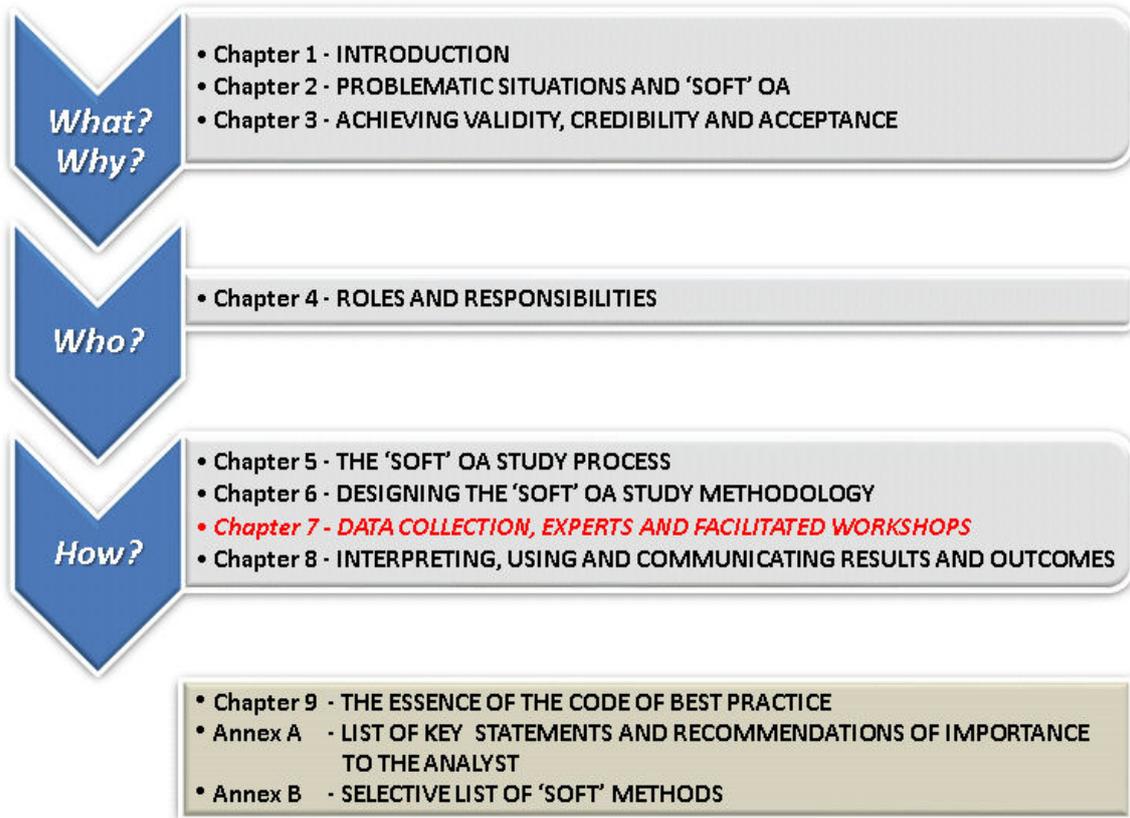


## Chapter 7 – DATA COLLECTION, EXPERTS AND FACILITATED WORKSHOPS



- Understand what the three viewpoints for using humans as data sources mean for the study: the cognitive, critical and constructive viewpoints. Understand types of bias that are recognised within each perspective's context.
- Consider carefully what stakeholders (including subject matter experts) to include in the study, and how they will be invited to participate.
- Design facilitated workshops in order to engage with stakeholders.
- Select the key conditions in the Schuman model that are considered to be critical to conducting workshops in the current study.
- Ensure that the 'theory of action' underpinning any considered course of action is understood and documented.
- Design (additional) data gathering to be conducted outside a workshop setting, including what sampling strategy is used.
- Consider using the Human Environment Analysis Reasoning Tool.
- Document all data collection measures taken in a study, including the methods, the sources and the collectors.

