Samuel Neaman Institute
for National Policy Research

How to Generate Information from Round Table Discussions

A Methodological Paper

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Executive Summary

Round tables (RT) are a basic method for gathering feedback and brainstorm on a wide range of topics. A RT is a gathering of stakeholders and specialists that meet from a couple of hours to a few days to exchange ideas on a focused topic. The common denominator in RT discussions is that an agenda with key questions and objectives is prepared and disseminated before the event. Some of the RTs are very structured and some are more loosely facilitated. Eventually, a report is prepared summarizing key findings and recommendations from the RT. This report is presenting several methodological approaches for structuring RT discussions. It provides a methodological background for researchers in a variety of fields. Specifically, we present four approaches to Round Table Workshops: 1) Workshops seeking inputs from international experts [Method 1], 2) Workshops involving the rating of alternative scenarios [Method 2], 3) Workshops aiming at the implementation of Quality Function Deployment (QFD) methods [Method 3] and a methodology for effective listening, speaking and responding during RT sessions [Method 4].

1. Background

The Samuel Neaman Institute (SNI) is actively involved in several national policy initiatives. A primary research tool applied by SNI is a round table (RT) discussion session. Such RT discussions have been carried out in a range of topics such as energy (Gershon Grossman), electrical vehicles (Ofira Ayalon and Idan Liebes), urban planning (Rachelle Alterman), emergency evacuations (Reuven Gal), analytics in advanced manufacturing (A. Zonneshain and R. Kenett), the North Project (G. Fortuna and A. Zonnenshain) and the Role of Engineers in the 21st Century (A. Bentur and A. Zonnenshain).

The common denominator in these RT discussions is that an agenda with key questions and objectives is prepared and disseminate before the event. Some of the RT are very structured and some are more loosely facilitated. Eventually a report is prepared summarizing key findings and recommendations. This note is presenting different methodological approaches for structuring such RT discussions and provides a methodological background for researchers in a variety of fields. Specifically, we present four approaches to Round Table Workshops: 1) Workshops seeking inputs from international experts [Method 1], 2) Workshops involving the rating of alternative scenarios [Method 2], 3) Workshops aiming at the implementation of Quality Function Deployment (QFD) methods [Method 3] and a methodology for effective listening, speaking and responding during RT sessions [Method 4].

Method 1 is based on experience gained by organizing a round table on the topic of analytics in advanced manufacturing. Method 2 is aimed at extracting quantitative information from such RT by applying a rating of scenarios by the RT participants. The approach was originally developed and deployed in the context of the FP7 RISCOSS project (www.riscoss.eu) that addressed the issue of risk management in the adoption of open source software (OSS). Method 3 is an adaptation of QFD to policy analysis. Method 4 was experienced and applied during the INCOSE Symposium IS2018 on July 2018.

We present these methods so that a researcher can plan RT workshops according to his needs and vision by applying an of these methods or combinations thereof.

The next sections provide a detailed introduction to these four methods.

2. Method 1: A round table with inputs from international experts

In order to introduce Method 1, we present its application in the context of a round table (RD) held at the Neaman Institute on 31/10/2017. The RD topic was Data Analytics as an Enabler of Advanced Manufacturing.

RT Background

Knowledge and information is a critical asset of a manufacturing enterprise. It enables a business to differentiate itself from competitors and to compete efficiently and effectively to the best of its ability. Information technology, telecommunications, and manufacturing are merging as the means of production becomes increasingly autonomous. Advanced manufacturing or INDUSRY 4.0 is based on three interconnected pillars: 1) Computerized Product Design and Smart Technology, 2) Smart Sensors, Internet of Things and Data Collectors and 3) Analytics, Control and Data Science.

Aim of the Round Table

i. To discuss the challenges & benefits of developing & using data analytics in the context of advanced manufacturing.

ii. To identify a roadmap for future activities in this area.

Organizers of the Round Table

Prof. Ron Kenett (Neaman Institute and KPA), Dr. Avigdor Zonnenshain (Neaman Institute).

Participants in the Round Table

Prof. Moshe Sidi (Neaman Institute), Dr. Gilad Fortuna (Neaman Institute), Prof. Avishai Mandelbaum (Technion), Dr. Gila Molcho (Technion), Dr. Diamanta Benson (Open University) , Dr. Eithan Adres (Neaman Institute), Dr. Orit Raphaeli (Ministry of Energy), Ron Kupershtein (Orbotech), Sarit Assaraf (IAI), Efi Tayer (IAI), Dr. Lina Teper (RAFAEL), Dr. Amit Teller(RAFAEL), Prof. Ran Jin-Virginia Tech (via skype), Prof. Anna Carbone- Politecnico di Torino (via skype).

