfriends wants is stated as followed by director Mr Quinten:

'' More tender pork with a high WHC and optimal pH 24 h value, with no high need for lean meat.''

This statement about the desired quality will be the quality standard Meatfriends wants to reach. The quality standard needs to be the bases for Meatfriends to build their chain. If Meatfriends want to reach more consistent and market orientated pork quality there needs to be a chain configuration how the chain should perform the different actions in order to reach this quality. The quality should be made market orientated based upon the wishes the customers of Meatfriends have. This means that the desired quality of Meatfriends is equal to the quality the market wants.

The results of the empirical research shows different conditions set to the quality and actions influencing the quality by the different chain actors, that should be taken into account when a configuration is to be implemented. These conditions are:

Quality conditions

- The farmers determine their choices on the base of economics
- Take meat quality into account in the pay-out for farmers, so farmers get the incentive to take meat quality into account
- Inform farmers more about meat quality and the actions they can take to improve it
- Give feedback about meat quality and the effect of the actions taken

These four conditions show what is needed to let farmers produce with the goal to reach a particular quality standard. So in order for Meatfriends to drive farmers to produce the quality desired by Meatfriends the following actions have to be taken to reach this. Meatfriends needs to make sure that farmers choose to produce the Meatfriends quality standard by offering a good return for it. To make sure that meat quality becomes one of the drivers of the supply chain, Meatfriends needs to take meat quality into account with the pay-out for farmers so they have got economic benefit. Next Meatfriends needs to educate farmers how they can reach this meat quality, because of the lack of knowledge. Therefore they also need to give feedback about the effect of the actions on the meat quality. The general statement about what Meatfriends needs to do to let farmers adapt meat quality as a driver for the production is:

1. **To make sure that farmers take meat quality into account as a driver for production, meat quality needs to be implemented into the pay-out system.**

The second part will be about the quality signals that influence the quality of the pork meat. By adapting a configuration based upon the quality standard by determining the different quality signals occurring within the pork chain. The quality signals of the pork chain will be the different actions that are influencing the quality. The configuration with the best fit to reach the desired quality is adapted from chapter 5. The configuration is shown in table 16.

Table 16: Configuration of the chain

Action	Preferred configuration	Influence on
genotype	Duroc breed	WHC, pH and tenderness
Diet	Low protein level	Tenderness
Vitamin E	Supplementation yes	Colour
Magnesium	Supplementation yes	WHC
Production system	Conventional 0,7m2 or 1m2	WHC, pH
Fasting	16 h > 24 h fasting (low acceptability)	WHC, pH
Pre-slaughter handling	Low stress levels are preferred	Colour, WHC and pH
Stunning	CO2 preferred above electrical stunning	Colour, WHC, pH and tenderness
Chilling	Usage of accelerated chilling	Colour positively, risk for cold shortening

The different quality signals are the actions taken within the pork chain which determine the quality. These quality signals are: genotype, feeding, production system and slaughter procedure. Based on the empirical research different conditions need to be taken into account with making the configuration.

Conditions for the configuration

- The genotype used by farmers is fixed with low acceptability to change
- The genotype and production system are linked at the farmer because both actions cannot be changed on the short term
- The acceptability to change feed is high
- The stress level is the most important factor to control during the entire slaughter procedure
- The CO2 stunning method with automatic driving of pigs is preferable for consistent quality
- Take into account the views and interests of all chain partners within the configuration
- There needs to be one strong chain leader

These conditions have an influence on the configuration. It starts with the changeable and unchangeable aspects. The farmers keep the genotype fixed and are not willing to change this, also the production system the farmer uses is not changeable on the short term. The feed is changeable on the short term. The consequences of these different conditions is that Meatfriends needs to choose between the genotype of the pigs or the production system used as the leading quality signal within their pork chain. Based on pork quality it is advisable for Meatfriends to take the genotype as leading quality signal and let the production system be dependable. This means that with finding the farmers, the genotype they are using is the

leading quality signal and the production system then will be dependable on the system these farmers are currently using. The acceptability to change
feed means that the diet used within the chain can be made consistently used by Meatfriends throughout the chain based on a partner who produces the feed. This means that all the pigs within the chain are fed the same feed. This is important for the consistency.

The slaughter procedure has one big factor influencing the meat quality. This is the stress level the pigs have before slaughter. During the entire pre-slaughter handling and stunning method the stress level needs to be low. The reason is that high stress levels will result in bad meat quality especially the WHC and pH 24h value will be lower. Therefore Meatfriends together with the slaughterhouse needs to instruct the farmers, transporters and staff of the slaughterhouse to make sure they keep stress levels low. This needs to be done by instructing and telling why these actions are important. The leading action with the choice for a slaughterhouse is the used stunning method. The CO2 stunning method with automatic driving to the stunner is the preferred method. This is because the handling and driving of the pigs is preformed the same way consistently through automatic driving which will result in more consistent meat quality.

Based upon the analysis the following statements can be made about the quality signals that Meatfriends needs to do:

2. **The genotype should be the leading action for choosing farmers, with the production system being dependable (on the chosen farmers) in the short term and the diet used changeable at farm level in the short term.**
3. **The preferable stunning method, CO2 stunning with automatic driving to the stunner should be the leading action for choosing the slaughterhouse.**

7.2 Coordination of the chain

The coordination of the chain is the third part of the quality management. In the literature review different factor were influencing the type of coordination that is needed within the chain. These factors determine the best usable type of quality management system and governance structures. The governance structure and the usage of coordination mechanisms are dependable on the quality management system which sets the standard. At the end of the literature research three different scenarios for the coordination of the chain are conducted. Based upon the findings of the empirical research the best fit scenario will be determined. The factors determining the best fitting scenario will be: owner of the system, scale of the system, scope of the system, governance structure, usage of coordination mechanisms, level of integration, level of demand set to the chain partners and the possibility for labelling. Based upon the empirical research the following conditions have been made for the coordination of the chain:

Conditions for the coordination

- Give all the participants the chance to tell their views and interests
- Farmers do not want to lose the freedom to make their own choices
- There needs to be made clear why an action is asked to perform and what the purpose of this action is
- There needs to be a reward for all the actions asked, generally profit is the best reward

- The used pay-out system needs to give farmers freedom to choose how they want to participate
- The farmers are opposed to the usage of contracts
- Information sharing is only accepted if there is a clear purpose and reward for it
- Information technology to share information about genotype, feeding patterns and health status is available through the chain information system and farm management systems
- Joint decision making need to be done through evaluating the configuration, with giving all chain partners the opportunity to give their views and interests for improvements or adjustments.

