Better communication for successful food technology development: A Delphi study

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Summary

Despite developments in technology, design and marketing, many new food products are not successfully commercialised. Communication between key players with different expertise (food technologists, consumers scientists, end consumers, etc.) seems crucial to improve food technology development, respond better to consumer wishes and reduce innovation failures. In this study, preliminary results of a Delphi survey aiming to identify opinions and priorities of various key players regarding the elaboration of an effective communication strategy during food product development are presented. Survey participants were recruited from an ad-hoc online community and personal contacts from different areas of expertise and sectors. Results revealed that disciplinary differences constitute an important barrier to such communication, and these may relate to both theoretical and linguistic differences between communities. 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. Some clear gaps between the perceptions of consumer scientists and food technologists exist, for example consumer scientists were more likely to agree that food technologists find it difficult to interpret consumer information, whereas food technologists were more likely to agree that consumer information is not specific enough for them to use. Given those identified barriers, it is important to explicitly recognise inter-disciplinary communication as a success factor in food development projects, with, e.g., the establishment of multi-disciplinary teams, and to improve knowledge and awareness of each other's subject.

Keywords: food product development; communication; food technology; consumer science; Delphi

JEL Classification codes:C83; D83; M10; O32; Q16

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1. INTRODUCTION

Despite developments in technology, design and marketing, many new food products are not successfully commercialised. The failure rate for new product introduction is approximately 70-80%. A notable example is consumer rejection of genetically modified food in Europe[1]. Failed innovations are not only a waste of investment, but may have implications for the effective implementation of policies linked to sustainable development of the bioeconomy, especially in the context of the current global economic crisis. Many technological advances in food production and processing are targeted at environmental preservation, energy saving, food quality and safety enhancement. Given that the success of innovations depends on consumers accepting novel products, it is important to know their needs and preferences in order to be incorporated into the development process. Such problems are then related to both technological sciences and social sciences, and communication between key players with different expertise seems crucial to improve food technology development (FTD), respond better to consumer wishes and reduce innovation failures.

The Connect4Action (C4A) project has received funding by the European Commission in order to connect all key players with different expertise in a dialogue in order to improve the success of food technology development and commercialisation in Europe[2]. Among the various approaches used to reach the objective of the project, a Delphi survey was conducted aiming at the identification of potential barriers, and success factors, from stakeholders' experiences, that underlie improved communication at various stages of the FTD process. This work presents results obtained from the survey.

The article is structured as follows. In the second section, the Delphi methodology is illustrated, followed by a description of participants collection and survey administration. In Section 3, results from the first and the second rounds are presented and discussed, especially those that are most important for the objective of the C4A project, and those indicating disagreement among participants. Finally, some final considerations and potential issues for open discussion are drawn, also in relation to the implications for the effective implementation of policies linked to sustainable development of the bioeconomy.

[1] See the Special Eurobarometer "Biotechnology" (2010) available at http://ec.europa.eu/public_opinion/archives/ebs/ebs_341_en.pdf

[2] See the C4A website for further details http://www.connect4action.eu/

2. RESEARCH METHODOLOGY

Delphi methodology was chosen as a flexible tool that allows a group of individuals to express their opinion on a complex problem, to interact in some way, and to revise their views, with their anonymity guaranteed.

The opinions of Delphi participants (also referred to as 'panellists') are collected over a number of rounds through the administration of a questionnaire, and controlled feedback of the results of each round is provided to participants (Linstone and Turoff, 1975). Panellists are usually recruited among 'experts', i.e. individuals with relevant knowledge and experience in a particular topic. Delphi overcomes the problems occurring in conventional meetings, like group pressure, strong personalities and the effect of status, but is also different to conventional surveys by allowing access to more geographically dispersed expertise, greater dialogue with respondents, and the possibility for participants to review their responses (Mullen, 2003; Rowe and Wright, 1999; Frewer et al., 2011a). On the other hand, some drawbacks of Delphi include administrative complexity, time required to complete the various rounds, self-selection bias, low response rates, and potentially high attrition rates (drop-out rates between rounds), although do not seem always to occur (Wentholt et al., 2012).

A two-round Delphi was utilized in this study.

A first questionnaire was developed incorporating issues identified in relevant literature and from a discussion among C4A partners held during a project consortium meeting in January 2012. A draft questionnaire was then reviewed by expert consortium members and subsequently revised. The final version of the questionnaire contained 15 questions and was structured in 3 sections:

- Part 1 included 4 contextual questions addressing the importance of NFTs in enhancing firm competitiveness, the factors relevant for the commercial success or failure of NFTs, the importance of communication between actors to avoid commercial failure, and the identification of critical communication problems which may determine the failure of NFTs;
- Part 2 contained 11 closed questions asking panellists whether they agreed or not with a statement, and to explain their answer, on 3 key stages in the FTD process, namely: generation of market information concerning consumer needs and preferences and exogenous factors which influence them, internal dissemination of market information among key actors, and the response by key actors to the market information that has been generated;
- Part 3 asked personal information on age, gender, country, job, sector, and experience in FTD, in order to allow segmentation of respondents across different criteria.

