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Health Consensus:
A Digital Adapted Delphi for Healthcare

J.M. Monguet, Universitat Politècnica de Catalunya, Barcelona, Spain
A. Trejo, Onsanity Solutions, Barcelona, Spain
T. Martí, Excelnets, Barcelona, Spain
J. Escarrabill, Hospital Clínic de Barcelona, Barcelona, Spain

ABSTRACT

New tools are needed to facilitate the involvement of health professionals in healthcare participative processes, partially because a relevant segment of healthcare knowledge and decision-making is capillary distributed among them. A collaborative design strategy has been applied to the creation of an Internet tool to produce digitally adapted Delphi for healthcare purposes. During the period 2012-16 the prototype of the tool has been gradually improved through its application to 18 real cases. It is proposed the model Health Consensus as a digitally adapted Delphi supported by the various capabilities of Internet. The authors agree that Health Consensus is a useful and expandable tool for participative processes. The Internet provides several opportunities to overcome many of the limitations of conventional Delphi, as well as improving the final studies with new functionalities.

KEYWORDS

Collaborative Design, Decision Making, Digital Delphi, Health Consensus, Healthcare Innovation, Real Time Delphi

INTRODUCTION

Rand Corporation developed the Delphi method as a forecasting system based on the aggregation of expert opinions and roundtable discussions. 84 years passed between the publication of the Jury Theorem (Condorcet, 1875) and the first formal implementation of consensus among experts (Helmer and Rescher, 1959). Condorcet stated that if each member of a voting group is more likely than not to make a correct decision, the probability that the vote of the group is the correct decision increases with the number of members of the group. This simple principle was applied by RAND researchers to forecast the impact of technology on warfare. Commissioned by the US Air Force, RAND created during the 50's the Delphi method. In the Delphi method, a group of experts anonymously reply to questionnaires and then receive feedback in the form of a statistical representation of participant's response. The process may be repeated several times with the intention of reducing the range of responses and arrive at something closer to expert consensus.

Although some authors consider this methodology to be in a developmental stage (Day & Bobeva, 2004), nowadays Delphi is recognised as a useful tool to build consensus by using questionnaires to collect data from panels of selected subjects (Dalkey & Helmer, 1963) and is widely accepted as a "scientifically and practically proven" research technique (von der Grach, 2012). The method is often

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employed in the absence of precise analytical techniques for gathering subjective judgments through group consensus (Linstone, 1978). Researchers and practitioners have successfully applied Delphi to forecasting, planning and needs assessment both in the public and the private sector. In a nutshell, Delphi enables groups of people to share understanding and knowledge. A group of participating individuals will reach a more informed answer than a single person's opinion to questions that have no alternative scientific answer.

Complexity rich domains like healthcare are ideally fitted for Delphi applications. In healthcare, there is an endless number of problems where solutions may be affordable, if the unevenly distributed knowledge and experience of healthcare professionals and patients, is tapped. Following the original use of Delphi in social sciences, the method has been widely used in healthcare research as an effective way to gain and measure group consensus (Holey, Feeley, & Dixon, 2007) and there is no doubt that it is an important method for achieving consensus on issues where is a lack of evidence (Keeney, Hasson, Mcckenna, & Kenna, 2006).

However, there are many situations where face-to-face meetings between all participants, that Delphi requires, is not possible due to time, space and cost constraints. Digital technologies may eventually overcome some of these limitations.

Since the first technology enabled Delphi back in the early seventies, digital methods have dramatically evolved. Delphi Conferencing was the first experience of using computers to assist in the method roll-out (Turoff, 1972). Along with the evolution and development of digital and communication technologies, several initiatives of what could be considered a digitally adapted Delphi have been reported in the literature, as networking, real time processing and social media boost innovation and new research opportunities to Delphi (Day & Bobeva, 2004) (Linstone and Turoff, 2002).

Looking ahead, information and communication technologies developments will continue increasing analytic capabilities by connecting relevant data to existing knowledge. Groups of people will be able to share information and connect in such a way that many of our current accepted paradigms will require a reformulation. Real time contextual analysis, large networks of experts and computational social science advances may lead to the development of a diversity of digitally enhanced Delphi methods (Lazer, 2009).

Finally, collaborative design is becoming an efficient approach to develop innovative products and services based on the systematic collaboration of agents and stakeholders. Computing operating systems, digital scanners or urbanisation of cities are just some of the many examples where the innovation process is conducted collectively by large groups or experts and/or crowds. Again, information and communication technologies leverage the collaborative process of design and innovation.