Contributors to the Round Table (through written contributions)

Prof. Pedro Saraiva, Member of Parliament and University of Coimbra, Portugal, Marco Reis, University of Coimbra, Portugal, Prof Jan Post, Phillips and Univ. of Groningen, Holland, Prof Bianca Collissimo, PoliMi, Italy, Prof Dean Bartles, UNH, USA, Dr. Ina Schiferdecker, Franhaufer Institute, Germany.

Topics for discussion

1. What are the main challenges of data analytics in advanced manufacturing?
2. What are the expected benefits of data analytics? Can we quantify the expected benefits?
3. What are the main barriers in developing & using data analytics?
4. How we can overcome these barriers?
5. What is the role of academia in developing data analytics knowledge and capabilities

6. What are success stories in Israel and other countries of using data analytics?

RT Preparation

- Step 1: We contacted experts interested in data analytics in advanced manufacturing in Israel and in the world from industry and from academia.
- Step 2: Prof Anna Carbone, Prof. Pedro Saraiva, Prof. Marco Reis, Dr. Jan Post, Prof. Bianca Colosimo, Prof. Ran Jin and Prof Dean Bartels submitted position papers.
- Step 3: We distributed these papers, and additional background, to participants who confirmed their participation in the round table meeting.
- Step 4: We prepared an agenda and a presentation and organized a note taking mechanism.

RT Minutes

Prof. Moshe Sidi presented the Neaman Institute (https://www.neaman.org.il/EN/Home).

Dr. Avigdor Zonnenshain presented the aim of the RT meeting.

Prof. Ran Jin (Virginia Tech) presented via skype the activity in his lab. He talked especially on data fusion applications in smart manufacturing. This was based on the paper he sent as background to the Round Table. Ran also addressed the questions for discussion:

1. What are the main challenges of data analytics in advanced manufacturing?
   - Not all data analytics projects and IT infrastructure investments improve efficiency
   - Lack of digitalization foundation in many industries
   - Lack of efficient data communication
   - Lack of technology roadmap for the transformation to advanced manufacturing
2. What are the expected benefits of data analytics? Can we quantify the benefits?
   - The benefits should be mainly related to improving manufacturing efficiency and lowering costs under mass customization and personalization.
3. What are the main barriers in developing & using data analytics?
   - Lack of high quality data
   - Lack of quality assurance processes for data & information
   - Lack of integration of data analytics with engineering domain knowledge.
4. How we can overcome these barriers?
   - Define and update roadmaps for specific industries on a regular basis
   - Allocate sufficient research resources to corporate R&D, research institutes, national labs and universities
   - Student education and workforce training
   - Do not underestimate the role of applied research as platform technologies for specific industries; fill in the gap between fundamental research and corporate R&D

5. What is the role of academia in developing data analytics knowledge and capabilities
    - Beside the fundamental research and student advising, academic experts should actively contribute on the roadmap development, successful case studies, and collaborative research for specific industries
    - They should also work with industries to maximize output from individual projects.
6. What are success stories in Israel and other countries of using data analytics?
    - Many examples. See https://sites.google.com/a/vt.edu/ran-jin/

Ran addressed several questions from the forum. He is interested in collaborating in joint research and projects.

Prof. Anna Carbone (Politecnico di Torino) presented her views via skype.

In Italy, the automotive and the Aerospace industries pioneered advanced manufacturing for designing and developing a wide range of high tech products. In other industries (like food & wine industries) it is only in the beginning. There is an urgent need for policy makers to enable a global value chain for advanced manufacturing, which include: Distributed Database, Peer-to-Peer transmission, Transparency with Anonymity, Irreversibility of Records. There is a need for MANAGEMENT 4.0 in the companies' management level and at the government level. The emerging challenges of industrial IoT are:

- Real time data analytics
- Security concerns
- Cultural change management
- Integration of different technologies

The emerging areas of industrial IoT are: Connected customers, auto diagnosis, asset tracking, connected cars, healthcare, supply chain control, smart factory, transportation, emergency &surveillance, smart cities, smart communication, building management, energy management, smart retail, smart agriculture.

