Connect4Action Strategies for improving communication between social and consumer scientists, food technology developers and consumers

SEVENTH FRAMEWORK PROGRAMME

Theme: Food, Agriculture and Fisheries, and Biotechnology

Round 2 of the Delphi study: conduct and outcomes

WP3

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Project Objective

The objective of the CONNECT4ACTION project is to improve communication between consumers, consumer scientists, food technology developers, and other key players in the food technology development and commercialisation process. Focusing on communication and knowledge exchange between food technologists and consumer scientists, the results of the CONNECT4ACTION project will contribute to improvement of the multidisciplinary dialogue and to increase consumer acceptance of new food products, thereby lower the failure rate of new (food) technologies in Europe.

A large group of stakeholders (food scientists and technologists from companies, universities and research institutes, together with consumer scientists, ethical experts, representatives of science media/journalist, and consumers) will be connected with the project and each other via the online CONNECT4ACTION community. This online community strengthens the project with input and feedback during various stages and serves as showcase of improved communication.

Based on effective communication strategies identified in the relevant literatures and, subsequently, opinions of experts based on their daily practices and experiences, this project will deliver an improved communication framework, accompanied by tools and training materials that enable food technology developers and other key players to step-by-step improve their food technology development processes.

This FP7 experienced consortium, consisting of a broad, multidisciplinary network of key players that are involved in food technology development and commercialisation, has the expertise and experience from the field to disseminate and successfully implement innovative communication strategies into daily life activities. Dissemination of project outcomes receives great attention, even after the project is finished. Finally, the networking effort of CONNECT4ACTION will result in a strengthened European cooperation between public and private stakeholders.

Deliverable D3.2, Short Summary
Building on the CONNECT4ACTION Round 1 Delphi study (D3.1), the Round 2 survey investigated the needs and approaches for improving communication between actors involved in the food technology development chain, particularly between consumer scientists and food development technologists, which might result in improved consumer acceptance of new food technologies. The survey was administered on-line to all respondents to the Round 1 survey and in all 54 usable responses were received (a response rate of 72%).

The Round 2 survey confirmed that incorporating consumer science information is perceived as important throughout development of both new technological processes and the resultant products, but especially to guide critical decisions in the early stages of both activities, and also before and after product launch. Information about consumers' preferred attributes and acceptability of products are ranked of higher importance than the acceptability to consumers of the underlying technological process.

Disciplinary differences form a key barrier to producing and using good consumer science information in food technology development. However, a lack of unanimous agreement signals that effective communication does sometimes occur. The utility of information produced by consumer scientists was criticised mainly because it is not specific enough or concrete enough to guide decision making. Further improvements would be obtained by improving the understanding by consumer scientists of the new technology in question. Lack of understanding of consumer science by food technologists meant they were sometimes not equipped to interpret and use consumer science information, or indeed to specify exactly what information was required. Differences in perceptions are further revealed by the differential responses of the two groups (CSs and FTs). Small and medium-sizes enterprises face the further barrier of a lack of internal capacity and the difficulty of identifying appropriate partners to work with.

To overcome the barrier posed by disciplinary differences, respondents indicated it was important to explicitly recognise that inter-disciplinary communication is an important part of food development projects and to establish mulitidisciplinary teams, preferably including one or more individuals with a good understanding of both disciplines. Face-to face interaction, including joint working on project elements, would be most important, whereas more formal communication management was less favoured.

Table of contents

1. Introduction

This deliverable reports on the conduct and findings of the final round of a two round Delphi study investigating communication between key actors during the development of new food technologies. The study contributes to the fulfilment of the overall objectives of Work Package 3 as outlined in the DOW, namely:
'To **identify barriers and critical factors which prevent effective communication between key actors**, policy-makers, stakeholders and end-users in the process of food technology development and commercialisation.'

The procedure for the Delphi study and the findings from the Round 1 Delphi survey are presented in D3.1. Round 1 elicited participants' perceptions of the barriers and their priorities and preferences for inclusion of consumer science information into the development of new food technologies and resultant products. Building on this, the second round survey seeks participants' views in respect of the optimisation of communication between consumer scientists and food technologists, including identification of potential barriers and concrete activities for improving communication and knowledge transfer. The information will be utilised in workpackage 4 of the Connect4Action project.

This report is structured as follows: Section 2 describes the approach adopted for the Delphi study Round 2, and Section 3 presents and discusses the results. Section 4 presents a discussion and key priorities for improving communication as identified by the Delphi study.

Finally, Annex A describes the efforts made to engage Small and Medium Sizes Enterprises (SMEs), defined as businesses employing fewer than 250 full time equivalent people, in the study. As explained in D3.1, the group responding to Round 1 contained relatively few industry participants. Moreover, because qualitative differences exist between small and large businesses, further understanding of this group's needs was sought, though was ultimately unsuccessful.

2. Introduction to Round 2 of the Delphi study

2.1 Method, approach

2.1.1 Questionnaire development

According to Delphi procedure, (including studies focused on the development of communication and information exchange, as well as policy development), the second and subsequent rounds of Delphi studies are characterised by providing participants with controlled and anonymous feedback on the previous round's responses (thereby providing a degree of interaction between participants), and by further data collection by means of a new or repeat questionnaire. (See, inter alia, Rowe and Wright, 1999, Frewer et al,2011)

The Round 1 survey had been informed by a small workshop at the project start-up meeting, although this had been attended primarily by project consortium members and could not be said to reflect the constituency of interested stakeholders and end-users. This suggests that an important issue may be stakeholder and end-user involvement in the issues to be discussed in the Delphi survey itself. As a consequence, when developing the first round questionnaire, reference was also made to the broader literature. The Round 1 survey asked a series of closed-choice questions consisting of statements to which respondents indicated agreement/disagreement. By means of an accompanying series of open questions, participants articulated a broad range of comments and explanations for their responses thereby providing more fine-grained information. The purpose of Round 2 was to provide feedback demonstrating the range of individual perceptions and proposals articulated in Round 1, and to confirm the extent to which these individual views are more widely accepted by the Delphi participants. This information could then provide practical guidance to inform a strategy to optimise communication, as well as provide evidence regarding the development of concrete and actionable policies and interventions salient to the central research issue regarding the integration of consumer science into food technology and associated commercialisation trajectories of novel foods and processes.

The Round 2 questionnaire was constructed round a number of principal themes identified during the Round 1 analysis:

1. At what stages is it especially useful for food technology developers to receive consumer science information?
2. What consumer science information is useful to food technology developers (FTDs) during *food technology* development?
3. What consumer science information is useful to FTDs during *food product* development?
4. What difficulties are experienced by FTDs when acting upon consumer science information?

5. What difficulties are experienced by consumer scientists (CSs) in generating useful consumer science information?
6. What strategies would promote interdisciplinary communication during food development projects?
7. What particular issues are faced by SMEs?
8. What specific activities would promote interdisciplinary communication?

To provide elucidation, a series of questions was generated for each theme that expressed the main ideas that were articulated around the theme by individual respondents as free comment during Round 1. In the second round these ideas were reflected back to the whole Delphi panel, and the extent of their agreement with the statements was elicited by a series of closed-choice questions for each theme.

All questions were answered using one of two five-point Likert scales. The first was anchored at 1= *Strongly disagree* to 5= *Strongly agree* and the second at 1= *Very unimportant* to 5 = *Very important*. Whereas the Round 1 survey provided a single alternative of '*Don't know*', Round 2 provided two options: '*Neither important or unimportant*' (or 'Neither agree or disagree') and '*Don't know*'. Respondents were again invited to provide comments.

Each themed group of questions was preceded with controlled feedback from Round 1. This reported the level of agreement/disagreement with Round 1 questions, accompanied by quotations to illustrate the main viewpoints expressed.

The final questionnaire appears as Appendix 1.

2.1.2 Survey administration

The questionnaire was administered to all respondents of the Round 1 questionnaire. Participants were sent a personalised e-mail containing a link to the Connect4Action survey which was only accessible to that individual. The questionnaire was completed on-line and responses were automatically downloaded into a MS Excel file accessible only by the survey administrator.

Alternative methods of administration were offered: the questionnaire was available in English and Italian as a MS Word document which could be completed off-line. Furthermore respondents had the option of completing the questionnaire in English, Spanish, Italian or Portuguese.

Two slightly different versions of the questionnaire were administered to allow a preliminary investigation of the impact on response rate and response quality of offering an incentive to participants who filled in the questionnaire. The incentive was that a 10 Euro donation would be made to a charity for each completed questionnaire. Participants were randomly assigned to one of 2 groups, a Control Group for whom no donation would be made, and a Treatment Group for whom a donation would be made on completion of the questionnaire.

The questionnaire was administered in January 2013 with a 3 week deadline for completion. A reminder was sent after 2 weeks, and a final contact was made to extend the deadline by a further week.

