Valorisation possibilities for return bread in the Dutch industrial bakery sector

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Abstract

In 2009 seven percent (35.000 ton) of the unsold fresh supermarket bread is returned from the retailer to the industrial bakery, this has a consumer value of 2.285 €/ton and € 80.000.000 in total. Currently the bakery sells the return bread as cattle feed for 30-40 €/ton. The objective of this thesis is to obtain insight in the broad range of current and future return bread valorisation methods usable for return bread in Dutch industrial bakeries and to identify industrial baker's drivers and barriers to choose for a specific method. The researched methods are: bread snacks, circle bread, cattle feed - extra, carton strengtheners, fermentation and biogas. Industrial symbiosis forms the theoretical framework, literature mentions six influencing factors: technical, communication, social, business, law and regulations and logistics. The theory is refined and tested by the Delphi method for which 14 experts were consulted. Important drivers to switch to another method are: higher profit, less labour and CSR. Individual bakeries are expected to wait for the developments around cattle feed – extra, the disadvantage is that the yield is relatively low. The methods to valorise to human food have a higher yield, for those methods the main barrier is the food safety risk. The risks can be guarded within the HACCP regulations however this requires extra willingness and labour from the retailer and bakery. For the three non-food methods the main barrier is technical uncertainty, which leads to business and logistical uncertainty. Individual bakeries have no sufficient R&D capacity, so it is recommended that a collective initiative of bakeries or an external party invests in these possibilities.

Key words: industrial bakery sector, return bread, waste stream valorisation, by product valorisation, industrial symbiosis, ecological industry, by-product synergy, recycling, reusing

Management samenvatting

In 2009 ging er 35.000 ton (7%) van het onverkochte verse supermarkt brood retour naar de industriële bakkerijen. Dit brood heeft in een consumentenwaarde van € 80.000.000, ofwel 2.285 €/ton (Weerd 2009). Op dit moment wordt het retourbrood voornamelijk doorverkocht als veevoer, de opbrengst is afhankelijk van de LEI-prijs en varieert de laatste jaren rond 30-40 €/ton. Verkoop als veevoer zorgt ervoor dat er geen extra kosten zijn voor het verwerken van afval, desalniettemin is er een groot financieel verschil. De afgelopen jaren zijn er meerdere projecten geweest om te onderzoeken of er valorisatiemethodes bestaan die voor minder economisch en/of voedselverlies zorgen. Dit heeft geleid tot een aantal interessante mogelijkheden, waarvan er echter nog geen enkele is toegepast in de praktijk. In deze scriptie worden zes valorisatiemethodes onderzocht namelijk broodsnacks, cirkelbrood, veevoer – extra, kartonversteviger, fermentatie en biogas.

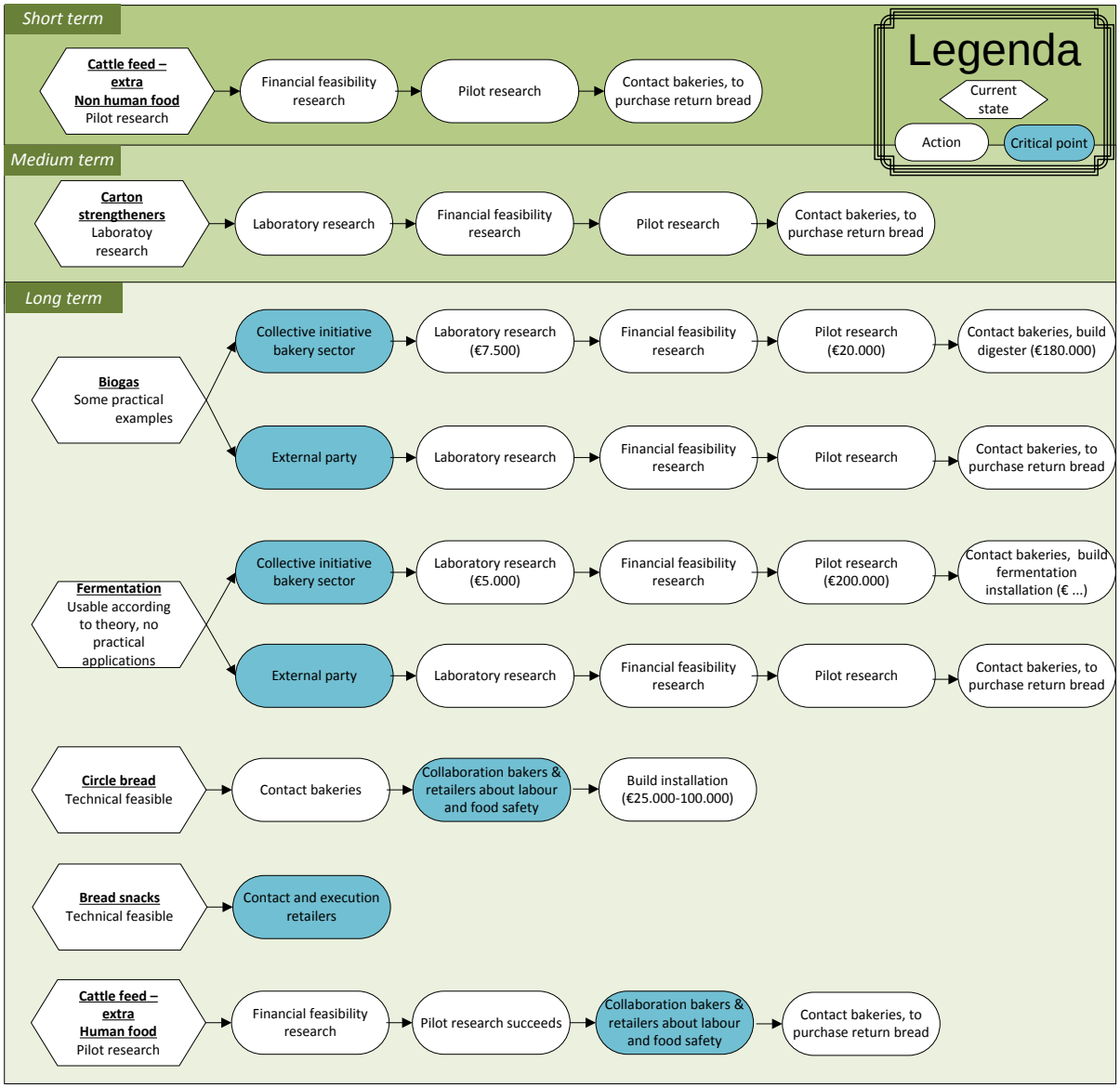
Het eerste doel van deze scriptie is om een beter inzicht te krijgen in het brede aanbod van huidige en toekomstige retourbroodvalorisatiemethodes die bruikbaar zijn voor de Nederlandse industriële bakkerijen. Het tweede doel is om de motivaties en barrières van industriële bakkers voor een specifieke methode te identificeren. Daarnaast is er de intentie om bij te dragen aan het innovatieprogramma 'Koplopers in Ambitie'- Reststromen van Food Valley NL, dat gericht is op agro-food ondernemers die serieus willen investeren en innoveren op het terrein van hun reststromen.

De onderzoeksvraag is:

Wat zijn de belangrijkste voor- en nadelen voor de verschillende retourbroodvalorisatiemethodes, zoals verwacht en ervaren door Nederlandse industriële bakkerijen?

Om deze onderzoeksvraag te beantwoorden wordt gebruik gemaakt van de industriële symbiose theorie. De belangrijkste achterliggende gedachte van deze theorie is dat "afval van het ene industriële proces kan dienen als grondstof voor een ander proces, daardoor vermindert de impact van de industrie op het milieu" (Frosch and Gallopoulos 1989). Volgens de theorie zijn er zes factoren die invloed hebben op het succesvol uitoefenen van een industriële symbiose. Het gaat om technische, communicatieve, sociale, bedrijfskundige, wet- en regelgeving en logistieke factoren. Door middel van de Delphi onderzoeksmethode is er gekeken hoe de zes factoren in deze situatie toepasbaar zijn in de praktijk en welke factoren voor welke valorisatiemethodes het meest relevant zijn. Voor de Delphi methode zijn er 14 experts in drie gestructureerde rondes geraadpleegd.

Er wordt verwacht dat wanneer enkele koplopende bakkerijen het initiatief nemen, andere bakkerijen vanzelf zal volgen. Figuur 1 geeft een overzicht van de benodigde acties voordat een valorisatiemethode kan worden toegepast binnen de korte-, middellange- en lange termijn. Deze verdeling is bepaald door de positie in de huidige situatie, de barrières die moeten worden overwonnen en de verwachte kans dat een partij initiatief neemt.



Figuur 1: Toekomst overzicht, benodigde acties voordat een methode kan worden toegepast in de praktijk

Veevoer – extra is een nieuwe methode, in het voorjaar van 2013 wordt het pilot onderzoek uitgevoerd door een veevoerverwerker en een bakkerij branche organisatie. Het doel is om uit de broodresten 60% glucose en 40% eiwitten te halen. De glucose wordt gebruikt als grondstof om bakkersgist op te laten groeien, de eiwitten zijn geschikt voor veevoer.

	Lab onderzoek (€)	Pilot onderzoek (€)	Installatie (€)	Opbrengst (€/ton)	Arbeid
Veevoer – extra (geen humane voeding)	0	0	0	30-40	Bakkerij: inzamelen retourbrood volgens GMP+ (uitscheiden van vleeshoudende producten)

Tabel 1: Overzicht van relevante bedrijfskundig en logistieke factoren voor industriële bakkerijen bij veevoer - extra (Onzekere gegevens)

Het voordeel voor veevoer – extra is dat de bakkerijen gewend zijn om samen te werken met veevoerverwerkers. Bovendien neemt de veevoerverwerker het economische risico om de technische haalbaarheid te onderzoeken, dat verlaagd de barriere voor bakkers. Het is op dit moment nog onzeker of de opbrengst per ton hoger zal zijn dan bij conventioneel veevoer (zie Tabel 1). Bij valorisatie tot dierlijke voeding moet er aan de GMP+ normering worden voldaan, dit kan voor bakkerijen zoveel tijd en arbeid kosten dat de methode financieel onhaalbaar wordt. Wanneer 60% glucose wordt verwaard tot humane voeding moet er aan de voedselveiligheidsregulatie (HACCP) worden voldaan. Dit brengt voor zowel bakkerijen als retailers veel extra werk met zich mee, waardoor uitvoering waarschijnlijk financieel onhaalbaar wordt. Daarnaast wil een bakker geen enkel voedselveiligheidsrisico nemen en is de veranderingsbereidheid bij retailers laag. Om de slagingskans voor veevoer –extra op korte termijn te verbeteren kan er beter worden ingezet op dierlijke voeding, of non-food doelen.

- *Aanbevelingen voor veevoer – extra:*
    - *De veevoerverwerker moet het humane voedingsdoel afwijzen, zodat:*
        - *Extra samenwerking met retailers niet nodig is*
        - *Er geen voedselveiligheidsrisico en mogelijke bedrijfsimago schade is.*

In Figuur 1 staat **kartonversteviger** bij de middellange termijn**.** Momenteel gebruikt de kartonindustrie zetmeel uit verse bloem als kartonversteviger. Als er voor een lagere prijs zetmeel uit retourbrood gewonnen kan worden biedt dat een interessant alternatief. Deze methode wordt onderzocht door een private initiatiefnemer en een kartonfabrikant.

	Lab onderzoek (€)	Pilot onderzoek (€)	Installatie (€)	Opbrengst (€/ton)	Arbeid
Kartonversteviger door externe partij	0	0	?	<300	Bakkerij: inzamelen retourbrood

Tabel 2: Overzicht van relevante bedrijfskundig en logistieke factoren voor industriële bakkerijen bij kartonversteviger (Onzekere en zeer onzekere gegevens)

In vergelijking met veevoer – extra is kartonversteviger in een vroeger onderzoeksstadium, daardoor is de verwachting dat het langer zal duren voordat de methode wordt toegepast. De onderzoeken worden gefinancierd door externe partijen, dit verlaagd het economisch risico voor een industriële bakkerij. Een ander voordeel is dat er geen rekening hoeft te worden gehouden met voedselveiligheidsregelgeving, daardoor is de methode minder arbeidsintensief. Voor uitvoering zal de methode technisch, financieel en logistiek haalbaar moeten zijn. Tot nu toe zijn er nog te veel onzekerheden, zie Tabel 2. Uiteindelijk zal toepassing in de praktijk afhangen van de uitkomsten van het onderzoek en de bereidheid tot overstappen van industriële bakkers.

- *Aanbevelingen voor kartonversteviger:*
    - *De externe partijen moeten de communicatie naar industriële bakkerijen verbeteren zodat de veranderingsbereidheid wordt vergroot*

De andere vijf methodes in Figuur 1 zullen naar verwachting pas op de lange termijn worden uitgevoerd. De uitvoersnelheid is afhankelijk van welke stakeholders als eerste zullen optreden en van de resultaten van het haalbaarheidsonderzoek.

Bovenaan bij de lange termijn verwachtingen staan de non-food methodes **biogas** en **fermentatie**. Biogas wordt gemaakt doordat bacteriën organische materialen omzetten tot gas. Bij fermentatie worden de suikers uit het retourbrood gehaald, die met behulp van microorganismen kunnen worden omgezet tot bioplastics of bioethanol. Beide methodes zijn nog niet specifiek voor brood toegepast in de praktijk.

	Lab onderzoek (€)	Pilot onderzoek (€)	Installatie (€)	Opbrengst (€/ton)	Arbeid
Biogas bij bakkerij	7.500	20.000	180.000	200 (incl. subsidy)	Bakkerij: plastic uitscheiden en gebruik van de vergistingsinstallatie
Biogas door externe partij	0	0	0	<200	Bakkerij: inzamelen retourbrood
Fermentatie (bio plastics) bij bakkerij	5.000	200.000	?	120	Bakkerij: plastic uitscheiden en gebruik van de fermentatie installatie
Fermentatie (bio plastics) door externe partij	0	0	0	<120	Bakkerij: inzamelen retourbrood

Tabel 3: Overzicht van relevante bedrijfskundig en logistieke factoren voor industriële bakkerijen bij biogas en fermentatie (Onzekere en zeer onzekere gegevens)

Het voordeel van deze non-food methodes is dat ze weinig arbeid vragen omdat er niet hoeft te worden voldaan aan voedselveiligheidsregelgeving. Het nadeel is dat er nog veel technische onzekerheden zijn die leiden tot bedrijfskundige en logistieke onzekerheden. Omdat reststromen niet de kerntaak van een bakker is en de investeringsmogelijkheden laag zijn wil hij zoveel mogelijk uitbesteden. Om dit op te lossen moeten er een aantal onderzoeken worden uitgevoerd (zie Figuur 1). Wanneer een externe partij investeert is het economisch risico voor bakkerijen lager, maar is de winst per ton waarschijnlijk ook minder.

- *Aanbevelingen voor biogas en fermentatie:*
    - *Externe partijen moeten de communicatie naar industriele bakkerijen verbeteren zodat de veranderingsbereidheid wordt vergroot*
    - *Externe partijen, of een gezamenlijk initiatief van bakkerijen, moeten investeren in technisch, financieel en logistiek haalbaarheidsonderzoek, zodat de onzekeheden worden verlaagd*

Onderaan in Figuur 1 staan drie methodes die valoriseren tot humane voeding. Het valoriseren van veevoer – extra tot humane voeding is naar verwachting financieel onhaalbaar. De andere twee humane voedingsmethodes zijn ook arbeidsintensief, maar hebben een hogere opbrengst (zie Tabel 4). **Broodsnacks** kunnen worden geproduceerd in een supermarkt waar brood wordt afgebakken. Het oude brood wordt nogmaals door de snijmachine gehaald, in een kant en klare marinade gedompeld en opnieuw afgebakken. Bij **cirkelbrood** wordt er van het oude brood een desem gemaakt, die kan worden gebruikt als ingrediënt voor het nieuwe brood. Consumenten kunnen geen verschil proeven.

	Lab onderzoek (€)	Pilot onderzoek (€)	Installatie (€)	Opbrengst (€/ton)	Arbeid
Broodsnacks	0	0	0	Retailer: 1.000	Retailer: bereiding volgens HACCP
Cirkelbrood	0	0	25.000-100.000	280	Retailer: brood retour volgens HACCP Bakkerij: sorteren op broodtype, plastic uitscheiden, etiketering allergenen

Tabel 4: Overzicht van relevante bedrijfskundig en logistieke factoren voor industriële bakkerijen bij broodsnacks en cirkelbrood

Zoals Tabel 4 laat zien zijn alle technische onderzoeken al uitgevoerd en is de opbrengst per ton hoog. Het nadeel is dat de methodes arbeidsintensief zijn en dit heeft een negatieve invloed op de uiteindelijke financiële haalbaarheid. Het belangrijkste punt bij deze methodes is echter het voedselveiligheidsrisico. Omdat er in Nederland zoveel belang wordt gehecht aan dit onderwerp kan het bedrijfsimago veel schade lijden als het publiekvertrouwen beschadigd wordt. Momenteel vertrouwen industriële bakkers de voedselveiligheid condities van het retourbrood niet. Om te voldoen aan de HACCP regelgeving is meer arbeid nodig, bij zowel de bakkerij als bij de retailer. Volgens de bakkerijexperts in dit onderzoek zijn retailers niet bereid om deze investering te maken. De verwachting is dat deze investering pas op de langer termijn zal plaatsvinden. De bereidheid om over te stappen op een van deze methodes is ook lager omdat er nog geen goede praktijkvoorbeelden bestaan.

- *Aanbevelingen voor de humane voedingsmethodes:*
    - *Bakkerijen moeten meer communiceren met retailers, waardoor de bereidheid van de retailer vergroot*
    - *Retailers moeten investeren in extra tijd, arbeid en educatie voor hun personeel, zodat zij kunnen werken volgens de HACCP normering en voedselveiligheidrisico's worden voorkomen*

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1. Introduction

The world's population is growing while the earth's resources are limited. Focusing on food provision this will impact all three levels of the People-Planet-Profit triangle (see Figure 1). In 2050 the food and fibre demand of all people will be increased with 70% (EuropeanCommission 2011b). Predicted is that even if the Millennium Development Goals are to be achieved by 2015, about 600 million people in developing countries would still be undernourished (FAO 2011). The impact on the planet is resource depletion. Furthermore, 20 – 30% of the environmental impact[1] of the total consumption is caused by the entire production and distribution chain of food and drink products (Tukker, Huppes et al. 2006). Finally, the product scarcity causes price volatility and affects individual businesses and the economy.

Figure 1: People – Planet – Profit triangle

Given this background one fundamental question is: 'How to feed 9.1 billion people in 2050?' The opinions on this issue are not unanimous; pessimists think it is not possible to reach this goal. Optimists think that the world has the resources and technologies to eliminate hunger and ensure long-term food security for all. To reach this goal policies need to change and investments must be made (FAO 2009). One of those changes is to make more efficient use of resources and among others: reduce waste (EuropeanCommission 2011a). The Dutch government and the European commission have developed regulatory programs to reduce the above described impacts. Policy focuses mainly on prevention of financial problems due to resource scarcity. Recently, the European Commission developed the 'Roadmap to a Resource Efficient Europe' (EuropeanCommission 2011b). The Dutch government encourages resource efficiency initiatives by an award, platform, pilots and working groups (Thönissen 2010-10-30). Via regulation within the National Waste Plan 2 (in Dutch: LAP2-2009-2015). Those governmental actions focus on all levels of the food chain: from farmer, via processor and retailer to the end-consumer. Two reduction methods are within the main focus:

1. Prevent pollution and inefficient resource usage and spillage.
2. Valorise waste streams and by-products.

In the present thesis the emphasis lies on valorisation of waste streams, with special focus of return bread in the Dutch industrial bakery sector. The aim is to contribute to the Ambitious Companies Programme (in Dutch: Koplopers in Ambitie = KiA) which is linked to Food Valley NL. This project is supporting ambitious agri/food companies to valorise their waste streams.
Waste stream valorisation is the core principle of industrial symbiosis (IS), for this reason IS will function as theoretical framework of this thesis (see Section 2).

[1] In this research the following environmental impact categories are taken into account: a-biotic depletion, acidification, eco-toxicity, global warming, eutrophication, human toxicity, ozone layer depletion and photochemical oxidation (Tukker, Huppes et al. 2006).

1.1. Food waste streams

It is difficult to get grip on the amount of food waste because companies are not willing to share information and different norms are used (Soethoudt and Timmermans 2013). To give an impression some recent numbers, from different sources are given below.
In the Dutch food chain the food loss is estimated between 32-39% of the total food production (AKK 2005); 2-10% of this total loss is caused by the manufacturing and distribution sector (AKK 2005). When zooming in into this sector, it is obvious that there are opportunities for improvement. In 2006 the amount of animal and vegetal waste from the food, beverages & tobacco manufacturing sector was six million tonnes (Monier, Mudgal et al. 2010). This is 393 kg/capita; the highest amount per capita of the EU-27. It should be added that a large part of this food is manufactured for export, which is not taken into account in the kg/capita calculation. According to another source, was the total amount of food waste in 2009 around 1,4 - 2,5 million tonnes, so 83 – 151 kg/capita. In 2011 it was estimated between 89 - 210 kg/capita (Soethoudt and Timmermans 2013). The financial losses because of food decay in the Dutch food manufacturing industry are 0.6 billion euro's. In the entire chain, including consumers, the loss is 4.4 billion euro (Timmermans 2009).
In this thesis the emphasis lies on valorisation of the so called 'return bread' (in Dutch 'retourbrood'). When bread is not sold in supermarket it is taken back to the industrial bakery by the truck that delivers the fresh bread. This procedure is a service by the bakeries. Industrial bakeries always weigh the weekly amounts of return bread; this means that they have good insight in the return streams. Nevertheless, there is no complete view on the total amount of returned bread, only estimations. According to the director of the Dutch Association for Bakeries (NVB) 10 to 12% of the total industrial bread production ends up as waste stream, both process losses and as return bread. In 2009 the amount of return bread is estimated on 7% of the fresh bread. 35.000 ton per year (Weerd 2009). The amount of return bread depends on the size of the bakery. According one of the industrial bakers interviewed for this thesis the return bread streams differ per bakery between two and 25 ton a week. This would mean that with 50 Dutch industrial bakeries the return streams are between 5.200 and 65.000 ton/year, or on average 35.000 ton/year. According to recent research also the amount of waste streams in the industrial bakery sector has increased since 2009 (Soethoudt and Timmermans 2013). 35.000 ton return bread has a consumer value of 80.000.000 euro, so 2.285 €/ton (Weerd 2009). The financial loss is for the supermarket, who already bought the bread from the industrial bakeries.

1.2. Waste stream valorisation

Waste streams and by-products can be reused in many forms. To cascade the end product's value the 'Ladder of Moerman' is developed (Ministerie van Economische Zaken 2012), see Table 1. The lower numbers on the top represent high valued products, which are only available in small volumes. The high numbers at the bottom represent low valued products, which are available in large volumes. In Dutch literature different hierarchical orders are mentioned (Eijk 2011; Snels 2012). So, it must be noted that the order represented in Table 1 is not the only order possible, since value is subjective and differs per goal. Questions like: 'what do you consider (ethically) more important?' and 'what end goal gains more economic profit?' must be asked. So, number 4, 5 and 6 of the hierarchy are interchangeable.
Waste prevention in the most sustainable option, however this is outside the scope of this research. Here the Ladder of Moerman will be used in such a way that it is applicable for the KiA project and industrial bakers. The KiA's aim is to assist bakeries to achieve waste valorisation with higher valued

end products. The initial intention was to focus the empirical research of this thesis on number 2-5, consisting of the following categories: human food, cattle feed and (bio-based) industry resources. However, during the execution of the research many bakers also mentioned digestion to biogas, so this option was added.
The methods 7 - 9, that generate fertilizer and energy, are the more conventional valorisation methods. According to Robert Jan ter Morsche, Branche manager FmV, those methods are applied by many waste processing companies. Additionally, these methods will almost certainly cost money, instead of gain money, making them less interesting for the KiA project and for this research. So they are excluded from research.

1	Waste prevention
2	Direct use for human food • Food banks • 'Sell as bread from yesterday'
3	Convert to human food • Circle bread • Bread snacks • Bread crums • Food ingredients • Fibers • Salt replacer
4	Use for cattle feed • Direct use • Proteins/Amino acids
5	Convert for resource in (biobased) industry • Fermentation to bio plastics • Carton strengthener
6	Digestion to biogas
7	Composting to fertilizer
8	Energy generation
9	Waste incineration

Table 1: 'Ladder van Moerman' (Ministerie van Economische Zaken 2012), including specific methods applicable for return bread

From the waste and by-products in the whole food chain 45,6% is incinerated, 22,4% is composted, 21,3 % is used as cattle feed, 6,8% is digested and 3% is dumped (Soethoudt and Timmermans 2013). In the industrial bakery sector almost all the waste streams are used for cattle feed. According to the cattle feed expert interviewed in this thesis yearly 300.000 ton cookies and bread waste streams are used as cattle feed. A ton of return bread is then worth 30-40 euro and is related to the LEI-price of grain. With this method there are no extra waste processing costs involved. However, with a consumers value of 2.300 €/ton the previous day there is a large financial gap. In recent years it was questioned whether there are valorisation methods that recover more of the economic and/or human food loss. Table 1 shows that there are many more opportunities that are also higher valued. To investigate this the Stichting Bakkerij Imago (SBI, in English: Bakery's Image Foundation) has performed the feasibility research 'Bread for Tomorrow', concerning multiple valorisation

possibilities in 2009 (Weerd 2009). This project led to some promising valorisation possibilities like baking new bread from daily old bread. Other opportunities are breakfast cereals, and carton and plastic packages made from return bread. After the 'Bread for Tomorrow'-project the circle bread and carton opportunities have been further researched. However, none of the possibilities are yet applied to practice by industrial bakers. Another valorisation project, 'Bread to Bread', on the initiative of a cattle feed processor, started recently with a pilot reactor. The goal is to valorise 60% to sugar as building material for (baker's) yeast and pharmacy and 40% as protein for cattle feed (Leijten 2013). The project is in collaboration with a bakery's branch organisation.

1.3. Research objective & questions

The topic of this thesis is valorisation of return bread in the Dutch industrial bakery sector. As described in the sections above there is a large amount of return bread and some valorisation opportunities are already available. Nevertheless, not all industrial bakeries are aware of all those opportunities. The objective of this research is to obtain insight in the broad range of current and future return bread valorisation methods usable for return bread in Dutch industrial bakeries and to identify industrial baker's drivers and barriers to choose for a specific method. The focus lies on the forerunning bakeries, which will probably take the first steps. The aim is to especially contribute to the Food Valley NL KiA project.
To reach this objective a research question and several sub research questions are developed. The terminology in the sub research questions is based on the Industrial Symbiosis theory, discussed in Sub sections 2.1, 2.2 and 2.3.

Research question:

- What are the main advantages and disadvantages of the different methods for return bread valorisation as experienced and expected by the Dutch industrial bakery companies?

Sub research questions:

1. To which extent do the aspects of the technical influencing factors affect the choice for a return bread valorisation method?
2. To which extent do the aspects of the communicational influencing factors affect the choice for a return bread valorisation method?
3. To which extent do the aspects of the social influencing factors affect the choice for a return bread valorisation method?
4. To which extent do the aspects of the business influencing factor affect the choice for a return bread valorisation method?
5. To which extent do the aspects of the influencing factor 'law and regulations' affect the choice for a return bread valorisation method?
6. To which extent do the aspects of the logistical influencing factor affect the choice for a return bread valorisation method?
7. Does the Cradle to Cradle basic idea to consider waste streams already in the designing phase influence the choice for a return bread valorisation method?
8. Does the practised waste exchange type, as distinguished by Chertow (2000), affect the choice for a return bread valorisation method?

The sub research questions are developed to give special focus on parts of the conceptual model (Figure 6), Section 2.4 describes which questions are used where. After the theoretic framework in Section 2, Section 3 explains how the Delphi methodology is applied. The results of the research are described in Section 4. Section 5 is for a discussion of the results. Finally Section 6 gives conclusions, recommendations and a future outlook.