Applying the Delphi principles to confine consensus in different healthcare innovation domains, the authors developed a digital adapted version called Health Consensus. A user-centred and collaborative design strategy was followed, throughout 18 healthcare applications where users' behaviour was observed and their feedback listened, to gradually improve the tool.

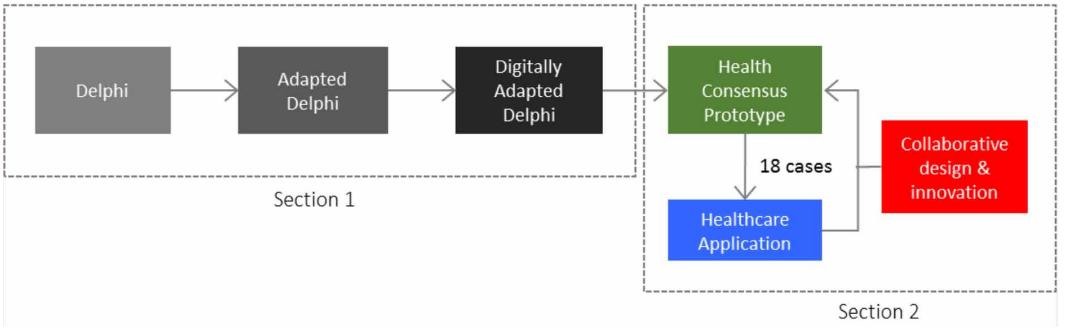
The aim of this paper is to contribute from the experience grounded in the application of Health Consensus to 18 real cases. The paper is organised in two sections outlined in Figure 1. The first section covers a literature review on adapted Delphi while the second section describes the process of Health Consensus gradual design and construction during the 18 cases. Finally, the impact of digital technologies in Delphi is discussed, and conclusions and future research directions are presented.

DELPHI AS A PROTO METHODOLOGY

This section presents a review of the literature of Delphi models to end up with a synthesis of the opportunities that digital innovation might bring to this kind of participative processes.

The Delphi method is defined as a process for structuring the communication of a group of experts acting together, to deal with a problem and it is considered an excellent way to collect and

Figure 1. General research framework



synthesize opinions (Gordon T., 1994). Initially conceived for forecasting, it has spread onto decision making, assessment or planning (Shelton & Creghan, 2015), facilitating the communication among experts and capturing tacit knowledge in an efficient way. Although the method admits a range of designs to systematically collect and contextualise the contributions of experts, all designs share a common set of features:

- It is an iterative communication process managed by a project moderator or facilitator;
- Experts get feedback during the different rounds of participation;
- There is a conclusion in the form of statement and its degree of agreement among experts;
- All participant experts are usually considered as equals and anonymous.

Delphi is a useful method in many healthcare areas, as its future is perceived as highly innovative. Closer collaborations between stakeholder groups, facilitated by Delphi methods, will be critical for quality improvement (Haluza & Jungwirth, 2016).

Dissection of Delphi

Nowack, Endrikat, & Guenther (2011) proposed a coding scheme for Delphi-based scenario studies that can be applied to the design of any Delphi application. Their taxonomy has been adapted for this work and Table 1 summarizes in categories and subcategories the elements involved in the design of a Delphi study.

Modification of Delphi

A modified Delphi process is like a classical approach as rounds, experts and similar objectives configure it, but with some changes in relation with the classical model. A modification might consist in the introduction of simple elements as pre-round work with literature reviews or interviews with experts on the topic. Modifications might also consist in more sophisticated arrangements that researchers require for adapting the method to suit their studies (Keeney, Hasson, Mcckenna, & Kenna, 2006).

Many researchers support that modified Delphi processes offers a system to achieve relevant and valid outcomes (Skulmoski, Hartman, & Krahn, 2007). Despite Nowack, Endrikat & Guenther's classification in three types (classical Delphi, Delphi study and Delphi technique), Delphi has become so diverse that it's hard to reach a closed definition of modified Delphi.