2.1.3 Response

In all 54 usable responses were obtained (including 3 partially completed responses), corresponding to a response rate of 72%. This is acceptable for Delphi surveys using online methodologies in the area of agriculture and food technology (see Frewer et al 2011) where a 25% drop in participation from round 1 to 2 can be expected. A further 3 responses were deemed too incomplete to be used. Tables 2.1 to 2.3 show the main sample characteristics. Attrition was not uniformly distributed across the sample and consequently there are two structural differences compared to the Round 1 panel:

● the reduction in the number of Consumer Scientists was larger than for other interests, and consequently a greater proportion of the panel are Food Technologists (43 % compared to 32% in R1)

● Altogether 12 with experience of developing new food products dropped out. This affects the CS group disproportionately as their number is reduced from 11 to 5.

Table 2.1: Round 2 respondents by sector and interest

	Interest						
Sector	Consumer or social scientist (CS)	CS and other	Food technologist (FT)	FT and other	CST and FT	Other	**Total**
Primary production			1			1	**2**
Food industry							
SME			2		1	1	**4**
Large	1		1	1			**3**
Multinational			2	1			**3**
Other (ref 13)					1		**1**
Academia/ research centre*	5		12	1	4	9	**31**
Regulation/ Government		1				3	**4**
NGO					1		**1**
Media							**0**
Other	1	1	1			1	**4**
Missing					1		**1**
Total	**7**	**2**	**19**	**3**	**8**	**15**	**54**

Table 2.2: Round 2 respondents with experience in developing new food products, by sector and interests

Sector			Interest	
Academia / Research	23		Consumer or social science	5
Food industry	9		Food technology	21
Primary production	2		CS and FT	8
Regulation / government	1		Other	5
Other	4			
Total	39			39

Table 2.3: Round 2 respondents and country of residence

Sector		
Country	Frequency	%
Central/Eastern Europe	10	18.5
Northern Europe	21	38.9
Southern Europe	20	37.0
Rest of World	3	5.6
Total	54	100.0

3. Results of the Round 2 Delphi study

3.1 Conventions used in the analysis

3.1.1 Between-group differences

Segmentation of the sample used 2 main respondent characteristics: interest and experience. In practice, for many questions, there were only minor between-group differences and these results are not shown. Furthermore, small group sizes limit the analysis that can be 'safely' performed without over-interpretation of the available data.

a. Experienced and Non-Experienced (EXP and NON-EXP)

For this analysis Experienced (EXP) respondents are defined as having been professionally involved with developing new food products. They are identified by having answered 'Yes' to one or more of the following questions in Round 1, Section 3:

1. I have been involved in developing new food products

2. I work or have worked as part of a food technology team developing new food products

3. I have worked with Natural Scientists in developing new food products

4. I have worked with Social and/or Consumer Scientists in developing new food products

b. Interest

Refers to the self-reported interest of a respondent in food technology development: whether as a consumer scientist (CS) a food technologist (FT), both of these (CS_FT), or 'Other'.

c. Experience X Interest

In practice the group of FTs 'with experience' is very similar to ALL-FTs as 21 out of 22 FTs has experience. Only 5 of 8 CSs has experience.

3.1.2 Calculating mean scores

The numerator for Questions 1, 2, 3 and 9 was calculated using the following scoring: 1 = 'Very unimportant', 2='Unimportant', 3='Neither important or unimportant', 4='Important', 5='Very important'. Mean scores above 3 indicate that the information is considered to be important, with a higher score indicating increasing importance. Scores below 3 indicate that the information is considered NOT to be important, where a score of 3 indicates indifference.

The numerator for Questions 4, 5, 6, 7 and 8, was calculated using the following scoring: 1 = 'Strongly disagree', 2= 'Disagree', 3='Neither agree or disagree', 4='Agree', 5='Strongly agree'.

Scores above 3 indicate agreement, with a higher score indicating increasing agreement, whereas scores below 3 indicate disagreement, and a score of 3 indicates indifference.
'Don't know' and missing responses are excluded from calculation of mean scores. Hence the denominator used to calculate means is ≤54.

3.1.3 Calculating responses by percentage

'Don't know' responses and missing values are included in calculations of responses by percentage. Hence the denominator is always 54. There are relatively few missing values, and in tables these responses are combined into a single category.

3.1.4 Consensus and controversy

Some questions show a division of responses between 'Agree' and 'Disagree'. Questions for which both the 'Agree' and 'Disagree' groups each contained ≥ 20%, are referred to as 'controversies'. Consensus refers to questions for which 80% or more of respondents provide the same answer.

3.1.5 Combining responses

For concision, in many tables the responses 'Very important' and 'Important' have been combined into a single category ('All-important'), and 'Very unimportant' and 'Important' into another ('All-unimportant'). Likewise, 'Strongly agree' and 'Agree' have been combined as 'All-Agree', and 'Strongly disagree' and 'Disagree' have been combined as 'All-Disagree'.

3.2 Analysis of the Round 2 Delphi study

Question 1

Question 1 investigated ***when*** information about consumer preferences is useful during development of new food technologies or resultant foods. Respondents to Round 1 of the Delphi study (Qs 1b and 1d) commented that communication with consumers at an early stage in developing new food technologies was necessary. In Round 2, Question 1 identifies more precisely the stages at which consumer information is needed and explicitly distinguishes between *process* development and *product* development.

Q1. The following list shows key stages in the development of new food technologies or processes, and in the development of new products resulting from applying the new technology. Please indicate how important it is to incorporate information about consumer preferences at each stage.

Responses to this series of questions register relatively high mean scores indicating quite a large consensus among respondents, even though we can observe a few interesting 'deviations'.
The consensus gained for certain questions indicates the stages where it is crucial to incorporate information on consumer preferences: 'Before starting to develop the new product' (c), 'Before marketing activity starts' (f) and 'After the first generation of products has entered the market' (g). In particular, incorporating such information at these stages is even more important than before starting work on developing the new technological process (Q1a), because – presumably – what consumers see, choose, buy and eat is a food product, and not the technology inside the product. Nevertheless 70% agreed that incorporating consumer information before starting process development is important. These are all stages at which key decisions are made.

Table 3.1 – Importance of incorporating consumer information during process and product development (n=54)

	Perceived importance of information *(% of respondents)*				
Stage in process/product development	**All important**	**Neither important or unimportant**	**All unimportant**	**Don't know + Missing**	**Mean**
a. Before starting work on developing the new technological process	70.4	5.6	22.2	1.9	3.89
b. During development of the new technological process	55.6	31.5	13.0	0.0	3.54
c. Before starting to develop the new product	96.3	3.7	0.0	0.0	4.54
d. Early in the product development process	79.6	14.8	5.6	0.0	4.13
e. Late in the product development process	59.3	22.2	18.5	0.0	3.56
f. Before marketing activity starts	88.9	3.7	7.4	0.0	4.31
g. After the first generation of products has entered the market (assuming modifications can be made at this stage)	90.7	3.7	3.7	1.9	4.43

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Agreement is much weaker for 2 questions: 'During development of the new technological process' stage (Q1b) and 'Late in the product development process', presumably because important decisions about whether to proceed with the development have already been made.
However, there is some controversy associated with Q1a as 22% consider consumer science is *unimportant* before starting process development. This confirms the ambiguity evident in Round 1 about whether development of new food technology is demand-led (i.e. developed to fulfil identified wishes of consumers) or supply-led (technology-driven). (For Round 1 Q2j, 63% agreed that 'The development of food technologies is driven more by technological advances than by consumer preferences and needs', and 94% agreed that 'Communication with end-users/consumers about new food technologies is critical to consumer acceptance'.) The following comment from Round 2 articulates this view:
'If research (fundamental or applied) is always dependent on the predicted or wanted outcome (consumer preferences) probably a lot of research will be stopped too early.' (Round 2, Q2)
Some differences in response between Experienced and Non-Experienced respondents is apparent for both this question and Q1b (see Table 3.2). It is striking that the importance of 1a and 1b are both considerably higher for the Experienced group compared to the Non-Experienced group. Most striking is that almost half of the Non-experienced group considers that incorporating consumer information before starting process development work is unimportant.

Table 3.2: Stage at which consumer information is important - Comparison of respondents with / without experience in new food product development

	Perceived importance of information *(% of respondents)*							
Stage in process/product development	**All important**		**Neither important or unimportant**		**All unimportant**		**Mean score**	
	Exp (n=39)	Non exp (n=15)	Exp	Non exp	Exp	Non exp	EXP	NOT_EXP
a. Before starting work on developing the new technological process	76.9	53.3	7.7	0.0	12.8	46.7	4.13	3.27
b. During development of the new technological process	61.5	40.0	25.6	46.7	12.8	13.3	3.59	3.40

Exp results do not sum to 100 due to omission in this table of one 'Don't know' response (=2.6%).

In conclusion, consumer information is important at all stages, but differentially so. Information from consumer studies can be useful especially to guide decisions in the earliest stages of process and product development, and later on when feedback on how to present the product on the market and adjustments to the product in case of weak consumer reaction are possible. However, there is a substantive and persistent counter-view that consumer information is not necessary before starting developing new processes, which in Round 1 was explained in 2 ways: that some

successful products have emerged directly from technology development, and that consumers don't always know what they want but may respond positively when confronted with the product.