The second questionnaire consisted of fewer questions (10) than the first one, but included considerable feedback text from the previous round in the form of listing some typical comments and/or summaries of how panellists had responded (i.e. percentages of respondents agreeing/disagreeing). The questions related to some key issues identified during the analysis of Round 1 responses, namely the stages of FTD where it is especially important for food technology developers to receive consumer science information, the kind of consumer science information that is useful during *food technology* development and *food product* development, the difficulties experienced by food technology developers when acting upon consumer science information, the difficulties experienced by consumer scientists in generating useful consumer science information, the relevance of disciplinary differences as a barrier to communication between key players, the strategies that would promote interdisciplinary communication during FTD, any particular issues faced by SMEs, the specific activities that would promote interdisciplinary communication.

All questions were offered in a closed format (5-point Likert scale), each (except 2) followed by an invitation to provide any further explanation or comment to the answer provided. One of two types of Likert scales were used, ranging from 1 (strongly disagree/very unimportant) to 5 (strongly agree/very important), and a 'don't know' option was included. Copies of the two questionnaires are available from the authors.

As usually adopted in Delphi studies, purposive sampling was deemed appropriate for identifying potential panellists. Contact names were drawn from an online stakeholder community established for the C4A project, and consisting of food technologists, product developers, consumer scientists across various sectors (industry, academic/research institutes, media, NGOs, etc.) from around Europe. However, as the number of identified stakeholders was lower than expected (123), and in anticipation of non-response lowering the final number of participants, a further 233 names were identified from personal contacts of C4A project members, reaching a total of 356 contacts, who received the first questionnaire. Incomplete information about contacts did not allow for sample stratification before the questionnaire was sent out. 83 responses were received, of which 8 contained limited or no information, yielding a total of 75 usable responses (21% response rate). The second questionnaire was administered to respondents of the Round 1 questionnaire, and a 72% response rate was obtained, which can be considered acceptable for online Delphi surveys in the area of agriculture and food (Frewer et al., 2011b).

The first questionnaire was launched in September-October 2012, and the second in January 2013.

3. RESULTS AND DISCUSSION

The most important results obtained from the 2 rounds of the Delphi survey are reported in this section. A simple frequency analysis of closed-choice questions was performed to identify the degree of agreement or disagreement with each statement, and a thematic analysis of the associated explanatory comments was also conducted.

The aim if this Delphi survey was not to achieve consensus among respondents, as often Delphi studies do, but to collect all differing opinions and the arguments for those opinions. We were concerned with determining the degree of both consensus and polarization (or disagreement) of panellists on the barriers and priorities for an effective communication among key players in the food innovation process. For this study, consensus was defined as the situation where 80% of respondents who answered a particular question gave the same answer. Disputes or controversies were defined as occurring where opposing answers to an individual question (Yes/No, or Agree/Disagree) are each chosen by at least 20% of respondents.

Special emphasis in the discussion is put on those results indicating disagreement among panellists, especially between groups of respondents. On this regard, segmentation did not reveal any consistent differences between the responses of those from the food industry or academia/research (the two largest sectoral groupings) or between food technologists (FTs) and consumer scientists (CSs) (the biggest interest groupings). Consequently, segmentation of the sample used two main respondent characteristics: interest and experience (see Sub-section 3.1 below). However, 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.

3.1. Respondent characteristics

Participant characteristics in Rounds 1 and 2 are detailed in Table 1, revealing attrition is not uniformly distributed across the sample.

A bias is evident towards people from academia or other research centres, representing more than a half of the total panel (in both rounds). As far as professional interest[3] is concerned, there was an almost even split between consumer or social scientists and food technologists in Round 1. Nearly one quarter of R1 respondents had an interest classified as 'other', with the majority of them declaring a professional interest in food safety. 55% of respondents are male and that geographical coverage includes all the main areas of Europe, including some non-member states. The mean age of respondents was 45 years (ranging from 25 to 65) and the mean years of experience was 18 (ranging from 3 to 40),

In Round 2, one relevant difference can be noted compared to Round 1, that is the number of consumer scientists hugely decreased.

Table 1. Characteristics of the panellists in each round (R1 and R2).

		R1 (no.)	R2 (no.)	Response rate (%)
Interest	Consumer/social science	21	9	42.9
	Food technology	24	22	91.7
	CS and FT	11	8	72.7
	Other	19	15	78.9
Sector	Primary production	3	2	66.7
	Food industry	14	11	78.6
	Academia/research centres	44	31	70.5
	Regulation/government	6	4	66.7
	NGOs	1	1	100.0
	Media	0	0	
	Other	5	4	80.0
	Missing	2	1	50.0
Professional experience	Experienced	51	39	76.5
	Not-experienced	24	15	62.5
Cross-disciplinary	Experienced	29		
	Not-experienced	46		
Gender	Male	41		
	Female	34		
Residence	Central/Eastern Europe	13	10	76.9
	Northern Europe	30	21	70.0
	Southern Europe	29	20	69.0
	Rest of the World	3	3	100.0
Total respondents		75	54	72.0

Source: own elaboration

It is interesting to cross-tabulate the professional interest with experience[4] (Table 2). In Round 1, 51 respondents (68%) reported experience in developing new food products. Of these, 34 had worked as part of

[3] 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'.