Through modifications, the response rate can be increased, consensus time reduced or accuracy of the results improved. In some cases, the quantification of responses has been applied (Ambrosiadou & Goulis, 1999). There's an ongoing debate whether modifications of the Delphi system can be

Table 1. Design elements in a Delphi study (adapted from Nowack et al., 2011)

Category	Subcategory	Description
Function		The function of the study may be a combination of idea generation, judgement and consolidation.
Iteration process (Based on participation rounds)	Pre-rounds	Actions before rounds start.
	Rounds	Number of rounds and typology.
	Post-rounds	Actions after rounds end.
Anonymity		Areas and degrees of anonymity of participants during the diverse activities of the process.
Questionnaire (List of questions to participants)	Source	The questionnaire inputs may be based on different information sources (literature reviews, expert interviews, etc.)
	Type of questions	Open-ended, closed or mixed.
	Focus of queries	Probability, desirability, prioritisation or mixed.
	Means	Channels used to transmit the study to participants.
	Comments	Participants' capacity of commenting the questionnaires.
Feedback (Information received by participants during the process)	Timing	Real time (synchronous), differed (asynchronous) or mixed.
	Type	Degree of analysis and synthesis of quantitative and qualitative information.
	Influence	Degree of influence in the process and degree of sharing and discussion.
	Changing opinion	Capacity to change the value or sense of contribution.
Participants	Invited	Number of experts invited.
	Participation degree	Number of experts actively participating.
	Selection	Criteria used for the selection of experts.
	Diversity	Composition, plurality and representativeness of experts as stakeholders.
	Level of expertise	Management of the level and type of expertise.
Results Presentation		Degree of detail and/or transparency in the publication of results.

allowed in a generally strict environment as the scientific one. In some cases, the modifications are meaningful and contribute to a better understanding of the technique, while in others they are random and arbitrary, thus undermining its quality and credibility. Thus, the versatility of Delphi is both its power and its fallibility (Gupta & Clarke, 1996).

A logical conclusion is that Delphi may be considered a seminal methodology adapted and modified systematically to meet requirements of researchers in specific areas and situations. Table 2 compiles a set of relevant modified Delphi versions.

A diversity of criticisms counterbalances Delphi's fertility. Some drawbacks are related to the content definition and results such as the lack of clarity in the selection of the consensus criteria and the discrepancies in the definition of what is consensus stressed by the heterogeneity of variables to ponder (Meijering, Kampen, & Tobi, 2013). Other reproaches point to a so called expert profile, such as the disparity in knowledge related to the parts of the construct under consensus, the variability of commitment during the participation results in concerns about the consistency and validity of the answers, the type and degree of feedback and the difficulty of reception control. (Bolger & Wright, 2011).

Table 2. Modified Delphi versions

Modified Delphi	Authors
Policy Delphi	(Turoff, The design of a policy Delphi, 1970)
Argument Delphi	Kuusi and Meyer
Rotational Delphi	(Cluster, Scarcella, & Stewart, 1999)
Malleable Delphi	(Romano, 2010)
Hybrid Delphi	(Landeta, Barrutia, & Lertxundi, Hybrid Delphi, 2011) (Davis, Romano, Schmidt, & Schultz, 2011)
Wideband Delphi	(Grzegorz Stochel, 2011)
Cloud Delphi	(Zhang, 2012)
Decision Delphi	(Rauch, 1979)
Dissensus Delphi	(Steinert, 2009)
Fuzzy Delphi	(Murray, Pipino, & van Gigch, 1985) (Agell, van Ganzewinkel, Sánchez, & Roselló, 2015)

DIGITIZATION OF DELPHI

Digital technologies allow a substantial improvement in the execution of a classical or minor modified Delphi study without significantly altering the essence of the method. Online questionnaires overcome time and space constraints of face-to-face meetings and accelerate the analysis of results. In all these cases technology facilitates the operative of the process but might not have a relevant effect on the design criteria of the Delphi studies. However, these technologies offer new opportunities when they are combined considering their new dimensions:

- **Time elasticity:** Time constraints and limitations shrink because of a free combination of synchronous and asynchronous processes that allows many alternatives to schedule participation, feedback and iteration;
- **Online participants:** Number of participants is unrestricted and the limits are based on the potential contribution of participants and their commitment with the participative process. Online participation may consist on any combination considering synchronous/asynchronous and face-to-face/distance communication;
- **Cloud data:** The geographical distribution and the mobility of participants is only limited by their real-time access to the internet cloud. The computation of data allows creating automatic logical processes to interact with participants;
- **Digital innovation:** Innovation based in digital technologies is continuous and open. The implication of diverse stakeholders, particularly users, in the evolution of the digital world is essential.