Questions 2 and 3

In Round 1, 93% agreed that it is important to take account of consumer preferences when developing new food products (Q2a). In Round 2, Questions 2 and 3 explore ***what*** information is useful to food technology developers when engaged in two different activities: developing new food technologies (*process development*), and developing new products based on the technology (*product development*). The options presented in these questions were derived from comments/proposals about information types made by individuals in the Round 1 survey (Qs 1b and 2a).

Overall, as shown in Table 3.3, relatively high mean scores were obtained for most elements of Questions 2 and 3, indicating that all types of information identified were considered to be important by the majority of the Delphi panel. Broadly, the information needs were similar for both process and product development activities. However, the ranking of mean scores shows one difference: 'b. Intangible attributes consumers would like' is ranked 4th in process development, but ranked more highly (2nd place) in product development.

Table 3.3: Importance to food technology developers of types of consumer information.

Type of information	**Perceived importance of information** *(% of respondents)*			**Mean score**
Q2: During process development	**All important**	**Neither important or unimportant**	**All unimportant**	
a. Tangible attributes consumers would like	92.6	3.7	3.7	4.61
b. Intangible attributes consumers would like	83.3	9.3	3.7	4.15
c. Long term trends in consumer preferences	88.9	9.3	1.9	4.24
d. Probable level of product sales	68.5	16.7	9.3	3.82
e. The relative importance to consumers of different attributes and trends	72.2	18.5	3.7	3.98
f. Acceptability to consumers of the specific technological process.	81.5	14.8	3.7	4.11
g. Acceptability to consumers of the products derived from the process.	90.7	7.4	1.9	4.33
Q3: During product development				
a. Tangible attributes consumers would like	98.1	1.9	0.0	4.81
b. Intangible attributes consumers would like	92.6	5.6	0.0	4.36
c. Long term trends in consumer preferences	85.2	9.3	3.7	4.15

d. Probable level of product sales	72.2	11.1	11.1	3.84
e. The relative importance to consumers of different attributes and trends	73.6	18.9	5.7	3.94
f. Acceptability to consumers of the specific technological process.	68.5	27.8	3.7	3.98
g. Acceptability to consumers of the products derived from the process.	83.0	15.1	1.9	4.30

During product development, information about the acceptability of technology (Q2f) is perceived to be less important than information about the acceptability of actual products (Q2g). Both are considered to be of greater importance during process development. This suggests that the specific technological process is not viewed as an intangible attribute. We might also speculate that for controversial technologies the acceptability of the process should be rated more highly by product developers.

Questions 4 and 5

The next 2 questions focused on improving the utility of consumer science (CS) information. Question 4 examines the communication of CS information to Food technology Developers (FTDs), and how this may be improved. In Round 1 ambivalent responseswere received to 3 questions related to this issue; almost half chose 'No opinion' to questions about whether consumer information is communicated effectively to FTDs (Q2c), the timeliness of the delivery of consumer information (2d), and to Question 2f which concerned the interpretation of consumer research so that it is actionable and salient for FTDs. By contrast, four of the statements extracted from Round 1 elicited over 50% agreement in Round 2 (Table 3.4).

Q4 - The following list shows reasons why it is difficult for food technologists to act upon information produced by consumer / social scientists. To what extent do you agree or disagree with each statement?

Responses to this series of questions appear in ranked order of mean value in Table 3.4. The main reasons why it is difficult for food technologists to act upon information produced by consumer / social scientists are 'Information from consumer scientists is not specific enough to the actual product or process being developed' (4a) , 'Food technologists do not share the language or terminology used by consumer scientists' (4e), and 'd. Interpretation of the significance of information from consumer scientists is difficult for food technologists'. There is least agreement that 'Food technologists have no experience in where or when to obtain consumer science information' (4f). However the range of mean values is relatively narrow.

Table 3.4: Barriers for food technology developers in using CS information, ranked by mean score

	Extent of agreement (% of respondents)				
Possible difficulties faced by food technology developers	**All_Agree**	**Neither agree or disagree**	**All_Disagree**	**Don't know + Missing**	**Mean**
a. Information from consumer scientists is not specific enough to the actual product or process being developed.	59.3	22.2	9.3	9.3	3.63
e. Food technologists do not share the language or terminology used by consumer scientists.	57.4	25.9	11.1	5.6	3.63
d. Interpretation of the significance of information from consumer scientists is difficult for food technologists.	57.4	16.7	22.2	3.7	3.46
b. Information from consumer scientists is not concrete enough for product and process developers to use in decision-making.	55.6	18.5	18.5	7.4	3.46
g. Food technologists do not know how to apply consumer science information.	44.4	16.7	25.9	13.0	3.32
c. It takes too long for consumer scientists to report their findings to food technologists.2	42.6	29.6	11.1	16.7	3.47
f. Food technologists have no experience in where or when to obtain consumer science information.	40.7	25.9	24.1	9.3	3.22

'It takes too long for consumer scientists to report their findings to food technologists' records the highest number of 'Don't know' responses (14.8%) and 'Neither agree or disagree' responses (29.6%).

Several questions appear to be controversial as they have relatively high levels of disagreement (b, d, f, and g). Comparison by interest revealed some marked differences in perceptions between Consumer scientists (CS) and Food technologists (FT), as shown in Table 3.5.

● A majority of the 'All-FT' group (which includes respondents both with/without experience in food product development) agree that information supplied by CS is not specific enough (Q2a and b), and not concrete enough, whereas only a (large) minority of the All-CS group agreed. A substantial number of the All-CS group disagree with both a and b.

● A gap in perceptions exists with respect to FTs' ability to interpret the significance of CS information (Q4d): CS are more likely than FTs to agree that FTs find this difficult. However around one quarter of both CSs and FTs disagree with the statement.

● CS are more likely than FTs to agree that Food technologists do not know how to apply consumer science information (2g). However this is a matter for dispute among FTs of whom 46% agreed and 32% disagreed with the statement.

● Although almost equal proportions of FTs and CSs agreed that Food technologists have no experience in obtaining consumer science information, (Q4f), a substantial number (23%) of FTs disagreed.

When responses of Experienced and Non-Experienced respondents are compared only very minor changes in the FT results occur, as 21 out of 22 FTs are also Experienced. (Results not shown in Table 3.5.) Only 5 of 8 CS are experienced, and this causes some percentages to change, although interpretation is awkward due to the small group size. As shown in Table 3.5 (right hand column), the experienced CSs have greater agreement about the defects of Consumer Science information - that it is not sufficiently specific or concrete (4a and b), and takes too long to produce (4c). This group also show greater levels of agreement about the difficulties of FTs in obtaining, interpreting and using Consumer Science information (4d and g). Surprisingly, perhaps, only a minority of experienced CSs agree that the lack of a shared language is a problem (4e), although the residual 60% of responses to this question are 'Neither agree or disagree' or 'Don't know' (Not shown in Table 3.5).

Table 3.5: Barriers for food technology developers in using CS information by respondent interest.

	Extent of agreement (% of respondents)				
	All-CS (n=9)		**All-FT (n=22)**		**CS exp* (n=5)**
Possible difficulties face by food technologists	**Agree-All**	**Disagree-All**	**Agree-All**	**Disagree-All**	**Agree-All / Disagree-All**
a. Information from consumer scientists is not specific enough to the actual product or process being developed.	44.4	22.2	63.6	4.5	60/20
b. Information from consumer scientists is not concrete enough for product and process developers to use in decision-making.	44.4	33.3	54.5	18.2	60/20
c. It takes too long for consumer scientists to report their findings to food technologists.	44.4	22.2	45.5	13.6	60/20
d. Interpretation of the significance of information from consumer scientists is difficult for food technologists.	66.7	22.2	45.5	27.3	80/20
e. Food technologists do not share the language or terminology used by consumer scientists.	66.7	0.0	54.5	13.6	40/0
f. Food technologists have no experience in where or when to obtain consumer science information.	44.4	0.0	45.5	22.7	60/0
g. Food technologists do not know how to apply consumer science information.	55.6	0.0	45.5	31.8	60/0

Notes

'Neither agree or disagree', 'Don't know' and missing responses do not appear in table so percentages do not sum to 100.

* CS exp refers to Consumer Scientists with experience of new food technology development

Consumer science information is commonly believed not to be specific or concrete enough. In some cases this will be due to weak capacity in companies:
' ….. referring only to those technologists who do not know or do not apply basic knowledge of the investigation of the consumer…….. If there is any activity related to market research and opinions or wishes of consumers, it is usually organized by engaging a staff person from selling, without the involvement of technologists to prepare questionnaires. In such situations, you can get answers that incorrectly direct the development of new technological processes or products."

Improved timing of FTD and CS activities would improve matters:
"The coordination between food technologists and consumer science information could be difficult because of lack of time."

Furthermore, CSs may not be involved until the latest possible moment, limiting the time available to conduct good studies:
"Food technology may have a tendency to be kept 'secret' when performed in company so there is no time at all for consumer scientists to research this. It should be a two way exchange of ideas and research, and then time scales can be set between them."