## 7.1 INTRODUCTION

This chapter discusses approaches for collecting and analysing judgement-based data. This chapter assumes that data collection is guided by four general premises [1]:

- Premise 1: Problems are socially constructed entities.
- Premise 2: Subjectivity is unavoidable.
- Premise 3: Clients want ‘satisficing’ solutions.
- Premise 4: Participation increases commitment for implementation.

These premises will inform how data is viewed and the choice of data collection methods. This is discussed in the first part of the chapter. The remainder of the chapter then discusses using workshops for data collection, other data collection approaches, and the use of Subject-Matter Experts (SMEs).

## 7.2 THE PROBLEMATIC NATURE OF DATA IN ‘SOFT’ OA

Collection of input material to help with formulating and characterising problems is a key aspect in ‘soft’ OA. Such inputs are usually referred to as ‘data’ though it is recognised that they are part of a hierarchy or pyramid comprising data, information, understanding, knowledge and wisdom [2]. We will not try to differentiate the lower-positioned concepts in this model but will note that there is deeper understanding of system behaviour as we move towards wisdom. Thus we will use data in its broadest sense – material (i.e. pieces of information) that we do not initially know but is potentially required in the study. Importantly, data should not be considered as merely quantitative properties of well-defined constituent items. In addition, we might need to know about procedures, interactions of system components, constraints and bounds, ownership of elements, relative importance and weightings, etc.; these are all data relevant to the problematic situation.

Different views on using humans as sources of data exist, originating from different views on how valid knowledge is created. As we attempt to mix methods from ‘hard’ and ‘soft’ approaches, none of them can be ignored in an investigation using human sources. In this chapter, these views will be called the *cognitive*, *critical* and *constructive* viewpoints.

### 7.2.1 The Cognitive Viewpoint

In this viewpoint, humans are seen as fallible observers of reality. Due to limitations in the cognitive system errors or biases appear – different errors in information processing may appear in different stages of the cognitive system [3], such as the following:

- The ease with which information can be recalled from memory affects how frequently a given type of event is deemed to be. Well-publicised events, such as tornadoes, may be assessed to be more frequent than they actually are.
- The mind does not register what it cannot perceive. We cannot know the actual performance of an option that was considered but subsequently rejected. In a game of chance, there is thus an inclination to believe that the actual outcome was more likely than it would otherwise have been deemed before the event.
- How information is presented affects how it is remembered. The first and last element in a list is more likely to be remembered. Easily available information may be prioritised over information that has to be sought after.
- Concrete information is more salient than abstract information. A vivid description is more easily recalled than statistically summarising data. One personal experience of a failure may be given more weight than statistics that show the system in question is actually quite reliable.

- What a person expects to see dramatically affects how reality is perceived. Playing cards with red spades, for instance, is extraordinarily difficult.
- There is also a confirmation bias, i.e. people tend to seek information that is consistent with their hypothesis rather than information that could cause them to reject a hypothesis.
- A special case occurs when experts are expected to quantify their input, such as when giving probabilities. If a person is an expert in a specific area, his judgement may be vulnerable to particular biases when assigning probabilities, but general risk management experts may be less affected ([4], [5]).
- A well-known bias associated with workshops is group-think. Symptoms of group-think include:
  - The illusion of invulnerability creating excessive risk-taking;
  - Collective efforts to discount warnings that might lead members to reconsider their assumptions;
  - An unquestioned belief in the inherent morality of the group;
  - Stereotyped views of rivals and enemies; and
  - Direct pressure on any members that express strong arguments against any of group stereotypes and self-censorship of doubts or counterarguments that a member of the group might have in order to create an illusion of unanimity within the group [4].
- Other types of bias that affect groups include:
  - Imposing imaginary constraints on the range of options;
  - Sensitivity to reference points (e.g. the way we mentally bracket groups of decisions together often influences how much risk we are prepared to take when making each decision; as an example: taking a broad view on study portfolios can act as an antidote to excessive risk aversion when dealing with individual studies); and
  - Non-rational escalation of commitment (an unwillingness of individuals to reverse decisions if they feel high personal responsibility for poor outcomes occurring early) [6].