Anna described the shift from linear economy (Take, Make, and Dispose) to circular economy – Technical circulation, Biological circulation, Money circulation. Anna is willing to collaborate with us through joint researches and projects.

Prof. Ron Kenett presented the background of the fourth industrial revolution and the possible elements of data analytics for driving and promoting advanced manufacturing. Specifically, he listed 9 areas where analytics plays a dominant role. These are:

1. Engineering Design
2. Manufacturing Systems
3. Decision Support Systems
4. Shop Floor Control and Layout
5. Fault Detection and Quality Improvement
6. Condition Based Maintenance
7. Customer and Supplier Relationship Management
8. Energy and Infrastructure Management
9. Cybersecurity and security related issues.

A paper expanding on these topics is available at https://ssrn.com/abstract=3003830

Prof. Dean Bartles (University of New Hampshire Center for Advanced Manufacturing)

addressed directly the questions for discussion, as follows:

- What are the main challenges in data analytics in promoting advanced manufacturing in the industry? Getting the data in a common format from machine tools “real time”.
- Which are the expected benefits of using data analytics in industry? Can we quantify the expected benefits? Reductions in cycle time by 30%; reductions in energy consumption by 30%.
- What are the main barriers in developing & using data analytics? Access to the data; data in various formats
- How we can overcome these barriers? International Standard adoption (e.g., MTConnect)
- What is the proposed role academia in developing data analytics knowledge and capabilities? if given access to the data, academia will play a critical role and analyzing the data and developing applicable algorithms.
- Can you share with us success stories in using data analytics? I refer you to an Israeli company called *Omative* with whom we did a BIRD project on Adaptive Control.

Prof. Pedro Saraiva (Univ. of Coimbra and past member of parliament in Portugal) stressed the importance of developing strong competitive manufacturing activities. He listed several areas that need to be addressed:

- Industry Internet of Things, New Data Sources and Scopes
- Multiscale Data and Decision-Making
- Broader System and Data Borders
- Connecting Different Types of Data and Using Best Available Technologies
- Developing and Using the Most Appropriate Models
- Real-time Adaptive Learning and Agile Decision-Making
- Customized Problem Formulations, Solutions and Decisions

Dr. Jan Post (Philips Consumer Lifestyle, Drachten) sent us the following comments.

In my opinion, the importance of the Digital Twin concept will increase: look on Youtube about what companies like Dassault, IBM, Microsoft, GE, Siemens are claiming, it is more framing than reality because all the content is not clear, we are in the beginning. The domain for me is: “Innovation of Innovation & Innovation of product & process”. It will be first about complex products like wind turbines, jet engines etc. The focus will be on maintenance (predictive if possible).

The main trends are:

- In product development, information will be based on Physical modelling and prototyping and it will be coupled with the whole CAD/CAM infra structure/ database.

- In production, real time information from the shop floor will be added and could be combined with the above point, but the information is different so the challenge is how to combine the data sources.
- In use of the product- real time information of the product will be added, could also be coupled, there is a EU project started around this: productive 4.0, very big 19 countries, more than 100 partners (http://productive40.eu/). Philips is one of the founders of this project, this is also where the EU wants to go: big projects, high impact.

The question will be about all the interfaces, using different environments, different processes, different software, different vendors etc, how to keep this controllable and open.

We (Philips Drachten) is one of the 40 partners) are starting another project (kickoff is in the beginning of October) called VMAP which is about material data in FEM simulations and hope to come with an advice about a possible standard). In my own opinion, this needs interfaces that will be based on data or data related models (= statistics) and not on algorithm, too complex, difficult to improve and to maintain. We will also need open standards, that's also where the VMAP project want to go with companies like Bosch, BMW, etc. My statement would be like: We need open data standards and data based models to make Industry 4.0 possible in all the aspect of digitalization, statistics will be in the middle with all kind of models: Regression, data reduction, neural networks, deep learning etc.

Prof. Bianca Colosimo (Polytechnic of Milan) shared with us a preview of a paper Intelligent sensing and computerized data analysis are inducing a paradigm shift in industrial statistics applied to discrete part manufacturing. Emerging technologies (e.g., additive manufacturing, micro-manufacturing) combined with new inspection solutions (e.g., noncontact systems, X-ray computer tomography) and fast multi-stream high-speed sensors (e.g. videos and images; acoustic, thermic, power and pressure signals) are paving the way for a new generation of industrial big-data requiring novel modeling and monitoring approaches for zero-defect manufacturing. Starting from real industrial problems, some of the main challenges to be faced in relevant industrial sectors are discussed. Viable solutions and future open issues are specifically outlined in her paper.