A key point, with implications for designing and targeting policy measures, is that considerable variability exists within and between groups. It is evident that differences in perceptions exist between CSs and FTs, and also within the CS group. Broadly speaking, the majority of Food technologists in the Delphi panel think the information delivered by consumer science is wrong (although 44% of CS also think this), whereas the majority of consumer scientists believe Food Technologists can't interpret or apply CS information (although 45% of Food Technologists agree). A useful strategy would seek to improve co-ordination to enable more specific CS information to be obtained, and to provide help with interpretation.

Question 5
Question 5 relates to how to produce good consumer science studies. In Round 1, 93% agreed that it is important to take account of consumer preferences when developing new food products (Q2a), and 77% agreed that more effective consumer research methods are needed (Q2b). However, in Round 1 there was ambivalence about whether CSs interpret their results in a way that is actionable and salient to FTDs (42% indicated 'No opinion') and about whether consumer scientists make effective use of information on FTD in their research (55% expressing 'No opinion').
In Round 2, there were high levels of agreement related to the need for CSs to have a good understanding of the technology behind the product or process (Q5 a and b) ('Consumer scientists

need to understand and be able to explain the pros and cons of the product/process to consumers' and 'It is important for consumer scientists to understand how the technology works'.) With regard to consumer science methods, responses to Q5 e and f suggest there are deficiencies in the methods available to CSs, rather than in the way consumer scientists apply them. In Round 1 it was suggested that some difficulties faced by consumer science relate to the time scale at which events occur. For Round 2, two propositions were derived from these comments: that consumer science studies are inaccurate because consumers are conservative and technological change occurs relatively quickly (Q5h), and that consumer preferences change relatively quickly compared to the slow pace of food technology development. These questions were actually controversial, with over 20% agreeing and disagreeing with them.

Q5 - The following statements refer to what consumer scientists / social scientists need to design good studies. To what extent do you agree or disagree with each statement?

Table 3.6: Requirements for designing consumer science studies, ranked by mean score

	Extent of agreement (Percentage)				
Potential barrier	**Agree-All**	**Neither agree or**	**Disagree-All**	**Don't know +**	**Mean score**
a. Consumer scientists need to understand and be able to explain the pros and cons of the product/process to consumers.	85.2	9.3	1.9	3.7	4.33
b. It is important for consumer scientists to understand how the technology works.	77.8	11.1	9.3	1.9	3.96
d. It is not clear to consumer scientists what information food technologists want from them.	51.9	25.9	9.3	13.0	3.64
f. Consumer scientists need to adopt more effective methods for gathering information about consumer preferences.	51.9	25.9	11.1	11.1	3.63
c. Often there is not enough information available about risk and uncertainty for consumer scientists to use	50.0	18.5	11.1	20.4	3.51
e. Consumer scientists have effective methods available, but they are not properly applied to produce outcomes which can be used by food technologists	27.8	33.3	18.5	20.4	3.19
g. Consumer science studies are inaccurate because consumer preferences change relatively quickly compared to the speed of technological development.	31.5	24.1	31.5	13.0	3.06
h. Consumer science studies are inaccurate because technological development progresses faster than changes in consumer preferences.	20.4	33.3	35.2	11.1	2.98

To some extent, CSs do not always have the means to produce good studies, in particular a clear brief (Q5d) and sufficient information about risk and uncertainty (5c).

'I think many different and standardized methods of collecting information are available, but it is important that the questions are clearly formulated in order to get an answer, yes or no. I think it is often a problem in an unprofessional approach to consumer testing'.

However, explaining risk may not be the best approach for new and unfamiliar technologies:
"Risk and uncertainty are, inherently almost, terms that deal with "not enough information", there is always a shortage .... Explaining it to consumers, even when the information is 'enough', is difficult and by default often distrusted. This implies that consumers will fall back on feeling, emotion, sticking to the known... It is the challenge of the future to get the people to accept risk and uncertainty, so rather than explaining risk or uncertainty to the best of knowledge, create transparency and invite consumers (and scientists) to be open and critical towards new developments as they emerge, rather than killing it while still in 'the egg'."

Some differences in perceptions between CSs and FTs are evident. Table 3.7 reveals big differences in the level of agreement for Q5 a, b, e, g and h. There are divisions *within* the CS group (controversies) for Q5e,f,g, and h, and substantial divisions within the FT group for Q5 d,f, and h. Interestingly, a majority of Consumer scientists agree that they need to adopt more effective methods (Q5f).

Table 3.7: Requirements for designing consumer science studies by interest.

	% of respondents			
	All CS (n=9)		All FT (n=22)	
Potential barrier	**All_agree**	**All_Disagree**	**All_agree**	**All_Disagree**
a. Consumer scientists need to understand and be able to explain the pros and cons of the product/process to consumers.	77.8	0.0	95.5	4.5
b. It is important for consumer scientists to understand how the technology works.	66.7	0.0	81.8	4.5
c. Often there is not enough information available about risk and uncertainty for consumer scientists to use	55.6	0.0	50.0	18.2
d. It is not clear to consumer scientists what information food technologists want from them.	44.4	11.1	50.0	22.7
e. Consumer scientists have effective methods available, but they are not properly applied to produce outcomes which can be used by food technologists	22.2	22.2	31.8	36.4
f. Consumer scientists need to adopt more effective methods for gathering information about consumer preferences.	55.6	22.2	59.1	31.8
g. Consumer science studies are inaccurate because consumer preferences change relatively quickly compared to the speed of technological development.	12.5	37.5	50.0	18.2
h. Consumer science studies are inaccurate because technological development progresses faster than changes in consumer preferences.	0.0	33.3	27.3	27.3

The key finding for Q5 is that it is important for CSs to understand the technical context for the study. Improved design of CS studies (to obtain more specific, concrete information) is sometimes hampered by the use of unsatisfactory methods, a failure to specify precisely the output that is required from the study, and a lack of information on risk and uncertainty.

Questions 6 and 7

In Round 1 (Q2g), 71% of respondents agreed that disciplinary differences represent an important barrier between food technologists and consumer scientists, although 15% disagreed. In Round 2, the question was asked again (as Question 6)

Q6. Please indicate the extent to which you agree or disagree with the following statement: 'Disciplinary differences represent an important barrier to communication between food technologists and consumer scientists.'

Compared to Round 1, agreement and disagreement was less common, witha transition of a minority of 'agree' and 'disagree' responses to 'Neither agree or disagree' (Table 3.8).

Table 3.8: Agreement whether disciplinary differences are a barrier to communication

	% of respondents		
	All	Experienced	Inexperienced
Strongly agree	7.7	10.5	0.0
Agree	53.8	50.0	64.3
Neither agree or Disagree	26.9	31.6	14.3
Disagree	5.8	0.0	21.4
Strongly disagree	3.8	5.3	0.0
Don't know	1.9	2.6	0.0
Total	100.0	100.0	100.0

A modest number of suggestions for improving the situation were made in Round 1, and these were reflected back to respondents in Round 2 as Question 7.

Q7. The following statements show some possible measures for promoting interdisciplinary communication during food development projects.
For each measure, please indicate the extent to which you agree or disagree that it will improve interdisciplinary communication

Responses appear in ranked order of mean score in Table 3.9, which show high levels of agreement that most suggested measures will improve interdisciplinary communication. It may be deduced from this table that there were only very small levels of disagreement, though there were substantive levels of indifference to Q7d and e.

Table 3.9, Agreement whether measures will promote interdisciplinary communication, ranked by mean score

		Extent of agreement (%)	
Measure	**Mean score**	**All_Agree**	**Neither agree or disagree**
b. Establish a multidisciplinary team for the project.	4.6	100.0	0.0
a. Explicitly recognise interdisciplinary communication as an important part of food development projects.	4.5	98.1	1.9
f. Include at least one person in the research team who is able to understand different disciplines.	4.3	90.4	7.7
c. Train multidisciplinary individuals who can contribute to both new technology development and consumer science.	4.1	82.7	7.7
d. Allocate part of the project budget specifically to aid communication between different disciplines and partners.	3.9	73.7	23.1
e. Establish one person with a specific role of managing and facilitating communication.	3.8	55.3	26.9

Though agreeing on the main results, comparison by interest revealed slightly different priorities between Consumer Scientists and Food Technologists (not shown in table).

- For Q7d, 87.5% of Consumer Scientists agreed that budget allocation would help, whereas only 63.6% of Food technologist agreed.
- For Q7e, only 50.0% of Consumer Scientists agreed that a communication manager would help, whereas 63.6% of Food technologist agreed.

Comparison by experience revealed no further differences.

Overall there was a very high level of agreement that interdisciplinary communication should be explicitly recognised. In practical terms this means working in multidisciplinary teams and including individuals who 'speak both languages'. There was less consensus and greater levels of indifference for formal management interventions such as establishing a budget and communications management (7d and e). It was commented that the specific measures needed depended on the size and complexity of the project.

