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The Crowdsourcing Delphi: Combining the Delphi Methodology and Crowdsourcing Techniques

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Abstract: In this study three strong methodological approaches are combined including The Delphi methodology, the Crowdsourcing Approach and the Boston Consulting Matric Approach, while proposing an extension to conventional Delphi methodology, which we name as the Crowdsourcing Delphi. This new approach is better and probably more efficient version of conventional tool package of the Delphi methodology. Thus, the contribution adds new understanding to modern innovation management based on expert evaluations, and in some special consumer driven cases, on laymen evaluations. The study will have many practical implications for the use of crowdsourcing methodology. All the key stakeholders of the Quartet Helix (university researchers, corporations, the government and customers), which want to utilize modern crowdsourcing techniques, could benefit from this study.

Keywords: Foresight, Delphi methodology, crowdsourcing, Boston Consulting Group Matrix, marine cluster

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1 Introduction

Foresight is a systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions (For Learn, 2013). Foresight can be seen as a pragmatic version of futures studies (Kaivo-oja & Stenvall 2013). Fully-fledged foresight includes three key elements: (1) the use of futures and foresight studies methods, (2) networking of key stakeholders and (3) visionary and strategic decision processes and needs (see e.g. Keenan, Loveridge, Miles & Kaivo-oja 2003). In this study we are especially interested on Delphi Methodology and Crowdsourcing Techniques in context of foresight research, which have been used in various innovation policy studies.

By the definition Delphi is a structured group communication process among group of experts, which are forecasting and/or solving complex problems (adapted from Linstone and Turoff, 2002). Partially respectively in crowdsourcing a task is delegated to a large group of people, which then suggests their own solutions for the defined task (Howe, 2006). Crowdsourcing methods provide new management and analysis tools to understand complex systems and the development of Real-time Delphi method has also taken methodological steps towards this direction (Gordon & Pease 2006, Gordon 2007). In practice there are many similarities among these two methodological approaches, yet there are also some differences, which needs to be clarified. In this study the methodological challenge of the Delphi methodology are reflected especially in terms of Sackman critique (1974, Sackman 1975) in order to further develop Delphi methodology to meet these challenges.

The importance of foresight methodology and theoretical developments has been stressed by many scholars in recent years (e.g. Voros, 2003; Popper, 2008), even if the foundations for modern future studies were established after world wold II (see e.g. Bell 1997, Slaughter 2005). Besides identifying large-scale paradigms such as critical futures studies vs. praxis foresight (Hideg, 2002, 2007), practical frameworks have been suggested in order to optimise and justify the method selection for foresight projects. This is important since the selection of foresight methodology is a multi-factor process which typically end-up on using five or more different methods while favouring qualitative approaches in a way that the four fundamental capabilities including creativity, expertise, interaction and evidence are met (Popper, 2008a). Therefore Popper (2008b) coined foresight diamond concept in which these capabilities are helping to understand the differences and inter-linkage between the different foresight methods.

Research objective

As in the case of many methods, we know that both Delphi Methodology and crowdsourcing methods have their limitations and strengths. Therefore, we will first introduce and discuss advantages and disadvantages of these two key methodologies of modern innovation management. Moreover, we will also discuss when the Delphi methodology is suitable approach and when crowdsourcing techniques should be used. As a result this theoretical comparison and consideration offers foundation for a novel methodological synthesis which we have named as *the Crowdsourcing Delphi*. In order

to test out and refine our theoretical construct, we will present a case study results with high policy relevance focusing on key priorities of R&D portfolio of the maritime industries in Finland. The case study helps us to discuss more deeply about methodological approaches and choices relating to suggested Crowdsourcing Delphi.