The respondents of the interviews said that there should be one strong leader that set the quality standard and together with the other chain partners should determine the configuration. This means that the leader of the chain should try to take into account the views and interests of all the chain partners when designing the configuration to make sure the acceptability will be higher for partners to participate. For the quality management system these conditions mean that there should be one clear owner of the system, this should be Meatfriends. The scope of the system should be chain wide, because all the chain partners need to be involved in order to influence all the different actions taken within the pork chain. The scale of the system should be small, this is because only the participants of the chain need to adapt to the system.

The results show that the farmers and participants are against the usage of contracts. The main reason is that farmers do not want to lose the freedom to make their own decisions. This means farmers prefer market orientated governance structures. The level of integration that the farmers prefer is a lower level of integration. They tell that the pay-out system should be leading for the terms and conditions and not contracts. The usage of information sharing is seen as a necessary coordination mechanism to make the pork quality consistent. The conditions set to information sharing is that all the information shared should have a purpose. The usage of information technology is necessary in order to enable information sharing. Usable technologies are the chain information system and farm management systems of the farmer. Joint decision making is mentioned as a key factor for the success of the chain. Especially at the start all the participants need to get the chance to tell their views and interests. This way the participants make a better start and they feel appreciated within the chain. The same thing occurs with the evaluation of the chain, by using joint decision making at the evaluation of the chain to give all the participants the chance to tell their views on adjustments and improvements helpful for the chain.

The level of integration within the chain is low. The farmers insist on a level of freedom to make their own decisions this means that the level of integration should not be to high. The level of demand set by the leader of the chain should be high. This is needed to reach the goals of the chain. The farmers are not opposed to high demands as long as they get the chance to tell their views on the demand and the demands are realistic and reachable for them. The possibility for labelling is no direct advantage for the farmer, but can be used to add-value to the chain. Based on the analyses the following statements can be made about the coordination that Meatfriends needs to do:

4. **Meatfriends needs to become the leader of the chain and determine the quality standard**
5. **Meatfriends needs to fill in the configuration of the chain to reach the desired quality based upon the views and interests of all the chain partners, to make sure the configuration is reachable and acceptable for the chain partners**
6. **The scale of the quality management system should be small (selected group of partners) and the scope (all the different chain actors should be involved) should be chain wide because all chain actor should be involved**
7. **The governance structure needs to make sure the farmers keep the freedom of choice about how much of the configuration they want to implement within their company**
8. **The coordination mechanisms Meatfriends should use are: pay-out system (instead of contracts), information sharing, information technology and joint decision making**
9. **The level of organization integration should be low**

A comparison between the findings of the empirical research and the different scenarios for the coordination of the chain resulting from chapter 4 based on the literature review is shown in table 17. In this table the matches between the two different researches are show.

Table 17: Comparison between scenarios and results

	Scenario 1	Scenario 2	Scenario 3	Criteria
Owner of the system	IKB	**Meatfriends**	**Meatfriends**	Meatfriends
Scale of the system	Large	**Small**	**Small**	Small
Scope of the system	**Chain wide**	Company to company	**Chain wide**	Chain wide
Governance structure	**Market/**verbal agreements	Formal contracts	Formal contracts	Market
Coordination mechanisms used	**IS**	Contracts, **IS, IT and JDM**	Contracts, **IS, IT and JDM**	Pay-out, IS, IT and JDM
Level of integration	No integration	**Low level of integration**	High level of integration	Low
Level of demand set for the chain partners	No demand set	Low level of demands set	**High level of demands set**	High, Reachable and realistic
Possibility for labelling	No	**Yes**	**Yes**	Yes, preferable
Score	3	7	8	

Bold = matching with the results of the analysis

Based upon the comparison of the different scenarios set for the coordination of the chain to the results following the analysis shows that the two best fitting scenarios are scenario 2 an 3 which are based on a private chain wide quality management system on top of the industry standard. Following the results of the empirical research some adjustments need to be made to the scenarios that should be taken into account. These are the usage of pay-out system instead of contracts, resulting in a more market orientated governance structure with freedom for the farmers. The last issue coming forward from the comparison is that the demand set to the chain partners should be reachable and realistic. By changing these issues the best fit scenario can be made as a recommendation to Meatfriends.

8. Conclusions and recommendations

The conclusions of the research will consist out of the statements following the analysis to which Meatfriends needs to adapt in order to reach the research objective to make their supplied pork meat, market orientated and of consistent quality. The recommendations will give and answer to the general research question:

'What strategy and methods would be suited to Meatfriends BV to make their supplied pork market orientated and of consistent quality"

The answering will be done through making a scenario Meatfriends can adapt to make sure the research objective is reached. By following the scenario Meatfriends should be able to make their supplied pork more market orientated and of consistent quality.

8.1 Conclusions

The conclusion following the research are based on the three different areas coming forward from the research. These three areas are: quality of pork, configuration of the chain and coordination of the chain. There are ten different criteria of importance to Meatfriends following the research.