One respondent commented that the attitude and the willingness of individuals with different skills to co-operate, would be important:
'…. [with a] willingness to learn from other person, open mind to new ideas, thoughts, opinions. It could be more effective than between people from the same background with closed minds'.

Question 8

A few respondents to Round 1 drew attention to the different problems that SMEs might face due to their different capacities compared to large firms. They suggested SMEs lack the range of expertise found in large firms, they lack partners, and they have difficulty ensuring legal protection with respect to contracts and IPR. From these comments a series of statements was derived which appear as Question 8.

Q8. Small and medium sized enterprises (SMEs) may face different issues compared to large firms. To what extent do you agree or disagree with each of the following statements?

Table 3.10 shows that there was near-consensus that, because of their lack of capacity in all areas, SMEs need to work with external collaborators if they are to develop new processes or products (Q8a). Almost two thirds agreed that it is difficult to find such collaborators (Q8d).

Table 3.10: Difficulties faced by SMEs (ranked by mean score)

	Mean score	All_agree (%)	Neither agree or disagree (%)	All_disagree (%)
a. SMEs don't have all the relevant skills 'in house' and need to work with other firms or institutions in developing new processes and products.	4.0	75.9	11.5	7.4
d. SMES find it difficult to identify appropriate partner companies or institutes.	3.3	61.1	19.2	3.7
b. Dialogue between disciplines within SMEs is effective.	3.2	46.3	25.5	11.1
e. It is difficult for SMEs to arrange contracts with other partners that protect their intellectual property rights sufficiently.	3.0	53.7	13.5	7.4
c. Dialogue between disciplines located in different SMEs is effective.	2.9	42.6	17.3	22.2

There was less agreement for other items, possibly reflecting a lack of knowledge/ experience by respondents. Alternatively, it may be a recognition of the variability of the experiences and practice of different SMEs such that it is difficult to generalise.

However, there was a substantive level of disagreement (controversy) for Q8c concerning dialogue between companies. Together, responses to Q8c and d suggest that communication can work well where it exists, but that it is difficult to establish these collaborative working relationships.

Comments in Round 2 proposed other difficulties faced by SMEs: that SMEs cannot afford to take the financial risk which innovative technological development involves; they are not educated in enterprising behaviour; they do not have confidence in external advisers, and find consumer science too speculative.

Question 9

In Round 1, 92% of respondents agreed that communication between key actors along the process of food technology development was important to avoid commercial failure (Q1c). Speaking 'different languages' was cited as a problem, but also working in isolation from each other and without a common understanding.

Round 2 Question 9 sought to explore which mechanisms – suggested by Round 1 respondents - might be of use in promoting effective communication.

Q9 - Please indicate how important the following activities are in promoting effective communication between actors from different disciplines during development projects

There was strongest support for a range of activities which brought direct contact between actors (Q7a,c,f). As for Q7e there was less support for recruiting facilitators (Q9d).

Table 3.11: Importance of different activities in promoting effective communication

	Perceived importance of activity *(% of respondents)*				
Activity	**All-important**	**Neither important or unimportant**	**All-unimportant**	**Don't know and missing**	**mean**
a. Face-to-face interaction and listening to each other.	94.4	1.9	0.0	3.7	4.6
f. Interaction between different disciplines throughout the whole process of development.	92.6	1.9	0.0	5.6	4.4
c. Individuals working together on elements of the project.	83.3	11.1	1.9	3.7	4.3
e. Recruiting team members with experience of successful cross-disciplinary work.	74.1	16.7	1.9	7.4	4.1
b. Reading reports and papers from other disciplines, to become familiar with their approaches, methods and terminology.	74.1	22.2	0.0	3.7	4.0
d. Including 'interpreters' in development projects who understand the methods and vocabulary of both social science and technology.	59.3	20.4	11.1	9.3	3.8

4. Discussion: Key priorities for improving communication.

With regard to consumer acceptance of new food technologies, the Round 1 Delphi study concluded that it is important to take account of consumer preferences when developing new food products, and that communication between key actors is important to avoid commercial failure when developing these technologies and associated products. However disciplinary differences between FTs and CSs constitute an important barrier to such communication, and these may relate to both theoretical and linguistic differences between communities.

In Round 2, further exploration of the topic has been conducted to identify significant barriers to communication, critical points for communication, and key priorities for improving communication. Because of the variability which exists in the activities, circumstances and complexity of what is undertaken during food technology development, it is inappropriate to develop hard-and-fast rules. However, a number of general guidelines can be developed to inform a strategy for improved communication.

In both rounds of the Delphi study, inadequate communication between consumer scientists and food technologists is commonly (but not unanimously) regarded as a barrier to inclusion of consumer science data into product development. The problems include insufficient, ineffective and excessively late engagement and also non-engagement between actors. For example, the information on consumer preferences and priorities might be identified too late in the product development trajectory to influence it. Practical consequences include:

- failure to consider consumer information adequately when engaged in FT development, thereby contributing to eventual consumer rejection of products;
- failure by CSs to deliver useful information to FTs;
- inability of FTs to interpret and apply CS information.

The Delphi study demonstrated some clear gaps between the perceptions of FTs and CSs, as is evident by their differential responses to questions concerning the nature of the information provided by CSs and its interpretation. For example, consumer scientists (CS) were more likely to agree that FTs find it difficult to interpret CS information, whereas FTs were more likely to agree that CS information is not specific enough for FTs to use.

A high degree of specialism in the individual's own subject, disciplinary differences and the lack of a common technical language were identified as barriers to communication. Consequently there is a need to equip practitioners so they can gain insight into other discipline(s) including their methods of working, and be able to communicate with those from other disciplines. This would help address a number of barriers concerning the inclusion of consumer information.

To achieve this, it is important to explicitly recognise inter-disciplinary communication as a success factor in food development projects. To promote this, the single most important measure is the establishment of multi-disciplinary teams, preferably including some members with experience of cross-disciplinary working, and possibly also individuals with understanding of all relevant disciplines. The favoured methods for knowledge transfer are by direct contact such as face-to-face meetings and collaborative working on elements of the project. Personal qualities are important, as a willingness to work with others and an openness to learning from them are necessary. This direct contact can be augmented by undertaking background reading in other disciplines. Thus it is more important to invest team members themselves with the ability to communicate with each other is, rather than by including a 'communications expert' to facilitate this.

The situation is likely to be different for SMEs compared to large firms. Development teams in large firms are presumed to employ a wide range of different disciplines, whereas SMEs need to identify suitable partners to plug the gaps in their expertise, which can be difficult for them. Moreover, issues about legal contracts and intellectual property rights may be raised, and extra attention may be required to ensure the development fulfils the goals of all partners, thereby cementing the commitment of all.

Better understanding of other disciplines and easier communication would overcome some of the identified problems of utilising CS information. Information delivered by CSs to FTs is not always useful. The main barriers to using it are that it is too vague (not specific to the actual process or product under development) and not concrete enough to be used in decision making. Sometimes it becomes available too slowly. Part of the problem is that it is not clear to CSs what information is needed from them, so better communication might lead to better-defined project briefs. Furthermore, CS who possess a good level of knowledge about the technological process and have the ability to explain it to consumers are expected to produce better studies (e.g. by means of better questionnaires) than those who do not. There was also a perception that the methods used by CSs are ineffective, though this was a point of some dispute. A further range of barriers which might be addressed through knowledge exchange is to overcome the perceived inability of FTs to understand, interpret and use CS information.
Having dealt with the question of *How* to communicate CS information, we turn now to the questions of *When* to communicate and *What* to communicate. Although interaction throughout the technological development process is important, the critical times for CSs to supply information to FTs are when key decisions are being made: prior to starting development of specific products; prior to product launch, and following launch when customer feedback can be integrated. Also key, though contested by a minority, is prior to starting the development of the technological process.

The most important type of information needed by FTs engaged in process or product development relate to the attributes which consumers would like, including tangible and intangible attributes, and long-term trends. Market information, specifically level of predicted sales, is ranked less highly.
Information about the acceptability of the specific technological process to consumers is ranked lower than product acceptability (though still scoring relatively highly), especially during product development (compared to process development). This suggests that a positive step, where technologies are likely to prove controversial, is to place increased emphasis on investigating process acceptance.

In conclusion, the key priorities for improving communication are:

1. Improve knowledge and awareness of CSs and FTs of each other's subject:
    - increased awareness of FTs of what information CS can deliver and the possible benefits of using it.
    - increased knowledge of CSs with regard to scientific and technical aspects so that better designed studies result.
    - improved interpretation of CS studies and their significance, so maximum use is made of the results.
2. Increase dialogue between FTs and CSs so there is better co-ordination of work and realisation of possible synergies. This is best achieved by establishing direct contact, for example by face-to-face discussions and collaborative working.
3. Establish multi-disciplinary teams which work together throughout the development project. These should include some individuals with experience of inter-disciplinary work and/or a working knowledge of both CS and FT disciplines.
4. Communicate early on in process and product development, rather than applying end-of-pipe solutions once the product is near to launch.
5. Enable CSs to improve the design of CS studies so that the results are specific to the project. Engagement of both CSs and FTs during study design to ensure the outputs will be actionable and salient.
6. Review of available CS methods and their application to establish whether the view that they are inadequate is justified.
7. Accept that due to variability of business structures, technologies and circumstances that any strategy would have to be flexible and a 'one size fits all' approach would not be appropriate.