2. Theoretical framework for industrial symbiosis

Industrial symbiosis (IS) is a concept that originated under the name ecological industry (EI). The underlying thought is that: "wastes from one industrial process can serve as the raw materials for another, thereby reducing the impact of industry on the environment" (Frosch and Gallopoulos 1989). This definition of EI is the first description of the concept. The theory was initially written for rough industries and not for food sector, however since because valorisation of food waste streams received more attention in the recent years, the theory is considered as applicable for this thesis. Halfway the 1990s the industrial park in Kalundborg became famous because its working method could be described as an ecological industrial park (EIP). Scholars were interested in the park and used it as an example. After Kalundborg it became popular to put industrial symbiosis into practice and those practical experiences are described in many scientific papers (Burström and Korhonen 2001; Tudor, Adam et al. 2007; Cimren, Fiksel et al. 2011; Sakr, Baas et al. 2011). In the first years the practice and theory of IS mainly focused on developing EIPs. Recently the focus changed and geographic distance became less important. In 1997 the scientific Journal of Industrial Ecology established. All this attention led to the use of similar terms of ecological industry: by-product synergy (BPS), eco industrial network (EIN), eco industrial park (EIP) and industrial symbiosis (IS). In this thesis there is chosen for the term industrial symbiosis because it is one of the more familiar terms. Furthermore, IS is not necessary bounded to geographical distance, like in the local EIPs. There are many definitions of IS. Quite recently, in February 2012, two new definitions were presented in the Journal of Ecological Industry (Chertow and Ehrenfeld 2012; Lombardi and Laybourn 2012). For this thesis I have chosen for the most recent definition of Chertow:

"The term industrial symbiosis can be used as (...) an inclusive descriptor for all arrangements where enterprises exchange outputs that, in the absence of a customer, would normally be discharged to the environment and hence become treated as environmental externalities. These resources include reused water, recovered energy, and material by-products—categories often called wastes (as in wastewater, waste heat, or solid waste)" (Chertow and Ehrenfeld 2012).

In this research the focus lies on return bread (organic material) and not on reused water and recovered energy. It must be noted that it might be impossible to find a consuming industry for every waste stream (Ayres 2004).

2.1. Waste exchange types

To distinguish different material exchange methods the taxonomy of Chertow (2000) is used, that separates types with different exchange channels. The types are showed in simplified flow charts (Figure 2, Figure 3, Figure 4 & Figure 5).

- Type A: One direction waste exchanges

In this type the material exchange flows towars one direction, namely from the firm to a broker or organization. The firm sells or donates its waste streams, which the other organization can use as a resource for a new product, see Figure 2. This system has a long history with scrap dealers and waste food collectors. Most common is the exchange of waste materials, but there also exist examples of heat, energy and water exchange. Chertow mentions that this type is the farthest from the IS definition. Nevertheless it is used in this thesis because it is commonly used in practice.

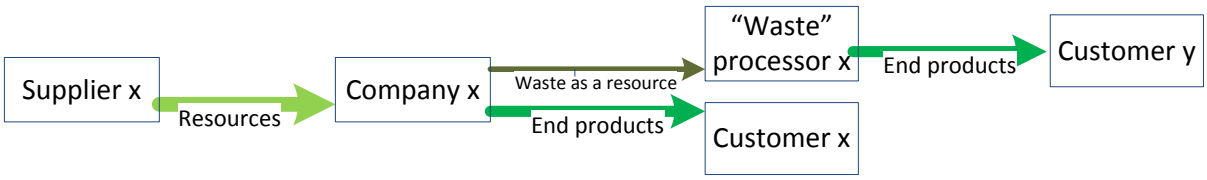

Figure 2: simplified mass flux type A: one direction waste exchanges

- Type B: within a company

An organisation can reuse its own waste as a resource (see Figure 3). This occurs often in large organisations with multiple entities and where these different entities can together act as a multi-firm approach of IS or in organisations with a large, uniform waste stream.

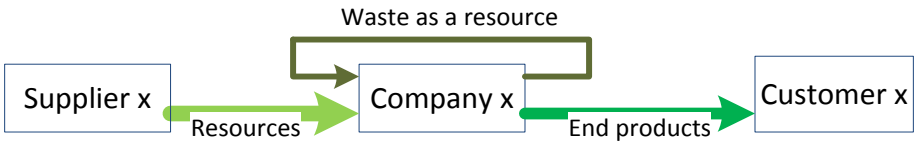

Figure 3: simplified mass flux type B: within a company

- Type C: Among firms located in a defined eco industrial park

An eco industrial park (EIP) is a local organized network of firms who reuses each others' waste streams as resource. Because of the local advantage it is easy and low priced to exchange waste streams including energy, water and other materials, see Figure 4. Chertow makes a distinction between collocated EIPs and EIPs that sprouted from already located firms. Because there are only few practical examples of EIPs in the food manufacturing sector this distinction is too detailed for this thesis.

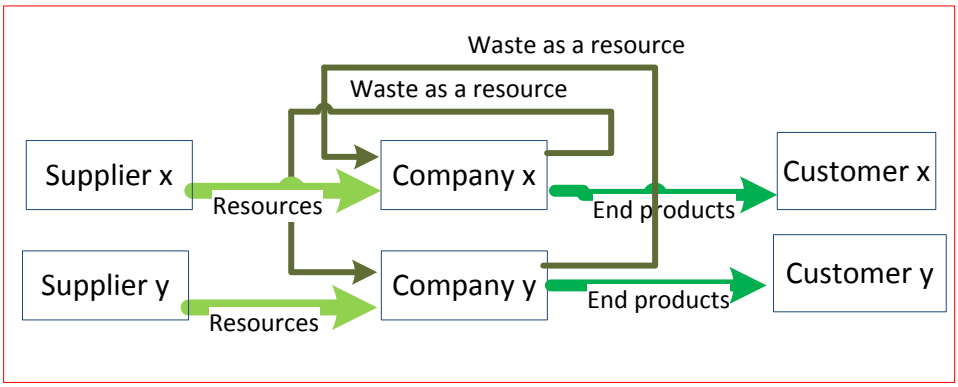

Figure 4: simplified mass flux type C: among firms located in a defined eco industrial park

- Type D: Among firms organised virtually across a broader region

Type D is similar to type C, without the geographic boundaries (Figure 5). For a long time it was assumed that IS was only efficient at a short distance. This because the expected low economic value of waste materials would not be worth the extra transport costs. However, when there is a good synergy with high economic benefit, the transport costs are not considered as a barrier (Lombardi and Laybourn 2012). This is of course limited for perishable and non transportable products. The

broader geographical vision is positive for the development of IS, because many companies are only willing to move to an EIP when this is in favour of their most important recourse (Desrochers 2004). When IS is seen in this broader view there are more synergies possible because it is simple to engage more firms (Chertow 2000).

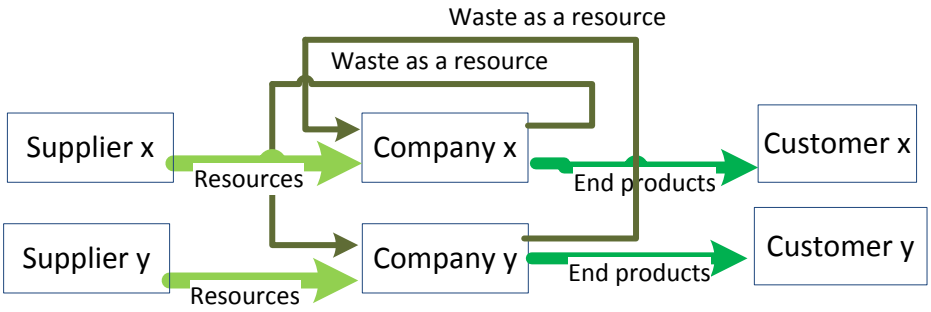

Figure 5: simplified mass flux type D: among firms organised virtually across a broader region

2.2. Influencing factors

The performance level of IS is influenced by different factors (Burström and Korhonen 2001; Koppen 2004; Tudor, Adam et al. 2007; Cimren, Fiksel et al. 2011; Sakr, Baas et al. 2011). How those factors influence IS will be described below, with the purpose to recognize these features in practice and learn from it. Figure 6 represents the positive triggering aspects of these influencing factors as the independent variables of the conceptual model.

Technical factors

First of all, investment in research and process development innovations is necessary. The process development will go faster when there is a structured system for technical assistance. The total amount of investment depends on the technical feasibility.

Communication factors

This factor mainly concerns communication between the involved companies, since good communication improves the industrial symbiosis results. Firstly, companies must be aware of IS principles and its possible benefits. The communication level can be increased by a transparent and efficient information exchange system, which can be leaded by an 'institutional anchor tenant'. The anchor tenant is often the largest tenant in an industrial area. In case of return bread the valorisation methods are not bounded to a geographic area. This means that there is no literal anchor tenant present, but there can be an individual actor with a key function, a so called 'champion'. This actor has motivation, knowledge and authority; he can work as key actor and speed the process up. Other characteristics for success for individual actors are competence, commitment and availability of a good network. Information exchange topics for the 'champion' are: candidate by-products characteristics, resource requirements, resource streams, potential partners, conversion technologies and economic information. Finally, a historic basis of waste material exchange between the involved companies will speed up the process. For all the valorisation methods the bakeries depend on third parties: even when the return bread is processed within the bakery itself, the technique is still developed by a third party. This means that the historic basis mainly relates to the relationship with the waste processer/expert.

Social factors

Companies must be willing to purchase products manufactured from waste, this willingness will also depend on the public trust in those actions. This means that retailers and also the final consumer must be taken into account. The presence of corporate social responsibility (CSR) values within the company will enhance IS. Furthermore active participation and involvement benefits the IS possibilities.

Business factors

First of all, the company must be willing to invest time and money in process development innovations. A decisive condition for companies is that waste stream exchange must gain economic added value, or be at least financial feasible. The final performance of IS will be positively influenced when reliable markets are available, the economic risk is low, large price fluctuations are absent and there are no available substitutions for the waste streams as resource. Besides, these factors trust in the competence of other companies is needed, which requires high transaction costs. Due to long term business commitments there is less flexibility in the market.

Law and regulations

Empirical research showed that policy intervention can catalyze IS, but too much involvement can distract the purpose from the company's perspective. It should be added that in the food sector health and safety regulations can impede waste stream reuse.

Logistical factors

The performance of the IS will grow when it is safe and economical feasible to transport the waste products. This will depend on the product types, valorisation opportunities and the distance between companies. These factors are described in IS theory under the name 'geographic conditions'. However in this thesis they will be referred to as 'logistical factors', because this name is better applicable for the practical situation of bakery companies.

2.3. Cradle to Cradle

Since the introduction of Cradle to Cradle (C2C) it is famous with its trademark 'waste = food', which is a popular expression of the first principle: 'everything is a nutrient for something else' (Stouthuysen and Roy 2010). This principle is integrated seamlessly with the IS theory. Nevertheless, it is an important vision to add in the theoretical research of this research because C2C goes a step further than IS. C2C takes into account that all the material end flows are caused by the resource choice in the designing state.

In IS waste is recycled, but according to the C2C paradigm recycling is in practice often 'downcycling' because the resource has less value than in its previous life. To prevent this, C2C states that products must be designed in such a way that they are easy to disassemble and redesign after use of the product. This idea can be used in the food manufacturing sector by paying beforehand more attention to the waste streams that occur during the processes. This method of reversed logistics for closed loop supply chains will be in the future more important for producers (Kumar and Putnam 2008).

"C2C is an approach designed to assist (the search for) better solutions (...). Rather than being a score sheet for compliance"(Stouthuysen and Roy 2010). Without seeing C2C as a 'score sheet' in this thesis one factor is included into the conceptual model (Figure 6). Namely, how detailed the waste

streams are considered when the product and process were developed. The idea is that when this aspect is considered in the designing stage, it is easier to valorise the waste streams.
C2C is based on three principles, however in this thesis only the above described part is used, because the second and third principles of C2C exceed the goals of the Food Valley KiA project. Those principles state that only renewable energy sources can be used and that diversity of species, culture and innovation must be celebrated (Braungart and Mulhall 2010). Above that C2C is developed for the areas of industry, buildings, governance and area spatial development (Stouthuysen and Roy 2010). For this reason not every aspect is applicable for the food manufacturing sector.

2.4. Conceptual model

The conceptual model developed for this research is based on the IS and C2C theoretical framework and on practical assumptions (see Figure 6). The independent variables (in the left part) are all the aspects from section 2.2 and 2.3 that have a positive influence on the performance level of IS. The distinction in performance level is difficult to make for two reasons. First, because in practice all the bakeries use the same valorisation method, namely cattle feed. Secondly, it is unclear what is considered as a high performance level: a sustainable method, a profitable method, a workable method or all in one? Instead of the performance level of IS this thesis looks at possible return bread valorisation methods and what the impact of the independent factors are in practice.

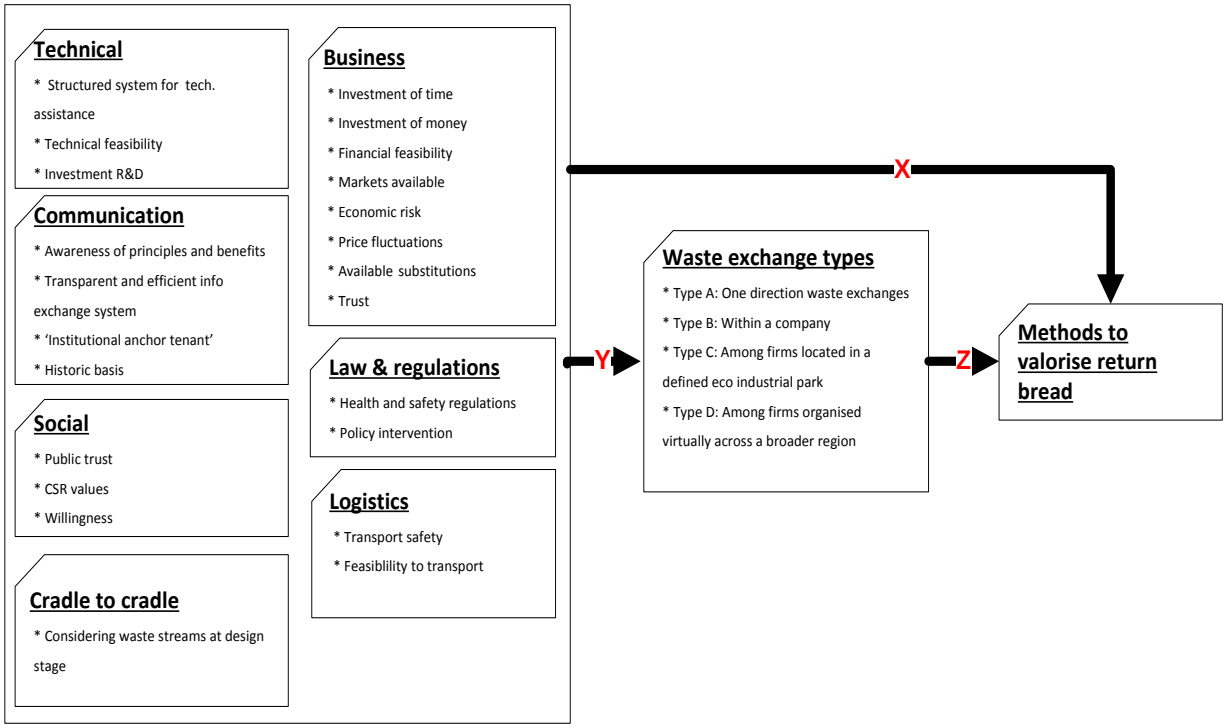

Figure 6: Conceptual model, based on IS theory. In the left square are the independent variables, the influencing factors, see Section 2.2 and 2.3. In the middle part are the moderating variables, the four waste exchange types, see Section 2.1. In the right square are the dependent variables, the methods to valorise return bread.

Arrows X and Y represent the influence from the independent variables on the moderating variables and dependent variable. These relationships are investigated by sub questions 1-7. The relationship represented by arrow X is a hypothesis based on literature. Arrow Y is a proposition based on the

current view on the practical situation. In practice waste exchange type A occurs more often than B and D, for exchange type C there is no practical example. It is logic that this unequal division is caused by the same independent variables which also influence the final performance. Furthermore the goal is to find the barriers to start with a new return bread valorisation method.
Arrow Z is also a proposition. It is added because different waste exchange types could obtain different performance results; this is questioned within sub question 8.
How this model will be refined and tested is described in the Sub section 3.4.

3. The Delphi methodology

For this thesis the Delphi method is used to obtain insight in the (future) advantages and disadvantages of the different valorisation methods of return bread. The Delphi method is a tool to forecast the future and assist a strategic decision making process. In multiple rounds experts are consulted to give their prediction, opinion and view.
This section starts with the origin of the Delphi method, followed by mentioning its many purposes and goals. Then the strengths and weaknesses are mentioned. Finally, it is explained how the Delphi method will be used in this thesis.

3.1. History

According to the legends, the ancient Greek consulted the oracle in Delphi to be better prepared for wars and other upcoming events (Gupta and Clarke 1996). After World War II, there was an increased need to make better use of expert's opinions in the policy domain. Kaplan performed the first modern Delphi, with forecasting as main purpose, in 1948 (Loo 2002). After the 1960s the use of the method became popular in many sectors (Gupta and Clarke 1996). Over the last decades scientific literature wrote about the many execution forms and purposes of the Delphi method (Gupta and Clarke 1996; Kuusi 1999; Loo 2002; Powell 2003; Okoli and Pawlowski 2004; Nowack, Endrikat et al. 2011).

3.2. Purpose

Delphi is "a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem" (Linstone, Turoff et al. 1975). The intention of the Delphi method is to unite the collective knowledge and experience of experts (Gupta and Clarke 1996). It motivates independent ideas and forms group solutions (Gupta and Clarke 1996) and also enhances creative thinking (Nowack, Endrikat et al. 2011). Besides forecasting, one of the initial goals of the Delphi method is to reach consensus in uncertain matters (Loo 2002; Powell 2003). Because practice showed that it is not always possible to reach consensus, other goals have become more important over the years. When Delphi results in multiple policy options, this is no direct reason to doubt the validity of the study (Loo 2002). Also when consensus is not reached, many (high-quality) ideas and arguments can be gathered. Those arguments can serve as identification for alternative future scenarios or enhance the managerial decision making process (Gupta and Clarke 1996; Okoli and Pawlowski 2004; Gordon and Pease 2006).

3.3. Validity

Most of the strengths of the Delhi method can be traced back to its strict structure, the fact that the participants stay anonymous and do not have direct contact. The distance in communication avoids negative aspects of group communication. This means that there is no bother from group pressure, interpersonal conflicts and individual dominance (Loo 2002). Furthermore it is easier for the participants to revise their opinion, because they do not need to admit their revision publicly (Gupta and Clarke 1996).
Delphi combines knowledge and abilities of expert participants, which brings a wide range of direct knowledge and experience together (Powell 2003). Delphi stimulates independent thought and gradual formation of group solutions, it empathises the creative aspects of a problem (Gupta and Clarke 1996). The successive rounds ensure that the moderator can continue the focus of the study (Loo 2002). Furthermore, the execution form of the Delphi method has few geographical and

financial limitations (Loo 2002). Finally, when panel members are also strategic decision makers the Delphi method does not only serve research and forecasting goals, but also facilitates learning and group decision making (Gupta and Clarke 1996). This since because participation can be motivating and informative (Pill 1971)

Like every research method also the Delphi method had some limitations. First of all, the validity of the end result is highly dependent on several aspects such as: group composition, knowledge, experience and motivation of the panel members, execution, questionnaires and the analysis (Gupta and Clarke 1996). The Delphi panels are usually small and probably not randomly selected, this can lead to a significant difference in answers between different panel groups (Loo 2002). In small panels, members could easily influence the outcomes in such a way that it is beneficial for their own interest (Gupta and Clarke 1996). It is difficult to notice the difference between an expert and a layman, which is essential for the panel selection (Gupta and Clarke 1996). While anonymity has many strengths it might also lead to hasty and less accountable answers (Powell 2003). Finally, the questionnaire has as disadvantage that it can be wrongly interpreted and that the moderator already gives (too) much direction of focus.

3.4. Delphi working method

3.4.1. Participants

The choice of the participating experts is essential because “the success of the Delphi depends on the combined expertise of the participants who make up the expert panel” (Powell 2003). For this decision it is important to first categorize relevant organizations and disciplines, so the whole spectrum of views is represented. In this case the spectrum includes: industrial bakers, people who are familiar with the Dutch bakery sector and experts in the mentioned valorisation methods. When it is clear which knowledge is needed for the research, the actual persons who can act as relevant experts can be identified (Okoli and Pawlowski 2004). There are three selection criteria: sufficient knowledge, sufficient experience or being a stakeholder (Loo 2002). It is difficult to select the experts randomly; unfortunately this creates a bias in the outcome of the research. It is important that the participants feel involved, so that they understand the research purposes and feel motivated to continue (Loo 2002; Powell 2003). Scientific literature gives different suggestions concerning the number of panel members. In general it implicates that an expected large variation in answers, requires a larger expert panel (Loo 2002) with at least 10 participants (Okoli and Pawlowski 2004). The participant’s anonymity is important to prevent negative aspects of group communication, everyone gets an equal opportunity to speak (Nowack, Endrikat et al. 2011). In a panel with participants with diverse backgrounds and perspectives, participants are more triggered to give high quality arguments to defend one’s point. Another positive aspect of a diverse panel is that experts gain a better view on the different perspectives and will earlier consider an alternative view (Powell 2003).

3.4.2. Rounds

The Delphi method works in structured ‘rounds’ in which participants give answers, arguments and feedback on each other’s statements. Figure 7 shows the flow chart for the Delphi process in this research.

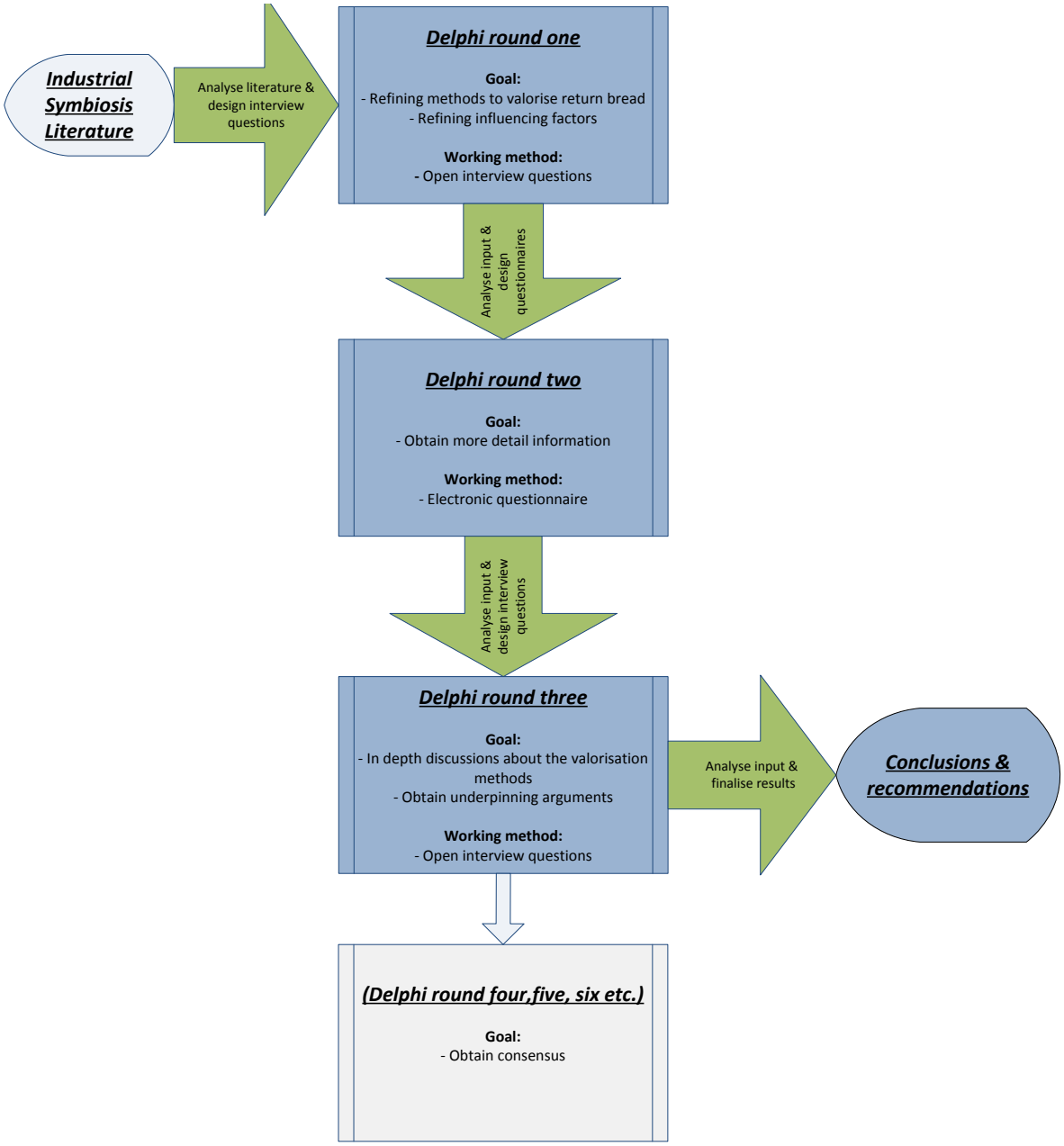

Figure 7: Process of the Delphi method in this research

The conceptual framework (see Figure 6) based on IS and C2C literature, will be the guidance for the execution of the Delphi method. The literature will be analysed and interview questions are designed. The first Delphi round is used to refine the independent variables of the framework and to make a selection for the valorisation methods. The input of round one is analysed and questionnaire questions are designed. The goal of the second Delphi round is to make the variables even more explicit by asking for exact numbers in a questionnaire. Then the questionnaire input is analysed and interview questions are designed. In the third round motivations, barriers and solutions are discussed with the participants. When the main goal of the Delphi study is to achieve consensus it is suggested to execute at least four rounds and preferably as many rounds as necessary. Since this thesis has strict time boundaries, only three rounds will be executed in which probably no consensus will be reached. Instead the goal is to achieve high quality arguments and a good insight in the (future) return bread valorisation possibilities. Based on the input of three Delphi rounds conclusions and recommendations are drawn.

Delphi round one

As can be seen in the conceptual model (Figure 6) there are three blocks which represent the independent variables (the influencing factors), the moderating variables (waste exchange types) and dependent variable (valorisation methods). The goal of the first Delphi round is to make a start with refining these three variables of the conceptual model. Subsequently, this information has been put together to develop a questionnaire for the second Delphi round.
The goals for the first round are achieved by asking four open questions in a short telephonic interview. The open questions ensure that researcher's opinion does not overrule the entire process, which might occur when the first round starts with a closed questionnaire (Powell 2003). Furthermore it gives participants a free scope and it obtains a more general view about the topic.

Refine valorisation methods

To indicate which valorisation methods (the dependent variable) are applicable and promising for further research an inventory of current and future methods is made. This is done by asking participants the following open question:

- *Which methods/technologies to valorise return bread can you mention? (note: also undeveloped technologies can be mentioned)*

All the input will be brought together resulting in a list from which valorisation methods are selected for further research. For this selection the following indicators are used:

- The number of bakery participants that mentioned the method;
- The methods should be explained clearly, this is necessary because it must be understandable and workable in the questionnaire of Delphi round two;
- The methods that are taken into account in this survey must together represent the broad range of possibilities;
- The methods should have (good perspectives on) economic and technical feasibility;
- The methods should not overlap each other.

Refine influencing factors

Secondly it is investigated which of the 'influencing factors' (the independent variables) are applied in practice. This is also measured by asking open questions instead of giving the participants a 'checklist' of the conceptual model. The asked questions are:

- *Which method/technology to valorise return bread is according to you the most promising? Why?*
  Per method:
- *Which advantages do you expect/are there for this method?*
- *Which barriers do you expect/are there for this method? What should happen to dissolve them?*

The risk here is that some aspects will be mentioned in a different way than described in theory. The advantage is that there is a bigger chance that also aspects from outside the theory will be mentioned, increasing the applicability for the practical scenario. The input from the answers is

brought together and from this list a selection for the rest of the Delphi research will be made. For making this selection the following indicators are used:

- The number of participants that mention the influencing factor;
- The used argumentation.

Delphi round two

Based on the information of the first round questionnaire questions for the second round will be developed. The goal is to survey the chosen methods and its influencing factors in more detail and to make a decision which valorisation methods are worth discussing more in detail in Delphi round three.

The survey constists of multiple choice questions and the possibility to support the answers with written argumentation. The advantage of asking questions in this format is that it is very structured and everyone gets the exact same questions asked in a neutral way. The disadvantage is that questions could be interpreted wrong. To solve this issue the participants will be interviewed in Delphi round three. A boundary condition is to stay within a time limit of 45 minutes, because that was what was agreed upon with the participants. Already in round one it became clear that the expertise of the participants lies on very different areas. Because the time of the participants is limited it is important to use their expertises as efficient as possible. Moreover, it is more useful to have results from experts than from lay-man. For this reason it was decided to develop three different questionnaires. Depending on the participant's expertise experts are asked to fill in (parts of) two questionnaires (see attachment, page 57).