Prof. Marco Reis (University of Coimbra) shared some insights on how advanced manufacturing opens new possibilities to boost operational and business performances. Industrial processes are however challenging, not only because they are inherently complex systems but also the data collected from them present wild structures which are not straightforward to handle. New strategies, software, interfaces, mindsets, and skills are also necessary, which are not yet set in place. His comments list three main challenges: i) Core level challenges. ii) Tangible level challenges and Intangible level challenges.

Discussion during RT

- Ron Kupershtein from Orbotech raised the problem of lacking connectivity between the Orbotech machines and the IT of the company. He claims that the solutions are not coming Top Down but Bottom Up. The engineers are raising the problems and the opportunities for solutions. The top management is reluctant to invest in INDUSTRY 4.0 as they are looking for fast and instant ROI. The top management is looking only for the bottom line profit. Ron mentioned that the Chinese government support and subsidized

the Advanced Manufacturing efforts and investments. Ron is expecting to get support for Orbotech activities in China.

- Ron mentioned also the challenge of transferring data from legacy systems to modern systems. Avishai suggested to consult with Prof Avigdor Gal.
- Ron Kenett proposed to promote standardization for advanced manufacturing
- Avishai suggested to include Data Sciences courses for managers so they will appreciate the benefits of Data Management & Data Analytics for the competitiveness of companies. Avishai mentioned that in his faculty they are helping researchers and students organize data for their learning and research needs.
- Sarit Assaraf asked for more success stories
- Orit Raphaeli mentioned European Project on Predictive Maintenance called Computational Advantage.
- The forum discussed the concept of Data as an asset.
- Diamanta Benson shared with us the programs at the Open University on Data Science, some of them in computer science and some of them in Industrial Engineering & Management.
- Avishai described the new four years undergraduate program in data sciences. This stage 1, in stage 2 they are building programs for experts in data sciences- ME, MSc, PhD. Also they are creating a Data Based Partnership with Bank Hapoalim- The bank is providing the data, and the faculty is providing the knowledge
- We discussed the possibility to create joint projects of Industry and Academia

Following the concept of Data Based Partnership. It is suggested to focus this partnership in the area of Conditioned Based Maintenance (CBM). IAI, RAFAEL and Orbotech are willing to participate in this type of collaboration.

Summary of RT

1. What are the main challenges of data analytics in advanced manufacturing?

   There are several challenges. One of them relates to effective data integration where inputs from sensors, recordings, videos and measurement devices are combined to generate improved planning and control activities. Another challenge is in the modeling of dynamic processes with adaptable data accumulation and process monitoring methods. Conditioned based maintenance is another challenge with the potential of providing significant cost reduction and improved quality. Preparing an adequate workforce which can exploit the new possibilities in manufacturing technologies and analytics is yet another challenge that needs to be overcome, at the national level.

2. What are the expected benefits of data analytics? Can we quantify the expected benefits?

   Advanced manufacturing creates a new paradigm with enhanced predictive and diagnostic capabilities. Quantification is an important task that requires simulation and modeling capabilities.

3. What are the main barriers in developing & using data analytics?

   Like in many other areas, management is the make or break ingredient. Some organizations realize that piling up data is not providing added value and that turning data into information of quality is both critical and, requires investments. In this process, good analytical methods are key to this transformation.

4. How we can overcome these barriers?

   It seems that a combined top down and bottom up approaches are required here. The top down includes government incentives and motivated management. We also discussed creation of a benchmarking data base to help management set goals and expectations.

5. What is the role of academia in developing data analytics knowledge and capabilities?

   Academia needs to support three pillars of advanced manufacturing: i) the sensor technology, ii) the manufacturing technology and iii) proper analytics. In addition some consideration of the change management activities necessary for introducing advanced manufacturing are required for exercising training and human resource dimensions.

6. What are success stories in Israel and other countries of using data analytics?

   At this point in time this is not clear. The Intel plant in Kiryat Gat might be considered such a success story. The smart plant and advanced technologies convention organized on 31/10/2017 by the Ministry of Economy and the Manufacturers Association of Israel was attended by an impressive number of start ups and participants

Next steps

At the conclusion of the RT, it was decided to focus on Conditioned Based Maintenance (CBM). Specifically, the Neaman Institute will foster projects combining faculty, students and industry in the area of CBM. Outcomes of this activity will be presented in a future RT.