Research design

This study is grounded on a constructive action research paradigm (e.g. Kasanen et. al. 1993) in context of single case study (Yin, 1994). Typically constructive research aims to develop a solution to a practically relevant problem by applying theoretical knowledge and demonstrating the functioning and innovativeness of the suggested solution (Jaatinen and Lavikka, 2008). As summarized by Cassel and Johnson (2006), a significant amount of different views, philosophies, typologies and methodologies of action research have been presented (e.g. Raelin, 1999; Reason and Bradbury, 2001; Chandler and Torbert, 2003) and there are even number of scholarly journals devoted to action research and related methodologies (Dick, 2004). However, in this study we follow a framework originally proposed by Kasanen et. al. (1993) and recently refined by Oyegoke (2011) in context of project management research. According to this framework we should 1) justify the practical relevance of our proposed problem (i.e. challenges and limitations of Delphi and crowdsourcing methods), 2) present the theoretical connection (i.e. the comprehensive understanding of the selected topic), 3) construct the solution (i.e. novel Crowdsourcing Delphi method), 4) demonstrate that the suggested solution is working and 5) finally present the research contribution including applicability of the solution.

First, to evaluate suitable theoretical frameworks for our Crowdsourcing Delphi concept, computerized searches to several different scientific journal databases were conducted. As a result, relevant theories for Delphi and crowdsourcing were identified and presented in next current understanding chapter. The summary of this analytical comparison is presented in a table format indicating the variations between the methodologies. *Second*, on the basis of these theoretical considerations and authors' practical experiences of previous projects in context of Delphi (Rikkonen, Aakkula & Kaivo-oja, 2006, Myllylä,, Sajeva, Kaivo-oja, & Aho 2011) and crowdsourcing (Santonen et al., 2007, Santonen et al., 2012), problems having research potential from theoretical and practical point of view were identified. *Third*, in order to suggest a solution for the identified problems, we propose Crowdsourcing Delphi construct. *Fourth*, in action research besides data collection for scientific purposes, researchers play an active and essential role in implementation efforts. Therefore, authors of this study co-implemented the Crowdsourcing Delphi project for Finnish maritime industry, which was acting as a development and testing environment for our methodological synthesis. The case study "Futures of Maritime Industries in Finland" was partially a typical Delphi study (Linstone & Turoff 1975) in which carefully selected experts answered survey questionnaires and participated workshops in multiple rounds, yet included elements relating to crowdsourcing. The key foresight outcomes of the case project are presented with the help of Boston Consulting Group (BCG) analysis tools (Stern & Deimler 2009) respectively to other foresights projects in Finland (e.g. Lehtinen et al 2001; Myllylä, 2003; Myllylä & Perttunen, 2011). Furthermore, the usefulness and challenges of the proposed Crowdsourcing Delphi construct are discussed in order to evaluate if the suggested solution is working or not. *Finally*, we identify our research contributions and

suggest further studies, which would provide more accurate evidence relating our construct and examine the applicability of the solution.

2 Current understanding of two methodologies

2.1 The Delphi Methodology

Linstone and Turoff (2005, p. 3) have defined Delphi methodology to be "Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem." There various platforms for the Delphi studies (Turoff 1970, Kuusi 1999, Linstone2002, Tapio 2003):

- Policy Delphi (focus on policy choices, policy agendas and priorities)
- Decision Delphi (focus on decision-making and well-defined policy choices)
- Argumentation Delphi (focus on experts´ argumentation logic and reason)
- Feedback Delphi (focus on feedbacks and comments of experts)
- Trend Delphi (focus on trend analyses with cross-impact analysis)
- Scenario Delphi (or Disaggregative Policy Delphi which focus on scenario analyses)

In the Delphi studies typical evaluations are: (1) Feasibility, (2) probability, (3) desirability, (4) impacts (in various scales, typically with cross-impact analysis), (5) importance, (6) risk level and (7) the level of consensus/disagreement. All these evaluations serve professional innovation management and smart R&D innovation portfolio selection. If we summarize the key aspects of Delphi methodology we can list the following aspects (Rowe and Wright 2012, 1489-1490)

(1) The central role of expert panel and its recruitment and retention.
(2) Creating useful heterogeneity of expert panel (even to have multi-panel studies).
(3) Enhancing information sharing process between panelists (feedback loops).
(4) Improving question formulation during the research process.
(5) Considering combining Delphi methodology with other techniques and methods.
(6) Anonymity.
(7) Avoidance of group thinking.
(8) Allows multi- and trans-scientific approaches

These aspects can be evaluated to be strong characters of the Delphi methodology. If experts of the Delphi panel are selected smartly to the panel it creates a good starting point for the research. Other needed aspects are heterogeneity of panel members, good information sharing process between panelists, improved question formulations, and possible links to other techniques and methods. These aspects can be advantages of the Delphi methodology.