[4] Experienced 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 statements in Round 1: 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

a food technology team, including 12 of the 13 food industry respondents. A very high proportion of food technologists had development experience (96%) compared to just over half of consumer scientists. In Round 2, 12 people with experience in developing food innovations dropped out. This affects the CS group disproportionately as their number is reduced from 11 to 5.

Table 2. Panellists with experience in FTD, by interest, in each round (R1 and R2).

	Experience in FTD							
	Experienced			Not experienced			Total	
Interest	R1	R2	Response rate	R1	R2	Response rate	R1	R2
Consumer science	11	5	45.5	10	4	40.0	21	9
Food technology	23	21	91.3	1	1	100.0	24	22
CS and FT	11	8	72.7	0	0		11	8
Other	6	5	83.3	13	10	76.9	19	15
Total	51	39	76.5	24	15	62.5	75	54

Source: own elaboration

3.2. Results from Round 1

From the first round, we found consensus among panellists on the following issues: food technology development is important in enhancing competitiveness; communication between key actors during development is important to avoid commercial failure; consumer preferences need to be taken into account when developing new food products; communication with consumers is critical to consumer acceptance.

However on several issues the picture is less clear. Sometimes communication is effective, and sometimes it is not, and successful communication is achieved for some technologies and products and by some companies, but not others. There was also not complete agreement on how to develop products that consumers want. The main approach suggested was to use consumer research methods to identify product attributes that fulfil consumers' wants.

Two views were expressed. First, consumer preferences are assumed to change relatively quickly compared to the long development times for technologically innovative processes and products, so consumer science needs improved methods which are better able to deal with such a moving target. An alternative view is that consumer preferences are slow-changing and lag behind technological development which is relatively quick, leading to rejection, so consumer science should understand the benefits of new technologies for the consumer.

However, there was strong agreement that development of food technologies is driven more by technological advances than by consumer preferences and needs.

Another critical need is an effective communication with consumers, from the earliest stages of development. Comprehensibility and trustworthiness of information were crucial for success. Risk and uncertainty should be communicated honestly.

Communication between actors (mainly consume scientists and food technologists) is important. There must be a common understanding of what the development does. Disciplinary differences were the most commonly mentioned barrier to achieving such communication and knowledge transfer.

The suggested solution lies in providing resources explicitly for communication including establishing multi-disciplinary teams with a leader, and building relationships between actors. Large companies appear

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.

able to internalise technological development, product development and consumer research functions, but outside these communication is problematic, partly due to legal and IPR issues.

3.3. Results from Round 2

Results obtained from the second round may be split in three groups, i.e. those dealing with the question of *when* to communicate information, *what* to communicate, and *how* 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.

Having dealt with the questions of *when* to communicate CS information and *what* to communicate, we turn now to the question of *how* to communicate.

The second round 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 (see Table 3).

Table 3. Barriers for food technology developers in using consumer information by respondent interest.

	All-CS (n=9)		All-FT (n=22)		CS exp* (n=5)
Possible difficulties faced by food technologists to act upon information produced by consumer/social scientists	Agree-All	Disagree-All	Agree-All	Disagree-All	Agree-All / Disagree-All
	(% of respondents)				
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	54.5	13.6	40/0
f. Food technologists have no experience in where or when to obtain consumer science information.	44.4	0	45.5	22.7	60/0
g. Food technologists do not know how to apply consumer science information.	55.6	0	45.5	31.8	60/0

Source: own elaboration

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 (see Table 4). 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.

Table 4. Requirements/barriers for consumer scientists in order to undertake good studies.

Potential barrier/ requirement for designing good consumer science studies	All CS (n=9)		All FT (n=22)	
	All_agree	All_Disagree	All_agree	All_Disagree
	(% of respondents)			
a. Consumer scientists need to understand and be able to explain the pros and cons of the product/process to consumers.	77.8	0	95.5	4.5
b. It is important for consumer scientists to understand how the technology works.	66.7	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	50	18.2
d. It is not clear to consumer scientists what information food technologists want from them.	44.4	11.1	50	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	18.2
h. Consumer science studies are inaccurate because technological development progresses faster than changes in consumer preferences.	0	33.3	27.3	27.3

Source: own elaboration

4. CONCLUSIONS

The key priorities for improving communication among key players in the FTD process that emerge from the Delphi survey are the following:

1. Improve knowledge and awareness of CSs and FTs of each other's subject:
    a. awareness of FTs of what information CS can deliver and the possible benefits of using it
    b. knowledge of CSs with regard to scientific and technical aspects so that better designed studies result
    c. 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.

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