An additional initiative is to consider building a benchmark data base of company experience in advanced manufacturing with measurable results. To set up this data base we consider contacting various players on the international scene as well as companies located mainly in Israel.

Main findings from RT with Method 1:

1. The international were involved through their position papers and their presentation by Skype/Webex.
2. All of the participants in the RT were actively involved in the RT, and have expressed their views.
3. All the dilemmas presented to the RT were addressed properly by focusing the discussion on the dilemmas.
4. The RT resulted in a concrete action plan for advancing Data Analytics in Israel.

3. Method 2: Evaluating alternative scenarios - The RISCOSS workshops

The RISCOSS workshops were designed to permit experts to discuss and assess risk indicators. These workshops carried out several similarities with the SNI RTs. The objective was to identify and assess the impact of risk indicators that represent a range of characteristics of the Open Source Software (OSS) community that can affect the adopter organizations' business. The tasks in the tactical workshops are a subset of a wider analytic methodology presented in [1].

Several tasks were conducted in the RISCOSS workshop according to QUELCE methodology [2]. First, experts determined a list of risk drivers and risk indicators. Each driver has a set of states, which were also defined. Experts then constructed subjectively network structure, evaluating the cause and effect relationships among drivers. Finally, alternative scenarios were designed using random number generation to obtain various combinations of the risk

driver states. Fig.1 shows the elements needed to build the scenarios for the activeness risk indicator. i.e. risk drivers, states and state values.

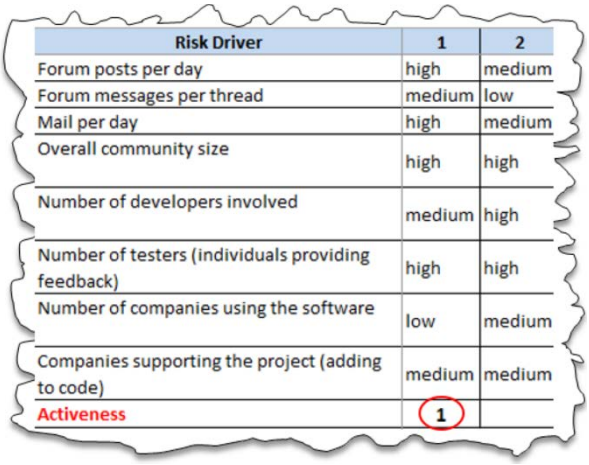
Figure 1: An example of risk drivers (e.g. Forum posts per day). their state (low, medium, high) and a risk indicator ("activeness")

Risk Driver	State 1	State 2	State 3	State 4	State 5
Forum posts per day	low	medium	high		
Forum messages per thread	low	medium	high		
Mail per day	low	medium	high		
Overall community size	small	medium	high		
Number of developers involved	small	medium	high		
Number of testers (individuals providing feedback)	small	medium	high		
Number of companies using the software	small	medium	high		
Companies supporting the project (adding to code)	small	medium	high		
Activeness	1	2	3	4	5
	Very Active	Active		Inactive	Very Inactive

The organizer role is defined in the Delphi method [3]. He is responsible for organizing, executing, and reporting the workshop results.

Selecting a group of domain experts is a difficult task. RISCOSS selected the experts for the workshops according to their experience in OSS adoption and community context. The adopter can be an individual, an organization or even the OSS community itself if other OSS is incorporated in their work [4].

Figure 2: Exert from excel spreadsheet for evaluation of risk drivers' impact



Risk Driver	1	2
Forum posts per day	high	medium
Forum messages per thread	medium	low
Mail per day	high	medium
Overall community size	high	high
Number of developers involved	medium	high
Number of testers (individuals providing feedback)	high	high
Number of companies using the software	low	medium
Companies supporting the project (adding to code)	medium	medium
Activeness	1	