What are disadvantages of the Delphi methodology? This question is a challenging question. During recent decades there have been critical discussions about the Delphi methodology. Maybe most well-known is critique Harold Sackman (1974) has presented. He presented the following disadvantages of the Delphi methodology:

(1) The selection of expert panel is not argued properly.
(2) Research questions are not explained in detail.
(3) Questions in Delphi survey formats are not clear and experts cannot answer to them properly.
(4) Statistical key indicators (validity and reliability) are not widely used in many Delphi studies.
(5) The aim is not natural consensus, but guided consensus.
(6) Delphi study can leave Delphi managers and organizers of the Delphi study without responsibilities.
(7) Gallup research can be more valid than Delphi studies.

Sackman critics (1974) have had various scientific self-correcting impacts on the Delphi studies (see e.g. Bolger & Wright 2011, Goluchowicz & Blind 2011). Many researchers have taken his critics seriously and developed (1) new tools for more balanced expert selection process (Hsu and Sandford, 2007), (2) utilized conventional statistical survey study criteria to the Delphi studies, (3) introduced both new consensus and non-consensus techniques, (4) increased transparency of the scientific organization of Delphi.

It may be possible to eliminate these disadvantages of the Delphi methodology by crowdsourcing methodologies and keep advantages of the Delphi methodology strong. Let´s explore the potential of crowdsourcing more in detail.

2.2 Crowdsourcing

Over the past decade, there has been a growing public interest in the complex connections of modern society and people seem to like to know how markets, networks and crowds function. Also the rapid growth of the Internet and the Web has made many forms of communication easier and faster and ordinary people have a good access to the Internet. The better skills and motivation to utilize the communication capacity of the Web and the Internet among common public makes crowdsourcing phenomena stronger and more relevant for many stakeholders. The digital technological evolution (Adami 1998), socio-cultural tribalism (McPherson, Smith-Lovin & Brashears 2006) and globalization (Ritzer 2006) make crowdsourcing an essential part of global communication and marketing operations and one of the key drivers for consumer- and user driven innovation management.

Crowdsourcing can be seen as a one alternative way to conduct open innovation (Leimeister et al. 2009, Chesbrough, 2003) and it has gained an interest among academics and practitioners ever since the term was coined by Howe (2006) even if Santonen *et al.* (2012) recently observed leveling interest towards crowdsourcing among scholars. An extensive attempt to define crowdsourcing term unambiquosly was recently made by Estellés-Arolas and González-Ladrón-de-Guevara (2012). In short crowdsourcing enlists a crowd for a problem solving (Whitla, 2009), idea generation (Poetz and Schreier, 2012), marketing (Parameswaran and Whinston, 2007) or microtasking (Eagle, 2009) as defined by the system owners (Doan et. al. 2011).

Moreover, crowdsourcing approach has also been conducted for foresight purposes, yet there are still some challenges which need to a solution (e.g. Hiltunen, 2011).

Moreover, Zhao and Zhu (2012) conducted an extensive critical examination of existing crowdsourcing research from information system perspective (IS) while introducing a framework for defining research objectives for crowdsourcing studies. However, in all the theoretical foundation of crowdsourcing is still undeveloped and various future research directions have been suggested (Brabham 2010, 2012, Whitla 2009). Therefore, in this study our aim is to extend our understanding between crowdsourcing and Delphi methodology and narrow down the gap between crowdsourcing and foresight studies.

We can see many advantages in crowdsourcing (Roth, Kaivo-oja,, Hirschmann & Jaccard 2013):

(1) crowdsourcing gives possibilities and voices for workers and idea creators inside organisations,
(2) it is an effective tool for consumer-driven innovations,
(3) it gives prize for active and innovative workers on a grassroot level,
(4) it channels innovative thinking towards business success and rewards,
(5) Crowdsourcing may help many organizations in log-frogging process, and
(6) crowdsourcing helps organizations and companies to develop their innovation capacity to be bigger and more extensive.