1. The general questionnaire, to obtain more insight in all eight methods.
2. The bakers questionnaire, to obtain more insight in baker's preconditions
3. The expert questionnaire, to obtain more insight in the specific expectations of experts per method.

The general questionnaire consists of the same seven questions for all selected valorisation methods (Attachment 2: The general questionnaire). After the methods are shortly explained, the participants are asked to give an indication of their knowledge concerning these methods. Next the participants are asked to give their expectation in how many years the method will be applied on larger scale. This is followed by two questions about the waste exchange types, namely: who shall further develop the method and who shall execute it. Finally, there are three questions about the cooperative image and public trust.

The bakers and expert questionnaire are almost the same (see: Attachment 3: The bakery questionnaire & Attachment 4: The expert questionnaire). The difference is that bakers are asked about their preconditions for applying a method and the experts about the conditions concerning 'their' method. The topics are: business, law and regulations, logistics and future predictions. The underlying idea is that by comparing the answers the perfect match can be found. In practice this is more complicated since all the different influencing factors also have internal relationships. To prevent hasty assumptions the questionnaire outcomes will be discussed with the participants in Delphi round three.

With the outcome of Delphi round two it is decided which methods are worth further research in round three. The used indicators are:

- Answers at the question: ‘Can the method be executed on a large scale’;
- Matches between the preconditions of bakers and the answers from experts;
- Whether mentioned bakers it as a ‘preferred method’.

Delphi round three

In the third round all the participants are interviewed. They will be confronted with the outcome of the second round and they are asked to give underpinning arguments or revise their statement. Another topic is how to find solutions to conquer the barriers. On beforehand the participants receive the interview questions and the relevant outcomes of Delphi round two.
The advantage of an interview is that it prevents miscommunications since more explanation can be provided in case unclearness arises. The disadvantage is that it is less structured and the conservation could drift off, because there are time boundaries other topics may receive less or no attention.
After the third round all the input is analysed and conclusions can be drawn.

4. Results

This chapter describes the results of the research. In Section 4.1 the Delphi participants and their backgrounds are described. Section 4.2 shows which valorisation methods are applicable for further research and which are not. The input of Delphi round one, two and three is taken together and discussed in Section 4.3 and 4.4. To get a better impression of the influencing factors, Section 4.3 regards how those factors from IS theory are related to the general valorisation practices of the bakery sector. Section 4.4 shows the specific influence of those factors per valorisation method.

4.1. Delphi participants

This section starts with a description of the three stakeholder groups and is followed by a description of the Delphi participants.

4.1.1. Stakeholder groups

In this thesis three major stakeholder groups are taken into account: the industrial bakers, the experts on valorisation of return bread and the retailers. The last group did not participate in the first two Delphi rounds but was consulted later. Below follows a short description of each stakeholder group and their relation to the return bread problem.

Industrial Bakers

Industrial bakers own the return bread; therefore this group can be seen as problem holder. Bakers see the returning of unsold bread from the supermarket as a service towards the retailers. They sell it as cattle feed and obtain 30-40 euro/ton. The awareness of other valorization methods is low. Bakers are not used to consider their waste streams as a resource; they are more focused on their core business, baking bread. Moreover the financial investment opportunities are limited.

Experts on return bread valorisation

This group processes the return bread streams or develop the technical solution so the bakery can process the streams itself. They see the return bread as a possibility, a resource to develop a new product. The experts that use return bread directly as a resource have a higher intention to invest. It is their core business, so they receive the direct benefits when a technique is sold.

Retailers

This group does not consider itself as problem holder. The fact that there are bread leftovers means that customers had a consumption choice until closure hour, which increases the customer's satisfaction. The unsold bread is returned to industrial bakeries which process it further; retailers do not have to worry about this. On the other hand, retailers already bought the bread from the industrial bakeries. They are the stakeholder group that have the financial burden of the unsold bread. Currently retailers are not aware of the opportunities of return bread. However, they can play an important role for valorisation to human food, as will be discussed in the Sections 4.4.1 bread snacks and 4.4.2 circle bread.

4.1.2. Delphi participants

The goal was to find at least ten participants with diverse backgrounds, so the whole spectrum of views would be represented. This goal is reached; there are 14 participating experts who have different approaches, visions and interests concerning return bread valorisation methods.
In a Delphi study it is common that participants stay anonymous. Therefore the participant's expertises are shown in a general and summarized way in Table 2. It must be noticed that in this

Delphi research not all opinions count equally. The opinion of an expert on its own topic is regarded as more important than the opinion of a lay participant. In this study every participant has its own expertise area.

Abbreviation	Expertise
BE-A	- Good understanding of the bakery sector - Experience with management, innovation, commercial -and logistic activities - Participated in earlier bread valorisation project - Expert in: Carton strengtheners
BE-B	- Good understanding of the bakery sector - Advisor
BE-C	- Good understanding of the bakery sector - Participated in earlier bread valorisation project - Experience with innovation, image improvement of the Dutch bakery, knowledge sharing networks and institutes
BE-D	- Good understanding of the bakery sector - Manager at a waste prevention and recycling consultancy
IB-a	- Director of an industrial bakery
IB-b	- Employee quality assurance at an industrial bakery
IB-c	- Director of an industrial bakery
SIB	- Representative of a Dutch small independent baker's association
E12	- Expert in: Bread snacks & Circle bread - Works at a company which sells ingredients necessary for those methods - Understanding of the bakery sector
E5	- Expert in: Cattle feed - Works at a cattle feed processer - Understanding of the bakery sector
E6	- Expert in: Carton strengtheners - Works at a paper and carton producing company which is investigating the possibilities of return bread as carton strengtheners
E7	- Expert in: fermentation - Works at an applied research institute - Used to work in the fermentation industry - Understanding of the bakery sector
E78	- Expert in: fermentation and bio gas, digestion - Works at a biotechnology and microbiology research company
E8	- Expert in: Bio gas, digestion - Works at a company that develops small scaled bioreactors for digestion of organic waste
Retailer	- Logistic waste streams manager at a Dutch retailer

Table 2: List of Delphi participants. Explanation abbreviations: BE = Bakery Expert, IB = Industrial Baker, SIB = Small Independent Baker, E = Expert in a valorisation method

Clarification for Table 2:

- The first four participants have a good insight in the bakery sector, they are called bakery experts (abbreviation is BE). They have worked with or at (industrial) bakeries. BE-A and BE-C joined a previous project about valorisation of return bread. BE-B advices bakers and BE-D is manager at a waste prevention consultancy. All four have a clear vision regarding waste valorisation in the bakery.
- The next three participants are currently working at an industrial bakery (their abbreviation is IB). They represent frontrunner bakeries which are already aware of their waste streams. The fact that they do not represent average bakeries is an advantage for this research, since if even the frontrunners see barriers, those barriers need to be taken seriously. Furthermore, it are the frontrunners who should start with improvements, the average bakeries will follow later.
- One participant represents the small independent bakeries (his abbreviation is SIB). Small independent bakeries have a different operation procedure for their unsold bread, not all these procedures can be applied by industrial bakeries. The underlying thought was that this participant could promote 'outside the box' thinking, because he has a bakery background but works with a different approach. Based on the input of Delphi round two it was decided that the answers from SIB differed too much compared with the industrial bakers. It can be concluded that valorisation methods applicable for the industrial bakeries can not be copied to small independent bakeries.
- For each valorisation method matching experts (abbreviation E-) were found. All experts work, or have worked, with the relevant valorisation method. Some of the valorisation methods are already brought into practice (bread snacks, circle bread, animal feed), so those experts have also experience and insight in the bakery sector. The experts for the newer methods (carton strengtheners, bio plastics and bio gas) have no collaboration experience in the bakery sector. This difference is kept in account during the questionnaire in the second round of the Delphi survey.
- At the end of Delphi round three it became obvious that also supermarkets could play an important role in the valorisation of waste streams. To obtain more insight in the position of retailers seven different supermarkets were contacted. Those were invited for a short telephonic interview of ten minutes. Only one retailer was eager to be interviewed, the opinion will probably not represent the complete sector. The interviewed retailer works at a supermarket that has a different return system. The bread is not returned to the bakery but collected in a large return-hall, together with the other food wastes. From the return hall the bread is sold to by cattle feed processors.

To ensure active participation, the participants were informed in advance about the time span of the entire survey with three rounds. Nevertheless, not all participants took part in all rounds, due to practical reasons. One baker joined later and skipped Delphi round one. Three participants filled in the questionnaires only partially. Some participants gave strict time boundaries for the interviews of Delphi round three. The variance in participation and its impacts on the research's validity are discussed in Section 5, Discussion.

4.2. Refining the valorisation methods

The first goal of Delphi round one is to make a selection of which 'return bread valorisation methods' are applicable to survey further. Table 3 and Table 4 give an overview of which methods are mentioned by which bakery participants. The methods in Sub section 4.2.1, (Table 3) are selected for further research; the methods in Sub section 4.2.2, (Table 4) are not. This distinction is based on a couple of indicators, described in the Section 3.4, Methodology. Sub section 4.2.2 also discusses two methods which were excluded after negative results in Delphi round two.

4.2.1. Valorisation methods applicable for further research

The methods in Table 3 are divided in three groups, namely (1) human food, (2) cattle feed and (3) non-food. The advantages and disadvantages of the methods within these groups are similar. The names are based on the Ladder of Moerman.

There are two methods to convert return bread to human food, namely bread snacks and circle bread. The method bread snacks is added because it is mentioned four times. Circle bread, where daily old bread can be used as ingredient for new bread, is mentioned by only two bakery participants. However it has good perspectives on economic and technical feasibility because the Dutch Nationale Denktank already performed a feasibility research (NationaleDenktank 2012).

The most often mentioned is cattle feed, the conventional method. Normally a Delphi research is used to only discuss future solutions. However, for cattle feed is made an exception because it gives a clear view of the current situation. It is important to know the current advantages and disadvantages, so these can be compared to newer methods. A coincidence is that during the execution of the second Delphi round the 'Bread to Bread' project was announced. This collaboration is between a feed processer and a bakery branch organisation. The goal is to valorise 60% of the bread waste as glucose, used for bakery yeast and 40% as proteins for cattle feed. This project gives new opportunities in this field, worth discussing in a Delphi setting. In this thesis this project is referred to as 'cattle feed – extra'.

In the non-food group two methods, carton strengtheners and biogas are added because four of the participants mentioned them. The method bio-plastics was only mentioned by two bakery participants, without explaining the production process. Although this method is unfamiliar for the bakery participants, the two experts in this research were very enthusiastic and see many opportunities. Bio plastics are produced by fermentation, which can also produce the fuel bio-ethanol, amino acids or a salt replacer. To maintain the overview in the questionnaire the fermentation method is there described as only bio-plastics. In Section 4.4.5 all four purposes are discussed.

Valorisation group	Valorisation method	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	SIB	Total
1. Human food	Bread snacks	+	+	+				+	4
	Circle-bread	+						+	2
2. Cattle feed	Cattle feed (– extra)	+	+	+	+	+	+		6
3. Non-food	Carton strengtheners		+	+		+		+	4
	Fermentation		+	+					2
	Bio-gas			+		+	+	+	4

Table 3: Valorisation methods applicable for further research, overview of which participant mentioned which valorisation method in Delphi round one

4.2.2. Valorisation methods excluded from further research

Table 4 gives an overview of valorisation methods which were mentioned in Delphi round one, but are excluded from further research.

Producing bread crums is mentioned three times, but with the remark that it is an old fashioned method which is not used anymore.

The methods petting zoo, church and giving it to own staff are only mentioned by the representative of small independent bakeries. These methods are too small scaled to be applicable for industrial bakeries. Although cattle feed could be seen as the larger scale version of petting zoo and the food bank as larger scale version of church community.

The method food ingredient, is mentioned four times, but none of the participants could clearly explain how the method should be executed or mention a straightforward goal. It was decided that the description for method was too vague to add in the questionnaire. This is also the case with the method building materials, which is mentioned once but without a clear production explanation.

Then some of the less-mentioned methods are added to give a broader selection of the possibilities. 'Selling yesterday's bread' and the food bank are only mentioned twice. Initially those methods were added for further research to a broad range of opportunities and not only focus on complicated technological methods. After too negative results in the questionnaire of Delphi round two those methods are excluded from discussion in Delphi round three. In the two sub sections below the methods and the reasons to exclude them are discussed.

	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	SB	Total
Bread crums		+	+			+		3
Petting zoo							+	1
Church community							+	1
Giving it to own staff							+	1
Food ingredients (vibers, starch, proteins, etc)	+	+	+		+			4
Building materials		+						1
Selling yesterday's bread	+	+						2
Food bank		+					+	2

Table 4: Valorisation methods not applicable for further research, overview of which participant mentioned which valorisation method

'Selling yesterday's bread'

There are some practical examples of small independent bakeries which sell the bread of yesterday in a special shell or store (Weerd 2012). The bread is sold for half the price and thereby it gains more profit than selling it as cattle feed. Professor Louise Fresco mentioned selling old bread in the supermarket as a solution against food waste (Rensen 2012). In this research two bakery experts suggested trying it for the industrial bakery. However the outcomes of the questionnaire in Delphi round two were very negative. Therefore it is decided to not discuss the possibilities further in Delphi round three. A short explanation of this decision is given below.

In the questionnaire half of the participants said that this method could not be executed on the large scale. None of the bakers or bakery experts preferred this method as 'favourable to work with'. A majority of the participants predicted a negative influence on customer's trust in food safety and quality. Also the predictions for the corporate image were mainly negative. Some participants suggested that this option is better or even only applicable for the small individual bakeries. The

reason why it is harmful for the corporate image is because the quality of one day old bread decreases. Bakery expert A predicts that when yesterday's bread will be sold, chemicals will be added to improve the taste for long expiable bread. "Within 15 year the supermarket's bread shell will be full with bread with an expiration date of five-six days. The waste stream problem will be solved and the prices will decreases (…) but the valuable bread image will be ruined. The industry, but also consumers do not prefer this."

Food bank

For this method the return bread is not collected by cattle feed processers but by the food bank. The food bank divides it, together with other donated food, for free under their clients. In the Netherlands you can become a food bank client when your monthly live allowance is lower than € 180, - per adult (StichtingVoedselbankenNederland 2013). Industrial bakeries could donate return bread and some are already doing that.

Also the method food bank is after Delphi round two excluded from further research. In general the opinions were less negative compared with 'selling yesterday's bread'. Three participants predicted a negative influence on customers trust in food safety or quality, five saw no difference. Six participants predict a positive influence on the corporate image. Probably because this method is directly for human food and it is high on the Ladder of Moerman. The main argument to exclude it from further research is because not a single baker mentioned it as a 'preferred method' in the bakery's questionnaire. There is no financial profit and it has a direct negative influence on the market demand. Finally, bakers find it difficult to guarantee food safety and they are not willing to take any risk.

4.3. Refining the influencing factors

Before discussing the impact of the influencing factors on the valorisation methods, first the general role of those factors in the bakery sector is refined. It is discussed how these factors work: are bakers scared or eager to innovate? How can the financial situation be sketched? How is CSR positioned in this sector? The information for this section is obtained from all the three Delphi rounds. The end of Section 4.3 represents the empirical framework, based on this new input.

Some of the factors which were mentioned in theory are found irrelevant in the bakery sector. Other factors are newly added, because of the practical applicability. The selection criteria for in- and excluding factors are described in the Methodology Sub section 3.4.

After this section, Section 4.4 describes how these factors influence the individual valorisation methods.

4.3.1. Technical factors

Table 5 represents the influencing factors concerning technical issues and how many times these were mentioned in Delphi round one. In general the technical issues are not often mentioned by participants. Apparently technical issues are not what the participants had in mind when mentioning barriers and advantages.

Technical	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	E12	E5	E6	E7	E78	E8	Total
Structured system for tech. assistance	+	+											2
Technical feasibility	+	+							+		+		4
Investment R&D											+		1

Table 5: How often the technical influencing factors from IS theory are mentioned by participants in Delphi round one. * = factors newly added for this research, ~~factors excluded~~ for this research

According to bakery expert B industrial bakers won't hesitate in the technical domain, because their daily work involves a lot of technique. However the technique to bake bread differs from techniques necessary to process return bread. Bakers are not used to consider the possible purposes of return bread; there is no technical historic basis within the bakery itself. Two other bakery experts stated that this will make bakers hesitant to take steps; for them processing waste streams is an unknown and complex process. Therefore bakers will prefer to outsource this to a third party, for who processing bread waste is a core business.

Investment in R&D is only mentioned once in Delphi round one. In the questionnaire it is asked per method who is the best stakeholder to further develop the method. For all methods the 'specialised processing company' was mentioned most frequent. Bakery experts D mentioned specifically that it is not up to bakers to invest in R&D and that this is the task of a waste processor. This third party should also provide the 'structured system for technical assistance', because a bakery does not have the resources and background to do this. Bakery expert A agrees with this statement and added that a new method needs to be perfectly ready before bakers use it. The experts of the different valorisation methods stated that technical assistance can be given during both the R&D phase and the practical execution.

The technical feasibility of a valorisation method will determine whether it can be applied in practice. For only two in this thesis research the technical feasibility is completely proven, namely circle bread and bread snacks. Nevertheless participants still doubted the workability of those methods. The other methods are in different phases of development, it differs per method how far it is researched and proven. This will be discussed in Section 4.4.

4.3.2. Communication factors

Table 6 represents the influencing factors concerning communication, and how many times those are mentioned in Delphi round one.

Communication	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	E12	E5	E6	E7	E78	E8	Total
Awareness of principles & benefits	+	+					+			+			4
Transparent and efficient info exchange system		+	+	+		+		+		+			6
'champion'	+	+	+										3
Historic basis	+	+					+			+			4

Table 6: How often the communication influencing factors from IS theory are mentioned by participants in Delphi round one. * = factors newly added for this research, ~~factors excluded~~ for this research

Raised 'awareness of principles and benefits' of waste stream valorisation can speed up the process to act. It must be noticed that bakers have good insight in their weekly return bread amounts. Nevertheless, they are not used to consider other valorisation methods than cattle feed. To start with a new valorisation method a baker has to collaborate with a new party as contact person. The effort to start a new business relationship and the lack of historic basis forms a barrier. According to literature a long term (business) relationship with a waste processor can speed up the IS process. There exists a historic basis with cattle feed processors, how this positively influenced the developments is discussed in Sub Section 4.4.3 cattle feed.
The 'champion' was in Delphi round one mentioned by multiple participants. The role of this tenant is, shortly summarized, to finish the technological and business requirements as good as possible. In Delphi round three the idea sprouted that when one person/company has a method that is ready for takeoff, others will follow this initiative. The most idealistic bakeries will be frontrunners.
The most frequent mentioned communication factor in Delphi round one is the presence of a 'transparent and efficient info exchange system'. It was not stated in the exact same sentence but described by the term chain management, which could be improved by developing a certification system. Later in the Delphi research it turned out that a new certification system is not needed, because the existing systems already cover all relevant issues. In the bakery questionnaire most participants stood open for extra chain management and communication, but during the interviews in Delphi round three it became clear that this is difficult to realize in practice. Bakers are not satisfied with the conditions of the returned bread. They have often tried to make clear agreements with the retailers, but the situation remains the same, currently bakers do not expect changes anymore.
In the questionnaire there is one question per valorisation method that concerns the predictions of feasibility on a larger scale. The answers on this question are in Section 4.4 showed under the header communicational factors instead of technical factors. This is because those predictions tell more about the awareness and attitude of the participants than about the actual technical feasibility.

4.3.3. Social factors

Table 7 represents the social influencing factors and how many times those are mentioned in Delphi round one.

Social	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	E12	E5	E6	E7	E78	E8	Total
Public trust		+								+			2
Corporate image*	+	+								+			3
CSR values	+	+			+								3
Willingness	+												1
High-quality purpose *	+	+			+		+	+		+		+	7

Table 7: How often the social influencing factors from IS theory are mentioned by participants in Delphi round one.
*** = factors newly added for this research, ~~factors excluded~~ for this research**

Food safety is an important topic in the Netherlands and bakeries are not willing to take a risk. The damage of a food safety incident can be inerasable. Therefore public trust and corporate image are essential for a food manufacturer. The oldest food safety affair in the Netherlands still has impacts. It concerns the Planta margarine incidents in the 1960s. In which a new emulsifier caused skin rash and fever among 100.000 citizens. Since the incident the brand name Planta is not used anymore in the Netherlands, while it is still sold in Belgium (Gulmans 2012). The topic consumer's trust is reflected in

the questionnaire in a set of three questions. Namely, the influence on: corporate image, trust in food safety and trust in food quality. The expected influences per method are discussed in the Section 4.4.

The choice to execute CSR can have two causes: a true idealistic desire to improve the world, or a more business related desire to improve the corporate image. One does not exclude the other. According bakery expert D industrial bakers are not idealistic; they are only trying to survive financially. Although she mentioned that there are exceptions, also bakery expert B knows bakers "who see a moral task for themselves". That mainly idealistic frontrunners are involved in this Delphi research is shown by a quote of industrial baker C. He said that even when the costs are higher than the benefits, he still might consider investing in CSR. "The possibility of distinguishing the bakery as responsible is also an added value." This side of CSR has a relation with 'willingness'; it shows that if a baker is very eager and willing to implement some changes, the other factors are of less importance. On the other hand, when there is no intention to change or improve a situation, every bit of effort is seen as too much. This is the other side of CSR when it is driven by price efficiency. Companies execute only the easy solutions which can also be presented as CSR. The CSR solutions that cost time and money are avoided. Bakery expert D also added that "'willingness' to change on paper is something different than exactly executing it." Willingness can be increased by external factors, like communication of a method, but it is also an internal process, dependent of the attitude of the baker.

Another newly added social factor is the 'high quality purpose' of a method. The Ladder of Moerman (Table 1) shows the quality levels of a valorisation method. 'High quality purpose' could also belong within the CSR-values of a company; nevertheless it is decided to split it because the participants mentioned it separately. Nowadays the bread waste is used as cattle feed. When there is chosen for a non-food solution, the return bread disappears from the food chain. This implements that extra resources and/or ingredients for human food and animal feed must be harvested. So there is an indirect negative effect. The Ladder of Moerman only considers value of food products and does not take the economic gain per ton into account.

4.3.4. Business factors

That business factors are important influencers is obvious. As seen in Table 8, those factors are most mentioned in Delphi round one. Also in the interviews of Delphi round three the business factors were a recurring item.

Business	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	E12	E5	E6	E7	E78	E8	Total
Investment of time	+	+		+			+				+	+	6
Investment of money	+	+		+			+				+	+	6
Financial feasibility	+	+			+	+	+	+	+		+	+	9
Market availability		+	+			+		+	+	+	+		7
Economic risk		+						+					2
Price fluctuations					+							+	2
Available substitutions		+			+				+			+	4
~~Trust~~													0
Uncertainty concerning business factors *		+			+	+							3

Table 8: How often the business influencing factors from IS theory are mentioned by participants in Delphi round one.
*** = factors newly added for this research, ~~factors excluded~~ for this research**

The goal of the questionnaire in Delphi round two was to make the business discussion more explicit by asking specific questions (see Attachment 3: The bakery questionnaire). It turned out that more than half of the participants had trouble answering these questions. In the questionnaire comments it was added that the financial investment relates to: the economic and sustainability gain, the payback time and the size of the bakery. One industrial baker commented that she did not know the answers. Bakery expert D mentioned that bakeries will also outsource these calculations to a third company, because it is not their core business. Taking a closer look at the questionnaire answers some amounts differ too much to calculate the average and draw general conclusions. This is the case with the maximal investment for a feasibility research, which differs from 200 to 10.000 euro and with the maximal total investment, which differs from 0 to 400.000 euro. The only conclusion that can be drawn is that the maximal investment will differ per bakery. The questionnaire's answers regarding the minimal financial profit are less spread and differ from 80 euro to 400 euro/ton. The current gain for selling return bread as cattle feed is 30-40 euro/ton. It is interesting to notice that minimal profit of a new valorisation method should at least be double, compared with the conventional practice. The average customers value for bread is around 2.300 euro/ton (Weerd 2009). The main part of this financial loss is paid by the retailers, who already bought the bread from the industrial bakers. Retailers do not get a financial compensation for the unsold bread; the returning option is a service from the bakeries.

How to describe the financial situation in the industrial bakery sector? Bakery expert D stated that "half of the industrial bakers are busy with surviving." The other bakery experts confirmed this statement. To take steps towards waste stream valorisation, financial investment is necessary. However, it is questionable whether industrial bakeries can invest. One of the bakers stated that at their bakery all the investments had stopped. The two other bakers have more investment space although not unlimited.

For most of the valorisation methods the technical feasibility is not yet ensured, this increases the uncertainty of many business factors. Because the theory of IS did not gave special attention to uncertainty, it is added as an influencing factor for this thesis research.

The three newer valorisation methods require research to define technical and economical feasibility. This feasibility research means another financial investment, even before the investment for new assets and installations. The lack of financial movement prevents bakers to take an economic risk, this reduces the opportunities for an elaborated research. Bakery expert D suggests that the waste processor should take the initiative and execute the feasibility research. She thinks this will increase the chance of success, but adds that the investment capabilities are low everywhere. Another option is a joint investment with multiple bakeries; none of the participants exclude this possibility.

It is easier to make an investment for a completely proven solution, which guarantees economic gain or - feasibility. According to bakery expert C, "real entrepreneurs will always make such investments." The outcome of the bakery questionnaire indicates that the insurance that investments are earned back should be 50% or higher. The maximal payback period differs from zero to seven years.

In Delphi round one, ten participants mentioned that there should be a market for the new product. The bakery questionnaire indicates that the certainty of market availability should be 50% or higher. Some of the researched valorisation methods create a product that can be used within the bakery itself, where other products require an external market demand. The market availability is discussed per method in Section 4.4. Another way to interpret market demand is that retailers can demand

from industrial bakers that they process their return streams in a specific way. In the Netherlands it occurred the last few years more often that retailers increased the CSR norms for certain products. Especially for their meat shells, under pressure of the animal rights NGO 'Wakker Dier' (Reijn 2013). Up to now no actions have occurred for the bread shells, but bakery expert D said that retailers are keeping this into mind. However, she added that the changes will not occur tomorrow but are seen on a longer time scale. She thinks that this will be the most important trigger to change. Bakery expert B describes the behaviour of retailers, where they demand suppliers to be more sustainable, as "an arrogant attitude". He states that retailers try to shift the responsibility to the suppliers, instead of acting themselves. Retailers are cutting off working hours and wages, so they spend not much time on a waste product as return bread. He finds this attitude not surprising, but thinks that in these days it should not occur anymore. The bakery expert's opinions of the future role of the retailers are divided. Bakery expert C thinks that bakers need to come with the solution and show the advantages to retailers, because this is not the core business of the retail.
Another issue is the available substitutions. It must be guaranteed that the usage of return bread is the best resource and that there are no better or cheaper resources available. It is also important that the newly valorised end product does not compete with the original product, namely the bread sale.
The next factor, price fluctuations, cold never be excluded. The purchase price of flower and the sale price as animal feed both depend on the LEI-price. Newly developed products will also have price fluctuations for example the biogas price depends on the gas price and subsidies.
The influencing factor 'trust' is mentioned by none of the participants. In literature trust means the competence of other companies. Although some participants spoke of an information exchange system in the form of certification (see Table 6) and about human health and safety regulations (see Table 9). None of them spoke about trusting another company without putting agreements on paper. Apparently that form of trust is uncommon is this sector; therefore it is decided to dismiss the factor for further research.

4.3.5. Law and regulations

Table 9 represents the influencing factors concerning law and regulations. The theory mentions 'health & safety regulations' as one factor, in case of return bread it can be split up in two types. One for direct human food and another for cattle feed.

Law and regulations	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	E12	E5	E6	E7	E78	E8	Total
Health & safety regulations		+	+			+							3
~~Policy intervention~~													0

Table 9: How often the law and regulation factors from IS theory are mentioned by participants in Delphi round one. * = factors newly added for this research, ~~factors excluded~~ for this research

To guarantee food safety there are European regulations, namely the HACCP (Hazard Analysis Critical Control Points). The goal of these regulations is to create risk awareness among food producers so they can take the necessary control measurements to guarantee food safety. Every food company must formulate a food safety system, which includes a risk inventory and how critical points can be guarded. The control of critical points must be verified, documented and monitored (NVWA 2013). The HACCP guidelines are generated for all food companies, this makes the implementation complicated and labour intensive. To simplify the task of the food producers it is allowed that companies meet the Hygienic Code formulated by the branch organisation. This prevents that every

company has to put effort in its own safety system. The Nederlands Bakkerij Centrum (NBC, in English: Dutch Bakery Centre) developed the Hygienic Code specific for bakeries and other business that work with bread. In the food sector the strict norms within the Hygienic Codes might cause more food waste than the HACCP (Yuca Waarts 2011). This is tested in the bakery questionnaire, none of the participants said that this is the case in the bakery sector. According to Kennisloket-NBC (in English: Knowledge Office) many Dutch industrial bakeries have chosen to work with an individual food safety system, based on HACCP; namely the British Retail Consortium (BRC) or International Food Standard (IFS). BRC and IFS are quality standards created by retailers; besides the food safety guidelines, which are similar to the HACCP, product uniformity is also guaranteed (KwaliteitIsKracht 2013). The influence of those quality standards on food waste is not measured within this research. The international norms to guarantee safety for cattle feed, the GMP+ (Good Manufacturing Practices), are described in Sub section 4.4.3 cattle feed - extra.