Case-Example of a Digitized Real Time Delphi

The example is based on the application of the Health Consensus model as a Delphi self-assessment tool, concerning the degree of participation in the organisation. The relevance and the degree of participation of employees in decision making or knowledge discovery in the organisation is something that might be the result of a consensus among all the people involved in the organization.

The capture in Figure 2 shows the precise moment when someone has participated. The data at the right appears once the user has voted. So, first vote is blind and is recorded, then changing vote is allowed. In some cases, consensus is reached (question 1) and in others is not (question 2). The vote may change because of arguments expressed by participants during a meeting, or as a personal reflection of the participant.

Figure 2. Interface of a health consensus case

Time Elasticity

Real time calculation of results opens new opportunities for the iteration and feedback. In a Real Time Delphi, the use of the Internet, or network computing, allows instant feedback after an expert placed input. Such proficient people can "respond, comment, or argue immediately, which allows direct feedback and almost infinite iterations" (Nowack, Endrikat, & Guenther, 2011). In fact, the core innovation of real time Delphi studies is the instant and automatic calculation and delivery of results (Monguet, 2010).

As it has been observed in other areas, the technology-enabled performance of adapted Delphi may affect traditional consensus criteria and opens opportunities to improve the efficiency by shortening execution times (Gordon & Pease, 2006). Due to the increasing number of design possibilities when setting up a real-time Delphi application, a key question will be how to ensure a systematic approach to conduct a Delphi study. There are guidelines for the management of a classical Delphi, but there is a lack of design recommendations for digital Delphi to ensure validity and trustworthiness.

Online Participants

Virtual space nearly allows an unlimited number of participants. Unleashing panel sizes may mean to move from the logic of experts to the wisdom of crowds. (Surowiecki, 2005). Furthermore, the proliferation and popularity of social networks help in the process of recruitment of participants and dissemination of results. "The more the better" or "quality versus quantity" are vividly open debates about the optimal number of participants and the marginal contribution once consensus has been reached. In some way, larger participations may cause reiteration.

Cloud Data

Central storage of information in the cloud and "mobile increased access" proved to be a productive combination in terms of convenience for user participation and innovation options for designers.

A digitally augmented Delphi implies a different data management approach. Data is now dynamic and results can be processed on the fly to inform participants about the current state of the question.

Digital Innovation

A digital environment is intrinsically connected with the concept of openness. Any digital design has the property of being continuously improved by the interaction of end-users and designers or even end-users as designers.

THE COLLABORATIVE DESIGN OF HEALTH CONSENSUS

Collaborative Processes in Design

Collaboration has been extensively used as a strategy to find solutions in society and industry. Methodologies such as focus groups or structured interviews with customers to explore market preferences and needs have been widely applied. On the other hand, and due in part to the evolution of collaboration platforms, organisations and companies are increasing their sensibility and awareness about the relevance of listening and capturing the knowledge of customers and users. This is especially important for any initiative of a product or service that depends on the use of information technologies.

Design is increasingly perceived as a social process that involves the participation of multiple agents with multiple, and often conflicting, needs, knowledge and goals (Alexiou, 2009). Although designing new products and services in the industrial age has always been a collective process, the term collaborative design has become increasingly popular within other communities. However, in the process of defining collaborative design there is a lack of delineation between recurring key terms like teamwork, co-design, participatory design, cooperation and so forth (Wang & Oygur, 2009).

A small number of user opinions may be very relevant in designing new products and services, so collective design activities that allow, explicitly or implicitly, that participants actively support their thoughts and design ideas can deliver a thoughtful help to designers.

Conscious or unconscious mass collaboration is behind newest solutions for web-related tasks and has been recognized to be an effective tool for corporate R&D departments (Merrick, Gu, Niazi, & Shafi, 2011).

The management of collaborative processes needs a framework for understanding what type of collective intelligence is possible, desirable and affordable and under what conditions. At a minimum, it is necessary to consider among others: loss of control, diversity versus expertise, engagement or policing (Bonabeau, 2009). By understanding such important issues many companies have successfully implemented Decisions 2.0 applications for a variety of purposes, including research and development, market research, customer service and knowledge management.

The design and development of online collective intelligence solutions are evolutionary and grounded with lots of trial and error processes in combining knowledge, design, technology, management and social interaction. Social networks proliferation and its use in professional or academic environments have increased the culture of participating and the sense of belonging (Monguet, Trejo, Bassolas, Martí, & Martí, 2014).