Considerable difficulties were found in attracting SME participants (see Annex A). The authors suspect that this was because

1. There are few food industry SMEs with and interest in introducing food technologies into product development. Many focus on (for example), niche products for specialised markets, often focused on artisanal or traditional production methods.

2. If food technology is of concern, they will have already developed a business plan based on market intelligence and so the survey appears more directed and relevant to large industry developers.
3. The smaller number of employees means that there is no designated employer with responsibility to examine the issues included in the Delphi survey. In addition, employees in an SME are less likely to perceive that have time flexibility to dedicate to participation in research surveys, even if they are rather short.

One conclusion is that the results of the project are more likely to be relevant to large industries interested in extending consumer science information to a range of potential new products. Excluded from the research was the issue of sensory analysis which is likely to be viewed as a more intrinsic part of product development by SMEs, but this is speculation given the research questions postulated at the start of the research process.

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Annex A: Investigation of small and medium sized enterprises in Connect4Action.

Introduction

Work Package 3 investigates how communication between key actors can be improved to increase the rate at which new food technologies and derived products are successfully commercialised. The investigation, by means of a Delphi study, is targeted towards all actors involved in product development. Finally, 75 usable responses were received to the Delphi, but the sample has a bias towards academics and other researchers who comprise 59% of the total sample. Unfortunately difficulties have been encountered in recruiting food industry participants, especially those from Small and Medium Sized Enterprises (SMEs) to the empirical phase of the work. These were not envisaged when the project proposal was developed. This short report describes and explains the difficulties of recruitment and involvement of SMEs, and the (theoretical and or practical) background of targeting SMEs.

Recruitment and involvement of food industry participants

As explained in D3.1, WP3's empirical work relies upon a database consisting of the Connect4Action on-line community of stakeholders, compiled as Task 1.1, to whom the Delphi survey could be administered. However, this exercise failed to recruit substantive numbers of individuals who work in food businesses. Out of 75 respondents to the first round Delphi study, 14 were from the food industry, of whom 4 worked in SMEs.

Consequently it was agreed at the 2nd Plenary Project Meeting (December 2012) that, in an effort to boost industry input, a questionnaire would be administered to delegates at the forthcoming 4th MoniQA International conference. (See Minutes, D7.2, Action point 7). A questionnaire was prepared and appears as Appendix 2. It is a simplified version of the Round 2 Delphi survey (see Appendix 1), suitable for face-to-face administration, and was also translated into Spanish, Italian and German. It was agreed that a particular effort would be made to target food industry delegates, especially those from SMEs. However this exercise was almost completely unsuccessful as only very few individuals who work in food production companies attended the conference.

A third attempt was made at the VMT Food Event on 26th of March 2013 in the Netherlands aimed at food industry professionals. In this case a new questionnaire was prepared and made available online in Dutch (See Appendix 2). In response to evidence described in the next section, the questionnaire contained exploratory questions about the nature of technological innovation in food SMEs. This survey aims to understand how SMEs make decisions about adopting new technologies, if and how they develop new food technologies themselves, and how they ensure that consumers still buy their products. Most of the participating professionals were from

multinationals, advisory organisations, education, NGOs and a few SMEs. Unfortunately only a few were willing to share their contact details in order to receive the link to the questionnaire.

Targeting SMEs

Consideration was given to identifying a more effective means of contacting food SMEs who develop or adopt new technology or might consider doing so. There is some evidence to suggest that such firms might not be common, as they may face significant barriers to technological innovation. The literature on innovation by food SMEs is limited (Baregheh et al, 2011; Avermaete et al, 2004) and sometimes suggests relatively high levels of innovation, although it is difficult to interpret such results in the present context. Firstly there are inconsistencies in the definition of innovation arising from self-reporting by respondents, and secondly many reported innovations are not relevant to this study. For example, position or paradigm innovations (Baregheh et al, 2011) such as changing marketing channels or making strategic decisions about the business, and product innovations which are achieved by altering packaging or recipes may not require new technology. Furthermore food innovation is sometimes characterised as incremental rather than radical (Capitanio et al, 2010).

There is anecdotal evidence (from expert colleagues) about the nature of technological innovation by SMEs in the food sector. A number of disincentives to innovation are evident in the UK, suggesting that such companies could be difficult to find. These include:

- Market structure. In the UK, the food retail sector is dominated by supermarkets who exert downward pressure on the price received by their suppliers.
- For competitive advantage, therefore, smaller food firms often rely on niche products whose identity may depend on using traditional production techniques.
- The investment needed in capital equipment is beyond the range of many SMEs. (Capitanio et al, 2010, suggest that in the Italian food industry process innovation is linked to the ability to invest in equipment and capital goods.) Moreover it is very difficult to prevent appropriation of ideas by other companies, so investment will not be worthwhile if only a short-term advantage is realised.

To contact sufficient numbers of SMEs which are engaged in using or developing new technologies, or who might consider doing so, either a large scale survey (scattergun approach) should be conducted, or else efforts should be put into identifying firms engaged in such activities, for example by using personal contacts. Both would be resource-consuming work and insufficient time was available to conduct it.

Conclusion

Within the resource constraints of the project it has not been possible to conduct a specific study of SMEs. The instruments employed so far have failed to deliver adequate numbers of SME participants to the study. At the same time, questions have been raised about 1.) whether

qualitative differences exist between SMEs and larger companies concerning development and adoption of new food technologies, and consequently 2.) the appropriateness of the Round 2 Delphi questionnaire, and 3.) the need for a more exploratory investigation of SMEs.
Task 3.4 (on-line forum discussion to further results of the Delphi study) might provide an opportunity to consider the circumstances of SMEs further. However, it will again depend on the composition of the forum members and their knowledge of the workings of food SMEs.

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Appendix 1: Questionnaire for Round 2 of the Delphi Study

Page 1

Thank you very much for completing Round 1 of the Connect4Action project's Delphi study. We obtained over 70 diverse and interesting responses, and hope very much that you will respond to this second (and final) survey.

The Connect4Action project, funded by the EU under Framework Programme 7, aims to improve communication between key players to improve the success of food technology development and commercialisation in Europe.

This Round 2 survey provides feedback on responses to Round 1, and goes into greater depth on certain topics which were found most relevant by survey respondents. Please be assured that your answers will be anonymous.

We estimate it will take 20 to 25 minutes to answer all questions. You can close the survey, and return to it later if you do not complete it in a single visit. (Use the personalized link in the email again.)

Please contact Marian Raley (m.e.raley@ncl.ac.uk) if you would prefer the survey as a Word document (available in English or Italian), or if you have any questions.

Again, many thanks for your help!
Yours sincerely,
Professor Lynn Frewer and Marian Raley, Newcastle University, UK
Professor Mario Mazzocchi and Dr Maddalena Ragona, University of Bologna, Italy
Dr Siet Sijtsema, LEI, Wageningen University & Research centre, The Netherlands

Page 2

▪ In Round 1 of the Delphi study, 92% of respondents agreed that communication between key actors (food technologists,consumer scientists, consumers, policy makers etc) during the process of food technology development is important to avoid commercial failure.

▪ Here are some typical comments:

'Communication is necessary to understand consumer needs.'

'Gathering knowledge of all actors will provide a better product in the end.'

'To avoid commercial failure the resulting product must suit all the actors' needs. This is only possible with good communication.'

‘Top-down food technologies (GMOs, cloning) have often failed because of consumer acceptance.'

SECTION 1: INFORMATION ABOUT CONSUMERS (1)

▪ In Round 1 of the Delphi survey almost all respondents agreed that it is important to take consumer preferences into account when developing new food products. Here are some typical comments which they made:

- 'If consumer preferences are not satisfied, consumers will not buy the products.'

- 'Simple mistakes can be avoided at an early stage.'

- 'Improvements can be included before production is started'.

▪ Some respondents also commented on shaping consumer preferences after a product has been developed:

- 'I recognise that sometimes technological research, instead of consumer research, has led to the development of new products.'

- 'I also think that public opinion can be created and new preferences established'.

TERMINOLOGY
In questions 1 to 3, we distinguish between two activities:

▪ 'Development of NEW FOOD TECHNOLOGIES (or processes)' refers to the generation and development of new technical methods for making food, and is the focus of Question 2

And

▪'Development of NEW PRODUCTS' refers to the development of food products which utilise the new technology, and is the focus of Question 3.

SECTION 1: INFORMATION ABOUT CONSUMERS (2)

Q1. The following list shows key stages in the development of new food technologies or processes and in the development of new products resulting from applying the new technology.

Please indicate how important it is to incorporate information about consumer preferences at each stage.