In the Netherlands much attention is paid to food safety. This frightens bakers to reprocess return bread for human food. The questionnaire outcome shows that more than half of the participants expect that the HACCP norms will form a barrier for valorising return bread. While when you strictly follow the regulations, this is not the case according to a HACCP expert. However, bakers are responsible for the product safety and they do not want to take a risk. The details about this discussion are described in the Sub sections 4.4.1 bread snacks and 4.4.2 circle bread.

Another point is that meeting the food and safety regulations always requires extra labour, which is for one interviewed bakery a crucial point to choose for a non-food solution. The three non-food methods do not have to meet health regulations. This saves man hours at the retailer and at the bakery. When a method is executed offsite, or at the bakery in a closed installation system, the incoming flows do not come in contact with other flows of the bakery. In total this means less (health) risk and less effort for the bakery.

In Delphi round one the factor 'policy intervention' was not mentioned. This means that assistance or interference from policy is not directly expected in this sector. However policy intervention is a plausible option because both the European Union and the Dutch government have intensions to encourage valorisation of food waste streams. During the interviews in Delphi round three, two bakery experts brought up this subject. They stated that if the bakery sector won't (together with the retail) come with a good solution for the return bread waste streams, the government would impose measures. For example stricter regulations, which oblige retailers to return bread according to HACCP standards and bakeries to valorise it to a higher level. Both bakery experts mention that it would be better to prevent those regulations, by letting retailers and bakeries act for themselves and create a covenant.

4.3.6. Logistical factors

In the discussion about logistics it becomes clear where the main difference between theory and practice lays. Table 10 represents the influencing factors concerning logistics and how many times these factors were mentioned in Delphi round one. Four topics that came up during round one were not mentioned in the literature. Because these are sector specific issues these topics are added for further research.

Logistics	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	E12	E5	E6	E7	E78	E8	Total
~~Transport safety~~													0
Feasibility to transport		+		+									2

Sector fragmentation and volumes *	+	+	+	+				+					5
Plastic filtration *		+	+		+	+			+				5
Bread type separation *					+		+		+				3
Amount of work*	+					+							
Storage capacity *						+						+	2

Table 10: How often the logistical influencing factors from IS theory are mentioned by participants in Delphi round one. * = factors newly added for this research, ~~factors excluded~~ for this research

The fact that the bakery sector is very fragmented and concerns many streams of small volumes of return bread was mentioned six times. One participant told that during the SBI valorisation project all solutions required larger volumes of return bread, otherwise they could not be executed. To reach those volumes a chain integrated system (industrial symbiosis) between multiple industrial bakeries is required. The SBI valorisation project is executed in 2009 and meanwhile three methods (circle bread, fermentation and biogas) developed further and can now also be executed on the bakery's location. Literature speaks of four different waste exchange types, see Sub section 2.1. To investigate the preference for a certain waste exchange type one questionnaire question per valorisation method concerned 'the best processing location'. For cattle feed, carton strengtheners, bio plastics and biogas most participants answered 'at the processor's company', so waste exchange type A. However, during the interviews it became clear that most participants did not know that a fermentation or biogas installation at location was also an option. Most participants revised their statement and said that waste exchange type B, within the company, could be a possibility. The main condition is that it is profitable, which depends on the amount of work. The advantage of waste exchange type B is that less transportation of waste materials is needed. Some participants also prefer processing at location, because the employees see direct results and it raises awareness. Others think that it might too far from the baker's core business and bakers could better not focus on waste streams.

A practical issue is the separation of bread types, which might influence the final quality of a product. Also the filtration of the plastic packages gives a practical issue since those can not be threw into the fermentation/digester installations. For circle bread a guaranteed 100% plastic separation is difficult to reach. The outcome of the bakery questionnaire shows that none of the participants consider the industrial bakery the best place to filter plastic. Besides, the bakers are not willing to filter plastic; on a scale from one to ten the maximum score is a four. Moreover, plastic filtration at a bakery is probably inefficient. An industrial baker estimated that filtering the weekly 30 tons bread by hand will take two fulltime employees, which is too expensive. In a large plastic separation installation it only takes one hour, but it is not efficient to build such an installation on a small scale. A possible solution for fermentation and biogas is to cut the packaged breads in pieces and soak them in water. Plastic does not dissolve in water, so in this way it can be filtered out. As far as known this filtration method is not yet executed in practice, it could be part of a pilot reactor.

Another issue concerning processing at location is that there needs to be sufficient room at the bakery. In the bakery questionnaire a question is asked about the baker's willingness to take a new installation into usage. The opinions are divided; two participants scored a one, so they are not willing to do this. The other four participants rated between a five and a seven. During the interview one baker said that he would consider it, but that he doubted whether every baker would place an installation at their factory grounds. To sum up, waste exchange type B, processing at location, has

some difficulties but it will not be rejected beforehand.
Two bakery experts suggested in the bakery's questionnaire that bread could best be separated at the retailer. Bakery expert C suggested this because the first selection takes place at the retail, if they don't separate in a proper way it gives double work. Currently double separation is daily practice, because the separation at the retailer is not sufficient and bakers need to guarantee cattle feed without meat holding products. Bakery expert B added that separation at the supermarket increases the awareness of the employees there; so they can act to reduce the waste streams. According to him separation at a bakery would be harder, because they work with unschooled personnel. The problem is that retailers also work with unschooled employees for who delivering good separation is also a difficult task.
With waste exchange type A, when return bread is collected by a central processor, the limited storage capacity at the industrial bakery is a point of attention. The storage capacity determines the regularity the return bread is collected at the bakery by the end processor.
Waste exchange type C and D (Figure 4 & Figure 5) do not occur in this sector and are in the complete Delphi research not mentioned. This is probably a step too far for this sector.
Finally, IS literature also mentions 'transport safety', this is not named in Delphi round one, probably because (return) bread is not a dangerous substance. Because it is not mentioned, it will not be taken into account in further research.

4.3.7. Cradle to Cradle

Table 11 represents the influencing factors concerning Cradle to Cradle factors. Although some participants came up with the idea to prevent waste streams. Only one mentioned to consider the valorisation process of return bread on forehand. She came with the idea to replace the plastic clip (to keep the sack closed) by a clip which is organically compostable so it is easier to fully separate the plastic from the bread.

Cradle to Cradle	BE-A	BE-B	BE-C	BE-D	IB-a	IB-b	E12	E5	E6	E7	E78	E8	Total
~~Considering waste streams at design state~~			+										1

Table 11: How often the Cradle to Cradle thought 'to consider waste streams at the design state' is mentioned by participants in Delphi round one. * = factors newly added for this research, ~~factors excluded~~ for this research

This shows that considering waste streams on forehand is not something bakers are concerning, they are more focused on the final product. Bakery expert A said: "what a baker loves to do is baking bread, and let the customers enjoy it fully". Baking bread is the main task of a baker he would not change its recipe to prevent eventual waste streams. The quality and image of fresh breads is more important than future waste streams. For this reason the Cradle to Cradle school of thought is seen not applicable for this sector and will be excluded from further research.

4.3.8. Empirical model

Section 4.3 'Refining the influencing factors' can be summarized with the empirical model in flow chart showed in Figure 8 below. In this figure all the arrows are black, in Section 4.4 the influencing factors are discussed per valorisation method, that section will discuss whether the influences will be positive or negative. The flow charts specific per group of methods is shown in the Conclusions in Section 6.1.
The six influencing factors have an impact on the final choice of a valorisation method. Some impacts are indirect because the factors also influence each other.

The business factors have the direct impact on the choice for a valorisation method and are influenced by the technical and logistical factors. Especially when the technical feasibility is uncertain, also the business factors become uncertain and the economic risk increases. Logistical factors also influence the business factors, for example when the execution of a method is labour intensive the financial feasibility is influenced.
Logistical aspects such as the amount, location and type of work are influenced by the technique necessary for a certain method. The amount of work is also influenced by the applicable law and regulations. Valorisation to human food involves stricter regulations and increases the labour intensity at the retailer and the bakery. This, again, influences the financial feasibility. Food safety is a very important topic for Dutch consumers and therefore for the bakeries. Indirect the amount and way of working influences the public trust and the corporate image. Bakeries do not want to take any risk, this can form a barrier on the choice of a valorisation method.
The logistical factors have an influence on the waste exchange type, arrow Y in the conceptual model. It turned out that waste exchange types function as a part of the logistic factors. Only waste exchange type A is executed in practice, type B, C and D are not. So, within this research it can not be concluded whether the waste exchange type has an influence on the final performance. The preference lies initially with type A, but as long as it is profitable type B should not be excluded. Type C and D are not realistic to execute for industrial bakeries.
The communication aspects can influence the willingness of a bakery, which is essential for the final choice. Finally the CSR values and high quality purpose of a method influence the corporate image, but this factor is less important than the food safety influence.

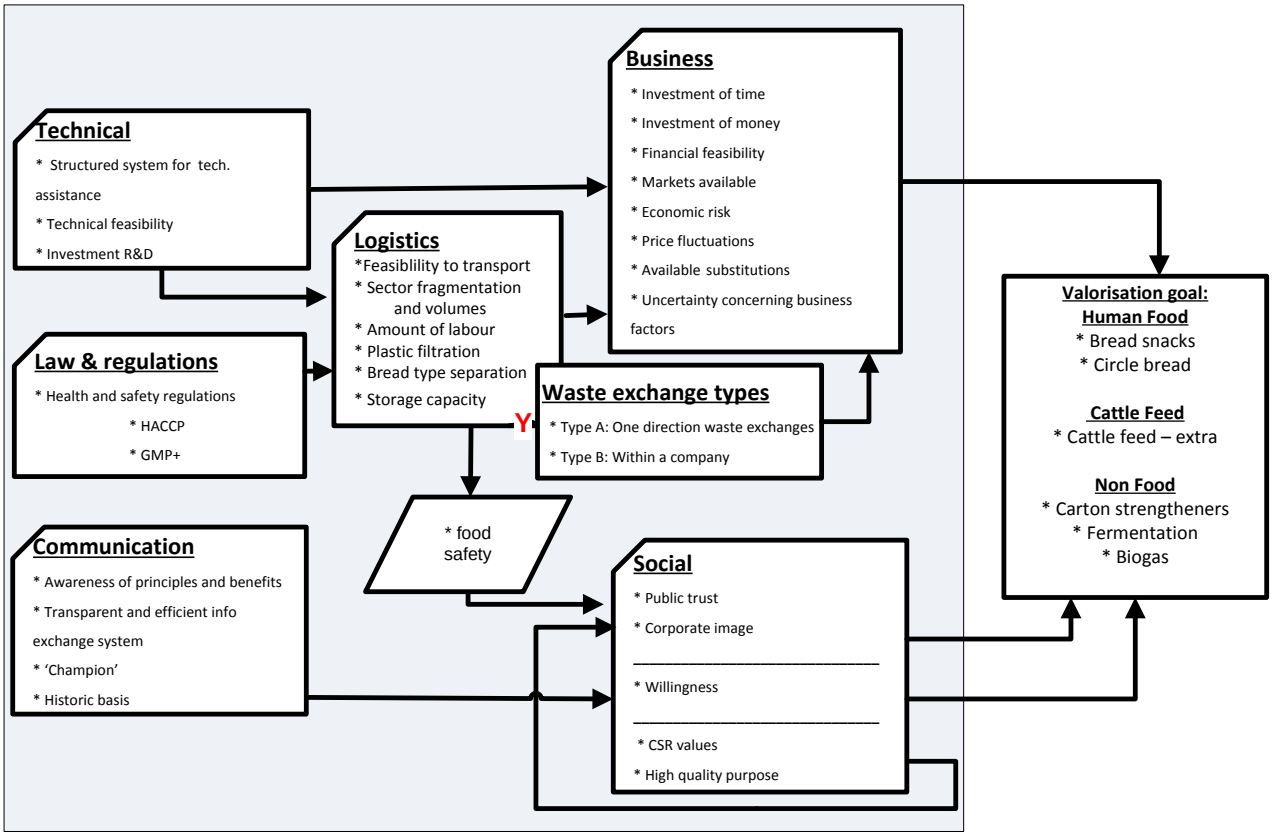

Figure 8: Empirical model based on IS literature and input from experts in Delphi round one, two and three

4.4. The return bread valorisation methods

In this section the specific influence of the six factors on the six surveyed valorisation methods are discussed.

4.4.1. Bread snacks

Technical

There are already some small independent bakeries which make bread snacks from their unsold bread. In this thesis it is suggested to execute the process from bread to bread snack at the retailer. The process is technically easy to execute and requires no investment in R&D (Heer 2012). The bread personal can produce this product in the quiet hours of the day. For supermarkets which bake off bread in the store the required installation is already available. The bread goes once more through the cutting machine so you have bread in the form of fries. Then the bread strips are marinated in a ready to use marinade after which it is put in the oven. The bread snacks have a longer expiration date than normal bread.

Although the process is technically easy, the barrier for supermarkets can be lowered by giving more assistance. A suggestion is to deliver a complete concept to supermarkets, including packages and labels.

Note: For the questionnaire in Delphi round two it was discussed to produce at the industrial bakery, but in Delphi round three production at the supermarket seemed more efficient. For this reason the execution location changed between Delphi round two and round three.

Communication

For this method there is a 'champion' available, namely the company of expert E12, which sells ready to use marinade and gives instructions.

The awareness of bakers is moderate. Half of the participants came up with this measure in Delphi round one. In the questionnaire it became obvious that more participants had heard of the method, namely eight out of nine. Since the technical feasibility is the highest when not the bakers but the retailers execute this method, especially the awareness of the retailers is relevant. The single retailer in this research had never heard of bread snacks, the awareness of other retailers is unknown. Thereby the lack of historic basis for the execution of this method at the retailer forms also a barrier.

Social

The main question is whether retailers are willing to produce bread snacks within their shop. The opinions of the bakery participants are divided. Three of them see possibilities, four don't. The three in favour gave the following arguments. First sustainability and CSR were mentioned, topics that become more important for the corporate image. Bread snacks are produced for human food, so it is a sustainable product, high in the Ladder of Moerman. The product fits within CSR goals, which makes it interesting to execute. Secondly, the technique is already available and the bread personal already has multiple responsibilities, so this could be added easily. The main argument from the other four participants is that bread snacks are too close to production and for this reason retailers will not do this. Baking and cutting bread is seen as preparing and not as production. One baker told that he proposed a similar option to the retailer he delivers to. The retailer "nearly laughed at" his suggestion. A last argument was that the benefits will not outweigh the costs. The single retailer in this research was not willing to execute this method, because it requires too much work.

The public trust is measured in the questionnaire by asking for the consumer's trust in food safety and quality. One participant predicted a positive influence on food safety and quality, four predicted

no changes and three predicted a negative influence. The three negative influences are predicted by the three industrial bakers. This aspect forms for them an important barrier to proceed with this method. The predicted influence on corporate image was five participants positive, two neutral and one negative. The more positive view on corporate image is caused by the sustainable character of this method.

Business

The investment costs for this method are low. To start it is technical proven, so no feasibility research is necessary. The assets for production are already available in the supermarket, also there no extra costs arise. The main investments are the purchase costs for the ready to use marinade and the production labour.
The bread snack expert states that the snacks could be sold for one euro per 100 gram, so the economic gain is 1.000 €/ton. One of the difficult points concerns the market availability, the amount of breads that can be valorised to snacks and sold. The bread snack expert estimated the market availability on 50% of the total amount of return bread. Other participants thought it would be a maximum of two breads a day. This would mean that producing bread snacks does not solve the entire return bread problem.
One of the participants, who favoured this method, added that the production of breads snacks gives a very nice smell in de supermarket. This could be one of the advantages to convince retailers.

Law and regulations

Bread snacks are meant for human consumption, so the HACCP regulations must be followed. Kennisloket-NBC says the following concerning the Critical Control Points applicable for the production of bread snacks. The extra risks could be caused by: the storage of the marinade, marinade leaking in the oven, mucked bread pieces and storage of the snacks. The Hygienic Code anticipates on guarding these risks, so regulations should not form a barrier. Important is that the bread personnel is well instructed. The mentioned risks can be guarded by: regular cleaning, a proper leaking plate in the oven and proper storage conditions. This involves extra labour and time for the retailers.

Logistics

The unsold bread is not returned to the bakery and stays in the supermarket. This makes the logistics less complicated. Except for the product development, all the labour takes place at the supermarkets. For retailers it requires extra time and energy to prepare the snacks, which is probably more complicated than baking bread. The bread personnel needs to be trained for this.

4.4.2. Circle bread

Technical

Circle bread can be produced with the use of a technique that is already in practice for the process waste streams within the bakery. The technology is also usable for return bread. It is surveyed and described by the 'Nationale Denktank' 2012 (NationaleDenktank 2012; Rensen 2012). The process is visualised in the flow chart in Figure 9. The process starts with hygienic and proper separation of unsold bread at the supermarket. In the industrial bakery the return bread must be sorted and the packages must be removed. Then the bread goes into a spiral kneader machine together with water and a special starter mix (in Figure 9: 'Sonextra Sustain'). To generate sour dough the mixture needs

to be in a closed bucket for twelve hours, after which the sour dough can be added to the standard dough. 20 parts of sour dough can be added to the normal white -, wheat - and whole wheat dough.

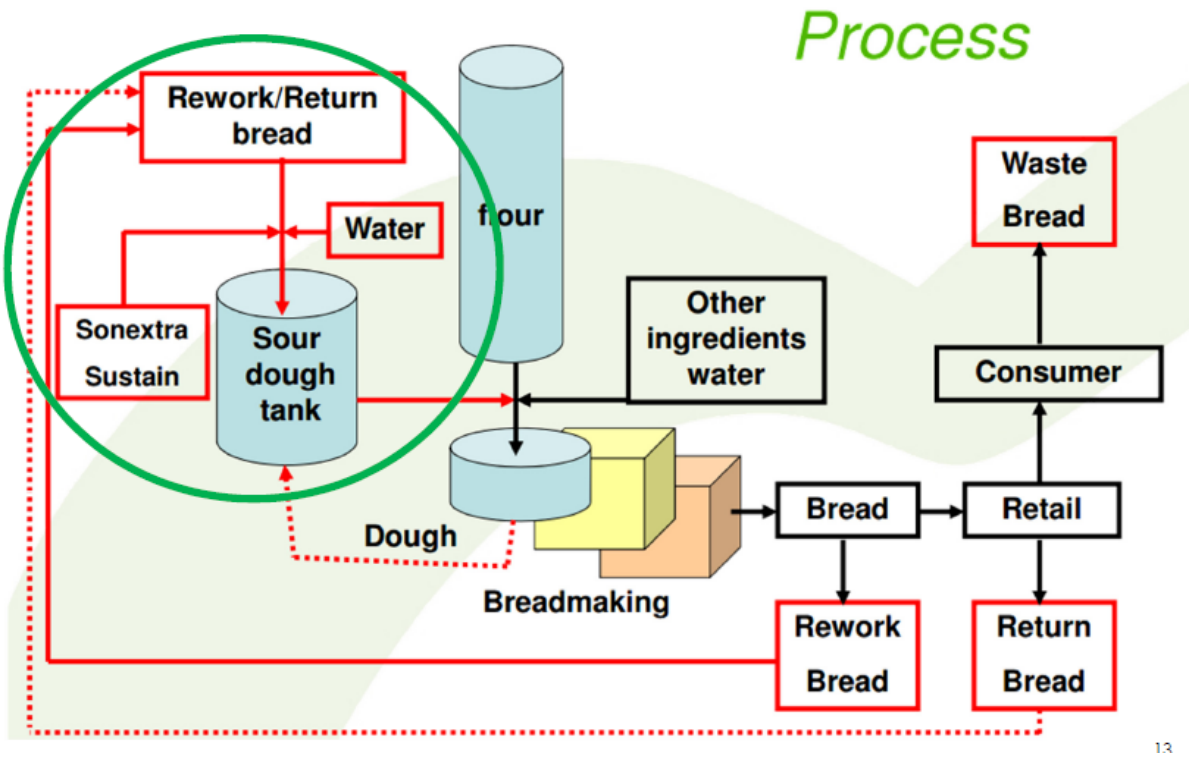

Figure 9: Process flow chart for circle bread (NationaleDenktank 2012)

According to the Nationale Denktank the influence of the process on the taste of the new bread is minimal and might even be positive. It is easy to control the processes that affect the taste, by using the right amounts. So consumers can not taste whether old bread sour dough is used or not. It is also possible to influence the taste on purpose, for example giving extra taste by the double fermentation process, or giving the bread extra taste of the sour dough by the digestion process.

Communication

In Delphi round one only two bakery participants came up with the circle bread method. When it was directly asked in the questionnaire of round two, all bakery participants except for one had heard of it.

Information exchange about this method is improved by the attention of the SBI project and the Nationale Denktank. Bakery expert A said that compared with five years ago, currently more bakers are considering it. He thinks that in another five years the real solution will be found. The questionnaire outcome shows that not every participant agrees with this statement. Three participants, two bakers and one bakery expert think this method is unfeasible to execute on a large scale. The main argument is the possible food safety risk.

Similar to the method bread snacks also circle bread has the company of expert E12 as ‘champion’. The company supplies the necessary ingredients and can give assistance for the new installations. Nevertheless, there are no practical examples of industrial bakeries that produce circle bread with their return bread. This lack of historic basis has a negative influence on the execution willingness.

As shortly mentioned above, also the retailers play a role for succeeding this method. However, the information exchange towards retailers is less efficient. The retailer in this research is unfamiliar with

the circle bread possibility and he doubted the financial feasibility. According to theory the barrier to act is larger when there is less awareness, this might also be the case here.

Social

Public trust is an important issue when return bread is valorised to human food. In the questionnaire the expected influence on consumer's trust in food quality and food safety is questioned. Three participants expect a negative influence, four expect no influence. One participant, bakery expert A, expects a positive influence. The main worry is whether the health and safety regulations can be met. The expected influence on the corporate image is more optimistic. Five participants expect a positive influence; two expect no influence and one a negative influence. The positive expectations are probably related with the valorisation high on the Ladder of Moerman. With this method the return bread stays in the food chain. The negative influence is related with the food safety issue.
For circle bread the willingness of bakers is complicated; the method is very sustainable and fits within the CSR goals. Large doubts are caused by food safety issues, for which the bakers need to take the responsibility. To make this method workable, retailers also need to be willing to invest time and effort. The contact person from the retail doubts whether circle bread is a good option. He was uncertain whether he was willing to proceed with it.

Business

Because circle bread is a proven technology a feasibility research is not necessary. The financial investment in a new kneader installation depends on the type of bread and the already available installations in the bakery. According to circle bread expert E12 the total costs will differ between 25.000 to 100.000 euro.
The energy reduction per bread will be around 3%. With the circle bread method less ingredients, mainly yeast and flower, are needed. This leads to 5% costs reduction for resource purchase. Per 1.000 ton flower the cost reduction is around 14.000 euro (NationaleDenktank 2012). Assuming that 5% cost reduction for resource purchase implies that the fraction used old bread is 5%, the value of return bread is 280 €/ton.
The method requires extra time and effort for sorting, package removal and ingredients/allergens labelling. The yearly salary for this work is estimated on 1.000 euro per 1.000 ton flower. This extra effort does not only take place at the industrial bakery, but also at the retailer. Read more about this in the section logistics below.

Law and regulations

The background of the HACCP is already described in the Sub section 4.3.5, law and regulations. To check whether the circle bread could be produced according to food safety regulations Kennisloket - NBC was consulted. There are only some standards that must be met the contact person "foresaw not many problems". To start, it is essential that the collection, storage and transportation proceed in a hygienic way, in order that (possible) contaminated bread does not return. The retailer and transporter will act as the baker's supplier. Suppliers and clients can make agreements concerning hygienic storage, transport and packaging, a guideline for this contact is described in the Hygienic Code. During storage it is important to prevent moulding, which is also described in the Hygienic Code. As long as the product is useable as human food it can also be used as a resource. According to the three industrial bakers this explanation is a typical example of something that is formally possible in theory, but not feasible in practice. Currently the bakery always rechecks the return bread loads, in order to meet the safety norms for cattle feed. The condition of the received return bread is so

messy that none of the bakers wants to take the risk to reuse it for human food. The return crates are filled with random, unsorted breads, sometimes there are even other waste products in the crates, like vegetables. According to the bakers making better agreements with retailers is not sufficient enough. Every few months they talk to the retailers in order to uptight and refresh the agreements.
Another aspect concerning regulation that must be kept in mind is the ingredients labelling for allergens. Ingredients get more complicated to trace when return bread is reused for new bread. One baker worries about cross-contamination because the bakery is responsible to prevent the food risk. According to circle bread expert E12 it is labour intensive but doable.

Logistics

The food safety regulations cause extra labour in both the supermarket and the industrial bakery. Bakeries created leaflets to explain to the supermarket staff 'what is (not) allowed in the return crates'. According to the Delphi participants the retail personnel who need to fill the return crates after closing hour are in a hurry and rather want to do it quick than good. All participants agree that the unschooled supermarket employees are the direct cause of the problem, also the contacted retailer. His supermarket works with a return hall and he expects that most of the extra labour costs would be at checking the return bread. He agrees that the unschooled supermarket staffs are not able to perform the job in a proper way. He did not have another solution than rechecking the return bread. One participant suggests that supermarkets with their own bakery make a start with this method, because the trust issue is less complicated for them.
In the industrial bakery the necessary separation of different types of bread forms a barrier. In the questionnaire of Delphi round two it was obvious that bakers are not willing do this, the maximum grade was a four, on a scale from one to ten.
Finally, not all industrial bakers prefer to work with a sour dough. According to one industrial baker sour dough gives an unstable final product. The quality differences are minimal, but do not meet the quality demands of their client. After a testing phase of four years this bakery decided to stop with the usage of sour dough. For this reason this baker doubts whether the quality levels for circle bread will be stable enough. Another industrial baker agrees that sour dough might be more complicated to work with, but he thinks that "sour dough gives the most beautiful and best bread there is".

4.4.3. Cattle feed – extra

Technical

Cattle feed is currently the most common used method to valorise return bread. Bakeries collect the packaged return bread in a special container which is picked up a couple times per week by a cattle feed processor. At the processor the plastic packages are removed, using a special developed technique. The details of these techniques are confidential and are not shared. After the package removal the bread is prepared as cattle feed, which the processor sells to livestock farmers.
In March 2013 it was announced that one of the feed processors is, together with a bakery branch organisation, developing a method to valorise return bread to a higher level. They collaborate under the name 'Bread to Bread'. The goal is 40% proteins for cattle feed and 60% glucose, which serves as resource for the yeast fabric and pharmacy (Leijten 2013). The cattle feed expert does not want to share any technical process details. The lab studies started in 2008 and in the spring of 2013 a pilot factory is ready to use. The goal is to progress the first streams in the second quarter of 2013.
These new developments concerning cattle feed took place during the research phase of this thesis and were announced after the questionnaires. Therefore it was not possible to discuss it in the

questionnaire, so those questions refer to the 'normal cattle feed' situation. However, during the interviews in Delphi round three this new technique and its implications are also discussed with the participants. To make the distinction with conventional cattle feed, this new method is called cattle feed – extra.

Communication

Cattle feed is the most used and best known method. The awareness of the benefits is very high. Already in the first Delphi round all the participants related to the bakery sector mentioned it. According to literature a historic basis and a long term relationship, between a company and its waste processor can accelerate the processes. From this viewpoint, it is logical that especially in this sector new developments occur.
The collaboration project of the cattle feed processor and the bakery branch organisation will work as an 'champion'. They do the research and investments, hence opening possibilities for other bakeries.

Social

On the questionnaire question concerning the corporate image, six participants answered that the use of this method has no influence. The cattle feed expert and the fermentation expert predict a positive influence. A negative influence is predicted by bakery expert A, who thinks the value of this purpose is too low. However in Delphi round three he mentioned that he is glad with the developments towards cattle feed – extra.
When return bread is used for cattle feed it is indirect used for human food. For this reason the method is on the fourth place in the Ladder of Moerman.
For cattle feed - extra 60% return bread which is used for bakery's yeast production, this is higher on the Ladder of Moerman. It also means that is must meet the HACCP regulations. Execution can give the same food safety risks as mentioned for the two human food methods. This forms a barrier for industrial bakers.