Methods for reducing the effects of cognitive bias include conducting statistical surveys (essentially in order to average out the bias), triangulating several sources and including technical or ‘hard’ investigations in order to confirm statements about measurable quantities. When addressing group-think, the critical aspect is effective facilitation (ref. Chapter 4 and Section 7.3).

### **7.2.2 The Critical Viewpoint**

Critical analysis of sources (be they humans directly in person or indirectly through written sources) view humans as actors with a possible stake in the situation. This view essentially includes the previously described cognitive viewpoint, but also adds that, as a stakeholder, the person may have an interest in concealing facts or taking a certain perspective on events to try to affect outcomes in his favour. Important criteria to look for in the critical analysis of any source are<sup>1</sup>:

- Authenticity (i.e. is the source what it claims to be?);
- Concurrence (i.e. is the source reasonably concurrent with the reported events, how close was the person to the events they are describing?);
- Independence (i.e. are two seemingly confirming sources actually mutually independent?); and
- Bias (i.e. does the writer have any reason to skew the message?) [7].

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<sup>1</sup> Note the relationship with issues discussed in Chapter 3.

Bias in this perspective is no longer merely the unconscious bias that comes from the cognitive shortcomings of humans as outlined in Section 7.2.1, but also the bias that comes from an actor with a stake, and his possible reasons to alter or conceal available information. Within the critical tradition, it is important to try and identify what the bias might be, and how the bias may affect the data.

Normally, several sources are used to conduct an investigation. In order to confirm any statements, it is important to know whether the sources are actually independent. A common occurrence is so-called ‘narrative contagion’ between sources, which, for instance, occurs when witnesses have had the opportunity to confer. This process creates a bias that means that the sources can no longer be used for mutual confirmation of statements.

Methods for conducting critical analysis of sources are primarily to assess each source according to the criteria for critical analysis (authenticity, concurrence, independence and bias) and again triangulating several independent sources in order to try to minimise the effects of the limits of each source.

### **7.2.3 The Constructive Viewpoint**

The two previous viewpoints are essentially realist; they take as their starting point the axiom that there is a reality ‘out there’ that can be discovered, at least imperfectly (as with *critical realism*; ref. Section 3.3). On the other hand, the constructive viewpoint takes as its point of departure that reality is essentially socially constructed. ‘Truth’ in this context is the best informed and most sophisticated construction on which there is consensus, though this definition allows several constructions that meets this criterion [8]. This is the tradition underpinning qualitative investigations in the social sciences.

Our starting point for ‘soft’ OA is that problems are socially constructed; thus this viewpoint is especially salient for problem formulation. In the constructive view, there is no such thing as an independent ‘fact’, facts only acquire meaning according to the context in which they become relevant. Thus ‘bias’ has no absolute meaning in the constructive viewpoint. Each stakeholder’s view is essentially equally legitimate. This could be construed as an ‘anything goes’ viewpoint, but the process of consensus acts as guarantor of ‘truth’ (or some truth at least), and thus protects to some extent against ‘anything goes’. In the context of ‘soft’ OA, the conclusion is that those stakeholders that meet to negotiate a problem formulation essentially create their own new ‘truth’ in that process, to the extent that they are able to reach consensus.

The main challenge when conducting an investigation from a constructive viewpoint is ensuring that all key stakeholders are given a ‘fair’ chance to air their view and take part in the construction of the problem, and that there is an equitable, facilitated process that allows reaching consensus.

### **7.2.4 Data Considerations in a Multi-Methodology Study**

Some proponents insist that the constructive and realistic paradigms cannot be used together, but experience shows that multi-methodology investigations work well in practice. This is also supported by extensive literature from the social sciences field, proposing the pragmatic position that considers the combination of quantitative and qualitative methods perfectly reasonable, and even innovative (for instance [9], [10] and [11]).