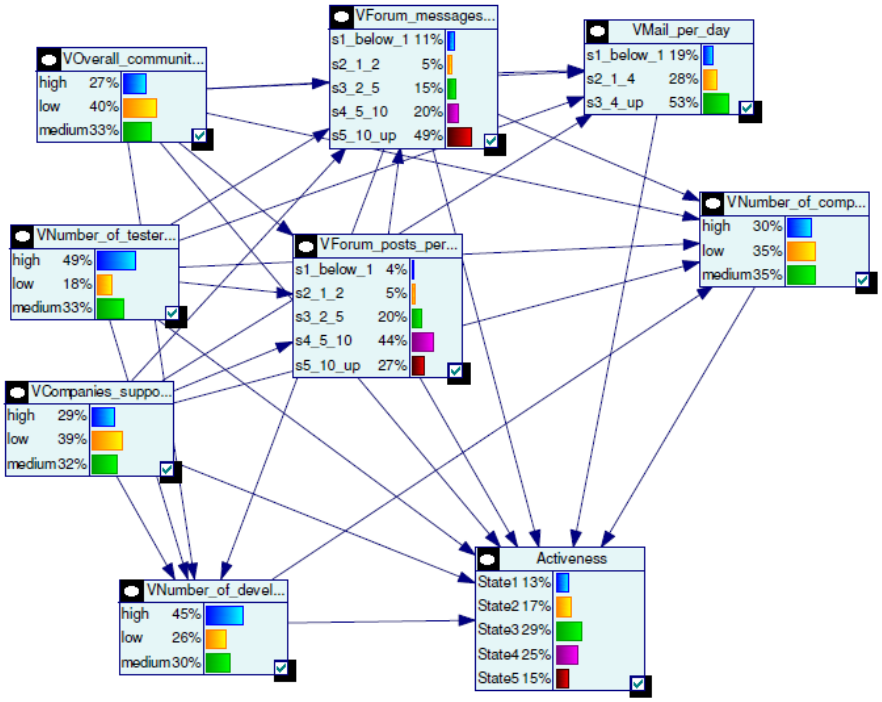
The workshops begin with an exposition about the main topics that will be covered. The organizer shows a summary of the RISCOSS project and the RISCOSS analytical platform and defines the parts of the workshops. Finally, the organizer explains in detail the instrument to be used by the expert to rate the risk indicators scenarios i.e. an excel file prepared for the purpose (See Figure 2).

The excel file used in the workshop is rating risk indicators according to risk drivers. It consists of:

- Risk driver: The name of the risk driver
- State 1 through 5: Some drivers have numeric state levels that were determined by statistical analysis; other drivers have three possible states, low (stable), medium and high (unstable or unpredictable)
- Input Scenario: All risk drivers states constitute an input use case scenario that affects the relevant risk indicator
- Rating of Risk Indicator: A level between 1 and 5 of the risk indicators that reflects the abstract concept it captures.

The data collected from this workshop is summarized using a Bayesian network that provides a graphic description of the relationship between risk drivers and their impact on risk indicators (Figure 3)

Figure 3: A Bayesian network linking risk drivers to the Activeness risk indicator



Bayesian networks provide several capabilities to decision makers:

1. They permit prognostic analysis by conditioning on specific values of variables at the root

2. They provide diagnostic capabilities by conditioning on child variables

3. They can be updated with data or revised expert opinions

4. They enable extensive sensitivity analysis to study the effect of various policy scenarios.

For more on Bayesian network applications see [7]

Outputs from RT with Method 2

The main output from RT with Method 2 is a diagnostic and predictive tool capturing the participants knowledge and experience, The Bayesian network derived from the RT can be completed with collected data and updated over time. It can be integrated in decision support systems, as was done in the RISCOSS project (see www.riscoss.eu).

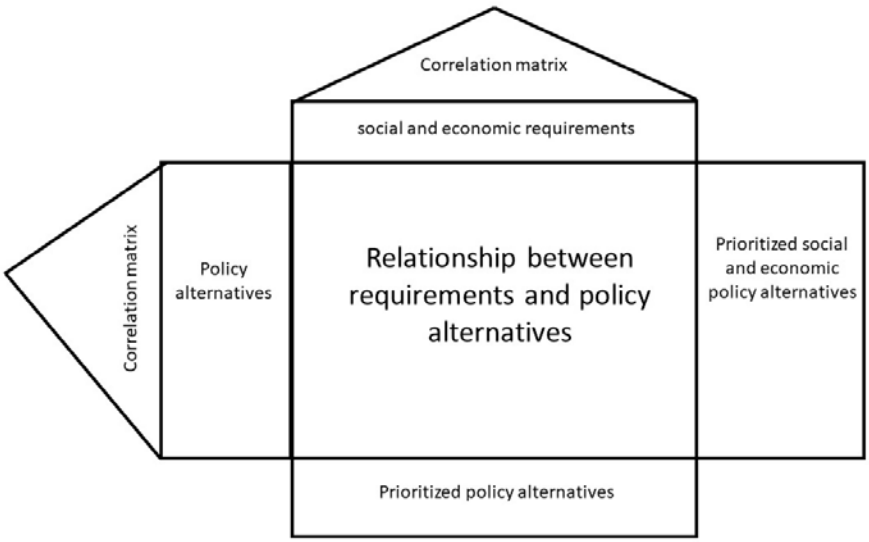
4. Method 3: Implementing Quality Function Deployment - The QFD Workshop