Quality of pork:

1. **To make sure that farmers take meat quality into account as a driver for production, meat quality needs to be adapted into the pay-out system.**

Configuration of the chain:

2. **The genotype should be the leading action for choosing farmers, with the production system being dependable (on the chosen farmers) in the short term and the diet used changeable at farm level in the short term.**
3. **The preferable stunning method, CO2 stunning with automatic driving to the stunner should be the leading action for choosing the slaughterhouse.**

Coordination of the chain:

4. **Meatfriends needs to become the leader of the chain and determine the quality standard**
5. **Meatfriends needs to fill in the configuration of the chain to reach the desired quality based upon the views and interests of all the chain partners, to make sure the configuration is reachable and acceptable for the chain partners**
6. **The scale of the quality management system should be small (selected group of partners) and the scope (all the different chain actors should be involved) should be chain wide because all chain actor should be involved**
7. **The governance structure needs to make sure the farmers keep the freedom of choice about how much of the configuration they want to implement within their company**
8. **The coordination mechanisms Meatfriends should use are: pay-out system (instead of contracts), information sharing, information technology and joint decision making**
9. **The level of organization integration should be low**

8.2 Recommendations

The recommendations will give an advice to Meatfriends about how they can reach more consistent quality and market orientated pork production. In the recommendations an answer will be given on the general research question. The general research question is:

'What strategy and methods would be suited to Meatfriends BV to make their supplied pork market orientated and of consistent quality"

The recommendation too Meatfriends will be based on the same structure as the scenarios , followed within the three different areas: quality standard, quality signals and coordination of the chain. Based on the analysis Meatfriends should build a private chain wide quality management system on top of the industry standard. This means that Meatfriends should be the owner of the system, it should be a small scale system with a chain wide scope.

8.2.1 Quality standard

The first action that Meatfriends as owner of the system needs to take is to determine their desired quality. The company needs to make a configuration based upon the desired quality. The desired quality that Meatfriends want to have is:

''More tender pork with a high WHC and optimal pH 24 h value, with no high need for lean meat."

Meatfriends based its desired quality on the market demands they experience from their customers. This desired quality results in a configuration of actions that are needed within the chain to reach this desired quality. The configuration that has the best fit with the desired quality is adapted from chapter five. The desired quality will become the quality standard that is set for the chain.

8.2.2 Quality signals

After setting the quality standard Meatfriends needs to derive a configuration that will result in the quality standard by filling in the different quality signals. The quality signals are the different actions within the chain that influence the quality attributes. The preferred configuration shows the ideal situation to reach the quality standard. Following the research some conditions are set to the possibilities Meatfriends has to reach the configuration in general and the way a particular signal is being influenced. The two most leading signals for Meatfriends within the configuration are the genotype in pig farming and the stunning method within the slaughter procedure. The result of this is that the production system is dependent on the genotype, because both are fixed at a farm level on the short term. The type of cooling used after the slaughter will be dependent to the stunning method because this is leading and the slaughterhouse has a system for both. In table 18 all the quality signals are shown together with the way they should be reached.

Table 18: Desired quality configuration

Action	Preferred choice	Reaching by	Influence on
genotype	Duroc breed	Search for farmer using Duroc	WHC, pH and tenderness
Diet	Low protein level	Changing the diet at farm level	Tenderness
Vitamin E	Supplementation yes		Colour
Magnesium	Supplementation yes		WHC
Production system	Conventional 0,7m2 or 1m2	Depended on the farmer in the short term	WHC, pH
Fasting	16 h > 24 h fasting (low acceptability)	Setting clear guidelines and arrangements for the different actors	WHC, pH
Pre-slaughter handling	Low stress levels are preferred		Colour, WHC and pH
Stunning	CO2 preferred above electrical stunning	Search for slaughterhouse using this method	Colour, WHC, pH and tenderness
Chilling	Usage of accelerated chilling	Depended on slaughter house	Colour positively, risk for cold shortening

8.2.3 The chain partners

After determining the configuration about how the chain actions need to be taken in order to reach the desired quality there can be started with building up the chain. The scale of this system is small this means that only the partners are working with the quality management system. The scale of the system should be chain wide. These two conditions mean that Meatfriends should determine partners for all steps within the chain. These partners are genetics company, feed company, slaughterhouse and farmers. For the chain there is only one feed company, one genetics company and one slaughterhouse needed. There are multiple farmers needed for the chain. This is important at the start of the chain. The first step is to start with the frame of the chain. The frame of the chain consists out of the partners that are the stable actors within the chain to make sure there is consistent quality. This frame consists out of the breeding company responsible for the genotype that is going to be used in the chain, the feeding company who is responsible for the diet used in the chain and the slaughter house who will slaughter the pigs.

First together with the genetic company there need to be determined the genotype that will be acceptable for the chain. The preferable genotype for the chain is the Duroc genotype. The genetics company has the responsibility for determining a range of boars that will be used within the chain to make sure the pigs have the same genotype. Meatfriends together with the genetics company has to determine which series of boars is going to be used within

the chain. The choice for the series of boars depends on the number of farmers using this boars. The genetics company is aware of the number of farmers using a particular boar. Based on this knowledge the series of boars accepted for the chain is determined in order to make sure the availability of pigs is sufficient for Meatfriends. This is because the genotype needs to be searched at the farmers. Together with the genetics company the different farmers can be approached if they have interest in participating in the chain.

Second together with the feeding and the genetic company the diet can be determined on the detailed level of a recipe for the feed used. This recipe will then be used within the chain. On the base of using the same diet with every farmer active within the chain the consistency will be improved. The dilemma that will exist with the feeding company will be the choice for the basic principle for the recipe of the diet. It can be a fixed recipe based on resources used or a recipe based on the nutritional values with variable resources used. The difference between the two principles are the costs and variability in feed. With the recipe based on resources the cost price will have much fluctuations because of the availability and thus changing prices of the resources. The second option based on nutritional values will have a higher fluctuation in the usage of the resources, but the advantage of the flexibility with the usable resources is that the cost price will be more constant. The choice preferable for Meatfriends is having a fixed recipe based on the resources, the recipe based on nutritional values is preferable for the chain. The recommendation to Meatfriends is to choose for a recipe based on nutritional values because this is preferable within the chain and therefore better usable to bind farmers.

There also needs to be chosen for the slaughterhouse that will slaughter the pigs. With the choice for the slaughter house it is important that the slaughterhouse uses the particular slaughter procedure of the configuration. The leading quality signal with choosing the slaughterhouse needs to be the stunning method. The method used should be CO2 stunning with automatic driving to the stunner. The reason is based on the better meat quality. Further the slaughterhouse needs to adapt a constant fasting of 16 hours and lair age time of 2 hours, good transportation practices with loading and unloading of the pigs. These conditions need to be arranged with the slaughterhouse to make the quality consist by using the same slaughter method every time.