While the viewpoints as discussed in Sections 7.2.1 – 7.2.3 may differ, the approaches for ensuring data quality have strong similarities. Triangulating several sources is therefore desirable, as is conducting a fair facilitation process. Triangulation is further discussed in Section 8.2.1.

Data may be gained from the field, through interpretation of procedures (e.g. manuals), generated by models or derived by artificial environments such as war-games or the use of workshops involving SMEs or by approaching experts individually. Data has been described as ‘hard’ or ‘soft’ depending on whether it is

respectively derived from observer independent or opinion/observer dependent sources [12]. A recent publication [13] has proposed that field data may be collected through the subjective opinions of stakeholders, through objective measurements or even from informed SMEs. This mix of subjective and objective data is a key aspect of ‘soft’ OA and should be regarded as a strength (because of its richness) rather than a weakness, even though there may be a perceived bias [14] towards quantitative data measured in a ‘statistical manner’. Nevertheless, the sources of data gained by different means should be well documented, particularly when one relies on subjective opinion and informed SME speculation.

### 7.3 WORKSHOPS, MODELLING AND FACILITATION

The conduct of workshops and facilitated model building is the most common approach taken by many ‘soft’ OA methods [15]. Understanding the main strengths and weaknesses of workshop methods is thus an important issue when conducting a ‘soft’ OA study. Workshops are mainly used to provide a venue for stakeholders to meet in order to inform each other, to agree on problem formulations and to create courses of action.

In a series of workshops addressing new operational concepts for maritime mine counter measures, participants sometimes had difficulty with keeping to agreed definitions and assumptions (new ideas kept popping up). Also the change of, in the first workshop, evaluating against each of several specific scenarios to, in the follow-on workshop, evaluating against a general mine-hunting setting appeared confusing for some and posed challenges to the facilitator. If a study requires several workshops with some participants always attending and others not, the end-to-end integrity of the analysis must be ensured.

Schuman and Rohrbaugh [16] have introduced a model for working with groups (Table 7-1<sup>2</sup>). In an ideal group, all the twelve conditions are fulfilled. The model can also be used for diagnosis if difficulties appear in conducting workshops. In a situation of limited resources, the facilitator may have to focus on fulfilling a selected sub-set of the Schuman conditions. The model should be used as a checklist by the analyst and facilitator to identify the key conditions that will ensure that the major obstacles to a successful outcome of the workshops are removed.

**Table 7-1: Conditions for Working with Groups (Adapted from [16]).**

Factors → Perspectives ↓	Group Context	Group Structure	Group Process
<b>Relational</b>	Incentives provided to motivate collective work.	Participants are sincere, open to each others' views and promote trust.	Conflict is managed.
<b>Political</b>	Resources adequate to complete task.	Legitimate leadership present; participants have authority to make decisions (up to a point).	Stakeholder interests well represented.
<b>Empirical</b>	Meeting environment designed to foster productivity.	Group composition provides needed skills and abilities.	Modes of communication enhance interactions.
<b>Rational</b>	All relevant data/artefacts/ expertise is available.	Goals, objectives, tasks clearly defined.	Problem exploring and (possibly) solving methods used.

A central requirement for conducting successful workshops is an independent, impartial facilitator. The facilitator should observe roles and role behaviour and needs to be aware of the power and politics

<sup>2</sup> Their circular model is shown as a table in the CoBP.

that may affect the group<sup>3</sup>. One option for addressing the possible bias that may occur due to power relations between the group members is to deploy a method that allows anonymous data entry, such as computer supported *Journey Making* [18]. Two important pitfalls are the emergence of ‘group-think’, and the tendency for premature concurrence. The facilitator needs to initially encourage divergent thinking in order to avoid group-think, and then help turn the group towards convergent thinking in order to reach consensus. The job of the facilitator is to encourage and support everyone within the expert group to do their best thinking. In addition, the facilitator needs to have enough knowledge about the subject matter being discussed and the acronyms being used during the workshop so that he can keep track of the flow of the discussions, ask the right questions and effectively guide group processes and procedures. It definitely helps, but it is not absolutely necessary, for the facilitator to have significant content related knowledge. For a further discussion of the facilitator’s role, see Chapter 4.