Despite the growing importance of collective intelligence, little is known about the design processes that leads to effective social innovation (Paulini, Murty, & Maher, 2012). Some of the mechanisms that produce successful community solutions inputs are:

- Structuring design as a hybrid process, which combines online communities for design development and appointed expertise;
- Providing distinct roles for users to assume manageable tasks for them to perform and clarifying task requirements;
- Supporting social communication to strengthen the impact of ideas, with focus on the social processes of ideation and evaluation.

Health Consensus Prototyping

During the period 2012 – 2016 the authors, playing the role of design-technology team, carried out a series of 18 consensus cases in the healthcare area. The agents listed in Table 3 participated in the creation process of Health Consensus. The prototype creation process was explicit for all the teams leading the diverse Delphi studies, although not all of them adopted the same degree of commitment with the creative attempts.

The development of Health Consensus can be considered a design project requiring the work of teams of professionals coordinating their varied expertise. Collaborative design has different dimensions that must be considered simultaneously (Alexiou, 2009). In Table 4 there is a preliminary reflection about the influence of this dimensions in the development of the Health Consensus prototypes.

Along with the development of the diverse cases, new opportunities arose in the form of requests from the leading groups as well as from designers. Thus, the Health Consensus prototype improved gradually with new functionalities only if they were viable and accepted by participants. Table 5 summarises the evolution of the prototype and the main features that were gradually added to the base version.

Table 3. Agents in the collaborative design process

Agent	Composition	Function
Technology-design team	Formed by a group of an engineer a designer and a health economics expert with different backgrounds and experience in health innovation.	Formal design and technical development of the 18 cases. Training and consultancy to support the leading teams
Leading teams	Formed by health professionals from the institutions that have commissioned the cases. Research Institutions (6), Networks of professionals (4), Health authorities (3) and Health Centres (2). A total of 15 different teams (one has participated in 3 cases and another one in 2 cases).	Development of all the content of the Health Consensus application consensus and decisions about the management of the process.
Participants	Formed by groups of health professionals ranging from tens to thousand's.	Answering participative questionnaires

Table 4. Dimensions in the collaborative design of health consensus

Dimension	Concept	In Health Consensus Creation
Social	Collaboration is mainly a social process. Values are the result of interactions between individuals that give rise to different kinds of conflicts.	Clinicians and researchers from leading teams constantly asked for more functionalities. It was the design-technology team responsibility to assess the viability and priority of demands. The user centred design strategy was based on piloting and testing the applications with short groups of people. Large groups were used to ascertain the level of satisfaction.
Knowledge	Knowledge is distributed through the members of groups, especially tacit knowledge. The value is then associated with knowledge sharing.	The relative value of functionalities in the prototype was not an explicit knowledge of the leading teams. A relevant task of the technology-design team consisted in fulfilling the requirements of the leading team.
Creativity	Creating something new is a process that combines collective and individual behaviors of communication.	The management of ideas provided by all participants, including final users, was one of the main concerns of the design-technology team. Formal and informal interviews with users were carried on for the 18 cases.

Table 5. Main characteristics of health consensus versions

Prototype Version	Description	Main Features
Version 1.0	Real-time Delphi with a single round.	Base version.
Version 2.0	Leading group feedback.	Double feedback: sample feedback and expert group feedback.
Version 3.0	Real-time Delphi with multiple rounds and waves.	Allows to add rounds of content and waves of participants.
Version 4.0	Customized scales.	Allows to define different scales for each question.

Description and Characteristics of the 18 Applications

The researchers were not free to decide by themselves the exact model to be applied in each case, as all of them were real commissions from healthcare institutions and industry. All the cases share the technical tool used and the training given to the leading group about consensus design and possibilities. So, for each application, customers made the final decision about style and design details. Professionals integrating all the leading groups had significant experience in research. Table 6 presents the 18 cases produced with Health Consensus during the period 2012-2016 in chronological order.