Crowdsourcing process can be either virtual or real and it can happen in many social contexts, inside organizations, in organizations, in regional contexts, in markets, in networks and in crowds. In practice crowdsourcing is very closely related to, but not the same process as, human-based computation, which refers to the ways in which humans and computers can work together to solve problems (Rausch, Sheta. & Ayesh 2013). Nowadays crowdsourcing is typically man-to-machine process, yet other forms of interaction can be identified such as

- man-to-man,
- man-to-machine/robot (in real life processes),
- man-to-avatar (in virtual environments),
- machine-to-machine oriented process, or even
- avatar-to-avatar process.

There are also many alternative ways for crowdsourcing. The starting point can be available data, information and knowledge. As we know all innovations are based on the available knowledge base. One way to identify key phases of crowdsourcing was presented by Prather (2010, 46), who noted that key phases of innovative problem-solving process in teams are:

(1) The challenge and its definition/s;
(2) Mind Mapping;
(3) Brainstorming;
(4) Pattern breaking;
(5) Present better solution proposals
(6) Idea Pool and Mapping Processes (evaluation of value and capability to realize ideas), and finally
(7) Present final, improved ideas.

To summarize above theoretical discussion we conclude that typically a crowdsourcing process is generating many suggestions for a defined challenge, which later on are filtered in a systematic way, while utilizing interaction models. Moreover, in appendix Table 1 and 2 the advantages and disadvantages of these two methodologies are compared.

3 The case study: The Future of the Finnish maritime industries

As suggested e.g. by Keenan *et al.* (2003), the fully-fledged foresight includes (1) the use of futures and foresight studies methods, (2) networking of key stakeholders and (3) visionary and strategic decision processes and needs. In term of this classification in the following we present our case study results based on the Maritime Cluster Delphi study of Myllylä (2013).

3.1 The use of futures and foresight studies methods

The selection of foresight methods is a multi-factor process which typically end-up on using five or more different methods while favouring qualitative approaches in a way that the four fundamental capabilities including creativity, expertise, interaction and evidence are met (Popper, 2008a). Popper (2008b) coined foresight diamond concept in which these capabilities can be constructed as a practical mapping framework while helping to understand the differences and inter-linkage between the suggested foresight methods.

Creativity dimension is referring to inventiveness of individuals. The ability to create a novelty is an essential cognitive skill of the human mind (Klahr, 2000, Thagard and Croft, 1999). Creativity can be defined as a process whereby an individual exceeds a conventional habit (Suomala et al., 2006) while using expectation or unexpected findings as an idea or innovation source (Santonen *et al.,* 2007).

Expertise dimension is linked to the skills and knowledge of participating actors relating to the selected topic area, which in our case was narrowed to the wellbeing and security services for independent living as well as the innovation needs in Finnish education system within those domains. Dreyfus and Dreyfus (1982) suggested a continuum model to classify expertise ranging from ignorance novice individuals who work by instruction to brilliance stage which includes superior performance. Moreover, Kuusi (1999) analysed how expert knowledge is linked to foresight processes and identified different types of experts about the future.

Interaction refers to collaboration among foresight project participants. As know from prior studies, the knowledge relevant to solve complex (Murtly, 2000), ill structured problems (Simon, 1973), which in foresight context have been referred also as wicked problems (Navarro *et al.* 2008) requires skills and socio-technological environments that bring together people with different, complementary, and often controversial points of view to form a community. Therefore, there have been efforts to define collaboration events in which interaction and heterogeneity of participants can be systematically planned in order to enhance innovation capability (e.g. Santonen and Saarela, 2013). Moreover, due to social media revolution and it's linkage to users as content creators (OECD 2007; Le Borgne-Bachschmidt *et al.*, 2009) and users driven innovation

(Wandahl *et al.,* 2011) phenomenon, mass collaboration also sometimes known as mass innovation systems have been introduced (Santonen, 2012). When combining a wide range of people and their different but complementary insights and creative interaction, a novel thinking outside the box is possible and mass innovations emerge (adapted from Leadbeater, 2008).