With the determination of these three partners the frame of the chain is build. This frame of the chain needs to secure that most of the quality signals within the chain are controllable and consistent. The only missing actor within the chain is the farmer who produces the pigs. The next step will be how to find the farmers that are willing to produce for the chain of Meatfriends.

8.2.4 Finding the farmers

After building the frame of the chain farmers who want to be part of the chain need to be found. The finding of the farmers start with the condition that the genotype is fixed for the farmers. In order to react to this Meatfriends needs to search the farmers already working with the Duroc genotype, currently there are approximately 2.3 million Duroc pigs in the Netherlands see section 2.1.5. There are two reason for searching farmers already using the desired genotype, first the farmer does not need to change the genotype and second this does not affect the cost price for the particular farmer. These farmers should be found in collaboration with the genetic company who knows the genotype farmers use.

The genotype is the leading action for searching the farmers. This means that the farmers who are able to participate within the chain have to be found together with the genetics company who has insight in the genetics the farmers are using. Based on the used genotype the farmers who are needed can be selected. This way Meatfriends knows which farmers it can approach.

8.2.5 Attracting the farmers

When it is known which farmers are possible partners for Meatfriends they need to convince the farmers to participate within the Meatfriends chain. The most effective way to attract the farmers is by given them a higher pay-out for their pigs. Therefore Meatfriends needs to design a pay-out system that gives farmers the incentive to participate in the chain. The fitting pay-out system that Meatfriends should adapt to should give farmers flexibility and freedom of choice. Therefore Meatfriends should use a flexible pay-out system. This system should start at a minimum level of effort asked from the farmer. This minimum level in the case of Meatfriends should be the used genotype. Because this is the criteria to find farmers. The pay-out at this level should be based on the current used pay-out system based on the fat/muscle composition, with the usage of the desired genotype.

Until this point there are no differences with other pay-out systems. The next step that Meatfriends should take is to implement the quality signals within the pay-out system. By rewarding these signals the farmers can earn a higher profit if they adapt to this quality signals. The different quality signals will be: diet used, production system, working in accordance with production system/labels and all other demands that Meatfriends can ask from the farmers. The result of such a pay-out system is that the farmer is given the incentive to participate in accordance with the desired configuration of the chain, because it will give them a extra profit. The advantage of this system is that the farmers keep the freedom to determine which step they want to take or not and stay in control of their own farm. The advantage for Meatfriends will be that the farmers who achieved a higher pay-out are bounded to the chain based on this higher pay-out. Additional request besides quality influencing actions can also be adapted into the pay-out system also. This is useful for Meatfriends, because this way they can implement actions asked through changing market demands directly without changing the entire pay-out system or configuration. By using this system the governance structure will be more market orientated which is preferred by farmers. With the opportunity for Meatfriends to bind farmers because of the higher pay-out which binds the farmers through a lack of alternative pay-out systems offering rewards for their efforts to work in accordance with the configuration of the chain. This means that the pay-out system creates and dependency between the farmer and the other chain partners, because of the structure of the pay-out system.

8.2.6 Coordination of the supply chain

When all the different chain partners are integrated into the supply chain there needs to be coordination to make sure that the consistency of the product is reached structurally. This is done by coordination mechanisms. The usage of coordination mechanisms needs to result in a chain working in accordance with the configuration instructed by Meatfriends. There are four types of coordination mechanism suitable in the chain: pay-out system (instead of contracts), information sharing, information technology and joint decision making.

The first coordination mechanism is the pay-out system. Farmers are generally against the usage of contracts. Therefore the usage of contracts should be replaced by the usage of a pay-out system that has the same characteristics in it like a contract. In the previous paragraph the pay-out system is explained based on the quality signals. This way the quality specifications are being described through the pay-out system. All the demands asked from the farmers are mentioned together with the reward they get for these actions. The big difference with the usage of a contract is that it is not binding and the farmers keeps it freedom, because he can influence the pay-out directly.

The second coordination mechanism used is information sharing. It is important to share information about the pigs and the actions taken throughout the entire supply chain. The information shared needs to be used as the base for the pay-out to the farmer. Through information sharing he needs to show that he has worked in accordance with the configuration, to see how high his pay-out is. So all the points from the configuration need to be shared. These points are genetics of the pig, diet offered to the pigs, production system used, health status of the pigs and all other things arranged for extra pay-out, for example ‘’Beter Leven Keurmerk’’, special conditions for animal health or actions for co2 reduction. All these information sharing points need to be arranged with each other and used as base for the pay-out so the farmers are given the incentive to share this information. The other way around Meatfriends needs to give feedback about the quality and consistency of the product. This way adjustments can be made and the farmers are informed about their performance. This information can also be connected to the pay-out system. Where one side of the pay-out system is about the actions taken and on the other side the effect of the taken actions. The pay-out system is used to give the incentives for all actions.

The third coordination mechanism is the information technology. Information technologies are the systems used to enable information sharing. In the pork chain the easiest way is to make use from the currently used information systems within the chain. The farmers have chain information and animal health monitoring systems to collect the information in their stable. This is necessary for the IKB certification. The only issue they currently have is that nobody asks for this information. This means there is no information sharing. In order to get the extra pay-out the farmers have to deliver the information about the pigs. They should deliver this information when they sell the pigs. This way Meatfriends get insight in the pigs that are going to be delivered. Another useful tool for the coordination of the information is audit management. Though audit management based upon surprise visits all chain partners can be controlled, the genetics company, feed company, farmers and the slaughterhouse. The purpose of the audits is to see if the chain partners keep themselves to the arrangement made. The linkage between the information needed and the information technology to enable the information sharing is shown in table 19, first the quality signal is mentioned then the information that should be shared about the quality signal. The next column mentions the system or technology used to obtain the information. The last column shows how it should be communicated too Meatfriends, this can be by a e-mail for information needed with every delivery and through a visit for used method to see how it is applied in practice. Audits will always be used as a control to the partners regularly.