QFD is a methodology originally developed in Japan to map customer requirements with engineering specification (see, for example [9]). In order to apply QFD in policy oriented research one needs to adapt the standard QFD process of implementing The House of Quality for policy formulation (Figure 4). Customers can be represented by stakeholders and engineering specification can be substituted by alternative policies or strategic decisions. The possible steps for building the House of Quality [10] are as follows:

1. Definition of the WHAT- the stakeholders' policy alternatives
2. Prioritization of policy alternatives by the stakeholders
3. Evaluation of alternatives which compete with the above alternatives
4. Definition of the HOW- the characteristics of the policy alternatives
5. Analysis of the interactions among the stakeholders policy alternatives and its characteristics
6. Evaluating the relative importance of the characteristics
7. Evaluating the performances of the competing alternatives
8. Analysis of the policy alternatives among themselves
9. Formulation of the target values for the policy alternatives

The outcome of the House of Quality are preferred policy alternatives (including their characteristics) based on collected data and the opinions of the stakeholders in a structured and documented way.

Figure 4: QFD framework for selection of industry development scenarios



The QFD Methodology can be used also for formulating policy or strategy which are robust to various scenarios. In this case it is recommended to apply the following QFD steps [11]:

1. Identification of relevant scenarios (WHATs)
2. Assessment of the likelihood of these scenarios
3. Selection of policy components (HOWs) which may resolve the various scenarios
4. Evaluation of the reduction the risk of each scenario as a result of using each policy component
5. For each scenario, identification which policy component supports (or obstructs) another policy component.
6. Calculation of policy components priorities

Estimation of the overall robustness of the preferred policy.

This methodology was applied for formulating policy or strategy for industrial companies or technological projects where the technological challenges are high and in risky environment. It can be applied by companies which are considering implementing advanced manufacturing, and there several potential scenarios for this initiative.

Main findings from RT with Method 3

1. The RT should include all relevant decisions makers who are relevant for the discussed policy.
2. The RT using the QFD methodology is a proper way to drive for consensus among the decision makers- This is usually a great asset for the policy making.
3. The QFD methodology enables quantitative and qualitative inputs, assessments and considerations from the RT participants.
4. The moderator of the QFD RT has to be highly knowledgeable on the QFD methodology, and very mature in effectively managing the RT sessions.

5. Method 4: Practicing Effective Listening, Speaking and Responding during RT Sessions

A RT session requires that each of the participants has the opportunity to present his ideas and points of view, and also, that everybody can listen to each other. In this context, it is reasonable to develop and practice effective listening, speaking and responding skills. During the 2018 INCOSE Symposium, which was held in Washington DC in July, we practiced a unique format of democratization of RT. The details are described in Appendix 3. This format was practiced in 4 morning sessions (7am-8am) during the symposium with attendance of about 30 people from different countries. Most of the people participated in all 4 morning sessions. The general topic for these RT was " What is SYSTEMS THINKING". Each morning there was a different facilitator for the session. The facilitator proposed the specific dilemma of the session, for example: " What are the variables/problems/questions that Systems Thinking has to advance in Systems Engineering?".

During the 60-minute session, the reading of the Facilitator Guide and RoundTable Guide is designed to only take five minutes. During the remaining 55 minutes, there is no attempt to control the topics or emerging topics. Instead, there is control of the time (e.g., two minutes each). Recall that participants are invited to “say something about today’s topic(s), or anything else that is on your mind.” And the only response they hear is “Thank you.”

Main findings from RT with Method 4

1. The approach implemented in the INCOSE RTs a very important methodology for improving the effectiveness of all types of RT.
2. It is possible to practice effective listening, speaking and responding abilities while the facilitator is leading the RT session according to the proposed rules.
3. Prior to the sessions, users determine several suggested and default questions/topics. During the sessions, each volunteer facilitator may suggest his/her own additional question/topic.