Business

The cattle feed processor executes the feasibility research, this lowers the economic risk for industrial bakers. According to the cattle feed expert, cattle feed – extra does not require financial investments of the bakeries. The financial profit depends on the grain price, in recent years this was around 30-40 €/ton. With the cattle feed - extra the feed can also be eaten by beef cows. The price per ton is expected to rise, but also the process cost will rise. At this moment it is uncertain whether there is a net gain. When the pilot phase of the cattle feed – extra finishes successfully every bakery can apply this method and no extra financial investments from the bakery are required.
According to the cattle feed expert, the Dutch cattle feed industry ensures a stable market for return bread. The industry processes approximately 16.000.000 tons of recourses, of which 300.000 tons are bread and cookies waste streams.

Law and regulations

To sell the return bread as cattle feed the processes must meet the certification norms for feed safety assurance. The most used certification method internationally is the Good Manufacturing Practices + (GMP+). The plus stands for the integration with the HACCP norms. In practice industrial bakeries make a difference between valorisation to human food or cattle feed. Since the chance for damage on corporate image is smaller in for cattle feed. Within GMP+ the conditions relating to production facilities of feed and for storage, transport, staff, procedures and documentation are

defined. Finally no meat containing products are allowed (GMPplus.org 2013). This can lead to extra work, as described in the sub section logistics below.
With cattle feed – extra the goal is to also valorise to human food, so the HACCP norms become relevant. According to the bakeries the regulations can not be met in practice, because the retailers deliver bread in too messy circumstances. This will also form a barrier for cattle feed – extra.

Logistics

As described in the technical sub section, the return bread is collected at the bakery and distributed to the feed processing company. All the Delphi participants think this the most effective way and also the cattle feed expert is satisfied, hereby every company stays to its core business. According to the cattle feed expert the working method for the cattle feed - extra will not change for the bakeries, the only change is at the processor's company. However when 60% of the return bread is valorised to human food this involves extra risk and labour for the bakers. The industrial bakers see many barriers for valorisation to human food, due to food safety risks. For cattle feed it is currently experienced easier, because the direct food safety risk is lower.
One of the requirements for the GMP+ certification is that no meat containing products are within the cattle feed resources. In order to prevent livestock diseases like BSE. Despite agreements with the retailers, there are sometimes meat products within the return bread load. To ensure meat-free resources the bakery staff or chauffeurs recheck all the return bread. According to the cattle feed expert, food processors are sometimes frightened when they see the requirements for cattle feed but get used to the method very fast so it becomes a part of the already existing quality system. One of the industrial bakers does not agree with this statement. For this bakery the recheck takes so many working hours that it becomes financially inefficient. Therefore this bakery is searching for a non-food purpose for its return bread.

4.4.4. Carton strengtheners

Technical

In the paper- and carton industry starch extracted from flower is used as carton strengtheners. The sector is also experimenting with the direct use of flower, instead of extracting the starch. At the same time it is investigated whether starch extracted from return bread can be used. This research is still in it lab's phase, so no details concerning the technical steps can be shared yet. It is required that the starch extraction method meets the quality levels of the carton industry. It is uncertain whether it is technological feasible and how much time and effort this process will take. However, the first analyses are promising enough for further research.

Communication

In Delphi round one, three bakery participants came up with this method. The questionnaire shows that seven out of nine participants are familiar with this method. Probably awareness is raised during the project of the SBI in 2009, where carton was one of the topics.
The future predictions estimate that in between one and five years this method can be brought into practice. Two participants think the method is unfeasible to execute in practice. During the interviews in Delphi round three there was no time for an in depth discussion about their argumentation.
Exclusive for the carton strengtheners method is that there is already a person (BE-A) who surveys whether the method is technically and financial feasible. When he is absolutely certain of the feasibility and all aspects can be prescribed he will go to the bakeries. The position of this person is

described in IS literature as 'champion'. He says the following about his drivers: "I do this mainly because I believe in a contribution to the sustainability of corporate Netherlands and to improve the profitability and opportunities in the bakery sector." His efforts give an advantage over fermentation and biogas, because the feasibility research is already financed and executed.

Social

A small majority (five out of nine) predict a positive influence on the bakery's corporate image, four out of nine predict no difference. None of the participants predicted a negative influence. This means that carton strengtheners scores the best on corporate image of all eight surveyed valorisation methods.

One of the bakers mentioned that he finds it difficult to reconsider that a food product would be used outside the food chain. However, the carton industry currently uses fresh flower, so the use of return bread has an indirect positive effect on the food chain because more (high valued) fresh flower becomes available for production of human food.

Business

The technical uncertainties, as described above, cause also an uncertainty at the business level. The feasibility research to clarify these issues is already executed by the 'champion'. This means that bakeries don't have to take the initial economic risk and can wait for the results. In a later phase, when the method is shown to be feasible, bakers probably have to make an investment for new assets or installation. However, at the current development phase, the sum of this investment is still unclear.

Currently the carton industry purchases fresh flower for around 300 €/ton (depending on the grain price). When return bread carton strengtheners can be produced for a lower price than 300 €/ton, the carton industry is interested to replace the resource. The motivation is higher when the price difference between is larger. Since there is a large demand for carton strengtheners, a product of good quality will have a guaranteed market.

Law and regulations

Because the goal of this method is non-food there are no obstructions by law and regulations expected.

Logistics

The size of the starch extraction installation will depend on further analyses. This size will determine what the best location to extract starch is; at a central processor or per bakery. To start, the expert on carton strengtheners stated that his company is not willing to execute the extraction. The company only wants to buy ready to use starch/carton strengtheners. An installation at the bakery's location will save time and costs for logistics. On the other hand, the bakery has to invest in construction and maintenance of the installation. Management of the installation will probably require some knowledge, which is again requiring an investment. It will depend on the opportunities and on the wishes of the bakers how this method will be executed.

Currently it is uncertain whether the separation of different bread types influences the final product quality. This uncertainty also causes uncertainty in the business factors and financial feasibility

4.4.5. Fermentation

Technical

All the methods discussed in this thesis are described by their final goal and not by the name of the

process. An exception is made for fermentation because the fermentation process can lead to different end-goals. To simplify the questionnaire, the questions there focused on bio plastics. Next to that the fuel bio ethanol can be produced. Another option are amino acids, which serve as supplement for animal feed and have a higher yield per ton. The final purpose is calcium lactate, a salt replacer which can be used in the bakery's own bread. The feasibility and profitability of those end products depends on how bread reacts in the fermentation process.
To prepare bread for fermentation the starch must be converted into glucose. This happens by hydrolyses, with water and an enzyme that splits the starch and converts it into glucose. The amount of the available fermentable sugars determines the effect of the second step. In this second step specific microorganisms ferment the sugars into one of the above mentioned purposes. Every end-product requires another type of microorganism for the conversion.
According to non-European literature bread waste has many fermentable sugars that could be used to produce bio ethanol (Awolu and Ibileke 2011). To find exact (Dutch) numbers, also for the other three end-products, a feasibility research must be executed. This can be done by a third party, specialised in fermentation.

Communication

Fermentation as solution for return bread is the method where the least participants had heard of. In Delphi round one only two bakery participants came up with bio plastics and bio ethanol is not mentioned at all. In the questionnaire it turned out that two/third had heard of the method. This lack of awareness and information exchange could lead to the following future predictions. Three participants stated that the method is 'unfeasible to execute on a larger scale', three predicted that it would take five years or longer. The two fermentation experts and bakery expert A, though that execution on a larger scale is possible in two years. Fermentation is, after 'selling yesterday's bread', the method with the most negative predictions. The reason to further research this method in Delphi round three is because this method is still in development and the literature and expert's forecasts are promising.

Social

An industrial baker mentioned in the third Delphi round that when the bread is used for one of the non-food fermentation goals, the return bread goes outside the food chain. This point is often referred to this point as the 'food for fuel' discussion. The 'first generation' technology to produce ethanol was developed to convert sugars directly from food crops. With an increased demand for bio ethanol in the USA the grain prices increased. This led to 'second generation' technology, where biomass (waste streams) is used instead of direct food crops (Awolu and Ibileke 2011). According to one of the fermentation experts return bread must be seen as a product in between food and residue. It is close to food, but when nobody is eager to put it back into the food chain, it remains a waste product. In that case the 'food for fuel' discussion does not apply. Nevertheless, when the return bread is used for another purpose than human food or cattle feed, extra resources are still needed to feed them.
Four participants, among whom three bakery experts and one baker, think there will be a positive influence on corporate image. The other five participants, among who the two fermentation experts, predict no changing influence on the corporate image.

Business

As explained in the section above, fermentation of return bread is not yet applied in practice in the Netherlands. One of the participants (BE-D) told that in the Netherlands plans for two fermentation reactors were cancelled. She assumed that, although the knowledge is there, fermentation is not yet economically interesting enough. The use of second generation waste streams requires more investment and research. According to fermentation expert E78 a first feasibility research, to get insight whether return bread is a valuable option for fermentation, will cost about €5.000. Subsequently it should be calculated whether it is also applicable on a larger scale and what else should be taken into account, according to fermentation expert E7 this will cost €200.000.
Without those feasibility researches there are many uncertainties and it is difficult to make predictions about business factors. Fermentation expert E7 assumed that one ton return bread could gain around €120. Fermentation expert E78 was cautious and did not make an estimation.
The economic profit also depends on the available substitutions, markets and price fluctuations. Those three factors differ per fermentation end product, short attention is put to all four end products. This are just first ideas based on discussion with experts, without calculations. Bakeries could use bio plastics as package material. When bio plastic is cheaper than regular plastic this gives an economic advantage. It is also a method to communicate CSR to the consumers. Bio ethanol can be used for the car park, the bakery is then less depended on the purchase of fuel. The price of the bio ethanol will fluctuate with the grain price instead of the oil price. Calcium lactate, the salt replacer, can in the first place also be used within the bakery. With larger amounts it might be feasible to also sell the product. Finally, amino acids could be sold as cattle feed, yielding a higher turnover compared to selling return bread directly as cattle feed. Although the cattle feed expert mentioned that synthetic amino acids produced in China are a cheap substitution.
All those uncertainties lead to a high economic risk, which is an important barrier for bakers.

Law and regulations

The influence of law and regulations depends on which fermentation purpose is chosen. For the non-food goals (bio plastics and bio ethanol), health regulations like HACCP and/or GMP+ are not applicable. This makes it easier to execute the process in practice, because there is no need to check the incoming return bread.
The third fermentation goal, amino acids for cattle feed, should meet the GMP+ regulations, like conventional cattle feed.
For the last fermentation goal, the salt replacer calcium lactate, the process needs to require the HACCP norms. Valorisation up to human food goals complicates the process; and according to all the bakers this is not realistic. See also Sub section 4.4.2 about circle bread.

Logistics

The law and regulations determine the amount of labour for the four fermentation goals. Valorisation to food or cattle feed implies extra labour, also for the retailer. To improve the feasibility non-food goals are preferred.
Fermentation of return bread is not yet in practice, therefore it is unclear what would be the best execution location. This also depends on the goal of the fermentation process.
One of the fermentation experts is in favour of fermentation at the bakery's location. In that case the construction, placement and installation of the fermentation installation can be outsourced. The use of the fermentation installation requires constant technical supervision of an educated daily supervisor. The bakery can purchase the necessary knowledge at a consultant who can further

develop the technique. The fermentation expert expects that the costs for hiring a supervisor will be covered by the higher yields. To separate plastic the solution discussed in Sub section 4.3.6 can be involved into the pilot reactor.
The other fermentation expert is in favour of outsourcing the fermentation process to a central processor. This company will collect the return bread and process it to the final product. The advantage is that it is easy, without a lot of effort for the bakery. The disadvantage is that there are extra transport costs, administration and the yields must be divided.

4.4.6. Biogas

Technical

Digestion of organic materials produces biogas. Currently this becomes a common practice for processing organic waste streams. In the digestion process bacteria, in an anaerobic environment, destruct organic materials. In multiple steps the bacteria convert the organic materials into biogas, which exist of methane (60%) and CO_2. Methane is the inflammable part of biogas and is the elementary component of natural gas. The biogas can be used for the heating the ovens and/or for the bakery's car park.
Currently, there are only a few digesters that are especially developed for bread (Weerd 2012; Witman 2013). A specialized third party needs to research this specific method further. A digester for bakeries can be developed in such a way that it can be used for both return bread and process waste. The technical uncertainty leads to practical and economic uncertainties.

Communication

Digestion of organic materials is a well known method. Half of the bakery participants came up with it in Delphi round one. Also all the questionnaire participants of the Delphi research had heard of it. This means that the awareness of this method is high. According to the biogas experts this is caused the subsidies and media attention. Because the method is already executed, none of the questionnaire participants mentioned that the method was 'unfeasible to execute on a larger scale'. Although one participant mentioned that it might be 'doubtful', because biogas is low on the Ladder of Moerman. During the interviews in Delphi round three two of the three bakers showed a preference for this method. The third baker let DWA, a Dutch installation and energy consultancy, perform a feasibility research six-seven years ago. He decided to not build an installation because the long payback period, the installation size and the dependability of subsidies. Moreover, to make it economically profitable he needed to process 2.400 ton return bread per year, this was only reachable by purchasing return bread streams from colleague bakeries. Currently the digesters are developed further; they applicable for smaller waste streams (100 ton/year) and also decreased in size.

Social

Concerning the 'corporate image' six participants think this method has a positive influence, four participants think there will be no influence and two predict a negative influence. The main arguments for a positive influence are that energy is generated without the use of fossil fuels, and that it fits in the CSR goals. The argument for a negative influence is that biogas is too low on the Ladder of Moerman. When biogas is produced instead of cattle feed, the bread is lost for the food chain.
One fermentation expert mentioned that digestion is a less controlled process where all the available sugars are converted into biogas. While with fermentation other (higher valued) goals can be

achieved. For example: bio plastics, bio ethanol, amino acids or a salt replacer. The other fermentation expert noticed that it is remarkable that grains are specially produced for fermentation into bio ethanol, while he had never heard of grains produced for biogas. According to him this comparison shows that biogas is less efficient.

Business

A bread digester is still in development making it difficult to state the exact business situation. The biogas expert states that according to literature one kilogram bread will give 400 liter biogas. The produced biogas is applicable for internal use and the car park, hence saving energy costs. When there is a gas surplus this can be delivered to the national gas network. Besides the energy savings, the bakery can also apply for SDE subsidy. This is a national Dutch subsidy to 'stimulate sustainable energy production' (SDE). The subsidy is, among others, applicable for a company which produces green gas by a digester. It compensates for the cost price differences between renewable - and 'grey' energy. Those cost prices are determined by the Ministry of Economic Affairs. For 2013 in total three billion euro is made available for which companies can do a request from April until half December (AgentschapNL 2013). With these energy cost savings on the one hand and subsidies on the other, it is estimated that the gas will yield approximately 200 €/ton. For determining more precise numbers a feasibility research must be executed. According to the biogas expert E8 this will cost € 7.500. When further investment is considered feasible a small pilot reactor can be build, this will cost € 15.000-20.000. The investment for a complete digester installation will cost around € 180.000.
The total amount of subsidy changes yearly and the current rule is 'first comes, first go'. So, when a company is too late with the request the yields become unstable and will fluctuate. This is also the case when the subsidy is eliminated. Currently it is unclear to what extent the economic profit relies on the SDE subsidy. The fermentation expert warned that the subsidy makes the situation economically unreliable.
Besides the subsidies the biogas prices depend on oil and gas prices. When a bakery arranges its own gas supply it is less dependent of energy companies and price fluctuations.

Law and regulations

Because biogas is a non-food goal there are no health regulations applicable.

Logistics

A digester can be located at the bakery's site or with a central processor. Participants think that bakers stand are willing to consider both options. The decision will depend on the bakery's specific situation.
A digester can operate with minimal 100 ton (return) bread per year, so approximately two ton per week. According to an industrial baker two tons a week is the minimal amount of return bread that industrial bakeries have. When the bread is digested on location the construction, placement and installation can be outsourced. The digester itself works automatically, a baker can independently work with it. Yearly a mechanic visits for a checkup.
For a bakery with 30-40 ton return bread a week, the size of the complete digester is estimated to be 10 by 10 meters, including shredder and stock. Similar to fermentation at location, also a digester can get clogged by plastic packages. The suggested solution to dissolve the bread in water and remove the packages can be tested.

When the baker decides to outsource the digestion process, a central processor picks up the organic waste streams and digests it to biogas. An advantage of this method is that it is less effort for bakeries. Disadvantages are the involved transport costs, administration and division of profit.

4.4.7 Comparison of the valorisation methods

In Table 12 an overview of the business and logistical factors for the researched valorisation methods is given. In the table financial investments, benefits and the amount of labour is summarized.

	Lab research (€)	Pilot research (€)	Installation (€)	Profit (€/ton)	Labour
Bread snacks	0	0	0	Retailer: 1.000	Retailer: preparation according to HACCP
Circle bread	0	0	25.000-100.000	280	Retailer: return according to HACCP Bakery: sorting bread type, filtering plastic, labelling allergens
Cattle feed – extra (no human food)	0	0	0	30-40	Bakery: collecting return bread according to GMP+ (filtering meat containing products)
Carton strengtheners @ external party	0	0	?	<300	Bakery: collecting return bread
Fermentation (bio plastics) @ bakery	5.000	200.000	?	120	Bakery: plastic filtering, usage of fermentation installation
Fermentation (bio plastics) @ external party	0	0	0	<120	Bakery: collecting return bread
Biogas @ bakery	7.500	20.000	180.000	200 (incl. subsidy)	Bakery: plastic filtering, usage of digester
Biogas @ external party	0	0	0	<200	Bakery: collecting return bread

Table 12: Comparison of business and logistical factors relevant for bakeries and (if mentioned) retailers. (Uncertain, highly uncertain)

The table shows that for the human food methods the financial investment is low, since this is already researched. The human food methods have high profits, although the market available for bread snacks is too low to solve the entire return bread problem. However the amount of labour is very high also for retailers, because the HACCP norms must be met.

Cattle feed – extra has low financial investments, since the research is executed by the cattle feed processor. Compared to the other methods the profit is low, currently it is uncertain whether the yield of cattle feed – extra will be higher, than conventional cattle feed. When return bread is not valorised to human food the amount of work is medium, because the GMP+ regulations must be met.

There are many uncertainties for the non-food methods. These need to be solved by a lab and pilot

research which requires financial investments. When an external party invests in this, the costs for a bakery will be lower. The profit in euro per ton is uncertain, but probably in between the yield for cattle feed and human food. The amount of labour is relatively low, because there are no food safety regulations to meet. An installation at the bakery requires more work, but the expected profit is also higher compared with outsourcing.

4.5. Future outlook

In the discussion with the bakery experts their future expectations came up. All experts agree that when a few frontrunners take the initiative many others will follow and some laggards will stay behind because of the lack of financial resources. Concerning the content and execution of this initiative the opinions are divided.

Bakery expert-C is very convinced of the succeeding chance of the 'Bread to Bread' project. "I think the bakers will wait until Bake Five announces that it works (…) subsequently they will also start with the same method." Bakery expert-A thinks that as reaction on the initiative of Bake Five other bakeries will execute new researches to also valorise their waste streams. He predicts that other interesting market initiatives will follow quickly. Collective investment with a group of bakeries is an option to spread the financial burden. Bakery expert-B also prefers a collective initiative he states "it would fit to the NBC, together with the NVB, to investigate this topic further and to see whether financial support is available." Bakery expert–D, mainly agrees with BE-C, and thinks the other bakeries will wait. She also has an idealistic vision, where the retail works as trigger. "In the ideal situation the retail makes agreements with the frontrunners; when those filled in the blanks, it is easy for the retail to say to the rest: I want you to act like this." BE-D is certain that bakeries will not individually invest in their waste streams. Another option would be that a waste processer would take the initiative; because it is their core business and they have direct benefits. Finally bakery experts B and C also came up with a non-preferred scenario, where bakeries are forced to valorise by top down policy intervention.

It should be kept in mind that once a bakery has chosen for a direction the chance is small that it will switch again. The implementation of changes always requires investment in time and money (Hayes 2010). Furthermore the new methods will definitely require extra investment in time and money, therefore the business and logistical factors must be more attractive than for cattle feed.

Often the Delphi method is used to reach consensus between the experts. This thesis research is limited by time boundaries, so consensus could not be reached. Instead the mentioned possibilities are taken along in the conclusions and recommendations.

5. Discussion

The focus of this thesis research is very broad, eight different valorisation methods are discussed, of which six more in depth. This means that the Delphi method is used in an alternative way, with multiple topics and participants with a very large variety of backgrounds. The participants can be divided in two groups: one as experts of the bakery sector, the other as experts of six different valorisation methods. The difference in expertise implies that the bakers have a lack of knowledge concerning the valorisation methods and that some of the experts are unfamiliar with a baker's daily business. In the questionnaire of Delphi round two the experts who were unfamiliar with the bakery sector only had to answer the questions related to their expertise. Because the broad variety of topics the actual number of participants per method is rather small. For most valorisation methods only one expert participated, except for fermentation and biogas. The small number of valorisation experts in comparison with bakery experts influences the outcome of the general questionnaire. When participants were asked to give a future prediction for a certain valorisation method, the bakers reacted different than the actual experts. The questionnaire outcome now mainly shows what bakers and bakery experts expect. Which is also interesting to measure the communication factor awareness, but it does not give a proper view of the technical feasibility of a method.

The small number of valorisation experts and the broad focus resulted in rather shallow discussions. The Delphi round three discussions could have been more in depth and topic specific, when there were more participating experts per method. In the ideal situation for each valorisation method a Delphi procedure would be executed. This would give a better impression per method and more in depth discussion.

Two valorisation methods were eliminated because the results were too negative, namely 'selling yesterday's bread' and the food bank. For those two methods no matching expert was found. With an expert involved this might have been different. However no person was available who could defend those valorisation methods. On the other hand, the fact that none of the approached experts were willing to participate, might also show that they did not see opportunities.

Not all participants participated in every Delphi round. Delphi round one is executed by 13 of the 14 participants. Two participants (E5, BE-D) did not take part in round one via answering questions by telephone, but instead participated at the KiA expert-meeting where they joined a workshop about return bread. Their ideas and opinions were gathered during the workshop and this was considered sufficient. A third participant (IB-c) enrolled for the Delphi survey later and stepped in during Delphi round two. Delphi round two is executed by 13 of the 14 participants. One participant (BE-A) had trouble with the inflexible question format, so I interviewed him instead. Two other participants (E5 and BE-B) only filled in one of the two requested questionnaires, because their time was limited. The irregular participation makes it difficult to get a proper overview and complicates the comparison.

Another aspect that causes comparison difficulties are the uncertainties related to the three non-food methods. In the questionnaire of Delphi round two six questions explicitly referred to concrete numbers for the business factors. Questions regarding the: payback time, payback certainty, profit (€/ton), total investment, customer market and feasibility research. The experts of the non-food methods could not answer these questions completely because it there is too much uncertainty. The uncertainty does not only make the baker's decision more complex but also makes it difficult to draw conclusions or provide a clear future outlook. Also the bakers and bakery experts could not answer

all questions and the given answers differed a lot. The interviews of Delphi round three did not clarify the business related factors.

Most valorisation experts have commercial interests to picture their method better than the others, except for the fermentation expert E7. These interests can give a distorted picture, in favour of a certain valorisation method. Another point is that sometimes participants could not give confidential information from their company. This was especially the case with the technical description of the method. Therefore the descriptions of carton strengtheners and cattle feed e stay very basic.

Only one retailer was willing to be interviewed. So the described position of retailers is now based on one interview and on the view of the bakers and bakery experts. This is a biased view, which not per se represents the actual view of the retailers.

After Delphi round one the Cradle to Cradle idea to consider waste streams at design state was excluded from further research, because the input was too low. However, this low input could also be caused by the type of questions in Delphi round one. Those focused on information about valorisation methods, and then it is 'outside the box' to also come up with Cradle to Cradle. When there would have been a direct question like 'how can the waste streams be considered at the product and process phase?' there might have been more relevant answers.

The developments around the 'Bread to Bread' project, cattle feed – extra, were published during Delphi round two. This development is not discussed in the questionnaire, but it is taken along after Delphi round three. It made one questionnaire question in the bakery questionnaire irrelevant. Namely the question that concerned the percentage industrial bakeries that will apply a new method to valorise return bread within five years. This initiative influenced the predictions; around 35% of the industrial bakeries are branch organisation member. So, when this pilot succeeds a substantial part of the sector has already chosen a direction.

Normally a Delphi research is used to reach consensus, this was not feasible in this thesis research. The bakery experts gave some future predictions, but there was no fourth Delphi round to discuss this further and reach a collective decision.

6. Conclusions & recommendations

The objective of this research is to obtain insight in the broad range of current and future return bread valorisation methods usable for return bread in Dutch industrial bakeries, and to identify industrial baker's drivers and barriers to choose for a specific method. In the sub-questions special attention is paid to the effect of the six influencing factors. After executing the research it can be concluded that all the influencing factors are interrelated to each other. Therefore all those influencing factors will also be involved to answer the research question:

- What are the main advantages and disadvantages of the different methods of return bread valorisation as experienced and expected by the Dutch industrial bakery companies?

In this thesis research six valorisation methods are discussed in detail. These six methods are divided in three groups: human food, cattle feed and non-food. Each group has its specific advantages and disadvantages that will be described below. The recommended improvement points are shown in the flow chart model in blue.

6.1. Advantages, disadvantages and recommendations

Human food methods

Figure 10 shows the flow chart for the two human food methods, bread snacks and circle bread. The lower part in the left represents the influence from the communication factors on the willingness. Willingness can also be formed internally, but external communication increases it. The two human food methods are not yet put in practice for industrial bakery's return bread. This means that there is no historic basis, hence lowering the bakery's awareness of the principles and benefits. The advantage is that there is a 'champion' company, which produces the ingredients needed to produce bread snacks and circle bread. Information is spread via the Nationale Denktank, the SBI project and some articles in bakery world. Furthermore there are some examples of small independent bakeries who execute the method. It is recommended to increase the communication (and thereby willingness) by finding industrial bakeries and retailers who want to be frontrunners. These pioneers can show whether the method is feasible and what the real practical barriers are. How the pioneering of the bakery and retailer could work is explained in the last paragraph of this section.
It is ensured that the two methods are technical feasible. So the business aspects are quite certain and no investment for a feasibility research is needed, which lowers the economic risk. The main financial investment regards the ingredients and new installations in case of circle bread. The execution of both techniques is labour intensive. To meet the HACCP regulations and work in hygienic conditions extra labour is required. This has a negative influence on the economic feasibility. The profits and/or cost savings are high because return bread is commercialized to human food. A disadvantage for bread snacks is that the customer's market will be small. Not all the unsold bread can be valorised to snacks, so this can solve the return bread problem only partially.
According to the industrial bakers the main barrier concerns the law and regulations. They state those can not be met because they do not trust the hygienic conditions of the return bread. In theory all the possible risks can be guarded within the HACCP regulations, by letting retailers act as food suppliers. But in practice meeting the HACCP means a lot of extra labour and the bakers stated that retailers are not willing to do this. Industrial bakers are not willing to take any food safety risk, public trust and corporate image are crucial. So, in practice not the law and regulations form the barrier, but the trust in the retailer and the necessary guarantee for food safety.
The recommendation to solve this barrier is to increase the communication and collaboration with

the retailers hence aiming to increase their willingness. Currently return bread forms no problem for retailers. They are not aware of the principles and benefits of valorisation to human food. The unsold bread is returned as quickly as possible since that is the most attractive financial option. The financial loss for unsold return bread is on the retailer's expense, so it is questionable whether this actually is the best financial option. The retailer's attitude might change in the future because resources are getting more expensive and sustainability becomes a customer's interest. Valorisation via circle bread leads to costs savings from which also the retailers can profit. Valorisation via bread snacks leads to a direct profit for the retailer. When retailers and frontrunner bakeries make agreements, the communication factors improve. This could also improve the trust and the willingness to act. Only if the retailer is willing to make some real steps towards sustainability the two methods to valorise return bread to human food become interesting. The main financial investment is the extra time and labour from the supermarket personnel, who also need more elaborated instructions. When bakeries trust the hygienic situation and the food safety risk is lowered the methods can be executed. With low investments the CSR-image of the supermarket and the industrial bakery improves. Whether retailers want to invest in extra man hours will mainly depend on the economic feasibility. This collaboration option is only applicable for the long term scenario.