Response options: Very important Important Neither important or unimportant Unimportant Very unimportant Don't know

a. Before starting work on developing the new technological process

b. During development of the new technological process

c. Before starting to develop the new product

d. Early in the product development process

e. Late in the product development process

f. Before marketing activity starts

g. After the first generation of products has entered the market (assuming modifications can be made at this stage).

Page 5

SECTION 1: INFORMATION ABOUT CONSUMERS (3)

▪ Respondents told us that consumer research does not always deliver information that is useful to food technologists. Questions 2 and 3 explore what consumer science information food technologists want.

Q2. How important is the following information about consumers for food technologists who develop NEW FOOD TECHNOLOGIES (or processes)?

Response options: Very important Important Neither important or unimportant Unimportant Very unimportant Don't know

a. The tangible attributes (such as taste, texture and colour) that consumers would like to find in new food products.

b. The intangible attributes (such as sustainability or ethical production) that consumers would like to find in new food products.

c. Long term trends in consumer preferences

d. Probable level of sales of derived products to consumers.

e. The relative importance to consumers of different attributes and trends

f. Acceptability to consumers of the specific technological process.

g. Acceptability to consumers of the products derived from the process.

Please add any further comments here

SECTION 1: INFORMATION ABOUT CONSUMERS (4)

Q3. How important is the following information about consumers for food technologists who are involved in developing specific PRODUCTS (and utilising a new technological process)?

Response options: Very important Important Neither important or unimportant Unimportant Very unimportant Don't know

a. The tangible attributes (such as taste, texture and colour) that consumers would like to find in new food products.

b. The intangible attributes (such as sustainability or ethical production) that consumers would like to find in new food products.

c. Long term trends in consumer preferences

d. Probable level of sales of derived products to consumers.

e. The relative importance to consumers of different attributes and trends

f. Acceptability to consumers of the specific technological process.

g. Acceptability to consumers of the products derived from the process.

Please add any further comments here

SECTION 2: ADDING VALUE TO CONSUMER SCIENCE INFORMATION

The next few questions ask about the relevance to food technologists of the information which is produced by consumer scientists.

In Round 1:

▪ 77% of respondents agreed that more effective consumer research methods are needed to determine consumer preferences.

▪ 27% agreed that consumer research results reach food technology developers too late. (However, 23% disagreed, and 50% indicated ‘No Opinion’.)

▪ 27% agreed that consumer scientists do not interpret research about consumer priorities and preferences in a way that would be actionable and salient to new technology development. (24% disagreed and 49% indicated ‘No opinion’.)

▪ 34% agreed that information about consumer requirements is not communicated effectively to food technology developers, whereas 18% disagreed and 48% indicated ‘No opinion’.

▪ 26% agreed that consumer scientists do not make effective use of information on food technology development in their research (19% disagreed and 55% indicated ‘No opinion’)

CONSUMER SCIENCE (2)

Q4. The following list shows reasons why it is difficult for food technologists to act upon information produced by consumer /social scientists.

To what extent do you agree or disagree with each statement?

Response options: Strongly agree Agree Neither agree or disagree Disagree Strongly Disagree Don't know

a. Information from consumer scientists is not specific enough to the actual product or process being developed.

b. Information from consumer scientists is not concrete enough for product and process developers to use in decision making.

c. It takes too long for consumer scientists to report their findings to food technologists.

d. Interpretation of the significance of information from consumer scientists is difficult for food technologists.

e. Food technologists do not share the language or terminology used by consumer scientists.

f. Food technologists have no experience in where or when to obtain consumer science information.

g. Food technologists do not know how to apply consumer science information.

Please add any further comments here

Page 9

CONSUMER SCIENCE (3)

Q5. The following statements refer to what consumer scientists / social scientists need to design good studies.
To what extent do you agree or disagree with each statement?

Response options: Strongly agree Agree Neither agree or disagree Disagree Strongly Disagree Don't know

a. Consumer scientists need to understand and be able to explain the pros and cons of the product/process to consumers.

b. It is important for consumer scientists to understand how the technology works.

c. Often there is not enough information available about risk and uncertainty for consumer scientists to use.

d. It is not clear to consumer scientists what information food technologists want from them.

e.Consumer scientists have effective methods available, but they are not properly applied to produce outcomes which can be used by food technologists.

f. Consumer scientists need to adopt more effective methods for gathering information about consumer preferences.

g. Consumer science studies are inaccurate because consumer preferences change relatively quickly compared to the speed of technological development.

h. Consumer science studies are inaccurate because technological development progresses faster than changes in consumer preferences.

Please add any further comments here

SECTION 3: EFFECTIVE COMMUNICATION

The next set of questions ask how interaction between different disciplines/ functions can be made more effective.

▪ In Round 1 of the Delphi survey, 63% could identify communication problems between key actors which in their opinion could determine the failure of new food technologies.

▪ 71% agreed that disciplinary differences represent an important barrier to communication between food technologists and consumer scientists.

▪ Here are some quotations from people who agreed that disciplinary differences represent an important barrier to communication between food technologists and consumer scientists:

- 'Food technology developers and scientists speak different languages'.
- 'The terminology is different as well as the interests of both sides'.
- 'Most experts are focused on their own topic of study'.
- 'Each domain of activity requires a high level of expertise. Only few people acquire the capacity to combine the two domains'.
- 'Different terminology, so not understanding the value and content of their respective research results'.

▪ Some people disagreed that disciplinary differences form a barrier:

- 'Less and less true, in my opinion'.
- 'It is not a problem in large firms.'
- 'Communication barriers due to disciplinary differences can be resolved relatively easily in multidisciplinary teams.'
- 'It is more a problem of too little communication'

Page 11

Q6. We'd like you to consider the question again.

Please indicate the extent to which you agree or disagree with the following statement:
'Disciplinary differences represent an important barrier to communication between food technologists and consumer scientists.'

Response options:

Strongly agree
Agree
Neither agree or disagree
Disagree
Strongly Disagree
Don’t know

Page 12

IMPROVING INTER-DISCIPLINARY COMMUNICATION

Q7. The following statements show some possible measures for promoting interdisciplinary communication during food development projects.

For each measure, please indicate the extent to which you agree or disagree that it will improve interdisciplinary communication

Response options: Strongly agree Agree Neither agree or disagree Disagree Strongly Disagree Don't know

Measure a. Explicitly recognise interdisciplinary communication as an important part of food development projects.

Measure b. Establish a multidisciplinary team for the project.

Measure c. Train multidisciplinary individuals who can contribute to both new technology development and consumer science.

Measure d. Allocate part of the project budget specifically to aid communication between different disciplines and partners.

Measure e. Establish one person with a specific role of managing and facilitating communication.

Measure f. Include at least one person in the research team who is able to understand different disciplines.

Please add any further comments here:

Page 12

SMEs

Q8. Small and medium sized enterprises (SMEs) may face different issues compared to large firms.

To what extent do you agree or disagree with the following statements:

Response options: Strongly agree Agree Neither agree or disagree Disagree Strongly Disagree Don’t know

a. SMEs don't have all the relevant skills 'in house' and need to work with other firms or institutions in developing new processes and products.

b. Dialogue between disciplines within SMEs is effective.

c. Dialogue between disciplines located in different SMEs is effective.

d. SMES find it difficult to identify appropriate partner companies or institutes.

e. It is difficult for SMEs to arrange contracts with other partners that protect their intellectual property rights sufficiently.

Please add any further comments here

Page 13

Q9: Please indicate how important the following activities are in promoting effective communication between actors from different disciplines during development projects

Response options: Very important Important Neither important or unimportant Unimportant Very unimportant Don't know

a. Face to face interaction and listening to each other.

b. Reading reports and papers from other disciplines, to become familiar with their approaches, methods and terminology.

c. Individuals working together on elements of the project.

d. Including ‘interpreters’ in development projects who understand the methods and vocabulary of both social science and technology.

e. Recruiting team members with experience of successful cross-disciplinary work.

f. Interaction between different disciplines throughout the whole process of development.

Please add any further comments here

Page 14

AND FINALLY!
In the Round 1 Delphi survey, respondents quite often wrote about the variability of interdisciplinary communication. In some circumstances communication was good, but in others it was poor.

Q10. Can you think of a specific example (preferably from your own experience) where effective communication between development chain actors has occurred during the development of new food technology and related products?
If yes, please describe the key features that produced effective communication.

Finally, please add your email address

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE.

We will contact you again when the results are available.

WITH BEST WISHES FROM CONNECT4ACTION

Appendix 2: Questionnaire for administration at the MoniQA conference, Budapest, February 2013

Dear Colleague,

Consumer opinions about products created with new technologies are important for their ultimate success.
There is however little agreement on how and when to involve consumer science in technology development.
To arrive at recommendations about how this can be improved, the EU has started the Connect4Action project ('Strategies for improving communication between social and consumer scientists, food technology developers and consumers').
We would like to ask for a few minutes of your time to learn your unique and valuable opinions on this topic.