Even in a single language setting, common words and phrases may have different meanings in different organisations or services. Hence, in order to avoid mis-communication, it may be useful to create a lexicon for participants that provides standard definitions of key terms used within the ‘soft’ OA study. Further, facilitators may need to provide assistance to participants in the NATO setting who do not have a good command of the chosen language in which the study is being conducted, e.g. remaining neutral but also helping such individuals in expressing and defending their viewpoints.

In most ‘soft’ OA methods, a model of some kind is a central artefact that the group constructs together. A model in this sense is a representation of reality built for some definite purpose [19]:

*“The model should serve as an aid to thinking and group learning but will not produce the right answer. The model should be ‘requisite’, i.e. sufficient in form and content to resolve the issues at hand. It represents the collective view of the group at any point during its generation and modification, and serves as a means to examine the impact of differences in perspective or vagueness in the data. Because the model is projected for all participants to see it as it is created, it is less likely to be perceived by participants as a ‘black box’, which helps to gain confidence in model results.” ([20], see also Section 5.4).*

These models are usually qualitative in nature. They describe the various concepts that are used in the problem formulation, and how the concepts can be combined. The different ‘soft’ methods have different approaches and styles of modelling.

If (parts of) the problem (are) is amenable to quantification, a qualitative approach can be supplemented with quantitative models. Suitable quantitative modelling environments that can be built in a workshop setting include System Dynamics and Bayesian networks. The analyst needs to be aware of which types of problems are suitable for quantitative treatment in a workshop setting (see also [21]).

The facilitated model can also serve as a test bed for suggested courses of action. If the model is used in this fashion, it serves as an aid for discovering the possible consequences of action. The group is starting to formulate a ‘theory of action’ for possible future interventions [22]. The facilitator can assist by making this theory more explicit. On occasion the theory can be compared with established knowledge on ‘what works’, but for many messy problems no such established theory exists. The group’s theory of action is essentially an assumption or a hypothesis on what **may** work.

As we have seen in Section 6.3, gaming may be a suitable approach when the problematic situation we are facing is dominated by intentional and qualitative uncertainty, as is often the case in a military context. Like workshops and facilitated modelling, gaming is (in this context) intended for collective learning

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<sup>3</sup> In the context of military decision making, the main client is normally either a senior officer or a senior Defence official. In addition, military procedures tend to be formal and traditional. This will affect how a problem can be approached and what methods may be socially (i.e. in a Defence environment) acceptable [17].

about the challenges facing stakeholders. Gaming should not be seen as a replacement for problem formulation, but as a continuation of the exploration of options for addressing the challenges ahead. Gaming approaches certainly include war-gaming to explore tactical and operational issues, but may also include other forms of games. Gaming may include an element of role-playing, when members of the gaming group assume different roles in order to explore the options available for external and internal stakeholders, and normally require one (or several) scenarios, a fictitious setting derived from the general problem statement. Gaming can give a deeper understanding of the nature of the problem, and the options available to external stakeholders [23].

In addition to some well-established methods for problem structuring in a workshop setting which are all usually carried out in a facilitated modelling mode ([1], [15]), another methodology that can be useful within a workshop setting is Multi-Criteria Decision Analysis (MCDA). This family of methods is focused on choice in a situation where a single criterion for choice between options does not exist, and on a structured approach to prioritising between multiple criteria [24]. The weighting and scoring activities that are required pose challenges to both the analyst and the facilitator when dealing with the different preferences that usually exist in groups.