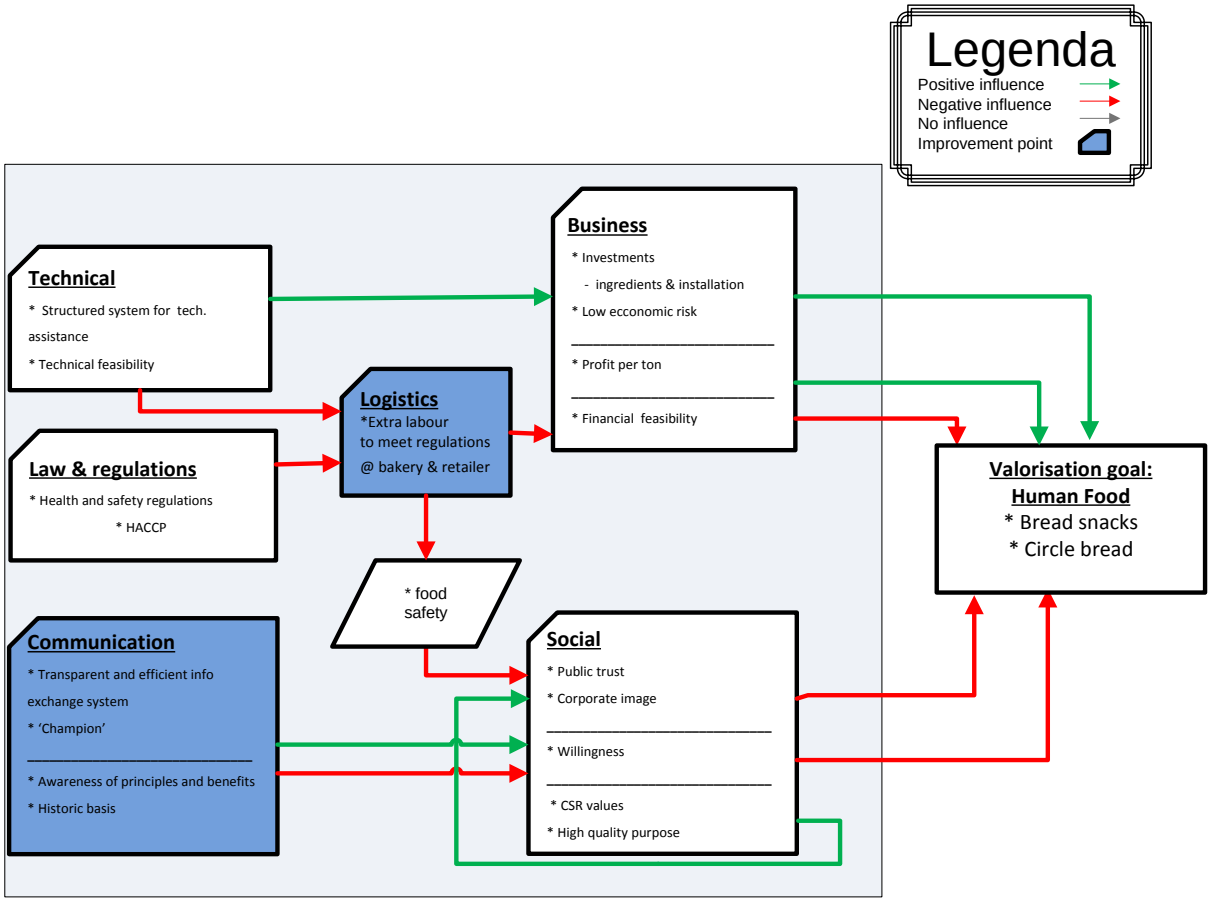

Figure 10: Flow chart for the two human food methods: circle bread and bread snacks

Summary of recommendations:

- *Bakeries must increase communication with retailers and thereby increase willingness from retailers.*

- *Retailers must invest in extra time, labour and education for their personnel, in order to work according to HACCP and prevent food safety risks.*

Cattle feed method

Figure 11 shows the flow chart for cattle feed - extra. Currently most industrial bakeries let their return bread valorise to cattle feed. Industrial bakers and cattle feed processers are used to collaborate and have an historic basis. This means that the communication factors have a positive influence on the willingness. It gives high expectations for the 'Bread to Bread' project, or as it is called in this thesis cattle feed - extra. The goal of cattle feed - extra is to valorise 60% to glucose as resource for bakery yeast and 40% as proteins for cattle feed.

The initiative for cattle feed - extra is taken by the cattle feed processer, who executes the feasibility research. The processer invests in R&D and creates a structured system for technical assistance for the bakeries. This means that the processer takes the economic risk and solves uncertainties. This lowers financial business barriers and has especially advantages for individual bakers with low financial resources. At this moment the technical feasibility is not yet completely worked out. It is uncertain whether cattle feed - extra will make a net profit, because the new process will probably also involve extra costs. The current yield for cattle feed is 30-40 €/ton and this might be improved by newer valorisation methods once those are further developed.

Because 60% is valorised to glucose for bakery's yeast, the entire process needs to meet the HACCP regulations. As explained in the section about food methods above, bakers will not take any food safety risk. Meeting the HACCP regulations is possible, but requires extra labour from both the retailer and the bakery. It is uncertain whether it is financially feasible to execute this extra labour. Moreover to change the mindset of bakers and retailers is a long term process. For the short term it is better feasible when the 60% of glucose is used for a non-food or cattle feed. This takes away the food safety issue and the involved disadvantages. Meeting the GMP+ norms requires also some extra labour for the industrial bakery, but less intensive than for human food. To remain profitable the labour costs must not exceed the 30-40 €/ton return bread. The main advantage for a non human food method is that retailers do not have to be involved for this. A disadvantage is that the green arrow from CSR values might become neutral.

On the short term the cattle feed – extra, with 60% glucose for non-food, it is the most realistic option for individual bakeries. When the 60% glucose is used for human food the barriers are larger and this option is less attractive.

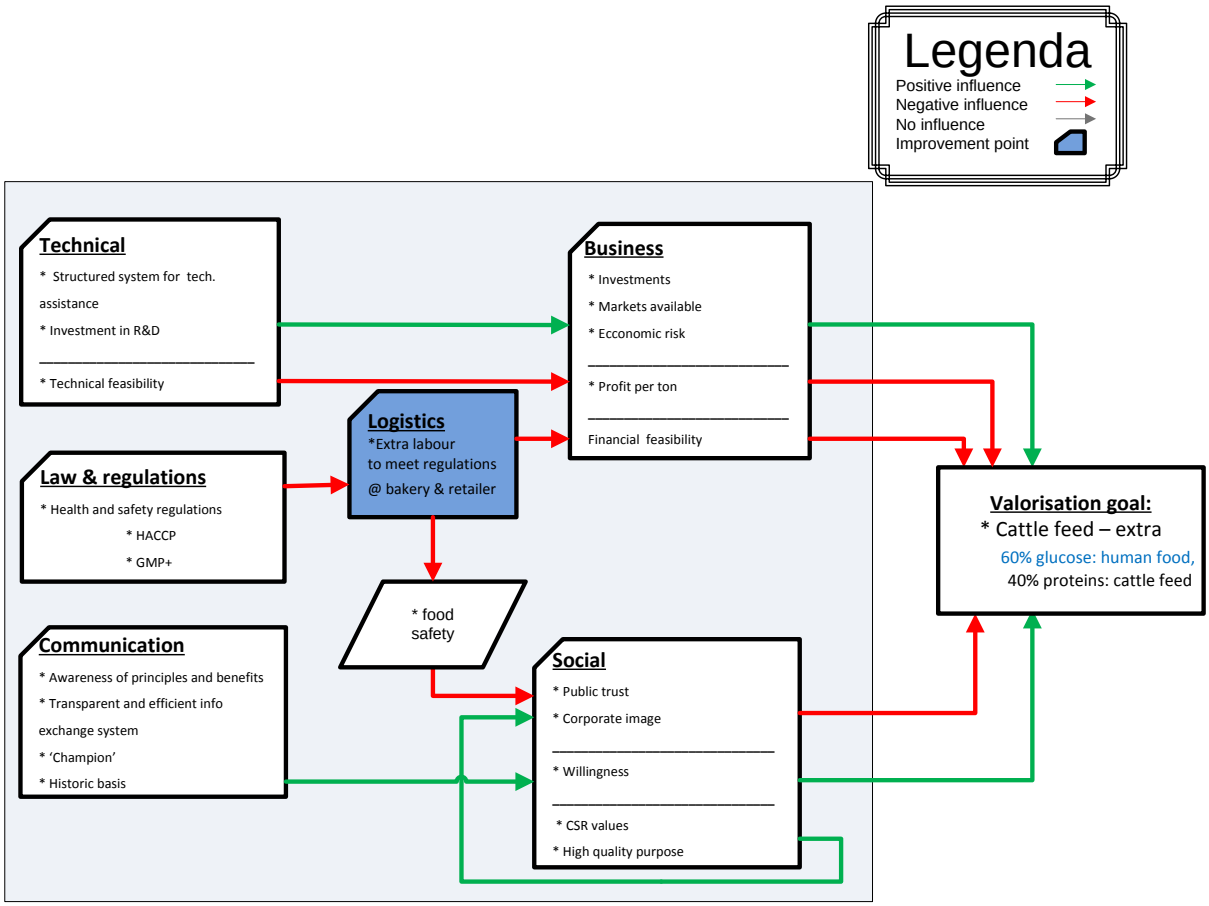

Figure 11: Flow chart for cattle feed – extra

Summary of recommendations:

- *The cattle feed processor must reject the human food goal, so:*
  - *There is no need for extra collaboration with the retailers*
  - *This eliminates the food safety risk and possible damage on the corporate image*

Non-food methods

Figure 12 shows the flow chart for the non-food methods. Currently the only advantage of a non-food method is that it does not struggle with HACCP regulations. Non-food means no health regulations, so no extra labour or risk taking.

The main disadvantage lies with the uncertain technical feasibility. This leads to many uncertainties in the business factors, like the investment of time and money, economic feasibility and the available market. The experts predicted that the profit per ton might be higher than with cattle feed, this stays very uncertain. Also some logistic issues are unclear, for example the separation of different bread types. These technical, business and logistic issues can be solved by a feasibility research, but the financial investment in such a research poses an economic risk. The financial situation in the sector allows not much investment space, so R&D investment of an individual baker is not a realistic option. There are two alternative scenarios to achieve this option, the first is an initiative from a waste processer or valorisation expert, the other is collective action.

An individual processer can take the initiative, because return bread valorisation is its core business and they have direct benefits. A new 'champion' can reach an agreement with bakeries, similar to the current practice of cattle feed processers. The key principle for success is that the method is ready to use for the bakery. A disadvantage is that bakeries often have long term contracts with their current waste stream processers. This means that a new processer has to take a large economic risk. The plausibility of this scenario depends mainly on the willingness of one person or company. For example the 'champion' who invests in the feasibility research for carton strengtheners. If this feasibility research succeeds he can individually find industrial bakeries to make contractual agreements regarding their return streams. The fermentation and digestion experts in the Delphi research pointed out that the bakeries need to invest in a feasibility research. Without financial input from the bakery sector those actors will not take an initiative. However there might also be other external parties.

Collective action from multiple bakeries and branch organisations is also an option, collaboration increases the investment space. It is plausible that a collective initiative will arise on the short term. At June 13th Food Valley NL organises a KiA waste streams gathering where experts will present valorisation methods especially for industrial bakeries. The goal of Food Valley NL is to find active KiA participants who really want to make improvements regarding their waste streams. When different actors are brought together two communication factors will change. Currently the awareness of principles and benefits for the non-food methods is low. Apart from a few digesters, there are no practical examples and there is limited information exchange. This unfamiliarity decreases the willingness to start with a new method. The KiA afternoon will function as a 'transparent and efficient information exchange system', and 'the awareness of principles and benefits' is raised. If the KiA programme will function similar as it does with other food companies there is a chance that the bakeries will take a collective initiative. Relevant organisations such as the NVB, NBC and some bakeries have already subscribed for the gathering. Motivations for extra research in the non-food direction are: a higher price per ton return bread, a less labour intensive method and lower food safety risks. With collective action the financial resources are limited, so the investors need to choose a direction. There are three substitutable non-food methods: carton strengtheners, fermentation and biogas. From these three methods fermentation is the most uncertain and unfamiliar option, which requires the highest investment for a feasibility research. Although the experts have high expectations for fermentation this is too futuristic for the bakery sector. It is more likely that the research will focus on carton strengtheners or digestion. This because the 'champion' of carton strengtheners already performed many research and some examples of bread digesters exist. Also those two methods require a more thorough feasibility research, but the primary research makes it less intensive than compared to fermentation. After the feasibility research many business and logistic uncertainties can be solved. It will depend on these research outcomes which of the two methods will be executed. To obtain successful execution the collective researchers should develop a ready-to-use method for the industrial bakeries. The final choice for one of the methods will depend on the economic feasibility and workability.
The uncertainty of the non-food methods and the high investments to solve these make these options not applicable for the short term.

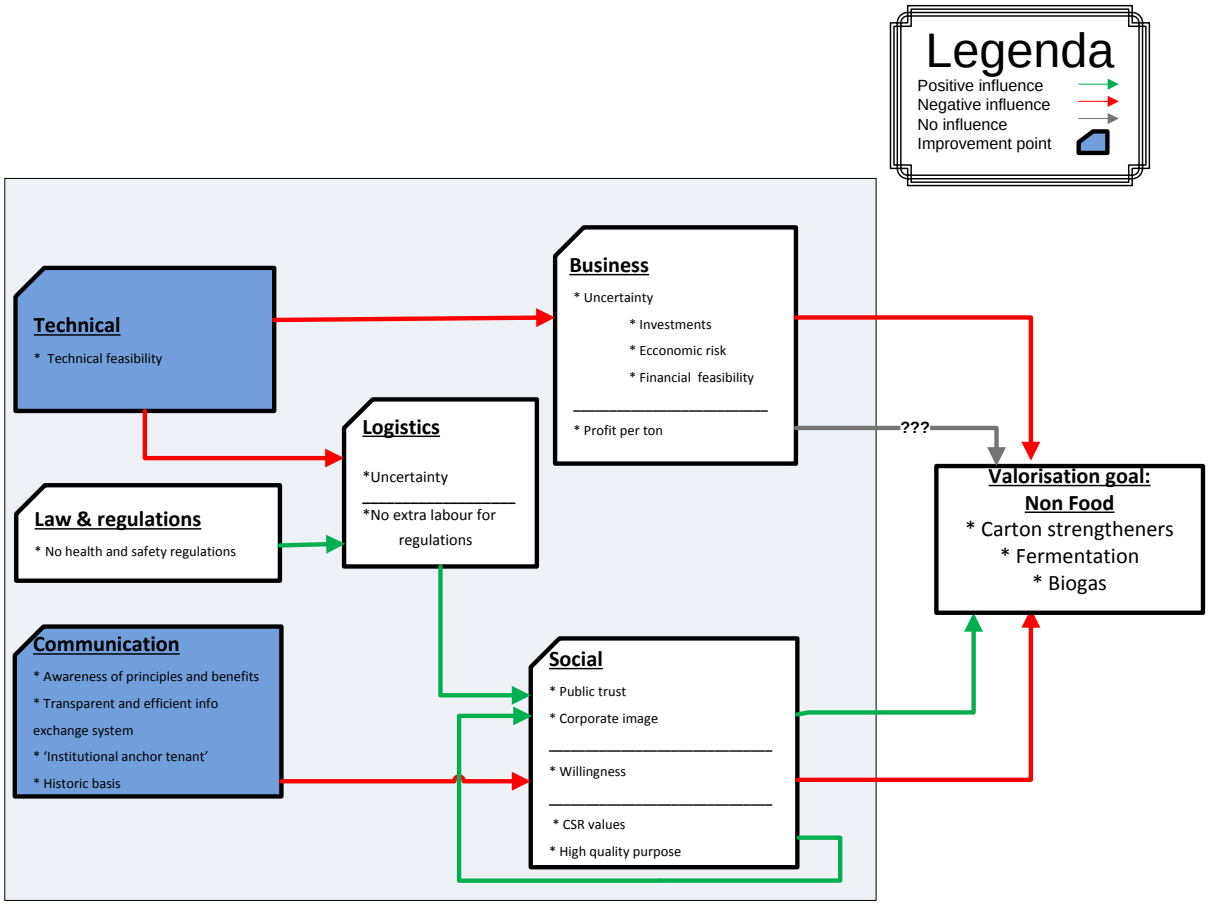

Figure 12: Flow chart for the three 'non-food' methods: carton strengtheners, fermentation and biogas

Summary of the recommendations:

- *External parties must improve the communication factors*
- *External parties, or a collective bakery initiative must invest in technical, financial and logistical feasibility research, to reduce uncertainties*

6.2. Future opportunities

The Figure 13 below shows an overview of which actions are needed before a valorisation method can be executed within the short-, medium- or long term. The blue blocks represent critical actions points, which can delay the process.

A combination of methods can also be an opportunity. For example by using the glucose in cattle feed – extra for fermentation to bio plastics or for the starch for carton strengtheners.

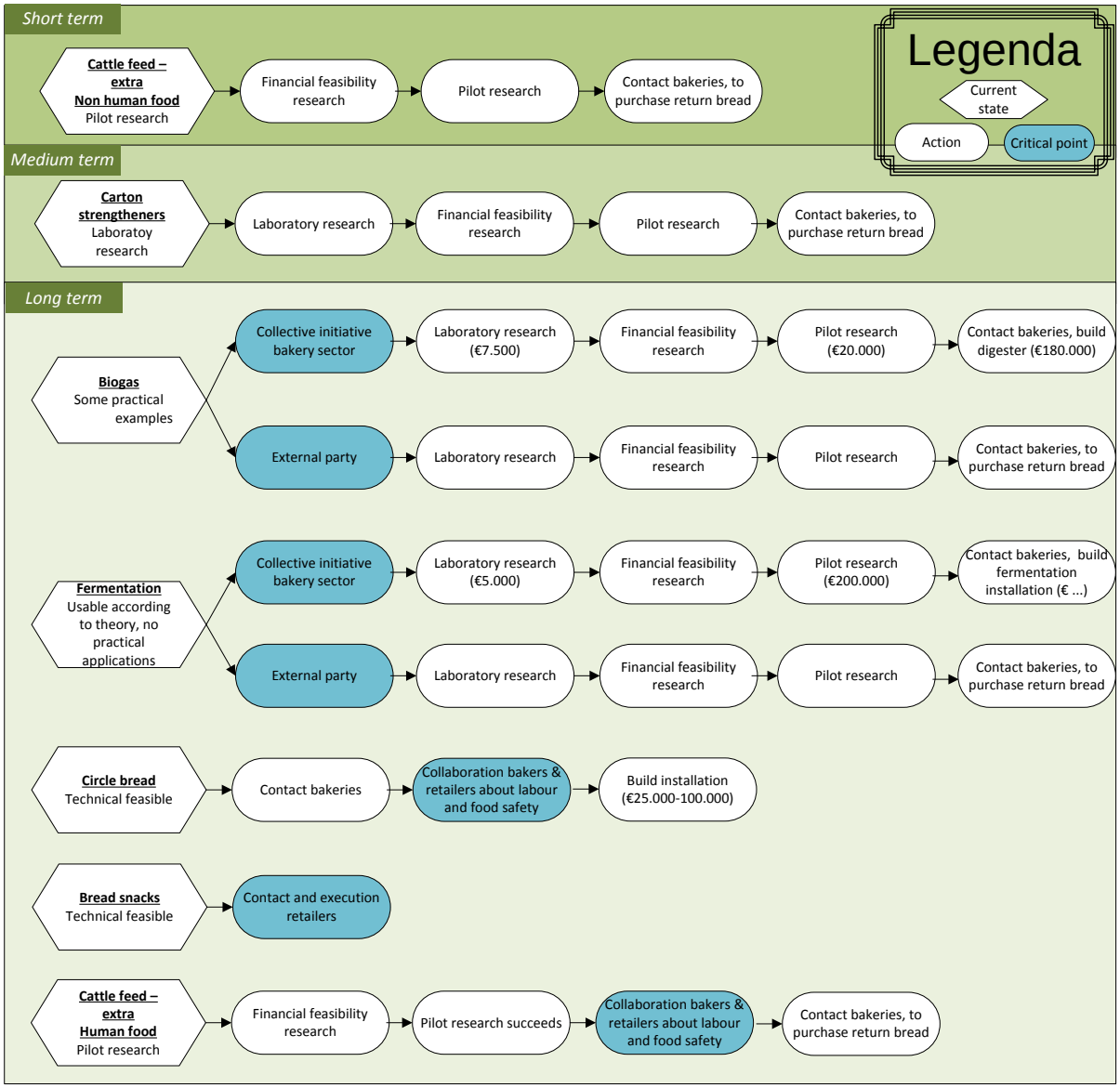

Figure 13: Future expectations, including actions necessary to execute a method in practice

When the cattle feed – extra approach chooses to use the 60% glucose for non human food this method can be executed on a short term. This prediction is based on the current state of the method and that the pilot research is already executed. Besides, bakeries and cattle feed processers have a historic collaboration basis.

On the medium term it is expected that carton strengtheners can be executed in practice. A 'champion' already executes the feasibility research, which is in the laboratory's phase. This means that, compared with cattle feed – extra, the research process requires more time. Whether the method will be applied in practice depends on the research outcomes concerning the technical, financial and logistical feasibility.

The other researched methods will be executed in on the long term. The execution speed will depend on the starting moment, which depends on the future willingness to act of 'champions'. The execution speed will also depend on the outcome of the research. Bakeries will not easily switch between methods, so the first actions will be important.

Biogas is the first method in the long term area. There are already some practical examples which

means that the feasibility research is not very elaborated. Someone needs to take the initiative to research this further. This can be done by a collective initiative from the bakery sector or by an external party.
The situation of fermentation is similar to biogas. The main difference is that the feasibility research is more expensive and the bakery sector is unfamiliar with it. This decreases the chance that the bakery sector will collectively finance the feasibility research for fermentation. Since the fermentation experts are more positive also an external party will take the initiative.
For the three human methods, at the bottom in Figure 13, collaboration with the retailers is required to meet the HACCP norms. Based on the interviews with bakers and bakery experts improvement of collaboration is a difficult and long term process. It will also depend on the willingness of retailers. Without collaboration with bakeries retailers can produce bread snacks. According to bakery experts consulted in this thesis retailers are not willing to do this since it is not a common practice and it involves extra labour and food risks.

6.3. Reflections on the industrial symbiosis theory

In this theory reflection special attention is paid to the applicability of the IS theory for this sector. Initially the IS theory is meant for the rough industry and not for the food manufacturing sector. The reason to apply the theory to this work field is because food waste valorisation is already a topic in European and Dutch policy. This means that some relevant aspects from practice could be missing in the theory. Therefore some influencing factors are added to the theoretical framework.
In this sector public trust is extremely important because of possible food safety risks. An extra factor added to measure customer's trust is 'corporate image'. Logistical factors are very sector specific, so also here factors are added including plastic filtration, bread type separation and the storage capacity.
CSR has a complicated position. According to theory, the presence of CSR works as a driver to valorise waste streams. This is the case for a only few idealistic bakeries, definitely not for the majority. Nevertheless, the added value of CSR, moral intensions and willingness must not be underestimated in this situation. A single 'champion', like with the carton strengtheners, could reach a lot in the pioneering area. All bakery experts agreed that a few frontrunner bakeries could encourage the others. So, if one person (or party) is willing to take the economic risk in order to obtain a sustainable goal, he can shape opportunities for the rest of the sector. Essential is that the final solution must meet the financial and technical demands, because those are important for companies that are not driven by CSR. If this is not achieved the solution will never be executed on larger scale.
IS theory does mention that the economic risk must be low, which indirectly implies that there is no uncertainty. In this research it turned out that uncertainty concerning business factors is the most important factor for industrial bakers. They will not invest in an uncertain, half finished method.

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Attachment 1: Invitation and participation in the three questionnaires

This table gives an overview which participants were invited for which questionnaires. The invitation is based on the expertise of the participants, which is shown in Table 2. The red minuses mean that the participant was invited but did not fill in the questionnaire.

Participant	1.General questionnaire	2.Baker's questionnaire	3.Expert questionnaire
BE-A	+	-	-
BE-B	-	+	-
BE-C	+	+	-
BE-D	+	+	-
IB-a	+	+	-
IB-b	+	+	-
IB-c	+	+	-
SIB	+	+	-
E12	+ All methods	-	+ Only method 1 & 2
E5	+ Only method 1, 2, 5 & 8	-	- **Only method 5**
E6	+ Only method 6	-	+ Only method 6
E7	+ All methods	-	+ Only method 7
E78	+ Only method 7	-	+ Only method 7 & 8
E8	+ Only method 8	-	+ Only method 8
Retailer	-	-	-

Attachment 2: The general questionnaire

Explanation for the participants

Beste deelnemer,

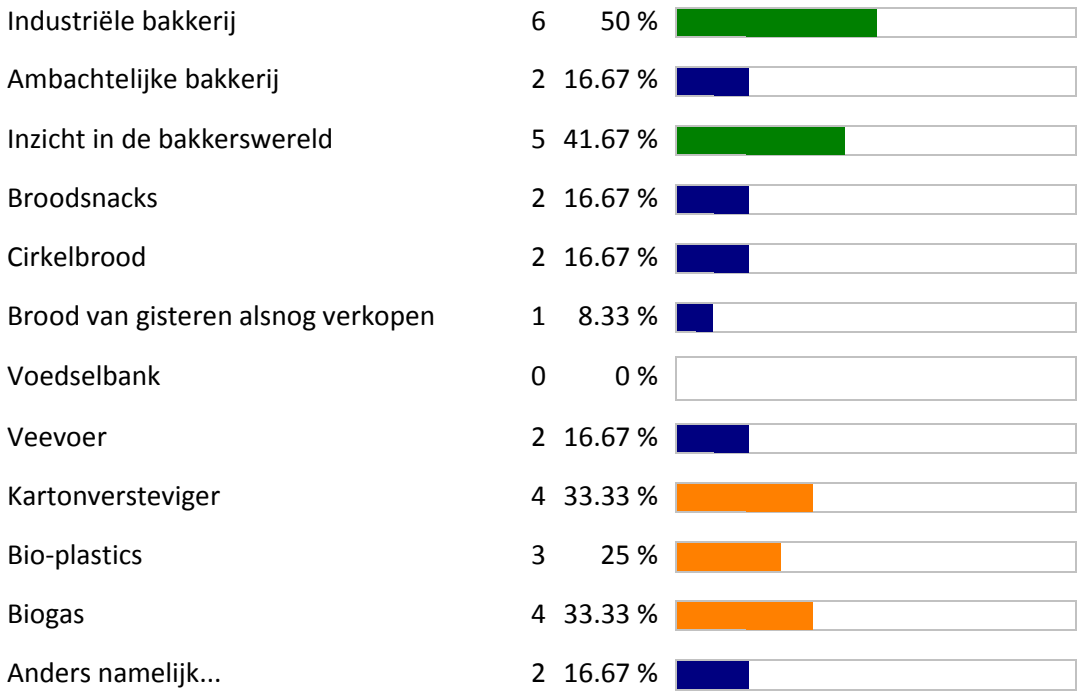
Deze vragenlijst gaat over acht valorisatiemethodes die genoemd zijn in de eerste ronde van het Delphi onderzoek (het telefoongesprek).
U krijgt telkens eerst een korte uitleg over de methode, vervolgens wordt gevraagd naar uw kennis, mening en verwachtingen. Bij elke methode worden dezelfde zeven vragen gesteld.
Onderaan de lijst is ook ruimte voor het maken van op- of aanmerkingen. De enquêtesoftware is zo ontwikkeld dat u de vragen in meerdere etappes kunt invullen, door onderaan de lijst de knop 'tussentijds bewaren' in te klikken..
Bij onduidelijkheden kunt u mij e-mailen of bellen. Wanneer u dat prettiger vindt dan kunt u mij ook opbellen en dan kunnen we de vragenlijst samen doorlopen. Kunt u voor maandag 25 februari alle vragen hebben ingevuld?
Vriendelijke groeten,

Anouk Schrauwen

06-25570157
anouk.schrauwen@wur.nl

General question

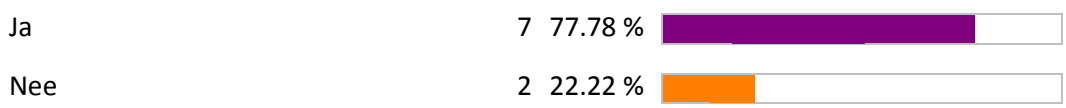
1. Wat is/zijn uw expertise(s)



1. Bread snacks

The questions 2-10 are filled in by: BE-A, BE-C, BE-D, IB-a, IB-b, IB-c, E12, E5 and E7

2. Heeft u wel eens van deze methode gehoord?



3. Zo ja, hoe beoordeelt u uw kennis over deze methode?

1	0	0 %	
2	0	0 %	
3	0	0 %	
4	0	0 %	
5	2	28.57 %	
6	2	28.57 %	
7	0	0 %	
8	1	14.29 %	
9	0	0 %	
10	2	28.57 %	

4. Binnen hoeveel jaar verwacht u dat deze methode op grotere schaal bij industriële bakkerijen is ingevoerd?

0	1	11.11 %	
10	3	33.33 %	
niet haalbaar	5	55.56 %	

5. Van welke partij(en) verwacht u dat zijn het initiatief zullen nemen om deze methode vanaf de huidige situatie (zoals hierboven omschreven) verder te ontwikkelen?