Table 19: Linkage between information shared and technologies

Quality signal	Information shared	Information technology	communicate to Meatfriends
Genotype	Which genotype the pig has	Farm management system/ IKB	Email before delivery
Diet	Diet fed to the pig/ composition of the diet	Farm management system/ IKB	Email before delivery
Production system	Used production system	Certificate/ audit	Visit
Fasting	Fasting time	IKB/audit	Email before delivery
Lair age	Lair age time	IKB/audit	Email before delivery
Stunning	Used stunning method	Certificate/audit	Visit
Chilling	Used chilling method	Certificate/audit	Visit

The fourth coordination mechanism is joint decision making. In order to make the chain well-functioning evaluation needs to take place. The evaluation is needed to see if all the chain partners are satisfied with the functioning of the chain. The evaluation should take place with the chain partners regularly. There will be two type of evaluation meetings, individual and chain wide.

The individual meetings will be with the different chain partners to have individual evaluation of the actions they have performed. This will be about the quality of pigs and the way the different partners have executed the actions. This results in suggestions to the farmers how he can improve or adapt to extra demands to reach a higher pay-out. The evaluation with the genetics, feed company and slaughterhouse will be done to see if the used genotype, feed and slaughter procedure is working as intended and to see if new techniques are available or useful to improve the chain.

The chain wide meeting will be a yearly meeting where all chain partners will be invited to tell about their experiences with the chain, their suggestions for improvement, interests and the adjustments needed for the chain. This then can be mentioned to the chain partners. This should create binding with the partners and collaboration to reach a better end product. The suggestions from this meetings should be used to improve the chain and to find common interests.

8.2.7 Overview

An overview of the plan how to build a pork chain to reach market oriented and consistent pork supplies is given. In the overview the different steps are shown with a short description of what should be done in these steps. The overview is given in figure 5.

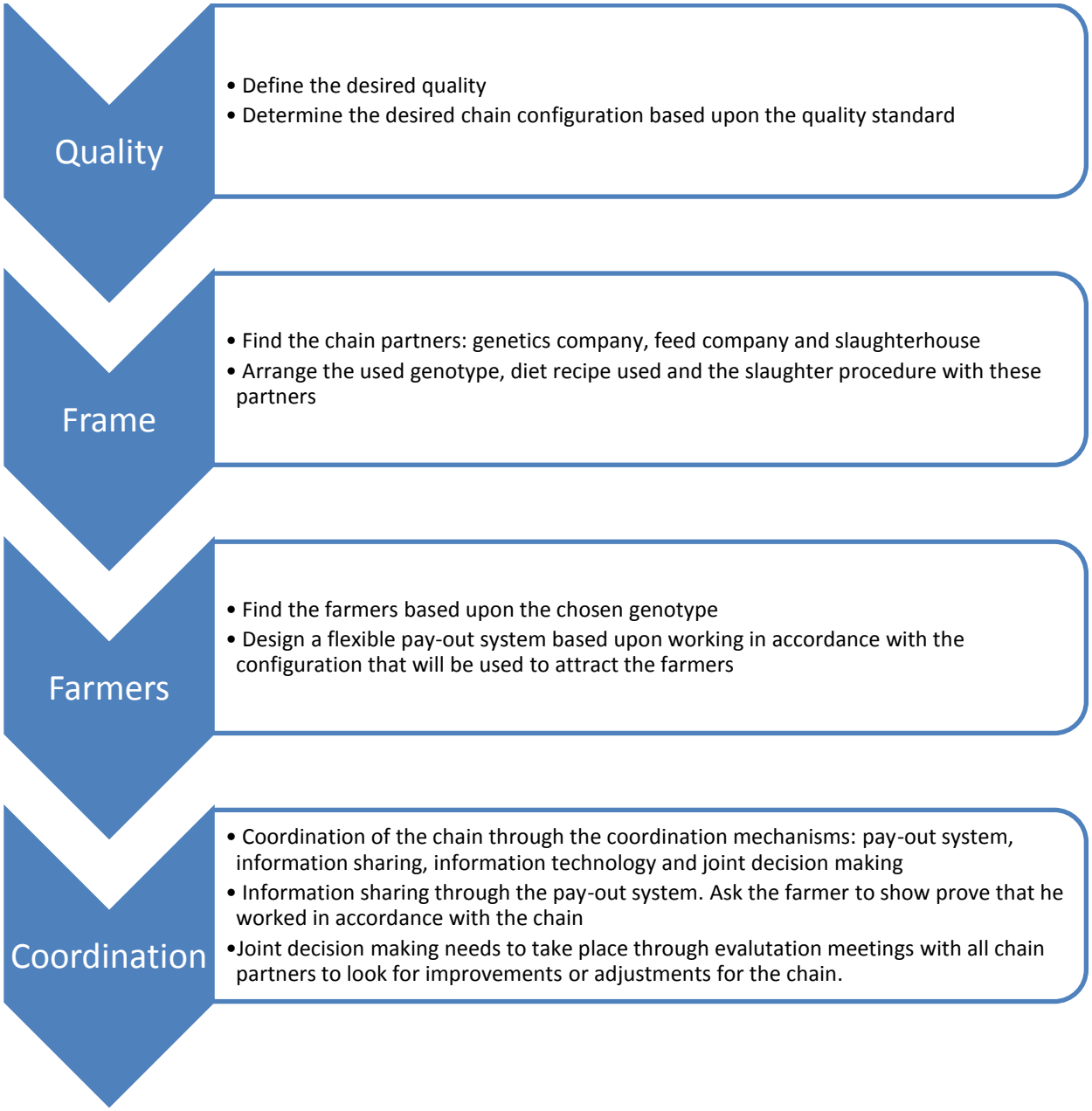

Figure 5: Overview of the different steps

In the recommendations all the different aspects from the scenarios are included. These aspects in the recommendations are compared to the results of the analysis to show the solutions in table 20:

Table 20: Comparison between recommendations and analysis

	Recommendations	Analysis
Owner of the system	Meatfriends	Meatfriends
Scale of the system	Small	Small
Scope of the system	Chain wide	Chain wide
Governance structure	Market with increasing dependency	Market
Coordination mechanisms used	Pay-out, IS, IT and JDM	Pay-out, IS, IT and JDM
Level of integration	collaboration with Genetics, feed company and slaughterhouse , Farmers stay free	Low
Level of demand set for the chain partners	High level of demands set with freedom for farmers to choose which demands they are willing to meet or not	High, Reachable and realistic
Possibility for labelling	Possible	Yes, preferable

Table 20 shows that the coordination from the recommendations is in accordance with the findings during the analysis.