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APPENDICES

A. The Delphi method

The Delphi method is a group technique aimed to obtain the most reliable consensus of opinion of a group of experts allowing to deal with a complex problem by a series of intensive questionnaires interspersed with controlled opinion feedback [5]. This technique was developed at the RAND Corporation in 1963. At the first stage a set of properly worded questions are given to each expert, to each such question the expert is supposed to give a specific value, the next task is to summarize the answers, to obtain statistical data, e.g., median, IQR. Any expert who wishes to maintain a viewpoint outside of the interquartile range is invited to state briefly the main reasons for holding such a viewpoint. In the second round the experts changed their opinions somewhat. The sequence of questioning could continue almost indefinitely, with developing arguments, provided the participants' patience remained, but cost constraints usually stop the sequence after three or four rounds. The method has been refined and developed so that it have eliminated the restriction of the obligatory search for consensus [6], so that today it might be defined as a social research technique that aims to obtain a reliable group opinion using an expert group and is a valid instrument for forecasting and supporting decision making [6].

B. Quantifying Uncertainty in Early Cost Estimation (QUELCE)

QUELCE is a method introduced by the Software Engineering Institute, (SEI) in 2011, for handling early project planning estimation. This method elicits information from domain experts about program change driver uncertainties. The information is transformed into Bayesian networks which models the interdependencies and their impacts on cost via likely scenarios of program execution [2]. The QUELCE method relies on expert judgment at several steps, including scenarios. (1) The identification of likely program change drivers that can affect the execution of a given project over its lifecycle. (2) The identification of states within a change driver for building. (3) The probability of a change driver departing from a nominal (planned) status; and (4) the nature and strength of the cause–effect relationships between and among change drivers. Consequently, expert judgment must be consistently dependable and repeatable to be used credibly within the QUELCE method [8]. The QUELCE method is used to resolve early cost estimates in the US Department of Defense (DoD), the values for the drivers have distributions rather than single point values and are assigned by the domain experts from the workshops. They used techniques for calibrating experts by using anchors and training exercises to guide their judgments can be efficiently adapted for the US DoD environment.

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RoundTable Guide – morning readings

SUGGESTED READINGS: RoundTable Guidelines (300 words, 2.5 min.)

OUR FORMAT. Our unique format is an eye-opening new practice in democracy. We spend 5 minutes listening to short readings and the suggested topics. We then spend 55 minutes on individual comments, time divided equally among all present (e.g. 27 people = 2 minutes each). Each morning, the session is facilitated by a different volunteering facilitator chosen from those in attendance.

OUR PURPOSES. We use a facilitator guide/script and basic readings--RoundTable Guidelines--for many reasons:

1- We pack in a great deal of information in a very short time, thus leaving maximum time for each of us to present our ideas.
2-The result is we hear everyone's point of view on a topic.
3- We experience some new real-time effortless democratic practices: including rotating, distributed leadership; equal time; as well as a simple scaffold to facilitate conscious self-guided evolution.
4- We have found that just as we break the sound barrier when we travel faster than the speed of sound, we break the communication barrier when we hear 20 authentic viewpoints in 60 minutes—and 4 different facilitators over the week.

GUIDELINES FOR LISTENING. Listening to the 5 minutes of readings allows us the opportunity to quiet our minds and silently reflect on the topics, the readings, our inner thoughts, and our work and lives. Listening to each other's comments, we hear a great variety of viewpoints. We consciously shift our attitudes from "evaluation" to "valuation," from critiquing to appreciating, from problem-solving to ideal-seeking -- towards one another and towards ourselves.

GUIDELINES FOR SPEAKING. At your turn, please say your name again. Then say something about today's topic, or anything else that is on your mind. Let's each take only one turn to speak and limit our time, so we can offer everyone a turn. Or, if you prefer, pass your turn and just listen today.

GUIDELINES FOR RESPONDING. The facilitator may say "thank you" after you speak. In the interest of time and purpose, we will save all other responses to each other until after the session. We don't want to divert others, or be diverted, from our own individual learning.

* **OUR SUGGESTED TOPICS include:** 1. Facilitator Choice

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2. What is ***SYSTEMS THINKING***? What are the links between SE and SS (Systems Science)?
3. Linking our conference aims (e.g., making a difference and best practices) to your field of expertise/study, what do you see as our challenges? What are your hopes?
4. What situations and projects did you leave behind to come here, and what could happen here that would be valuable to you in your work and life back home?