Evidence as final dimension is grounded on the support of reliable documentation and appropriate analysis which are usually utilized in form of quantitative methods. Models for evidence based decision making have described relating to innovation management (Chalkidou *et al.* 2008).

In the case study we have used various foresight methods. The key dimensions, creativity, interaction, expertise and evidence were linked to the case study in the following ways:

Table 1 Dimensions of Popper´s Diamond and the case study

Dimensions	*Foresight tools and processes in the case study*
Creativity	Futures workshops, theme interviews
Interaction	Futures workshops, pre-Delphi process, Internet web-pages (3600 visitors)
Expertise	Competency-interest –matrix, Delphi rounds, Expert panels, Boston Consulting Matrix Analysis
Evidence	Pre-Delphi process, argumentation of experts

In all total requests for Delphi interviews were sent to about 350 experts. The so-called competency-interest –matrix was used in the selection of experts for interviews. In addition, personal interest towards Arctic marine technology was also required from a corporate point of view, from the technical point of view and from the public sector administration point of view. There were also the so-called business and policy actors. Many experts of the Delphi panel are in a central location in a society in deciding the Arctic marine industry-related issues. Many of them are labour and economic policy representatives from the ministries. As a result of filtering participants, the study identified key small expert crowds of the Finnish maritime industries. The study is based on the key idea that small crowds are representative groups of larger expert crowds.

In the first phase of the Delphi process, the so-called pilot interview was attended by 14 top level experts. The face-to-face pilot interview was semi-structured by means of the Delphi research themes (challenges of maritime industries) and related content. Pilot interview were providing deeper themes for the annual interviews. Participation activity to the Annual 1 Interview was round of 43 experts, and to the 2nd Annual Interview round was 39 experts and a series of future enrolled activities participated 93 experts. Thus 189 experts of maritime industries took part in the interview rounds, or in the future workshops. Almost all 137 participating individuals were mainly Finnish, but there were also some foreign experts who live in Finland.

The Delphi Panel 2 round phase of interviews was conducted entirely by the eDelphi software. The eDelphi software provides operation of the ideal real-time Delphi process. The software will automatically send each party to be called the panelist's own voice IDs.

The panelist´ answers will be treated anonymously, but respondents' list can be printed, and so it was done in this Delphi study case. The software also provides the ability to sub-group respondents. The results were driven out of the two main categories of software. Sections were (1) business-oriented maritime industry actors and public sector players. In particular, special crowds based follow-up measures of attention was paid to the responses, where the business community and public sector agents´ opinions differed from each other. As a rule, there were no significant differences in opinions, only in few questions. The main differences were a maximum of 0.5 units on a Likert scale of 1-5.

During interview rounds, summaries of the reports were studied by experts in a social media environment: www.amtuusimaa.net. In this social media environment there were about 3700 visits during the first project year from March 2012 to March 2013. On the basis of summary reports there were three intensive strokes and two press releases. The project started in December 2011 and a final report was delivered in March 2013. The project was participatory foresight project with some elements of crowdsourcing. The activity rate was quite high taking into consideration that expert community of maritime industries is not so large. Key crowds associated to business community, technology community and public administration were participating to the project. Even if our case example was not fully utilizing the crowdsourcing approach, it is argued that these experiences will provide valuable insight in order to further develop our initial Crowdsourcing Delphi approach.

3.3 Visionary and strategic decision processes and needs

The future horizon of the project was year 2030 (in the operating environment factors). The key results of the Finnish maritime industry case study is reported and presented following the logic of the Boston Consulting Matrix (Stern & Deimler 2009). Thus, the study identifies: (1) question mark R&D portfolio, (2) star R&D portfolio, (3) cow R&D portfolio and (4) pet R&D portfolio for innovation policy portfolio. The Boston Consulting Group matrix and associated portfolio analysis, in particular, are based on the results of Delphi Panel 1 interview round. Deeper BCG analysis in accordance with the policy recommendations for action, are based on all interview rounds. For the BCG analysis, the field of arctic marine technology is divided into ten functional sub-fields (see Fig. 2).