When Meatfriends manages to follow this plan and finds the right partners who want to participate and believe in the concept they can be successful in achieving a consistent market orientated pork. The most important issue with the total supply chain will be the combination of cost and profit. So the most important driver that gives incentives for the chain will be the pay-out system used to reward the efforts taken by the different chain partners.

9. Discussion

Further research

Based upon the research for the pork supply chain supply chain different suggestions can be done for further research within the pork supply chain and perhaps for supply chains in general about the relationship between the desired quality of a buyer and the efforts that the supplier needs to make to meet this desired quality. Looking at the pork supply chain there can be said that the buyer want the specific meat quality, in order to reach this quality the supplier need to produce his pigs in accordance with this demands. To do this the buyer needs to offer incentives to the supplier. In order for the desired quality the buyer needs to use coordination to make sure its quality is reached. So in the pork supply chain the relationship between the buyer and supplier is that the buyer sets the desired quality standards based upon the market. Also the buyer needs to coordinate the quality within the chain through the coordination mechanisms. On the other hand the supplier needs to do actions in order to reach the desired quality. Therefore incentives are necessary for the supplier to perform actions demanded from the buyer. When putting these four dimensions together in a model seen in figure 6.

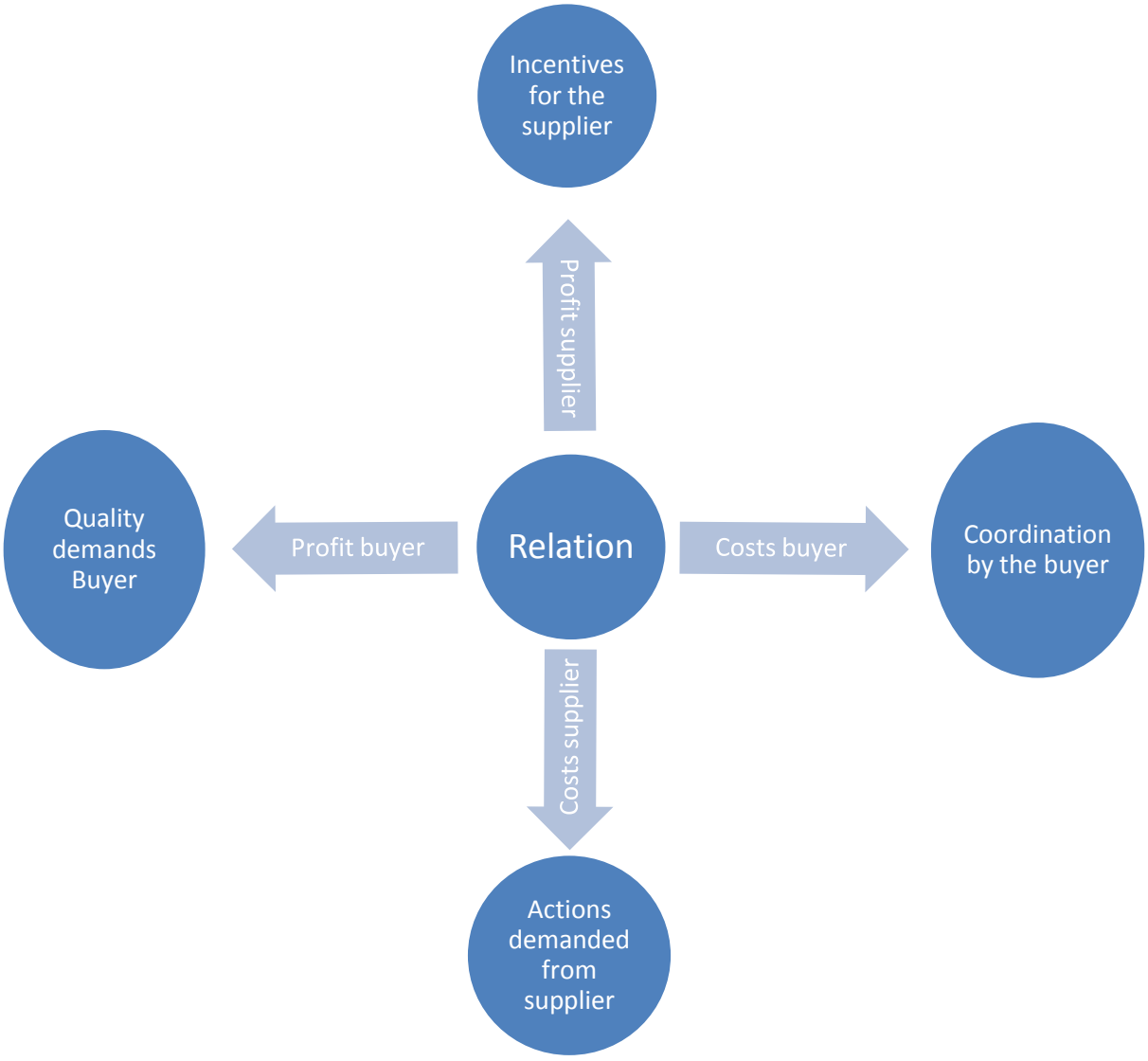

Figure 6: Relation between different dimensions

Based upon this model further research can be done about if the model is correct and how strong the different relations between the four dimensions are. In my opinion the four dimension should all be on the same level in order to reach the desired quality. This means that the incentives given to the supplier should be in accordance with the incentives given to him. Also the coordination done by the buyer should assure that the demands of the buyer can be coordinated. So if the buyer demands higher quality he need to say what he wants to get improved, so which actions does the buyer needs to do. There also need to be given incentives for the supplier to take these measures. Finally the buyer needs to coordinate the process, to make sure the higher quality standard is reached. I think that the limitation in the pork chain in concern to the improved quality is the need to produce for lower cost prices, because there are no incentives given to take the measures. So the big limitations is that all actors in the chain want low cost prices which results in low coordination and collaboration. Perhaps in further research the relation between these four dimensions can be investigated.