Table 6. Health consensus applications description

Application	Content
1. Chronic Care Indicators (I)	Assessment of indicators of chronic care performance (Monguet et al, 2015).
2. Primary care management	Assessment of trends in primary care management.
3. Primary care strategy	Assessment of a corporate primary care strategic plan proposal.
4. Arthroplasty management	Measurement of arthroplasty efficiency.
5. Leadership evolution in hospitals	Identification and definition of management criteria for units in hospitals.
6. Chronic Care Indicators (II)	Prioritisation of indicators of chronic care performance.
7. National health plan	Collective assessment and forecasting of a regional health plan. (Martí, Monguet, Trejo, Escarrabill, & Constante, 2014)
8. IT trends in health care	Trends in information technology development in health services.
9. Quality indicators of hospitals	Agreement on the main indicators of the level of quality of a hospital.
10. Innovation management in primary care	Assessment of strong and weak points for innovation in a group of primary care centres.
11. Non-technical skills assessment	Consensus about the level of non-technical skills of the group of professionals of a centre. (Martí, Trejo, Monguet, & Escarrabill, 2015).
12. Management of healthy aging (I)	Strategies to manage chronic disease and healthy aging across the lifecycle.
13. Diabetes care patients	Consensus about the current management of poorly controlled patients with diabetes.
14. Nurse prescription	Views and concerns of professionals about the future rights of nurses in giving prescriptions.
15. Aggressiveness of back surgery	Development of tools to predict the risks associated with the type of surgery planned.
16. Management of healthy aging (II)	Strategies to manage chronic disease and healthy aging across the lifecycle.
17. Suicide management	Assessment of the current model of suicide management.
18. Health literacy	Agreement on a health literacy measurement tool.

Table 7 provides the main parameters of all cases where:

- Leading group is formed by the people proposing the model for consensus;
- Rounds go from 1 to 3;
- Participants and invited refers to the active participants and called participants;
- Mode can be synchronous or asynchronous (during several weeks);

Table 7. Health consensus cases - basic data

Project	Leading Group	Rounds	Participants	Invited	Mod.	Weeks	Anonym.	Items	Questions
1. Chronic Care Indicators	Research institution A	1st 2nd 3rd	21 100 394	21 121 1.118	Sync. Asyn. Asyn.	0 4 6	Yes No No	85 52 36	85 260 108
2. Primary care management	Healthcare professionals network	1st	21	21	Sync.	-	Yes	9	54
3. Primary care strategy	Primary care management team A	1st	128	164	Asyn.	8	No	3	35
4. Arthroplasty management	Research institution A	1st 2nd	43 234	80 585	Asyn. Asyn.	1 6	No No	33 30	99 90
5. Leadership evolution in hospitals	Research group from a business school	1st 2nd	27 60	27 72	Sync. Asyn.	- 6	Yes No	71 50	71 50
6. Chronic Care Indicators	Health Authority A	1st	170	355	Asyn.	3	No	31	93
7. National health plan	Health authority B	1st	2.838	6.854	Asyn.	6	Yes	20	64
8. IT trends in health care	Innovation professionals network	1st	47	113	Asyn.	1	No	18	18
9. Quality indicators of hospitals.	Research institution A	1st 2nd	10 265	10 694	Sync. Asyn.	N N	No No	96 100	96 100
10. Innovation in primary care	Primary care management team A	1st	39	100	Asyn.	1	Yes	27	27
11. Non-technical skills assessment.	Health authority	1st	172	320	Asyn	6	Yes	19	38
12. Management of healthy aging 1	Research institution C	1st 2nd	27 24	43 43	Asyn. Asyn.	6 6	No No	16 15	57 51
13. Care of diabetes patients	Research institution B	1st 2nd	10 160	- -	Asyn. Asyn.	1 6	No Yes	10 10	41 41
14. Nurse prescribing	Network of nursing professionals	1st 2nd	18 355	18 -	Asyn. Asyn.	1 8	No Yes	2	20
15. Aggressiveness of surgical intervention	Physicians professional association A	1st 2nd 3rd	16 - -	18 18 -	Sync. Asyn. Asyn.	- - -	No No No	2 2 2	13 12 12
16. Management of healthy aging 2	Research institution C.	1st 2nd	- -	24 24	Asyn. Asyn.	6 6	No No	16 16	61
17. Suicide management	Physicians professional association B.	1st 2nd	14 64	22 -	Asyn. Asyn.	4 8	No Yes	21	21
18. Health literacy	Research institution D.	1st	-	-	Asyn.	4	No	13	13

Mode: Synchronous or Asynchronous

- Process can be anonymous;
- Items refer to the number of concepts to agree;
- Questions the total number of questions users had to respond.

All applications had alpha and beta versions usually with larger dimensions.

All cases except the number 7 had similar dimensions in terms of users, so in Table 8 data are presented except the case.

DISCUSSION

Because of the experience gained with this research the impact of Internet on the current concerns about the Delphi method can be widely discussed.