Producenten van ingrediënten	2	28.57 %	
Industriële bakkerijen	4	57.14 %	
Verwerkingsbedrijven gespecialiseerd in deze methode	3	42.86 %	
Commerciële onderzoeksbureaus	0	0 %	
Universiteiten	0	0 %	

De Nederlandse overheid	0	0 %
Anders namelijk...	2	28.57 %

6. In de bovenstaande omschrijving staat dat de industriële bakkerij bij deze methode de verwerking zelf uitvoert. Welke partij kan, volgens uw visie, deze methode het beste uitvoeren?

Industriële bakkerijen	3	33.33 %
Verwerkingsbedrijven gespecialiseerd in deze methode	5	55.56 %
Anders namelijk...	1	11.11 %

7. Consumentenvertrouwen in de voedselveiligheid

Positieve invloed	1	12.50 %
Geen invloed	4	50 %
Negatieve invloed	3	37.50 %

8. Consumentenvertrouwen in de voedselkwaliteit

Positieve invloed	1	12.50 %
Geen invloed	4	50 %
Negatieve invloed	3	37.50 %

9. Bedrijfsimago

Positieve invloed	5	62.50 %
Geen invloed	2	25 %

Negatieve invloed	1	12.50 %

10. Ruimte voor opmerkingen over deze methode:

Toelichting haalbaarheid: nooit op grote schaal. Broodsnacks zullen altijd een kleine markt blijven
Toelichting vraag 5: kruidenleveranciers

Toelichting haalbaarheid: wordt niet ingevoerd, want te kostbaar. Teveel man uren nodig.

Toelichting vraag 5: retailers
Toelichting vraag 6: Industriele of ambachtelijk bakkerijen die hier een aparte ruimte/productielijn voor hebben ingericht

Toelichting: brood dat retour komt mag m.i. op deze wijze niet meer verwerkt worden voor humane consumptie

2. *Circle bread*

The questions 11-19 are filled in by: BE-A, BE-C, BE-D, IB-a, IB-b, IB-c, E12, E5, E7

11. Heeft u wel eens van deze methode gehoord?

Ja	8	88.89 %
Nee	1	11.11 %

12. Zo ja, hoe beoordeelt u uw kennis over deze methode?

1	0	0 %
2	0	0 %
3	3	37.50 %
4	1	12.50 %
5	1	12.50 %

6	0	0 %
7	2	25 %
8	1	12.50 %
9	0	0 %
10	0	0 %

13. Binnen hoeveel jaar verwacht u dat deze methode op grotere schaal bij industriële bakkerijen is ingevoerd?

0	1	11.11 %
1	1	11.11 %
10	1	11.11 %
15-20	1	11.11 %
2	2	22.22 %
niet haalbaar	3	33.33 %

14. Van welke partij(en) verwacht u dat zijn het initiatief zullen nemen om deze methode vanaf de huidige situatie (zoals hierboven omschreven) verder te ontwikkelen?

Producenten van ingrediënten	4	44.44 %
Industriële bakkerijen	8	88.89 %
Verwerkingsbedrijven gespecialiseerd in deze methode	0	0 %
Commerciële onderzoeksbureaus	0	0 %
Universiteiten	0	0 %
De Nederlandse overheid	1	11.11 %
Anders namelijk...	2	22.22 %

15. In de bovenstaande omschrijving staat dat de industriële bakkerij bij deze methode de

verwerking zelf uitvoert. Welke partij kan, volgens uw visie, deze methode het beste uitvoeren?

Industriële bakkerijen	6	75 %
Verwerkingsbedrijven gespecialiseerd in deze methode	1	12.50 %
Anders namelijk...	1	12.50 %

16. Consumentenvertrouwen in de voedselveiligheid

Positieve invloed	1	12.50 %
Geen invloed	4	50 %
Negatieve invloed	3	37.50 %

17. Consumentenvertrouwen in de voedselkwaliteit

Positieve invloed	1	12.50 %
Geen invloed	4	50 %
Negatieve invloed	3	37.50 %

18. Bedrijfsimago

Positieve invloed	5	62.50 %
Geen invloed	2	25 %
Negatieve invloed	1	12.50 %

19. Ruimte voor opmerkingen over deze methode:

Toelichting vraag 14: overkoepelende initiatieven, als NBC, retail

Toelichting vraag 14: retailers, zij zijn de één na laatste stap in de keten en afnemer van de industriele bakkerij
Toelichting vraag 15: beide (=industriële bakkerijen en gespecialiseerde verwerkingsbedrijven) is mogelijk mits, juiste apparatuur in training (kennis) in huis.

Toelichting: retourbrooddeeg zal met een overmaat vers deeg moeten worden gemengd (werkzame gluten nodig)

3. *'Selling yesterday's bread'*

The questions 20-28 are filled in by: BE-A, BE-C, BE-D, IB-a, IB-b, IB-c, E12, E7

20. Heeft u wel eens van deze methode gehoord?

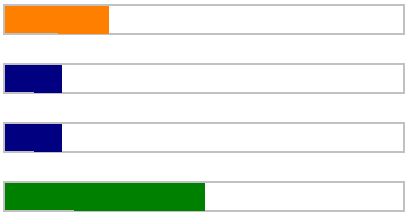
Ja	7	87.50 %	
Nee	1	12.50 %	

21. Zo ja, hoe beoordeelt u uw kennis over deze methode?

1	0	0 %	
2	0	0 %	
3	0	0 %	
4	1	12.50 %	
5	1	12.50 %	
6	1	12.50 %	
7	3	37.50 %	
8	1	12.50 %	
9	0	0 %	
10	1	12.50 %	

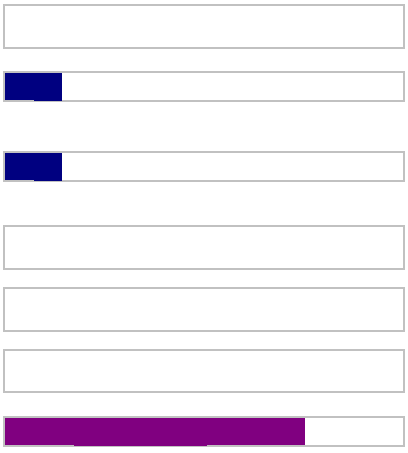
22. Binnen hoeveel jaar verwacht u dat deze methode op grotere schaal bij industriële bakkerijen is ingevoerd?

0	2	25 %
2	1	12.50 %
5	1	12.50 %
niet haalbaar	4	50 %



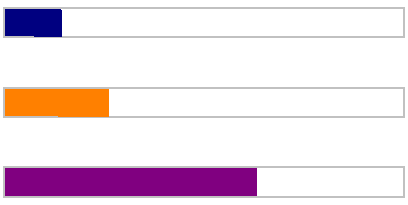
23. Van welke partij(en) verwacht u dat zijn het initiatief zullen nemen om deze methode vanaf de huidige situatie (zoals hierboven omschreven) verder te ontwikkelen?

Producenten van ingrediënten	0	0 %
Industriële bakkerijen	1	12.50 %
Verwerkingsbedrijven gespecialiseerd in deze methode	1	12.50 %
Commerciële onderzoeksbureaus	0	0 %
Universiteiten	0	0 %
De Nederlandse overheid	0	0 %
Anders namelijk...	6	75 %



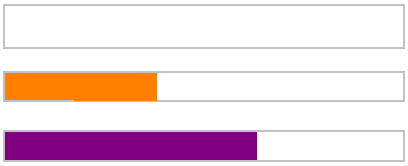
24. In de bovenstaande omschrijving staat dat de industriële bakkerij bij deze methode de verwerking uitbesteedt. Welke partij kan, volgens uw visie, deze methode het beste uitvoeren?

Industriële bakkerijen	1	12.50 %
Verwerkingsbedrijven gespecialiseerd in deze methode	2	25 %
Anders namelijk...	5	62.50 %



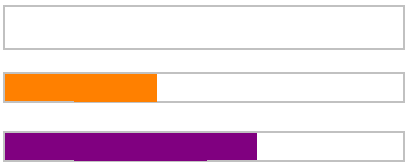
25. Consumentenvertrouwen in de voedselveiligheid

Positieve invloed	0	0 %
Geen invloed	3	37.50 %
Negatieve invloed	5	62.50 %



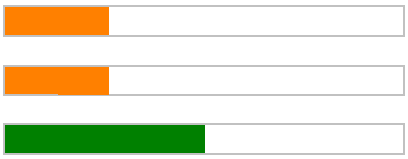
26. Consumentenvertrouwen in de voedselkwaliteit

Positieve invloed	0	0 %
Geen invloed	3	37.50 %
Negatieve invloed	5	62.50 %



27. Bedrijfsimago

Positieve invloed	2	25 %
Geen invloed	2	25 %
Negatieve invloed	4	50 %



28. Ruimte voor opmerkingen over deze methode:

Toelichting vraag 23: ambachtelijke bakkerij

Toelichting vraag 23: blijft bij ambacht. Supermarkten gaan dit niet doen.
Toelichting vraag 24: voedselbanken

Toelichting vraag 23: retail
Toelichting vraag 24: retail

Toelichting vraag 23: retailer verkoop de andere dag dan minder vers brood
Toelichting vraag 24: product zal dan verkocht moeten worden door retail tegen of onder de kostprijs

toelichting haalbaarheid: moeten we niet willen (imago).

toelichting vraag 23: ambachtelijke bakkerijen en supermarkten

toelichting vraag 23: geen
toelichting vraag 24: geen

4. *Food bank*

The questions 29-37 are filled in by: BE-A, BE-C, BE-D, IB-a, IB-b, IB-c, E12, E7

29. Heeft u wel eens van deze methode gehoord?

Ja	7	87.50 %	
Nee	1	12.50 %	

30. Zo ja, hoe beoordeelt u uw kennis over deze methode?

1	1	14.29 %	
2	0	0 %	
3	0	0 %	
4	0	0 %	
5	0	0 %	
6	3	42.86 %	
7	1	14.29 %	
8	2	28.57 %	
9	0	0 %	
10	0	0 %	

31. Binnen hoeveel jaar verwacht u dat deze methode op grotere schaal bij industriële bakkerijen is ingevoerd?

0	5	55.56 %	

1	2	22.22 %
2	1	11.11 %
niet haalbaar	1	11.11 %

32. Van welke partij(en) verwacht u dat zijn het initiatief zullen nemen om deze methode vanaf de huidige situatie (zoals hierboven omschreven) verder te ontwikkelen?

Producenten van ingrediënten	0	0 %
Industriële bakkerijen	5	71.43 %
Verwerkingsbedrijven gespecialiseerd in deze methode	1	14.29 %
Commerciële onderzoeksbureaus	0	0 %
Universiteiten	0	0 %
De Nederlandse overheid	1	14.29 %
Anders namelijk...	2	28.57 %

33. In de bovenstaande omschrijving staat dat de industriële bakkerij bij deze methode de verwerking uitbesteedt. Welke partij kan, volgens uw visie, deze methode het beste uitvoeren?

Industriële bakkerijen	2	25 %
Verwerkingsbedrijven gespecialiseerd in deze methode	3	37.50 %
Anders namelijk...	3	37.50 %

34. Consumentenvertrouwen in de voedselveiligheid

Positieve invloed	0	0 %
Geen invloed	5	62.50 %

Negatieve invloed	3	37.50 %

35. Consumentenvertrouwen in de voedselkwaliteit

Positieve invloed	1	12.50 %
Geen invloed	4	50 %
Negatieve invloed	3	37.50 %

36. Bedrijfsimago

Positieve invloed	6	75 %
Geen invloed	1	12.50 %
Negatieve invloed	1	12.50 %

37. Ruimte voor opmerkingen over deze methode:

Toelichting haalbaarheid: moeten we niet doen

Toelichting vraag 32: retail
Toelichting vraag 33: retail

de voedselbank kan ooit de hoeveelheden afzetten; kwaliteit en hoeveelheid valt niet samen met behoefte.

toelichting vraag 32: retail kan dit weggeven voor hun imago, maar vanuit kosten halen zijn meer uit herverwerking (marge)
toelichting vraag 33: de voedselbank kan dit toch zelf ophalen mocht deze methode wenselijk zijn?

5. Cattle feed

The questions 38-46 are filled in by: BE-A, BE-C, BE-D, IB-a, IB-b, IB-c, E12, E5, E7

38. Heeft u wel eens van deze methode gehoord?

Ja	9	100 %	
Nee	0	0 %	

39. Zo ja, hoe beoordeelt u uw kennis over deze methode?

1	0	0 %	
2	0	0 %	
3	0	0 %	
4	0	0 %	
5	1	11.11 %	
6	1	11.11 %	
7	0	0 %	
8	2	22.22 %	
9	2	22.22 %	
10	3	33.33 %	

40. Binnen hoeveel jaar verwacht u dat deze methode op grotere schaal bij industriële bakkerijen is ingevoerd?

0	6	75 %	
1	2	25 %	

41. Van welke partij(en) verwacht u dat zijn het initiatief zullen nemen om deze methode vanaf de huidige situatie (zoals hierboven omschreven) verder te ontwikkelen?

Producenten van ingrediënten	0	0 %	

Industriële bakkerijen	5	55.56 %	
Verwerkingsbedrijven gespecialiseerd in deze methode	6	66.67 %	
Commerciële onderzoeksbureaus	0	0 %	
Universiteiten	0	0 %	
De Nederlandse overheid	0	0 %	
Anders namelijk...	1	11.11 %	

42. In de bovenstaande omschrijving staat dat de industriële bakkerij bij deze methode de verwerking uitbesteedt. Welke partij kan, volgens uw visie, deze methode het beste uitvoeren?

Industriële bakkerijen	1	11.11 %	
Verwerkingsbedrijven gespecialiseerd in deze methode	7	77.78 %	
Anders namelijk...	1	11.11 %	

43. Consumentenvertrouwen in de voedselveiligheid

Positieve invloed	1	11.11 %	
Geen invloed	7	77.78 %	
Negatieve invloed	1	11.11 %	

44. Consumentenvertrouwen in de voedselkwaliteit

Positieve invloed	1	11.11 %	
Geen invloed	7	77.78 %	
Negatieve invloed	1	11.11 %	

45. Bedrijfsimago

Positieve invloed	2	22.22 %
Geen invloed	6	66.67 %
Negatieve invloed	1	11.11 %

46. Ruimte voor opmerkingen over deze methode:

Toelichting vraag 41: het is een manier om geld voor een afvalstroom te krijgen, maar dat is minder dan de kostprijs

toelichting vraag 42: milgro

6. *Carton strengtheners*

The questions 47-55 are filled in by: BE-A, BE-C, BE-D, IB-a, IB-b, IB-c, E12, E6, E7

47. Heeft u wel eens van deze methode gehoord?

Ja	7	77.78 %
Nee	2	22.22 %

48. Zo ja, hoe beoordeelt u uw kennis over deze methode?

1	0	0 %
2	0	0 %
3	0	0 %
4	2	28.57 %
5	0	0 %
6	1	14.29 %

7	2	28.57 %
8	1	14.29 %
9	1	14.29 %
10	0	0 %

49. Binnen hoeveel jaar verwacht u dat deze methode op grotere schaal bij industriële bakkerijen is ingevoerd?

1	1	11.11 %
2	2	22.22 %
3	1	11.11 %
4	1	11.11 %
5	1	11.11 %
5-10	1	11.11 %
niet haalbaar	2	22.22 %

50. Van welke partij(en) verwacht u dat zijn het initiatief zullen nemen om deze methode vanaf de huidige situatie (zoals hierboven omschreven) verder te ontwikkelen?

Producenten van ingrediënten	0	0 %
Industriële bakkerijen	4	44.44 %
Verwerkingsbedrijven gespecialiseerd in deze methode	8	88.89 %
Commerciële onderzoeksbureaus	1	11.11 %
Universiteiten	1	11.11 %
De Nederlandse overheid	1	11.11 %
Anders namelijk...	1	11.11 %

51. In de bovenstaande omschrijving staat dat de industriële bakkerij bij deze methode de

verwerking uitbesteedt. Welke partij kan, volgens uw visie, deze methode het beste uitvoeren?

Industriële bakkerijen	0	0 %
Verwerkingsbedrijven gespecialiseerd in deze methode	9	100 %
Anders namelijk...	0	0 %

52. Consumentenvertrouwen in de voedselveiligheid

Positieve invloed	1	11.11 %
Geen invloed	8	88.89 %
Negatieve invloed	0	0 %

53. Consumentenvertrouwen in de voedselkwaliteit

Positieve invloed	1	11.11 %
Geen invloed	8	88.89 %
Negatieve invloed	0	0 %

54. Bedrijfsimago

Positieve invloed	5	55.56 %
Geen invloed	4	44.44 %
Negatieve invloed	0	0 %

55. Ruimte voor opmerkingen over deze methode:

Toelichting vraag 50: Papier- en Kartonindustrie

Toelichting vraag 50: verwerkingsbedrijven gespecialiseerd in deze methode = de verpakkingsbrance

Toelichting: Verwerkingsbedrijven gespecialiseerd in deze methode = kartonproducenten

7. *Fermentation (Bio plastics)*

The questions 56-64 are filled in by: BE-A, BE-C, BE-D, IB-a, IB-b, IB-c, E12, E7, E78

56. Heeft u wel eens van deze methode gehoord?

Ja	6	66.67 %
Nee	3	33.33 %

57. Zo ja, hoe beoordeelt u uw kennis over deze methode?

1	0	0 %
2	0	0 %
3	0	0 %
4	0	0 %
5	1	16.67 %
6	0	0 %
7	0	0 %
8	2	33.33 %
9	3	50 %
10	0	0 %

58. Binnen hoeveel jaar verwacht u dat deze methode op grotere schaal bij industriële bakkerijen is ingevoerd?

2	3	33.33 %
5	2	22.22 %
5-10	1	11.11 %
niet haalbaar	3	33.33 %

59. Van welke partij(en) verwacht u dat zijn het initiatief zullen nemen om deze methode vanaf de huidige situatie (zoals hierboven omschreven) verder te ontwikkelen?

Producenten van ingrediënten	0	0 %
Industriële bakkerijen	3	33.33 %
Verwerkingsbedrijven gespecialiseerd in deze methode	7	77.78 %
Commerciële onderzoeksbureaus	0	0 %
Universiteiten	1	11.11 %
De Nederlandse overheid	0	0 %
Anders namelijk...	1	11.11 %

60. Deze methode is nog niet in gebruik. Welke partij kan, volgens uw visie, deze methode het beste uitvoeren?

Industriële bakkerijen	0	0 %
Verwerkingsbedrijven gespecialiseerd in deze methode	9	100 %
Anders namelijk...	0	0 %

61. Consumentenvertrouwen in de voedselveiligheid

Positieve invloed	1	11.11 %

Geen invloed	8	88.89 %
Negatieve invloed	0	0 %

62. Consumentenvertrouwen in de voedselkwaliteit

Positieve invloed	1	11.11 %
Geen invloed	8	88.89 %
Negatieve invloed	0	0 %

63. Bedrijfsimago

Positieve invloed	4	44.44 %
Geen invloed	5	55.56 %
Negatieve invloed	0	0 %

64. Ruimte voor opmerkingen over deze methode:

Toelichting vraag 59: chemie

Toelichting: Verwerkingsbedrijven gespecialiseerd in deze methode = fermentatieindustrie

8. Biogas

The questions 65-73 are filled in by: BE-A, BE-C, BE-D, IB-a, IB-b, IB-c, E12, E5, E7, E78, E8

65. Heeft u wel eens van deze methode gehoord?

Ja	11	100 %
Nee	0	0 %

66. Zo ja, hoe beoordeelt u uw kennis over deze methode?

1	0	0 %	
2	0	0 %	
3	2	20 %	
4	1	10 %	
5	2	20 %	
6	0	0 %	
7	1	10 %	
8	2	20 %	
9	1	10 %	
10	1	10 %	

67. Binnen hoeveel jaar verwacht u dat deze methode op grotere schaal bij industriële bakkerijen is ingevoerd?

0	2	18.18 %	
1	3	27.27 %	
10	1	9.09 %	
2	1	9.09 %	
5	3	27.27 %	
twijfelachtig	1	9.09 %	

68. Van welke partij(en) verwacht u dat zijn het initiatief zullen nemen om deze methode vanaf de huidige situatie (zoals hierboven omschreven) verder te ontwikkelen?

Producenten van ingrediënten	0	0 %	

Industriële bakkerijen	3	27.27 %	
Verwerkingsbedrijven gespecialiseerd in deze methode	10	90.91 %	
Commerciële onderzoeksbureaus	2	18.18 %	
Universiteiten	1	9.09 %	
De Nederlandse overheid	3	27.27 %	
Anders namelijk...	2	18.18 %	

69. In de bovenstaande omschrijving staat dat de industriële bakkerij bij deze methode de verwerking uitbesteedt. Welke partij kan, volgens uw visie, deze methode het beste uitvoeren?

Industriële bakkerijen, zij kunnen het biogas gebruiken voor hun wagenpark en/of de ovens	0	0 %	
Verwerkingsbedrijven gespecialiseerd in deze methode, in dat geval wordt het biogas geleverd aan het gasnetwerk	9	81.82 %	
Anders namelijk...	2	18.18 %	

70. Consumentenvertrouwen in de voedselveiligheid

Positieve invloed	1	9.09 %	
Geen invloed	8	72.73 %	
Negatieve invloed	2	18.18 %	

71. Consumentenvertrouwen in de voedselkwaliteit

Positieve invloed	0	0 %	

Geen invloed	10	90.91 %	
Negatieve invloed	1	9.09 %	

72. Bedrijfsimago

Positieve invloed	5	45.45 %	
Geen invloed	4	36.36 %	
Negatieve invloed	2	18.18 %	

73. Ruimte voor opmerkingen over deze methode:

Toelichting vraag 68: Verwerkingsbedrijven gespecialiseerd in deze methode = Biogas producenten welke opzoek zijn naar goedkope grondstoffen voor het proces

Toelichting vraag 68: energiebedrijven
Toelichting vraag 69: combinatie van beide antwoorden: energie voor eigen gebruik bakkerij en levering aan het net

Toelichting vraag 69: een combinatie van de twee voorgaande antwoorden (=industriële bakkerijen en verwerkingsbedrijven). Een verwerkingsbedrijf levert de verwerkingsinstallatie, en het biogas wordt lokaal gebruikt (dwz in de ovens en of het wagenpark)

toelichting haalbaarheid: twijfelachtig, te laagwaardig

Comments

74. Ruimte voor opmerkingen/suggesties:

De opties broodsnacks en circelbrood leveren voor de bakkerij en retailer het meeste geld op qua geld en op gebied van duurzaamheid, omdat je van eten voor de mens opnieuw eten voor de mens maakt op een voedselveilige manier.

De vragen binnen hoeveel jaar verwacht wordt dat deze methode wordt toegepast laat geen ruimte voor nuancering of de verwachting dat dit in het geheel niet zal gebeuren.

Ik had het al telefonisch aangegeven: maar wat echt nodig is, is een ketenaanpak, voor al deze methodes. Zo is de vraag, binnen hoeveel jaar...., alleen van toepassing als de ketenaanpak gehanteerd gaat worden. Zonder deze operatie wordt denk ik niet 1 'nieuwe' methode succesvol.

Attachment 3: The bakery questionnaire

The questions 1-27 are filled in by: BE-B, BE-C, BE-D, IB-a, IB-b, IB-c

Explanation of the questionnaire

Randvoorwaarden voor industriële bakkers

Beste deelnemer,

In dit deel van het onderzoek ben ik op zoek naar de randvoorwaarden die industriële bakkerijen stellen bij het gebruik van een nieuwe valorisatiemethode. Natuurlijk zou het ideaal zijn wanneer het invoeren van een nieuwe methode geen geld of moeite zou kosten, in de praktijk zal dit echter zelden het geval zijn. Vul daarom de onderstaande vragen in als de maximale inspanning/investering die u verwacht dat een industriële bakker wil leveren.
- Als u zelf bij een industriële bakkerij werkt kunt u de vragen beantwoorden zoals uw bedrijf zou handelen.
- Als u niet bij een industriële bakkerij werkt kunt u ook alle vragen invullen. Gaat u dan bij het beantwoorden van de vragen uit van een industriële bakker die open staat voor een nieuwe valorisatiemethode en daar in de nabije toekomst (komende 5 jaar) mee aan de slag wil.

In beide gevallen kunt u m.b.v. de onderstaande stellingen aangeven met welke zaken dan rekening gehouden dient te worden.
Er is ook ruimte voor het maken van op- of aanmerkingen. De enquêtesoftware is zo ontwikkeld dat u de vragen in meerdere etappes kunt invullen, door onderaan de lijst de knop 'tussentijds bewaren' in te klikken..
Bij onduidelijkheden kunt u mij mailen of bellen. Wanneer u dat prettiger vindt dan kunt u mij ook opbellen en dan kunnen we de vragenlijst samen doorlopen. Kunt u voor maandag 25 februari alle vragen hebben ingevuld?
Vriendelijke groeten,

Anouk

0625570157
anouk.schrauwen@wur.nl

General question

1. Wat is/zijn uw expertise(s)

Industriële bakkerij	5	83.33 %
Ambachtelijke bakkerij	2	33.33 %
Inzicht in de bakkerswereld	3	50 %
Broodsnacks	0	0 %
Cirkelbrood	0	0 %
Brood van gisteren alsnog verkopen	1	16.67 %
Voedselbank	0	0 %
Veevoer	0	0 %
Kartonversteviger	1	16.67 %
Bio-plastics	1	16.67 %
Biogas	0	0 %
Anders namelijk...	2	33.33 %

Business factors

2. Een industriële bakker is bereid in een valorisatiemethode te investeren als het bedrag binnen zoveel jaar wordt terugverdiend:

0	1	16.67 %
1	1	16.67 %

2	1	16.67 %
3	1	16.67 %
5	1	16.67 %
7	1	16.67 %

3. Wanneer een industriële bakker investeert in een valorisatiemethode, hoeveel procent zekerheid dat hij de investering terugverdient dient er dan minimaal te zijn?

100	1	16.67 %
50	1	16.67 %
70	1	16.67 %
80	2	33.33 %
90	1	16.67 %

4. Bij een nieuwe valorisatiemethode dient de opbrengst van het retourbrood minimaal ... €/ton te zijn:

100	1	16.67 %
150	1	16.67 %
400	1	16.67 %
80	2	33.33 %
?	1	16.67 %

5. De maximale investering die een industriële bakker voor de invoering van een valorisatiemethode wil doen bedraagt … euro.

0	2	50 %
150000	1	25 %
400000	1	25 %

6. Wanneer een industriële bakker investeert in een valorisatiemethode, hoeveel procent zekerheid dat er een afzetmarkt voor dit nieuwe eindproduct aanwezig is, dient er dan minimaal te zijn?

100	2	33.33 %
50	1	16.67 %
70	1	16.67 %
80	1	16.67 %
90	1	16.67 %

7. Stel, er is onzekerheid over de financiële haalbaarheid/de aanwezigheid van een afzetmarkt. Om meer zekerheid te verkrijgen dient er een haalbaarheidsonderzoek te worden uitgevoerd. Wat is de maximale investering die een industriële bakkerij hiervoor wil maken?

10000	2	33.33 %
200	1	16.67 %
500	1	16.67 %
5000	2	33.33 %

8. Ruimte voor extra opmerkingen over de 'financiële haalbaarheid en afzetmarkt':

5. Investering is direct gerelateerd aan de opbrengst en met name terugverdientijd.
7. Investering is eveneens direct gerelateerd aan de terugverdientijd van het geheel.

Bij beide vragen is de omvang van het bedrijf bepalend: een grote industriële bakker heeft in geld meer te winnen en zal dus bereid zijn meer in geld te investeren.

De hoogte van de investering voor een alternatieve verwerking is sterk afhankelijk van de verwachte meeropbrengst per ton product en de bijdrage die het levert aan verduurzaaming. Dit kun je op voorhand niet vangen in vaste en concrete bedragen.