Products with low market share and slow growth are Dogs or Pets. They may show an accounting profit, but the profit must be reinvested to maintain share, leaving no cash throw-off. The product is essentially worthless, expect in liquidation." (Stern & Deimler 2009, 35). If there is too much "dogs production", this is not good policy issue for future develop.

All products eventually become either Cash Cows or Pets (Dogs). The value of product is completely dependent upon obtaining a leading share of its market before the growth slows." (Stern & Deimler 2009, 35). This is basic logic of economic develop according to BCG portfolio analysis framework. That is why the strategic importance of Cash Cows is so important for companies and states.

Low-market-share, high-growth products are the Question Marks. They almost always require far more cash than they can generate. If cash is not supplied, they fall behind and die. Even when the cash is supplied, if they only hold their share, they are still pets when the growth stops. The question marks require large added cash investment for

market share to be purchased. The low-market-share, high-growth product is a liability unless it becomes a leader. It requires very large cash inputs that it cannot generate itself. (see Stern & Deimler 2009, 35-36). The have some future potential, regions need pay serious attention to Question Marks. Typically this means active science, technology and innovation policy activities. There will not be any Question Marks to observe, if there is not some kind innovation system.

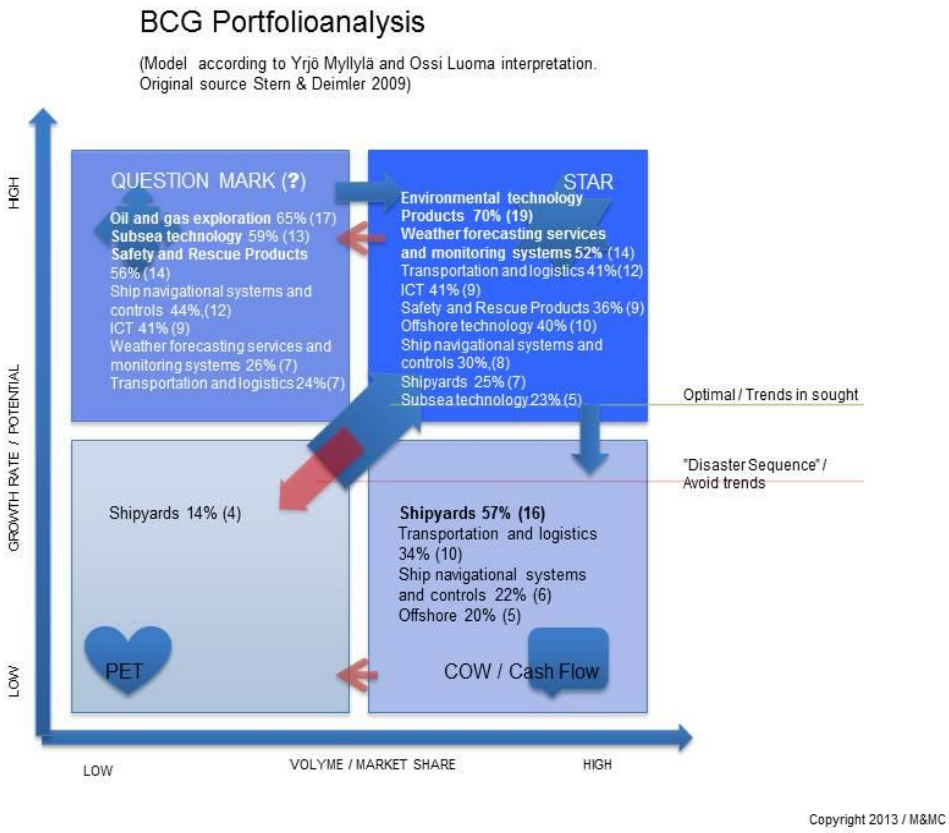

Figure 1. Arctic sea-tech sub-fields in Uusimaa region in year 2030 according to the BCG¨-analysis and Delphi-panel interviews. Percent (%) from number of respondents, in parentheses number of respondents (Myllylä 2013).