Once the ‘right’ terms are identified, objective errors (measuring the thing ‘right’) appear in addition to residual subjectivity issues. Any term ending in ‘ility’ (such as mobility) or a similar suffix (such as ‘ness’ or ‘ment’) is likely to be prone to this problem. Such issues are an indication of the appropriateness of a ‘soft’ OA approach. Thus, for example, military effectiveness may be reasonably proposed to comprise a mix of subjectively weighted terms like lethality, mobility, survivability and sustainment. Each of these derived terms is challenging to define and is likely to be composed of another subjective weighting of selected surrogate terms. There are established means to treat such weightings ranging from consensus to sophisticated MCDA approaches [25]. Again an audit trail and agreement are required<sup>4</sup>.

A study involved a 3-day workshop covering the design and preliminary evaluation activities regarding alternative options for new operational concepts for maritime mine counter measures. It used expert opinion in addition to previously assembled assessment information in a multi-methodology analysis. After this, a more technology-oriented description of the concepts was evaluated in a follow-on workshop: experts assessed the technology and its impacts on the operational concepts using multi-criteria analysis.

Presence of technical (in addition to operational) expertise as well as all relevant organisational parts of the Navy being represented proved to be crucial in both workshops.

Proper planning and preparation for the group session is critical in order to help develop participant confidence, cooperation and ownership of the session’s products. The following should be addressed as part of the planning process: session objectives, actual products of the session, session stages<sup>5</sup> and agenda, participants, presentations, reading package, consultation and expectation management (‘probable issues’), record keeping arrangements, and organisational practicalities. The reader is referred to [28] for further information on facilitating workshops.

The quality challenges that appear in problem formulation in a workshop setting are more or less connected to the fairness of the process, for example:

- Were all key stakeholders considered?
- Was the process accepted by the involved stakeholders?
- Does the problem formulation accurately reflect the concerns of the stakeholders?

<sup>4</sup> Although scores and weights of ‘dissenters’ may be investigated in a sensitivity analysis, rather than forcing them to agree to consensus.

<sup>5</sup> The use of short scripts (‘thinklets’ [26], or a ScriptsMap framework [27]) that describe and visualise distinct activities during a session may be helpful to get the purpose of these activities across to the participants and create a desired collaboration mode.

These challenges are met by adhering to process and facilitation standards as indicated earlier.

Other quality challenges are added when options for action are considered, for example:

- Will the options work as intended?
- Will the options meet their objectives?
- Will the options be executable within reasonable constraints in terms of time and resource allocation?
- Will the options be acceptable by key stakeholders?

These challenges can only partially be met within the framework of the workshop setting. There, these issues should be addressed by ensuring that the right experts are consulted and that the assumptions underpinning the options are made explicit, including the ‘theory of action’<sup>6</sup> behind each option. If the situation is characterised by dynamic uncertainty, designing options that retain freedom of action and support knowledge generation should be considered.

## 7.4 OTHER DATA SOURCES AND SAMPLING STRATEGIES

It may not be possible or desirable to conduct all required data collection for a certain study in a workshop setting. Other data collection approaches may be necessary<sup>7</sup>. Studies of documents, conducting interviews with stakeholders and eliciting opinions from experts are other options for data collection. This could include experts or stakeholders who, for some reason, could not be included in the problem formulation process, but could be consulted in order to get a view from outside the core group conducting the problem framing.

When working with judgement-based data collection, it is important to have a purposeful sampling approach, i.e. to know why certain sources, stakeholders or experts are chosen for inclusion in the study. The sampling approach also need to take into account what approach was used for including stakeholders in the problem formulation process in the first place. Options for qualitative sampling are described in Patton [9].

In the development of NATO maritime capability, user requirements for monitoring ‘white’ shipping were not well understood. To improve understanding, a cognitive task analysis was conducted using critical incident inquiry to identify the specific cues that alert operators to suspicious behaviour.