Remarks

Different remarks can be made about the research. During the research there were interviews with different chain actors. Based upon the uniformity of answers following ten different interviews with experts and chain actors there was chosen to say that ten interviews were sufficient to give an advice. Also based upon the answers the structure was changed from looking based upon the view of the different actors to view on the different aspects namely: quality, actions influencing the quality and the coordination.

The question of Meatfriends to give a indication of the cost of filling in the different actions was not possible because there was especially for feed to much fluctuation in prices to give an indication. For the genetics it was said that by looking for farmers already working with the genetics it would not affect the costs. This is from the view on the extra cost for the farmers.

The answers on the last three questions within the interviews, about the suggestions for value-adding and the usage of labels within the pork chain were very different. The answers given generally were negative and mostly saying that another chain partners should do different or better. Therefore the answers on these questions were not taken into account during the results, because they had no contribution to the research.

Reference list

Aarnink, A. & Verstegen, M., 2007. Nutrition key factor to reduce environmental load from pig production. *Livestock science,* pp. 194-203.

Andriessen, P., 2012. *Interview vleeskwaliteit* [Interview] (9 May 2012).

Apple, J., 2007. Effects of nutritional modifications on the water-holding capacity of fresh pork: a review. *Journal of animal breed and genetics,* pp. 43-58.

Arshinder, K., Kanda, A. & Deshmukh, S., 2008. Supply chain coordination: perspectives, empirical studies and research directions. *International journal of production economics,* pp. 316-335.

Boler, D. et al., 2010. Ultimate pH explains variation in pork quality traits. *Journal of muscle foods,* pp. 119-130.

Boler, D. et al., 2009. Effect of different dietary levels of natural-source vitamin E in grow-finish pigs on pork quality and shelf life. *Meat Science,* pp. 723-730.

Bonneau, M. & Lebret, B., 2010. Production systems and influence on eating quality of pork. *Meat science,* pp. 293-300.

Bont, C. d., Everdingen, W. v., Knijff, A. v. d. & Meulen, H. v. d., 2011. *Actuele ontwikkeling van resultaten en inkomens in de land- en tuinbouw in 2011,* Wageningen: LEI.

Bourland, K., Powell, S. & Pyke, D., 1996. Exploiting timely demand information to reduce inventories. *European journal of operational research,* pp. 239-253.

Brinkmann, D. et al., 2011. Towards a chain coordination model for quality management strategies to strengthen the competitiveness of European pork producers. *Chain and network science,* pp. 137-154.

Camp, L., Southern, L. & Bidner, T., 2003. Effect of carbohydrates sources on growth performance carcass traits, and meat quality of growing pigs. *Journal of animal science,* pp. 2488-2495.

Camps, B., 2012. *Interview vleeskwaliteit* [Interview] (12 April 2012).

Cannata, s. et al., 2010. Effect of visual marbling on sensory properties and quality traits of pork loin. *Meat science,* pp. 428-434.

Channon, H., Payne, A. & Warner, R., 2001. Comparison of CO2 stunning with manual electrical stunning (50 Hz) of pigs on carcass and meat quality. *Meat science,* pp. 63-68.

Cheng, Q. & Sun, D.-w., 2008. Factors affectinf the water holding capacity of red meat products: a review of recent research advances. *Food science and nutrition,* pp. 137-159.

De Vaus, D., 2001. *Research design in social research.* London: SAGE publications Inc..

Derix, H., 2012. *Interview vleeskwaliteit* [Interview] (17 April 2012).

Derks, S., 2012. *Interview vleeskwaliteit* [Interview] (19 April 2012).

Dierenbescherming, 2011. *Ieder jaar een beter leven voor steeds meer dieren,* sl: Nederlandse vereniging tot bescherming van dieren.

D'Souza, D., Warner, R., Dunshea, F. & Leury, B., 1999. Comparison of different dietary magnesium supllements on pork quality. *Meat Science,* pp. 221-225.

Edwards, D., Bates, R. & Osburn, W., 2003. Evalutation of Duroc- vs. Pietrain-sired pigs for carcass and meat quality measures. *Journal of animal science ,* pp. 1895-1899.

Edwards, S., 2005. Product quality attributes associated with outdoor pig production. *Livestock production science ,* pp. 5-14.

Eikelenboom, G., Bolink, A. & Sybesma, W., 1991. Effects of Feed Withdrawal Before Delivery on Pork. *Meat Science ,* pp. 25-30.

Fransen, H., 2012. *Interview vleeskwaliteit* [Interview] (26 April 2012).

Garcia-Rey, R., Quiles-Zafra, R. & Luque de Castro, M., 2005. Effect of genotype and seasonality on pig carcass and meat charactaristics. *Livestock production science ,* pp. 175-183.

Gispert, M. et al., 2007. Relationships between carcass quality parameters and genetic types. *Meat Science,* pp. 397-404.