Please give your opinion on the following statements:	completely disagree	disagree	neither agree or disagree	agree	completely agree	Don't know
1. Consumer research should be involved during the development *of products based on a specific new technology*	○	○	○	○	○	○
2. Consumer research should be involved during the development *of the new food technology itself.*	○	○	○	○	○	○
3. Knowledge on consumer preferences *for tangible attributes of food* (e.g. taste, texture, colour) is important to technology developers	○	○	○	○	○	○
4. Knowledge on consumer preferences *for intangible product attributes* of food (e.g. sustainability, production process) is important to technology developers	○	○	○	○	○	○
5. Knowledge on *likely consumer demand for products created by a new technology* is important to technology developers	○	○	○	○	○	○
6. The acceptability to consumers of *the technology used to produce a product* is important knowledge for technology developers	○	○	○	○	○	○
7. It is difficult to use consumer science in technology development *as the information is not specific and concrete enough*	○	○	○	○	○	○
8. It is difficult to use consumer science in technology development *because food technology developers are not used to interpreting and applying this type of information in their day-to-day practice*	○	○	○	○	○	○
9. Often consumer scientists do not have sufficient knowledge about the technology to be able to produce good studies.	○	○	○	○	○	○
10 .Consumer science studies are inaccurate because technologies develop relatively quickly and consumer research lags behind	○	○	○	○	○	○
11. Consumer science studies are inaccurate because consumer preferences change more quickly than the speed of technological development	○	○	○	○	○	○
12. Disciplinary differences represent an important barrier in communication between food technology	○	○	○	○	○	○

developers and consumer scientists						
13. *Personal contact* between food technology developers and consumer scientists is important to promote communication between the disciplines	○	○	○	○	○	○
14. *Reading reports and papers of other disciplines* is important to promote communication between the disciplines	○	○	○	○	○	○
15. Including individuals in the development team with *previous experience in working with both food technology developers and consumer scientists* is important to promote communication between the disciplines	○	○	○	○	○	○
16. Involving both food technology developers and consumer scientists at every stage of food technology development is important to promote communication between the disciplines	○	○	○	○	○	○

Do you have any ideas for improving communication between food developers and consumer scientists?

What kind of training courses (if any) do food developers and consumer scientists need to be able to communicate effectively with each other? Please comment on content and structure. Please describe briefly any experience you have of such a course.

What is your age: ○ Below 35 yrs ○ 35-49 yrs ○ 50-65 yrs ○ older than 65 yrs

Country of residence …….

Gender : ○Male ○Female *(Please tick as appropriate)*

Job title ……..

Number of years in the job / experience ……..

Sector where your work

- ○ Primary production
- ○ Food industry SMEs
- ○ Food industry large
- ○ Food industry multinational
- ○ Academia

My interest in food technology development is as *(more than one answer is possible)* ○ A food technologist ○ A consumer or social scientists ○ Other (please state)……	○ Regulation / governments ○ NGO ○ Media ○ Other (please specify) ……

I am or have been involved in developing new food products	○ *YES*	○ *NO*
I work or have worked as part of a food technology team developing new food products	○ *YES*	○ *NO*
I work or have worked with Natural Scientists in developing new food products	○ *YES*	○ *NO*
I work or have worked with Social and/or Consumer Scientists in developing new food products	○ *YES*	○ *NO*

Thank you very much for your help with this research.

Please hand in the survey to Dora Lakner or Marian Raley, or leave it at the mailbox at the Connect4Action poster.

If you want more information about Connect4Action, please have a look at our poster at this conference or go to our website: http://www.connect4action.eu/

Appendix 3: SME survey

Dear Participant
Once more thank you for your willingness to participate in this survey.

Every year, new technologies are developed which can change the way in which food products are produced or packaged. These may deliver improved food safety or food quality, reduce resource use and environmental impacts, or lower costs.

This survey aims to understand how SMEs (Small and medium-sized enterprises) make decisions about adopting new technologies, if and how they develop new food technologies themselves, and how they ensure that consumers still buy their products. We would also like to find out what barriers SMEs perceive to be relevant in preventing them from adopting new technologies.

This survey is part of a large European project, Connect4Action (www.connect4action.eu), which is being administered by the Universities of Wageningen (Netherlands), Bologna (Italy) and Newcastle (UK)

Kind regards
Dr Arnout Fischer, Dr Siet Sijtsema, Marian Raley, Prof dr Lynn Frewer & Dr Maddalena Ragona

In this survey,' new technology' includes any technology used in food processing and packaging to improve food safety or quality, reduce resource use or environmental impact, or lower costs.
It can be new technologies in each production phase aiming at safer products, products with specific nutritional value, products with different sensory characteristics (for example taste, texture and colour), products with longer shelf live, etc
Examples of these technologies are applications of genetic modification, innovative packaging, nano-production etc. It includes technologies which directly influence the product and the production process, and not those innovations which do not change the product. Thus it does not include innovative heating systems in glasshouses or up scaling of existing methods.

SECTION 1: Filter

F1 Has your company developed new technology in the last 5 years? Yes /No

F2 Has your company adopted new technology (i.e. new technology that was not developed in-house) in the last 5 years? Yes /No

F3 Are you considering adopting/developing new technology now? Yes /No

<u>SECTION 2A: IF responded NO</u> to ALL 3 filter questions

Barriers

NON1 How important are the following factors in preventing your business from adopting/developing new technology? (5 point Likert scale)

a. Not aware of any relevant new technology.
b. There is relevant new technology, but I'm uncertain about what it can do for my products
c. There is no reason to change at the moment
d. Too expensive to buy
e. Lack of budget for research and development.
f. Don't have appropriate scientific/technical expertise in this business.
g. Uncertain about consumer reactions to the new products.
h. Don't need it – product identity depends on using traditional methods
i. Availability of capital.
j. Poor return on investment.
k. Can't assess likely returns on investment.

GO TO SECTION 3.

<u>SECTION 2B: Adopters, IF responded</u> <u>YES to one or more filter questions</u> (Already adopted/developed, or Want to adopt/develop):

You mentioned that your company is working on new technology. Can you please tell us some more about this?

ADP1 What is the name of the technology(-ies) that your business adopted/developed, or are considering adopting/developing? (open question)

ADP2 What does this technology consist of? (open question)

ADP3 What are the benefits of this technology? (open question)

ADP4 What was/is your business' motivation for adopting/developing this technology?

a. Need to innovate to remain competitive
b. Wanted to be one of the first businesses to use this technology
c. Strategic change in the business e.g. a new manager
d. To comply with regulations
Other – please explain……

ADP5 How do / will you acquire this new technology?

a. Develop it ourselves
b. Buy in 'ready-made'
– who from?.....
c. Buy in and then adapt
– Who bought in from?.....
d. Develop in cooperation with other businesses or research institutions (collaborative innovation)
e. Other – please explain……..

Could you please explain how you decide with whom you are going to cooperate in the area of new technology (open question)

ADP6 How relevant are the following problems to your business when adopting/developing the new technology?

Likert scale (very relevant, relevant, neither relevant or irrelevant, not relevant, not relevant at all)

a. Not aware of any relevant new technology.
b. There is relevant new technology, but I'm uncertain about what it can do for my products
c. There is no reason to change at the moment
d. Too expensive to buy
e. Lack of budget for research and development.
f. Don't have appropriate scientific/technical expertise in this business.
g. Uncertain about consumer reactions to the new products.
h. Don't need it – product identity depends on using traditional methods
i. Availability of capital.
j. Poor return on investment.
k. Can't assess likely returns on investment.

Information sources

ADP7 What sources of information about consumers does your business use when deciding what new products to develop? (more than one response is possible)

a. Academia
b. Food industry associations
c. Other food businesses

d. Official statistical sources (e..g. Eurostat)

e. Media

f. Consumer trends or market studies

g. Other (please specify) ……..

ADP8 What are the main difficulties which SMEs in general experience when adopting or developing new technology?

……..

ADP9 What policies or regulations make it difficult for SMEs to develop new FT?

……..

ADP10 What can policy and regulation do to help SMEs develop new FTs?

a. tax credits for research investment
b. development of "innovation centres,"
c. support for business angels (seed capital scheme, and set of tax initiatives to incentivise start-up funding)
d. stimulate cooperation to link SMEs with universities and industry
e. protecting patents
f. other (please specify)……

SECTION 3: ALL RESPONDENTS

Please describe your business:

3.1 How many employees has your company (open question)
3.2 How many years has your company been running? (open question)
3.3 What are the most important products for your company? (open question)
3.4 Are these niche products?

a. No, not at all. All my products are general
b. Some are niche products
c. All my products are niche products

3.5 Please indicate in the table below what expertise you have available within your business.

Job area	Available in our SME
	Yes/no
Technical development	
Engineering	
Micro biology	
Product development	
Consumer research	
Marketing	

3.6 Could you please indicate which expertise you get from external organisations

Job area	Other companies	universities	government	NGO's
Technical development				
Engineering				
Micro biology				
Product development				
Consumer research				
Marketing				

3.7 Please give the most important reason why you chose any specific organisations? (open question)

End of questionnaire

Thanks a lot for your time and effort.
If you want to know more about the project and results please visit www.connect4action.eu or join our community on LinkedIn.