Stars. The results show that in the year 2030 star sub-fields of are environmental technology - including oil spill response technology and meteorology, weather, measurement and monitoring systems (more than 50% of the respondents). Transportation and logistics and ICT, offshore technologies were sub-fields at least 40% of the respondents felt that they are the star field clusters at the time.

Question marks. Sunrise sectors of the question marks are most noticeable: oil and gas exploration, subsea technology, and safety and rescue products (more than 50% of the respondents). In particular, the oil and gas explorations are seen now as a major

question mark, and as a potential sunrise sector in the Arctic region. This view is shared by 65% of the respondents. The second sub-field, subsea technology, as well as safety and rescue products are seen (more than 50% thought so) as sunrise sub-fields. Similarly respondents evaluated the ship navigational systems and controls.

Cows. As a cow sub-field is seen most clearly in shipbuilding (more than 50% of the respondents felt that). Also, transport and logistics systems have a strong role in sub-fields of dairy cows. As sources of cash flow, cash cows fields, was seen in 2030 more ship yards. More than 50% of the respondents analysed situation in this way. The shipyard strategy could mean construction of icebreakers and other specialised ice class vessels. The second strategic cow field was the transport and logistics products and systems. This might mean, to build cargo handling equipment at ports and on ships. For the year 2030 this strategy would mean more cash flow sources, if stakeholders invest in the shipbuilding industry conditions. It would be important to utilize existing infrastructure and industrial capacity in yards. For the Delphi panel, Finnish and Russian co-production opportunities, and the promotion of these activities are important follow-up in the coming years. Also co-operation with the Kronstadt ship yard and Finnish Shipyards is important for the strategy of maritime cluster. Cities of Kronstadt and St. Petersburg are planned to be production plants for the Arctic ships yards. Finns should be actively monitoring the strategic situation in the Baltic Sea region.

Pets. Some shipyards were seen as dogs (or pets).

Deeper BCG analysis. If we look at the most important advocated follow-up projects of the maritime industries, the results of BCG-matrix analysis in 2030 and respondents´ comments about the most important development projects in the years 2013-2017 indicate the following strategy: (1) the development of training in offshore-theme, (2) to development of infrastructure of oil spill response laboratory and training and (3) development activities to develop ice management activities and simulation environment.

To create better ice laboratory is one of the most important development issue in the future. This strategic project helps also indirectly to maintain the competitiveness of shipyards and maritime cluster in Finland. The expert panel identified as key activity to develop the Arctic marine technology exposition of Finnish international communications and promoting export strategy of the maritime cluster. Physical conditions of the yards, competitiveness and productivity must be improved with tailored sub-strategies such as training of supervisors and leaders.

More particularly from the view of shipbuilding for the Arctic region, the economy of Uusimaa should be focused on one vessel types: research vessels, icebreakers, supply ships, ice management vessels, oil recovery vessels, rescue boats and hybrid-/multifunctional vessels. The Delphi panel results indicate that in 2030, there will be new emerging fields, whose first steps and roots are probably already seen. To development pre-conditions for these emerging new fields need more strategic attention now. The Delphi panel noted that important follow-up activities that support the development of these sub-fields the following: (1) offshore education and training development, (2) reinforcement of project management skills, (3) marine and mining opportunities identification for joint exploration, (4) the development invention and innovation capacity to development these issues further and (5) improvement of competence and training capacity of anticipation/foresight.

3.4 Synthesis of two approaches: Core questions and other panel questions of research in the Crowdsourcing Delphi process

One key issue in combining the Delphi methodology and crowdsourcing techniques is how to present right questions to right people. The problem in crowdsourcing is that we cannot ask too many questions in the crowdsourcing processes. In the Delphi expert panels we can ask more detailed questions. This methodological puzzle needs a solution. Our proposal is a following. Let´s allocate core questions to crowds (laymen) and let´s give other questions to the experts of panels. This methodological solution could help us to combine the Delphi methodology and crowdsourcing techniques. It would be also good to create more interaction between experts and laymen (crowds). One methodological innovation of the crowdsourcing Delphi could ask crowds to present special questions to experts. This kind of combination of two key methodologies could lead to more interesting research.