Concept mapping was employed to record and analyse operator strategies and reasoning as they worked with systems to complete tasks. Performance and standard work load measures were also collected and combined with the concept maps to provide an overall assessment.

Expert and well calibrated observational data was required for reasonable interpretation of the way operators use strategies. While some data collectors/observers were comfortable with the tools and methods being used, several were only available for two days before the execution to train and exercise. This caused some difficulty in the analysis, and necessitated a much greater amount of post experiment analysis. Even with a standard method for recording observational data, collectors need to have appropriate time and training to be familiar with the relevant methods and theoretical implications associated with the behaviours being observed.

Stakeholders can be interviewed in order to get an understanding of their view on an issue, or to gather deeper knowledge. Options for interview styles include the interview guide approach, where the topics of the interview is identified, but the actual formulation of the questions takes place during the interview, and the standardised open-ended interview, where the exact questions are formulated before the interview. Interviews are normally conducted one to one, but focus group interviews are also an option. The quality of the results of an interview is largely dependent on the skills of the interviewer [9].

<sup>6</sup> The ‘theory of action’ [22] (or ‘theory of change’) answers the question “Why do we think this course of action will reach our objectives?”.

<sup>7</sup> Several kinds of more in-depth quantitative investigations may be part of a study, but data quality issues for quantitative investigations are not considered in this CoBP.

The NATO SAS-074 Activity has recently devised a Human Environment Analysis Reasoning Tool (HEART). The tool is designed to enhance access to data and methods relevant to human performance. ‘Soft’ methods are often the only techniques through which human aspects can be addressed. It is recommended that ‘soft’ OA analysts should access the tool where appropriate<sup>8</sup>.

## 7.5 USING SUBJECT-MATTER EXPERTS

The opinions of SMEs can be vital to a ‘soft’ OA study. SMEs may be included in workshop sessions or interviewed. Another option, that does not require a workshop setting, may be to conduct a Delphi study. The SME is one source of input to a ‘soft’ OA study. While the SME does have detailed knowledge it should be recognised that it is not likely to be complete, could be biased (whether intentional or not) and is only one source. Of course, unless the analyst has intimate knowledge of the system, one of more subject-matter experts should be involved in a ‘soft’ OA study at some point. Franco and Meadows [29] propose four stages where SMEs may usefully contribute, with this CoBP’s corresponding phases added between brackets:

- Gathering information about the problematic situation (Appreciation phase);
- Structuring issues (Analysis phase);
- Designing options (Assessment phase); and
- Evaluating options (Assessment phase).

In addition, this CoBP proposes an Action phase (Chapter 5), where it is most likely that SMEs will contribute too.

As a study participant, the responsibility of a SME is to provide his informed opinion, based on his knowledge, experience, and (technical, military, social, etc.) expertise. SMEs are recognised as experts by their peers; they may be military or civilian. For example, the SME may be asked to provide assumptions regarding future doctrine, performance data, force mixes, organisational structures, or force employment scenarios. In the development of a war-game, the SME could contribute by proposing system descriptions or by developing realistic scenarios, and during its execution, the SME could consequently play the role of sub-unit commander.

In NATO a capability manager was asked to consider the future capabilities that might be needed for expeditionary operations. He took the NATO definition of Expeditionary Operations as his starting point, however he found it vague and all-encompassing and therefore not useful to direct or inform capability requirements analysis. Morphological analysis was identified as a tool to obtain a more detailed description of expeditionary operations that could be used. One issue that the study had to overcome was the number of experts that needed to participate due to the broad subject area. A simple electronic data collection tool was developed to collect views on the components of Expeditionary Operations using Morphological Analysis as a framework. This tool was able to be sent out via email for relevant subject-matter experts to complete individually. It was also used as a data capture tool in a series of workshops, allowing flexibility in data collection. The tool had to be carefully designed to allow remote collection of qualitative data.