The matter of strictness and validity in the application of Delphi method is a main concern inside the research community (Shelton & Creghan, 2015) (von der Grach, 2012) (Skulmoski, Hartman, & Krahn, 2007). Issues include the definition of problems, structure of panels, methods of feedback and measurement of outcomes (Cantrill, Sibbald, & Buetow, 1996). So, although accepted as a research method, some aspects of Delphi remain still open to discussion. As it has been commented before, Delphi's malleability forces a constant validity review.

Standards for consensus in Delphi research have never been rigorously established (V.W. Mitchell, 1991), and the monitoring team must define criteria for each Delphi process individually, this may be part of the reason of weakness in methodology in this kind of research (von der Grach, 2012).

There is evidence that Delphi predictions are quite accurate (Parente & Anderson-Parente, 2011) but are difficult to perform well. A great deal of attention must be given to the choice of participants; the questionnaires must be meticulously prepared and tested to avoid ambiguity. Multi-round studies require a great deal of time; inevitably, some participants will drop out during the process (Gordon T., 1994).

Table 9 summarises the discussions about concerns and/or risks of the Delphi that can find a way of improvement through the application of digital strategies. It might be argued that Internet could eventually stress some of the current difficulties, but these drawbacks can be traded-off with a range of advantages.

CONCLUSION

Since the 60's the consensus among experts as a research method has adopted numerous variants and has gained followers, especially in the field of health. The number of researchers who apply methodologies inspired by the Delphi model has increased continuously over the past years. Delphi method remains nowadays active and open to new modification, particularly the digitisation has considerably increased the potential for improvement, so Delphi can be really considered a seminal methodology.

Table 8. Participation

	Effective	Invited	Turnout
Totals	**5.392**	**12.139**	**44%**
1st Round	3.627	8.217	44%
1st Round except case 7	789	1.363	58%
2nd Round	1.311	2.704	48%
3rd Round	454	1.218	37%

Table 9. Concerns of Delphi method and potential impact of Internet

Category	Concerns	Internet Potential Impact
Function	Benefits of Delphi that may come along with the research main purpose. For example, being a learning instrument or carrying on creativity strategies. (Gupta & Clarke, 1996)	Reinforce the value of the Delphi process by saving, processing and sharing any information produced during the communicative process.
Presentation of information	The selection, quality and format of scientific information (Black, Murphy, Lamping, McKee, & Sande, 1999).	Use of animations, video or other resources to present the content.
Communication process	The efficient structuring of a group communication process (von der Grach, 2012).	Facilitate a general vision of the whole process and the ability to guide the users through the Delphi process.
Time	A weakness of the Delphi method is the time that it takes. "A single round can easily require three weeks; a three-round Delphi is at least a three- to four-month" (Gordon T., 1994)	The time to design and discuss the process may be even longer as design possibilities increases. Nevertheless, execution may be reduced to one day.
Balanced process	Ensuring equitable participation. Participants with extreme opinions may work harder than others (Gordon T., 1994).	The analysis of the data provided by any group of digital participants allows discerning if asymmetries in the participation process affect the results of the research.
Number of participants	The size of a "small" Delphi sample has not been unequivocally established (Akins, Tolson, & Cole, 2005) and quite often convenient samples have been chosen upon availability of experts and resources (Akins, Tolson, & Cole, 2005) ranging from 10 to more than 1.000.	Sample size of a Delphi is not a statistically-bound decision and good results can be obtained by a comparatively small group of correctly selected experts. Nevertheless, Internet allows to overcome restrictions in dimension of groups of participants.
Quality of participants	Experts are multi-faceted and there are difficulties in defining and justifying their selection. Researchers have difficulties in conceptualising their expertise and current literature fails to defend the pros and cons of a panel selection (Baker, Lovell, & Harris, 2006). The direct self-weighting of the expertise of participants have disadvantages (Gordon T., 1994).	Profiles data provided by participants allow analysing among others: - Homogenous/heterogeneous degree of groups of participants and quotes of stakeholders. - Inclusion-exclusion criteria. - Assessment of theoretical and practical preparation.
Panel composition	The point of view of panellists may be different if this is from inside or outside the organisation, patient or professional. (Förster & von der Gracht, 2014)	Different stakeholders may be treated differently depending on the vision they have.
Anonymity	It is considered that anonymity eliminates the effect of dominant individuals and facilitates free change of opinion when others cannot see. So, main argument for anonymity is to avoid negative impacts of group communication processes (Nowack, Endrikat, & Guenther, 2011).	Internet offers the possibility of establishing and ensuring a degree of anonymity. Participants may be completely anonymous or in the other extreme in a face-to-face meeting it is possible to publically share extreme opinions. In some cases, it could be interesting to promote discussions among professionals. Real time digital management of data allows to maintain anonymity and at the same time show the aggregated opinions of participants by profiles.