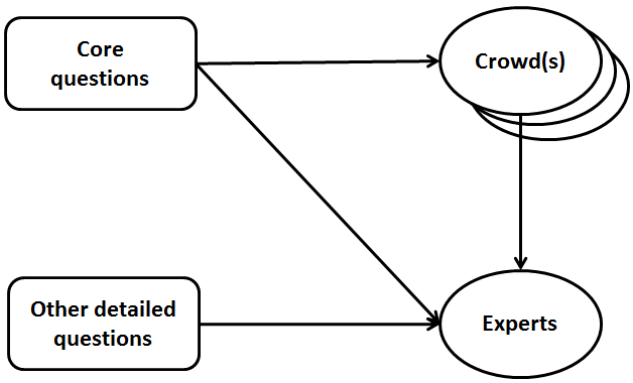

Figure 2. Allocation of questions to experts and laymen in Crowdsourcing Delphi

4 Conclusions

In this study three strong methodological approaches were combined including the Delphi methodology, the Crowdsourcing Approach and the Boston Consulting Matric Approach, while proposing an extension to conventional Delphi methodology, which we named as the Crowdsourcing Delphi. This new approach is better and probably more efficient version of conventional tool package of the Delphi methodology (and existing variations of the Delphi).

Thus, the contribution adds new understanding to modern innovation management, which are in typical cases based on experts´ evaluations, and in some special consumer driven cases, on laymen evaluations. The study will have many practical implications for the use of crowdsourcing methodology. The study also proposes some ideas how smartly combine the Delphi methodology and crowdsourcing techniques. All the key stakeholders of the Quartet Helix (the academia, corporations, the government and customers), which want to utilize modern crowdsourcing techniques, could benefit from this study.

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Appendix 1: Comparing the advantages of Delphi and Crowdsourcing

The Delphi methodology	*Crowdsourcing methodology*	*The Crowdsourcing Delphi*
The central role of expert panel and its recruitment and retention.	Masses of laymen, different crowds	Experts and laymen can have special roles.
Creating useful heterogeneity of expert panel (even to have multi-panel studies).	Heterogeneity is high	Even better heterogeneity.
Enhancing information sharing process between panelists (feedback loops).	No information sharing	Information sharing between crowded sub-groups.
Improving question formulation during the research process.	Few core questions	Possibility to test questions formulations by crowds (yes/no, good/bad).
Considering combining Delphi methodology with other techniques and methods.	Statistics	Big data provides reliable base for all kind of statistical analyses (better validity and reliability).
Anonymity.	Anonymity	Anonymity.
Avoidance of group thinking.	Group thinking problem	Avoidance of group thinking but also possibility to analyze what groups are really thinking.
Allows multi- and trans-scientific approaches.	Only few core questions	Allows multi- and trans-scientific approaches, but allows relevant analyses for markers, networks and crowds.

Appendix 2: Comparing the disadvantages of Delphi and Crowdsourcing

The Delphi methodology	*Crowdsourcing methodology*	*The Crowdsourcing Delphi*
The selection of expert panel is not argued properly.	Statistical survey criteria applied	Allows various sub-panels and their selections.
Research questions are not explained in detail.	Simple core questions	Research questions must be very clear to crowds.
Questions in Delphi survey formats are not clear and experts cannot answer to them properly.	Very simple and easy questions are presented to crowds-	Research questions must be very clear to crowds.
Statistical key indicators (validity and reliability) are not widely used in many Delphi studies.	Statistical verification and statistical cross-checks	Big data allows all possible statistical checks and tests.
The aim is not natural consensus, but guided consensus.	Shows consensus or non-sensus	Consensus and non-sensus are allowed
Delphi study can leave Delphi managers and organizers of the Delphi study without responsibilities.	Crowdsourcing study can leave managers and organizers of the study without responsibilities.	Can be a problematic issue also in the field of crowdsourcing studies.
Gallup research can be more valid than Delphi studies.	Can be more flexible than Gallup research.	Gallup research cannot be more valid than Crowdsourcing Delphi.