Ik denk dat de ind bakkerij dit hele onderwerp aan derden gaat overlaten; zij zijn te druk met

hun eigen core business

Zijn vragen waar ik zo geen goed antwoord op kan geven, gegevens van bovenstaande vragen zou ik niet meenemen in je onderzoek.

Law and regulations

9. Verwacht u dat de huidige wet – en regelgeving een barrière vormt bij het invoeren van een nieuwe valorisatiemethode?

Ja	3	60 %	
Nee	2	40 %	

10. Zo ja, kunt u kort aangeven welke specifieke aspecten van wet – en regelgeving een barrière vormen?

Als je een BRC-certificaat wilt behouden, dan zit je met je borging van de gevaren, ook met de allergenen, het is buiten je proces geweest in een niet te controlere omgeving.

Met name de beperking in herverwerking van retourbrood voor humane consumptie. Als brood buiten de bakkerij is geweest is traceability niet meer mogelijk. Je weet niet wat er met het brood tussen afleveren in de winkel en weer ophal;en is gebeurd.

in sommige gevallen voedselveiligheid

11. Worden de in vraag 11 genoemde barrières gevormd door de HACCP regelgeving, of door de daarvan afgeleide hygiënecode van de brancheorganisatie?

HACCP regelgeving	4	100 %	
Hygiënecode van de brancheorganisatie	0	0 %	

12. Ruimte voor extra opmerkingen over de 'wet- en regelgeving':

Dit lijkt mij niet haalbaar voor brood wat buiten het proces is geweest, te veel gevaren die je niet kan borgen.

Logistical factors

13. Is een industriële bakker bereid om voor een nieuwe valorisatiemethode extra ketenregie en -communicatie toe te passen?

1	1	16.67 %	
2	0	0 %	
3	0	0 %	
4	0	0 %	
5	1	16.67 %	
6	3	50 %	
7	1	16.67 %	
8	0	0 %	
9	0	0 %	
10	0	0 %	

14. Is een industriële bakker bereid om voor een nieuwe valorisatiemethode een nieuw certificeringsysteem in te voeren?

1	1	16.67 %	
2	0	0 %	
3	2	33.33 %	
4	0	0 %	
5	1	16.67 %	
6	2	33.33 %	
7	0	0 %	
8	0	0 %	

9	0	0 %
10	0	0 %

15. Is een industriële bakker bereid om voor een nieuwe valorisatiemethode de plastic verpakkingen uit het retourbrood filteren?

1	1	16.67 %
2	0	0 %
3	2	33.33 %
4	3	50 %
5	0	0 %
6	0	0 %
7	0	0 %
8	0	0 %
9	0	0 %
10	0	0 %

16. Is een industriële bakker bereid om voor een nieuwe valorisatiemethode de verschillende broodsoorten te scheiden?

1	2	33.33 %
2	0	0 %
3	2	33.33 %
4	2	33.33 %
5	0	0 %
6	0	0 %
7	0	0 %
8	0	0 %
9	0	0 %

10	0	0 %	

17. Is een industriële bakker bereid om voor een nieuwe valorisatiemethode een nieuwe installatie/techniek in het eigen bedrijf te nemen?

1	2	33.33 %	
2	0	0 %	
3	0	0 %	
4	0	0 %	
5	1	16.67 %	
6	1	16.67 %	
7	2	33.33 %	
8	0	0 %	
9	0	0 %	
10	0	0 %	

18. De scheiding van verschillende broodsoorten en het uitfilteren van plastic kan het beste worden uitgevoerd door:

Supermarkt	2	33.33 %	
Industriële bakker	0	0 %	
Gespecialiseerd tussenbedrijf	1	16.67 %	
Eindverwerker	3	50 %	

19. Wanneer er uitsluitend wordt gekeken naar de opslagcapaciteit van een industriële bakkerij, hoe vaak dient het retourbrood dan te worden verwerkt/opgehaald?

1 x per week	1	16.67 %	

2 x per week	2	33.33 %
3 x per week	0	0 %
4 x per week	2	33.33 %
5 x per week	0	0 %
6 x per week	1	16.67 %
7 x per week	0	0 %

20. Ruimte voor extra opmerkingen over de 'logistiek':

14. Een nieuw certificeringsysteem: hangt sterk af van de complexiteit en kosten. Ook is het de vraag of het een extra voedselveiligheidscertificering of bijv. procescertificering is. Voorwaarde is, dat het eenvoudig in het door de bakker gebruikte systeem is in te bouwen.
15. Bereidheid is klein: kost tijd & geld. Waarschijnlijk is het proces complex. En daarmee onaantrekkelijk om te realiseren.
16. Dit is (haast) ondoenlijk, omdat zowel verpakte als onverpakte broden retour komen. Voor laaggeschoold personeel lijkt het niet mogelijk om op de juiste manier te scheiden. Bart's Retail (Bakker Bart) heeft/had wel een scheidingsysteem, waarbij handmatig producten met vlees (zoals saucijzenbroodjes) gescheiden worden van de hoofdstroom.
17. Een nieuwe techniek is niet zo'n punt. Veel hangt af van de investering en de tijd van werknemers.
18. Voordeel van scheiding in de supermarkt is, dat je de medewerkers van de broodafdeling bewust maakt van de 'waste'. Zij zijn de eersten, die de waste kunnen beïnvloeden door beter te bestellen en af te bakken.
19. Ophalen bij de industriële bakker door een extern bedrijf, neem ik aan? Verwerken dient dagelijks te gebeuren i.v.m. risico van contanimatie met verse producten, ongedierte, etc.

Future predictions

21. De bovenstaande vragen heeft u beantwoord voor een industriële bakker die open staat voor een nieuwe valorisatiemethode en daar in de nabije toekomst (komende 5 jaar) mee aan de slag wil. Kunt u inschatten hoeveel van de industriële bakkers in deze groep vallen?

10	1	16.67 %

15	1	16.67 %	
2	1	16.67 %	
40	1	16.67 %	
50	1	16.67 %	
75	1	16.67 %	

22. Met welke valorisatiemethode(s) gaat u het liefste aan de slag en waarom?

'broodsnacks'	1	20 %	
'cirkelbrood'	2	40 %	
'brood van gisteren alsnog verkopen'	0	0 %	
'voedselbank'	0	0 %	
'veevoer'	2	40 %	
'kartonversteviger'	3	60 %	
'bio-plastics'	2	40 %	
'biogas'	3	60 %	

23. Waarom kiest u voor deze methode(s)?

Meeste affiniteit mee.

Omdat hier de minste druk geeft op het gebied van certificaten en eisen aan het product.

de methode moet in alle gevallen de consumentenvoesdelveiligheid niet negatief kunnen beinvloeden.
Wij weten niet met zekerheid wat er met het brood uit de supermarkt is gebeurd las het terugkomt ...

eigenlijk geen van allen: het probleem moet in de keten aan de voorkant worden aangepakt: hoe zorgen we dat er zo min mogelijk verspilling ontstaat. Dat is een ketenverhaal dat de komende jaren zeker aandacht zal en moet krijgen, waarbij het initiatief bij de Retail gaat liggen.

meest realistich in tijd en kosten bij twee van de drie voorkeuren blijft het brood direct of indirect in de voedselketen

24. Ruimte voor extra opmerkingen over de methode keuze en/of 'toekomstvisie'

Valorisatie van oud brood kan ook op de winkelvloer gebeuren met slimme concepten. Mogelijk zijn daarvoor de opbrengsten nog niet aantrekkelijk genoeg. Maar je zou je voor kunnen stellen, dat medewerkers van de supermarkt door de dag heen oud brood van gister versnijden en in de aanwezige oven bijv. roosteren met tapenades of kruiden tot broodchips, zoals Bakker Lamers uit Heesch al jaren doet. En waarom zou een retailer niet 'brood van gisteren' in een apart schap aan bieden, zoals de nodige ambachtelijke bakkers al doen. En nog mooier idee zou zijn als de retailer het oude brood op locatie verwerkt en benut om energie op te wekken om de energievraag van de eigen winkel deels af te dekken.

21. Bereidheid zal hoog zijn, omdat ook veel industriële bakkers een moreel probleem hebben met het onbenut weggooien van brood. Daarnaast kan retourbrood door het juist te verwerken zorgen voor een hogere opbrengst dan die van afval. En met de marges, die altijd en nu helemaal fors onder druk staan is dat aantrekkelijk. Overigens zal de retailer ook zien, dat industriële bakkers een hogere opbrengst voor hun retourbrood hebben. En daar willen ze dan natuurlijk ook een (groot) deel van. Verder is het de vraag of het gaat om bereidheid van de bakker of de opgelegde wens van de retailer. Als AH en Jumbo over de mogelijkheid horen, dan past het - gezien hun duurzaamheidsbeleid - om bakkers te verplichten retourbrood te valoriseren.

Attachment 4: The expert questionnaire

1. *Bread snacks* The questions 2-20 are filled in by: E12

Financiële haalbaarheid en afzetmarkt

3. Wanneer een industriële bakker in deze methode investeert dan kan het investeringsbedrag binnen zoveel jaar worden terugverdiend:

1

4. Wanneer een industriële bakker in deze methode investeert, dan is er zoveel procent zekerheid dat hij de investering terugverdient.

100

5. Bij deze methode is de (verwachte) opbrengst per ton retourbrood ...

1000

6. De investering die een industriële bakker voor de invoering van deze methode moet maken bedraagt ... euro.

0

7. Voor hoeveel procent is het zeker dat er een afzetmarkt voor dit nieuwe eindproduct is?

50

8. Stel, er is onzekerheid over de financiële haalbaarheid/de aanwezigheid van een afzetmarkt. Om meer zekerheid te verkrijgen dient er een haalbaarheidsonderzoek te worden uitgevoerd. Hoe veel zou deze investering kosten?

9. Ruimte voor extra opmerkingen over de 'financiële haalbaarheid en afzetmarkt':

Voor broodsnacks hoeft geen investering gedaan te worden op het gebied van apparatuur.
Enkel aanschaf van product zoals Sonextra Marinade
In principe kan dit gemaakt worden met de standaard apparatuur binnen de bakkerij.
Geen kanibalisme op het huidige assortiment brood, omdat het een snack is.

Wet- en regelgeving

10. Verwacht u dat de huidige wet – en regelgeving een barrière vormt bij het invoeren van een nieuwe valorisatiemethode?

Nee

11. Door welke wet- en regelgeving worden de genoemde barrières gevormd?

product voldoet aan wetgeving

12. Ruimte voor extra opmerkingen over de 'wet- en regelgeving':

Product broodsnacks voldoet aan de wetgeving, qua hygiene ook ingedrienten declaratie voor de consument kan op de verpakking worden vermeld.

Logistiek

In hoeverre is het voor de uitvoering van deze methode noodzakelijk om ...

		1 Totaal niet nood-zakelijk	2	3	4	5	6	7	8	9	10 Heel erg nood-zakelijk
13.	... extra ketenregie en -communicatie toe te passen?					5					
14.	... een nieuw certificeringsysteem in te voeren?	1									
15.	... de plastic verpakkingen uit het retourbrood filteren?										10
16.	... de verschillende broodsoorten te scheiden?										10
17.	... een nieuwe installatie/techniek in het eigen bedrijf te nemen?	1									

18. Hoeveel retourbrood is er minimaal nodig om deze methode rendabel te houden?

altijd rendabel, geen kanibalisatie

19. Hoeveel retourbrood is er maximaal nodig om deze methode rendabel te houden?

is altijd rendabel, niet transporteren opnieuw

20. Ruimte voor extra opmerkingen 'logistiek':

Broodsnacks maken op de plaats waar het product verkocht wordt.
Veel koude bakkers hebben wel een oven staan om broodjes op te warmen, hierin kan deze snack bereid worden.
Verkooppersoneel kan dit eenvoudig snijnden en voorbereiden in de rustige uren en het brood opsparen van 1 of 2 dagen.

2. *Circle bread*

The questions 21-38 are filled in by: E12

Financiële haalbaarheid en afzetmarkt

21. Wanneer een industriële bakker in deze methode investeert dan kan het investeringsbedrag binnen zoveel jaar worden terugverdiend:

2

22. Wanneer een industriële bakker in deze methode investeert, dan is er zoveel procent zekerheid dat hij de investering terugverdient.

23. Bij deze methode is de (verwachte) opbrengst per ton retourbrood ...

24. De investering die een industriële bakker voor de invoering van deze methode moet maken bedraagt ... euro.

75.000

25. Voor hoeveel procent is het zeker dat er een afzetmarkt voor dit nieuwe eindproduct is?

100

26. Stel, er is onzekerheid over de financiële haalbaarheid/de aanwezigheid van een afzetmarkt. Om meer zekerheid te verkrijgen dient er een haalbaarheidsonderzoek te worden uitgevoerd. Hoe veel zou deze investering kosten?

3.000

27. Ruimte voor extra opmerkingen over de 'financiële haalbaarheid en afzetmarkt':

Opbrengst afhankelijk van de kostprijs brood, wordt 100% herverwerkt dus minder ingredienten nodig voor een nieuwe batch deeg.
Verschillend per bakkerij welke apparatuur aanwezig is en hoeveel broden per dag zij produceren.
Installatie kan bijv. varieren van 25.000-100.000 euro, maar afhankelijk van aantal broden per dag en dosering desem

Wet- en regelgeving

28. Verwacht u dat de huidige wet – en regelgeving een barrière vormt bij het invoeren van een nieuwe valorisatiemethode?

Nee

29. Door welke wet- en regelgeving worden de genoemde barrières gevormd?

juiste handeling (kennis) bereiding product

30. Ruimte voor extra opmerkingen over de 'wet- en regelgeving':

Logistiek

In hoeverre is het voor de uitvoering van deze methode noodzakelijk om .....

		1 Totaal niet nood-zakelijk	2	3	4	5	6	7	8	9	10 Heel erg nood-zakelijk
31.	... extra ketenregie en -communicatie toe te passen?										10
32.	... een nieuw certificeringsysteem in te voeren?	1									
33.	... de plastic verpakkingen uit het retourbrood filteren?										10
34.	... de verschillende broodsoorten te scheiden?										10
35.	... een nieuwe installatie/techniek in het eigen bedrijf te nemen?										10

36. Hoeveel retourbrood is er minimaal nodig om deze methode rendabel te houden?

?

37. Hoeveel retourbrood is er maximaal nodig om deze methode rendabel te houden?

?

38. Ruimte voor extra opmerkingen 'logistiek':

Conform HACCP vervoeren.

3. Selling yesterday's bread

Not filled in by an expert

4. Food bank

Not filled in by an expert

5. Cattle feed

Not filled in by an expert

6. *Carton strengtheners*

These questions are filled in by: E6

Financiële haalbaarheid en afzetmarkt

3. Wanneer een industriële bakker in deze methode investeert dan kan het investeringsbedrag binnen zoveel jaar worden terugverdiend:

   4

4. Wanneer een industriële bakker in deze methode investeert, dan is er zoveel procent zekerheid dat hij de investering terugverdient.

   80

5. Bij deze methode is de (verwachte) opbrengst per ton retourbrood ...

   1000

6. De investering die een industriële bakker voor de invoering van deze methode moet maken bedraagt ... euro.

   250.000

7. Voor hoeveel procent is het zeker dat er een afzetmarkt voor dit nieuwe eindproduct is?

   100

8. Stel, er is onzekerheid over de financiële haalbaarheid/de aanwezigheid van een afzetmarkt. Om meer zekerheid te verkrijgen dient er een haalbaarheidsonderzoek te worden uitgevoerd. Hoe veel zou deze investering kosten?

   10.000

9. Ruimte voor extra opmerkingen over de 'financiële haalbaarheid en afzetmarkt':

   Het proces om zetmeel af te scheiden uit brood ken ik niet. Deze vragen kan ik daarom niet goed beantwoorden.

Wet- en regelgeving

10. Verwacht u dat de huidige wet – en regelgeving een barrière vormt bij het invoeren van een nieuwe valorisatiemethode?

    Ja

11. Zo ja, kunt u kort aangeven welke specifieke aspecten van wet – en regelgeving een barrière vormen?

    Als dit brood 'wordt "geklassificeerd" als afval, geldt de afvalwetgeving en mag de Papier- en kartonindustrie dit niet verwerken. Er zal een uitbreiding van de vergunning nodig zijn.

12. Door welke wet- en regelgeving worden de genoemde barrières gevormd?

    vergunning inzet grondstoffen (milieu-wetgeving??)

13. Ruimte voor extra opmerkingen over de 'wet- en regelgeving':

Logistiek

In hoeverre is het voor de uitvoering van deze methode noodzakelijk om .....

		1 Totaal niet nood-zakelijk	2	3	4	5	6	7	8	9	10 Heel erg nood-zakelijk
14.	... extra ketenregie en -communicatie toe te passen?								8		
15.	... een nieuw certificeringsysteem in te voeren?		2								
16.	... de plastic verpakkingen uit het retourbrood filteren?								8		
17.	... de verschillende broodsoorten te scheiden?							7			
18.	... een nieuwe installatie/techniek in het eigen bedrijf te nemen?					5					

19. Hoeveel retourbrood is er minimaal nodig om deze methode rendabel te houden?

    1000 ton

20. Hoeveel retourbrood is er maximaal nodig om deze methode rendabel te houden?

    maximaal kan

21. Ruimte voor extra opmerkingen 'logistiek':

    Rendement van zetmeel uit retourbrood speelt een belangrijke rol bij de logistieke vragen. Dit is nog niet bekend. Echter, Papier- en kartonindustrie zijn "grootverbruikers" van grondstoffen. Er zal een mininmumhoeveelheid zetmeel van bv 100 ton per jaar beschikbaar dienen te zijn.

7. Fermentation (Bio plastics)

The questions 116-135 are filled in by E7 (below) and E78 (see next page)

Financiële haalbaarheid en afzetmarkt

117. Wanneer een industriële bakker in deze methode investeert dan kan het investeringsbedrag binnen zoveel jaar worden terugverdiend:

2

118. Wanneer een industriële bakker in deze methode investeert, dan is er zoveel procent zekerheid dat hij de investering terugverdient.

50

119. Bij deze methode is de (verwachte) opbrengst per ton retourbrood ...

120

120. De investering die een industriële bakker voor de invoering van deze methode moet maken bedraagt ... euro.

200.000

121. Voor hoeveel procent is het zeker dat er een afzetmarkt voor dit nieuwe eindproduct is?

50

122. Stel, er is onzekerheid over de financiële haalbaarheid/de aanwezigheid van een afzetmarkt. Om meer zekerheid te verkrijgen dient er een haalbaarheidsonderzoek te worden uitgevoerd. Hoe veel zou deze investering kosten?

50.000

123. Ruimte voor extra opmerkingen over de 'financiële haalbaarheid en afzetmarkt':

Het verwerkingsproces moet plaats vinden bij een fermentatiebedrijf. Dat fermentatiebedrijf zou gezamelijk met de Industriele bakkerij moeten testen of het brood als grondstof is te gebruiken. Dat ondrzoek kost 200.000 euro.

Wet- en regelgeving

124. Verwacht u dat de huidige wet – en regelgeving een barrière vormt bij het invoeren van een nieuwe valorisatiemethode?

Nee

125. Zo ja, kunt u kort aangeven welke specifieke aspecten van wet – en regelgeving een barrière vormen?

126. Door welke wet- en regelgeving worden de genoemde barrières gevormd?

127. Ruimte voor extra opmerkingen over de 'wet- en regelgeving':

Logistiek

In hoeverre is het voor de uitvoering van deze methode noodzakelijk om .....

		1 Totaal niet nood-zakelijk	2	3	4	5	6	7	8	9	10 Heel erg nood-zakelijk
128.	... extra ketenregie en -communicatie toe te passen?							7			
129.	... een nieuw certificeringsysteem in te voeren?			3							
130.	... de plastic verpakkingen uit het retourbrood filteren?								8		
131.	... de verschillende broodsoorten te scheiden?			3							
132.	... een nieuwe installatie/techniek in het eigen bedrijf te nemen?					5					

133. Hoeveel retourbrood is er minimaal nodig om deze methode rendabel te houden?

50.000 ton/jaar

134. Hoeveel retourbrood is er maximaal nodig om deze methode rendabel te houden?

135. Ruimte voor extra opmerkingen 'logistiek':

Financiële haalbaarheid en afzetmarkt

117. Wanneer een industriële bakker in deze methode investeert dan kan het investeringsbedrag binnen zoveel jaar worden terugverdiend:

118. Wanneer een industriële bakker in deze methode investeert, dan is er zoveel procent zekerheid dat hij de investering terugverdient.

119. Bij deze methode is de (verwachte) opbrengst per ton retourbrood ...

120. De investering die een industriële bakker voor de invoering van deze methode moet maken bedraagt ... euro.

121. Voor hoeveel procent is het zeker dat er een afzetmarkt voor dit nieuwe eindproduct is?

122. Stel, er is onzekerheid over de financiële haalbaarheid/de aanwezigheid van een afzetmarkt. Om meer zekerheid te verkrijgen dient er een haalbaarheidsonderzoek te worden uitgevoerd. Hoe veel zou deze investering kosten?

5.000

123. Ruimte voor extra opmerkingen over de 'financiële haalbaarheid en afzetmarkt':

De antwoorden 117-121 zijn allemaal afhankelijk van de resultaten hoeveel suikers er vrijkomen (afhankelijk van het type brood). Dit moet op een laboratorium getest worden en in kaart gebracht worden. Dit zou bij MicCell Bioservices gedaan kunnen worden.

Wet- en regelgeving

124. Verwacht u dat de huidige wet – en regelgeving een barrière vormt bij het invoeren van een nieuwe valorisatiemethode?

Nee

125. Zo ja, kunt u kort aangeven welke specifieke aspecten van wet – en regelgeving een barrière vormen?

126. Door welke wet- en regelgeving worden de genoemde barrières gevormd?

127. Ruimte voor extra opmerkingen over de 'wet- en regelgeving':

Dit is niet mijn achtergrond, maar ik verwacht toepassingen te kunnen vinden in de huidige regelgeving.

Logistiek

In hoeverre is het voor de uitvoering van deze methode noodzakelijk om .....

		1 Totaal niet nood-zakelijk	2	3	4	5	6	7	8	9	10 Heel erg nood-zakelijk
128.	... extra ketenregie en -communicatie toe te passen?								8		
129.	... een nieuw certificeringsysteem in te voeren?										
130.	... de plastic verpakkingen uit het retourbrood filteren?										10
131.	... de verschillende broodsoorten te scheiden?	1									
132.	... een nieuwe installatie/techniek in het eigen bedrijf te nemen?					5					

133. Hoeveel retourbrood is er minimaal nodig om deze methode rendabel te houden?

134. Hoeveel retourbrood is er maximaal nodig om deze methode rendabel te houden?

135. Ruimte voor extra opmerkingen 'logistiek':

Vraag 133-134 is afhankelijk van het soort brood, dus hoeveel suiker er gebruikt kunnen worden. Dit zal getest moeten worden. Dit zou MicCell Bioservices in kaart kunnen krijgen.

8. Biogas

The questions 136-154 are filled in by E78 (below) and E8 (next page).

Financiële haalbaarheid en afzetmarkt

136. Wanneer een industriële bakker in deze methode investeert dan kan het investeringsbedrag binnen zoveel jaar worden terugverdiend:

137. Wanneer een industriële bakker in deze methode investeert, dan is er zoveel procent zekerheid dat hij de investering terugverdient.

138. Bij deze methode is de (verwachte) opbrengst per ton retourbrood ...

139. De investering die een industriële bakker voor de invoering van deze methode moet maken bedraagt ... euro.

140. Voor hoeveel procent is het zeker dat er een afzetmarkt voor dit nieuwe eindproduct is?

141. Stel, er is onzekerheid over de financiële haalbaarheid/de aanwezigheid van een afzetmarkt. Om meer zekerheid te verkrijgen dient er een haalbaarheidsonderzoek te worden uitgevoerd. Hoe veel zou deze investering kosten?

5.000

142. Ruimte voor extra opmerkingen over de 'financiële haalbaarheid en afzetmarkt':

De antwoorden 136-140 zijn allemaal afhankelijk van de optimalisatie van de vergistingscultures (afhankelijk van het type brood). Dit moet op een laboratorium getest worden en in kaart gebracht worden. Dit zou bij MicCell Bioservices gedaan kunnen worden.

Wet- en regelgeving

143. Verwacht u dat de huidige wet – en regelgeving een barrière vormt bij het invoeren van een nieuwe valorisatiemethode?

Nee

144. Zo ja, kunt u kort aangeven welke specifieke aspecten van wet – en regelgeving een barrière vormen?

145. Door welke wet- en regelgeving worden de genoemde barrières gevormd?

146. Ruimte voor extra opmerkingen over de 'wet- en regelgeving':

Dit is niet mijn achtergrond, maar ik verwacht toepassingen te kunnen vinden in de huidige regelgeving.

Logistiek

In hoeverre is het voor de uitvoering van deze methode noodzakelijk om .....

		1 Totaal niet nood-zakelijk	2	3	4	5	6	7	8	9	10 Heel erg nood-zakelijk
147.	... extra ketenregie en -communicatie toe te passen?								8		
148.	... een nieuw certificeringsysteem in te voeren?										
149.	... de plastic verpakkingen uit het retourbrood filteren?										10
150.	... de verschillende broodsoorten te scheiden?	1									
151.	... een nieuwe installatie/techniek in het eigen bedrijf te nemen?					5					

152. Hoeveel retourbrood is er minimaal nodig om deze methode rendabel te houden?

153. Hoeveel retourbrood is er maximaal nodig om deze methode rendabel te houden?

154. Ruimte voor extra opmerkingen 'logistiek':

Vraag 152-153 is afhankelijk van het optimalisatie en opbrengsten van de vergisting. Dit zal getest moeten worden. Dit zou MicCell Bioservices in kaart kunnen krijgen.

Financiële haalbaarheid en afzetmarkt

136. Wanneer een industriële bakker in deze methode investeert dan kan het investeringsbedrag binnen zoveel jaar worden terugverdiend:

3

137. Wanneer een industriële bakker in deze methode investeert, dan is er zoveel procent zekerheid dat hij de investering terugverdient.

95

138. Bij deze methode is de (verwachte) opbrengst per ton retourbrood ...

EUR 200

139. De investering die een industriële bakker voor de invoering van deze methode moet maken bedraagt ... euro.

180.000

140. Voor hoeveel procent is het zeker dat er een afzetmarkt voor dit nieuwe eindproduct is?

98

141. Stel, er is onzekerheid over de financiële haalbaarheid/de aanwezigheid van een afzetmarkt. Om meer zekerheid te verkrijgen dient er een haalbaarheidsonderzoek te worden uitgevoerd. Hoe veel zou deze investering kosten?

7.500

142. Ruimte voor extra opmerkingen over de 'financiële haalbaarheid en afzetmarkt':

De kosten en baten van de huidige(!) manier van verwerken dienen eerst in kaart te worden gebracht. Deze worden afgezet tegen de kosten en baten van de nieuwe vorm van verwerken. Hierbij wordt een calculatie gemaakt van de investering en een ontwerp van de installatie die het retourbrood verwerkt. Ook wordt via een relatief eenvoudige proef de specifieke biogas opbrengst van het retourbrood bepaald.

Wet- en regelgeving

143. Verwacht u dat de huidige wet – en regelgeving een barrière vormt bij het invoeren van een nieuwe valorisatiemethode?

Nee

144. Zo ja, kunt u kort aangeven welke specifieke aspecten van wet – en regelgeving een barrière vormen?

145. Door welke wet- en regelgeving worden de genoemde barrières gevormd?

146. Ruimte voor extra opmerkingen over de 'wet- en regelgeving':

Het systeem is geheel afgesloten. Dat betekent dat stromen die in de verwerkingsinstallatie gaan, niet in contact komen met andere stromen in het bedrijf. Het risico op contact tussen het retourbrood en de bakkerij is daarmee de facto uitgesloten.

Logistiek

In hoeverre is het voor de uitvoering van deze methode noodzakelijk om .....

		1 Totaal niet nood-zakelijk	2	3	4	5	6	7	8	9	10 Heel erg nood-zakelijk
147.	... extra ketenregie en -communicatie toe te passen?			3							
148.	... een nieuw certificeringsysteem in te voeren?	1									
149.	... de plastic verpakkingen uit het retourbrood filteren?								8		
150.	... de verschillende broodsoorten te scheiden?	1									
151.	... een nieuwe installatie/techniek in het eigen bedrijf te nemen?					5					

152. Hoeveel retourbrood is er minimaal nodig om deze methode rendabel te houden?

100 ton/jaar

153. Hoeveel retourbrood is er maximaal nodig om deze methode rendabel te houden?

nvt

154. Ruimte voor extra opmerkingen 'logistiek':

Verwerking op locatie is altijd eenvoudiger en goedkoper dan het op laten halen van het retourbrood.