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Table 9. Continued

Category	Concerns	Internet Potential Impact
Dimension of questionnaires	Generally, it is necessary to sacrifice questions and rounds to guarantee panel participation and continuity (Landeta, 2006)	Although dimension of Delphi is limited by time constraints of participants, segmentation of workload and increase of participants may help to overcome limitations.
Interpretation of questionnaires	Assuming all the participants understand and interpret the questions or item of discussion in the same way (Black, Murphy, Lamping, McKee, & Sande, 1999).	Pilots are fundamental to ensure that everything works as intended during the design phase, and internet assisted Delphi facilitates testing.
Feedback	Consensus may occur because of pressure brought on participants who have extreme opinions (Rowe G. et al., 1991).	Feedback may be regulated following specific rules, and the participative process can be made more transparent, by publishing the registration data.
Stability of participation	It may be necessary to test stability between successive Delphi rounds before the analysis of the level or type of consensus (Dajani, Sincoff, & Talley, 1979).	The analysis of data in real time may alert about eventual problems with stability or inconsistency of the questions or participants.
Strictness	The stricter the criteria, harder it is to achieve consensus among the expert panel. (von der Grach, 2012)	Strictness could be regulated in different ways depending on the kind of content and participants.

A digital adapted Delphi method based on Internet facilitates the effective involvement of participants in knowledge sharing and decision-making. The experience presented in this research, in the development of Health Consensus, shows that the collaborative design strategy applied, has proved to be useful in the creation and improvement of the system. This design strategy might continue being useful in the future as digital innovation is accelerated.

Across the eighteen cases reported, Health Consensus has become a useful tool for the creation of knowledge and decisions making throughout participative processes in a variety of healthcare domains. The cloud-based nature of the model, provides several opportunities to overcome many of the limitations of conventional Delphi as well as improving the Delphi method with new functionalities. However, many features might be still added to the system to increase usefulness, effectiveness and efficiency. This opens a wide horizon of future research and innovation particularly in the domain of balancing expertise and crowd intelligence.

The analysis and the management of data created during the application of digital Delphi is a promising field of innovation. Real time statistics will be a key source for the collective intelligence development of participants.

The application of information technologies multiplies Delphi possibilities. Internet and mobile devices allow introducing innovations and variations in the method to adapt it to many different needs. Online Delphi known as Real Time Delphi has a lot of future in a wide variety fields as research, knowledge management, decision making, prioritization or even the organizational learning.

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J.M. Monguet has a PhD in Industrial Engineering from the Higher School of Engineering of Barcelona. He is Professor at the Universitat Politècnica de Catalunya. His professional and research activity focuses on innovation in the application of ICT and design in the Healthcare field. He has worked in innovation and research projects with industry and public organizations in areas of health processes simulation, telemedicine, eLearning and multimedia applications for 30 years. He has developed leading positions at UPC Multimedia School as founder and director. He has directed diverse postgraduate training initiatives in collaboration with industry and has participated in the creation of university's spinoff.

A. Trejo holds an Engineering degree (UPC - Polytechnic University of Catalonia, 2003), an MSc in Business, Design & Technology (UPC - Polytechnic University of Catalonia, 2011) and Onsanity Solutions Ltd. Cofounder. Since 2000, he has focused most of his working experience in project management and currently his business revolves around innovative solutions and knowledge management applied to the health sector and life sciences. His research focuses on the field of technology agreement, the social and collective intelligence. He has experience in design management, technical development and media content management, innovation, integration, solutions and services associated with ICT in Health environments.

T. Marti is an International Area manager at TicSalut where he is responsible for coordinating of EU ehealth projects in integrated care, mobile health and personal health records. He is also finance manager at CASAP, a primary care consortium in Castelldefels. His 15 years' experience in the health sector encompasses different positions in the area of healthcare management and health policy in the Catalan Department of Health and ICS as well as international healthcare consulting for WHO Europe and IASIST. Tino is an economist and holds a Master degree in Health Economics and Healthcare Management from University Pompeu Fabra. He is the Founding member of Bsalut and editor of RISAI, Journal of Healthcare Innovation and Integrated Care.