Grunert, K. G. et al., 2011. Consumer demands and quality assurance: segmentation basis and implications for chain governance in the pork sector. *Chain and Network science,* pp. 89-98.
Guardia, M. et al., 2005. Risk assessment of DFD meat due to pre-slaughter conditions in pigs. *Meat Science,* pp. 709-716.
Hambrecht, E., Eissen, J. & Verstegen, M., 2003. Effect of processing plant on pork quality. *Meat Science,* pp. 125-131.
Hamilton, D., Ellis, M., McKeith, F. & Eggert, J., 2003. Effect of level, source and time of feeding prior to slaughter of supllementary dietary magnesium on pork quality. *Meat Science,* pp. 853-857.
Hansen, L., Claudi-Magnussen, C., Jensen, S. & Andersen, H., 2006. Effect of organic pig production systems on performance and meat quality. *Meat science,* pp. 605-615.
Holmer, S., McKeith, F. & Killefer, J., 2008. The influence of early post-mortem enhancement and accelerated chilling on pork quality. *Meat Science,* pp. 211-216.
Jeleninkova, J., Pipek, P. & Miyahara, M., 2008. The effect of breed, sex, intramuscular fat and ultimate pH on pork tenderness. *European food research and Technology,* pp. 989-994.
Kalathas, A., 2007. *Quality management practices and consumer demand in the Dutch pork supply chain,* Wageningen: Management studies group .
Kapper, C., 2012. *Interview vleeskwaliteit* [Interview] (8 May 2012).
Lambooij, B., 2007. *Effect van diervoeding op vleeskwaliteit en gezondheid in het bijzonder in de biologische varkenshouderij,* Wageningen: LEI.
Lambooij, B., 2012. *Interview vleeskwaliteit* [Interview] (24 April 2012).
Larsen, T., Thernoe, C. & Anderson, C., 2003. Supply chain collaration theoretical perspective and empirical evidence. *International Journal of Physical Distribution and Logistics,* pp. 531-549.
Lebret, B., 2008. Effects of feeding and rearing systems on growth , carcass composition and meat quality in pigs. *Animal,* pp. 1548-1558.
Lebret, B. et al., 2006. Influence of rearing conditions on performance, behavioral, and physiological responses of pigs to preslaughter handling, carcass traits, and meat quality1. *Journal of animal science,* pp. 2436-2447.
Lebret, B. et al., 2011. pshysiological traits and meat quality of pigs as affected by genotype and housing system. *Meat science,* pp. 14-22.
Lee, S. et al., 2012. The influence of pork quality traits and muscle fiber charactaristics on eating quality of pork various breeds. *Meat Science,* pp. 284-291.
Lindahl, G., Henckel, P., Karlsson, A. & Andersen, H., 2006. Significance of early postmortem temperature and pH decline on cour characteristics of pork loin from different crossbreeds. *Meat science,* pp. 613-623.
Lindahl, G., Karlsson, A., Lundstrom, K. & Andersen, H., 2006. Significance of storage time on degree of blooming and colour stability of loin from different crossbreeds. *Meat science,* pp. 603-612.
Loenen, P., 2012. *Verdeling afzet Varkens K.I. Nederland 2011.* [Online]
Available at:
http://www.varkenski.nl/Portals/0/Downloads/NE%20KIN%20afzet2011.pdf
[Geopend 13 July 2012].
Management studies group, 2011. *Thesis manual.* Wageningen: Management studies.
Meinert, L. et al., 2008. Eating quality of pork from pure breeds and DLY studied by focus group research and meat quality analyses. *Meat Science,* pp. 304-314.
Morrison, R., Johnston, L. & Hilbrands, A., 2007. The behaviour, welfare, growth performance and meat quality of pigs housed in a deep-litter, large group housing system compared to a conventional confinement system. *Applied animal behaviour science,* pp. 12-24.
Ngapo, T. & Gariepy, C., 2008. Factors affecting the eationg quality of pork. *Food science and nutrition,* pp. 599-633.

Overvarkens, 2012. *overvarkens.* [Online]
Available at: http://www.overvarkens.nl/varkens_link.php
[Geopend 28 february 2012].
Perre, V. V. d. et al., 2010. Effect of unloading, lairage, pig handling, stunning and season on pH of pork. *Meat Science,* pp. 931-937.
Philippe, F., Cabaraux, J. & Nicks, B., 2011. Ammonia emissions from pig houses: Influencing factors and mitigation techniques. *Agriculture, ecosystems and environment,* pp. 245-260.
Poels, A., 2012. *Interview vleeskwaliteit* [Interview] (16 April 2012).
PVE, P. v. e. v., 2009. *Slachten, wegen en classificeren van vleesvarkens.* [Online]
Available at:
http://www.pve.nl/wdocs/dbedrijfsnet/up1/ZgocogaII_SWC_Varkens_2009.pdf
[Geopend 15 february 2012].
PVE, P. v. e. v., 2009. *Slachten, wegen en classifiseren van vleesvarkens.* [Online]
Available at:
http://www.pve.nl/wdocs/dbedrijfsnet/up1/ZgocogaII_SWC_Varkens_2009.pdf
[Geopend 8 Februari 2012].
Quinten , S., 2011. [Interview] (14 November 2011).
Quinten, S., 2012. *Desired meat quality meatfriends* [Interview] (23 March 2012).
Roefs, H., 2012. *Interview vleeskwaliteit* [Interview] (25 April 2012).
Rosenvold, K. & Andersen, H., 2003. Factors of significance for pork quality a review. *Meat science ,* pp. 219-237.
Savell, J., Mueller, S. & Baird, B., 2005. The chilling of carcasses. *Meat Science,* pp. 449-459.
Springer, M., Carr, M., Ramsey, C. & Miller, M., 2003. Accelarated chilling of carcasses to improve pork quality. *Journal of animal science ,* pp. 1464-1472.
Sterten, H. et al., 2010. Effect of fasting prior to slaughter on pH development and energy metobolism post-mortem in m. longissimus dorsi of pigs. *Meat Science,* pp. 93-100.
Suzuki, K. et al., 2003. Meat quality comparison of Berkshire, Duroc and crossbred pigs sired by Berkshire and Duroc. *Meat Science,* pp. 35-42.
Te Pas, M., 2012. *Interview vleeskwaliteit* [Interview] (23 April 2012).
Tikk, K., Lindahl, G., Karlsson, A. & Andersen, H., 2008. The significance of diet, slaugter weight and aging on pork colour and colour stability. *Meat science,* pp. 806-816.
Tsay, A., 1999. The quantity flexibility cantract and supplier-costumer incentives. *Management science,* pp. 1339-1358.
Varkensenzo, 2012. *Varkensenzo.* [Online]
Available at: http://www.varkensenzo.nl/NL/index.php?file_id=9
[Geopend 28 February 2012].
Verschuren, P. & Doorewaard, H., 2010. *Designing a Research Project.* The Hague: Eleven international publishing.
Wever, M., Wognum, N., Trienekens, J. & Omta, O., 2010. Alignment between chain quality and chain governance in EU pork supply chains: A transaction-Cost-Economics perspective. *Meat Science,* pp. 228-237.
Wood, J. et al., 2008. Fat deposition, fatty acid and meat quality: a review. *Meat science,* pp. 343-358.