In order to meet his responsibility, the SME may need to prepare for his sessions by reading study background material that has been supplied to him. SMEs should be selected in a way that helps ensure that experts from all major points of view are represented, hence helping to minimise bias. SMEs may be selected by relying on the primary client’s knowledge to identify SMEs and/or by asking known SMEs to name other SMEs. However, the latter may result in a lack of diversity in viewpoints. The number of SMEs chosen to participate depends on the nature of the topic being addressed, the desired type of interaction between the

<sup>8</sup> Draft NATO/RTO Technical Report (IST-999) to be published in 2011. See also [a] in Section 7.7.

SMEs (e.g. face-to-face group session, Delphi) and SME availability and willingness to participate. If too few SMEs are chosen then the broadness of the discussions may be too limited, whereas having too many SMEs may mean that not everyone has an adequate opportunity to contribute.

In inviting SMEs to participate in a study, information needs to be provided on the study aim, the identity of the sponsor, what tasks the SMEs will be expected to perform, and how much time it is expected that the SMEs will need to devote to the study and over what period of time. Some of the real experts may be too busy to participate at the required level of effort. They may change their minds if they are motivated by the opportunity to make a significant contribution to the issues being addressed by the study and by the recognition such contributions may result in. Rewarding SMEs for their services may slant the results [30].

Expert judgement is affected by the process of gathering it. It can be conditioned by how questions are phrased. Experts need to understand what they have to do in the working group session and why (e.g. how their outputs are to be used) and how they are expected to do it. There needs to be a clear and common interpretation of terminology being used, the scales on which judgements (e.g. ordinal measurements) are expressed and how uncertainty is to be dealt with (e.g. provision of estimates as a range of values rather than a point value). Facilitators may need to deal with situations in which there is wide disagreement between experts' judgements or in which there is a seeming consensus in the judgements except for one significant outlier. Study results will be criticised if there is the perception that there was a skewed choice of experts or if irregularities are perceived in the elicitation and analysis process. Readers interested in more detail on the elicitation of (quantitative) judgements are referred to one of the books on knowledge elicitation (e.g. [30]).

As for any 'soft' OA study, circumstances will dictate where and at what stage of the study an SME could be used. In this respect, the situation for 'soft' OA will most likely be different from that for a 'harder' OA where there is more certainty of the issues, data and nature of the study on the outset. For this reason early involvement of SME is often recommended in optimisation-biased OR textbooks. The pros, cons and requirements of SMEs are summarised in Table 7-2 in terms of the '4 A-phases' model described in Chapter 5.

**Table 7-2: Pros and Cons of Including SMEs in Different Phases of the Study.**

<b>Stage</b>	<b>Pros of Involving a SME</b>	<b>Cons of Involving a SME</b>	<b>SME Requirement</b>
<b>Appreciation</b>	Detailed inside knowledge. Could be tasked to obtain specific information.	Incomplete knowledge of the system. Need to balance analyst team contribution against SME.	In depth knowledge of how the system should operate and its actual behaviour. Ability to work with analysts.
<b>Analysis</b>	Gives peer review. Provides sources of data to test the model. Provide personal experience on current deficiencies. May provide useful speculation on new ideas.	Might bias the rest of the study through a personal or institutional mind set. Formulation of a model that is too literal with little opportunity to explore innovative changes. Embarrassment to the study team if the model is poor and this is the first time the SME sees it. May be reluctant to provide useful speculation on new ideas.	Acceptance of another's perception of his system. Ability to work with analysts. Ability to generalise on the nature of data and its applicability. Ability to speculate on 'out of the box' interventions. Ability to work with analysts.
<b>Assessment</b>	May identify the study team's unknown obstacles to change.	May apply their own filters if the changes do not fit their value systems.	Ability to provide an honest sanity check. Ability to work with analysts.
<b>Action</b>	Provides credibility to the study. Identifies pragmatic courses of action.	Would probably have to be involved in most of the process – time constraint.	Needs to speak with authority and be recognised as such by the executive decision makers.

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## **7.7 RECOMMENDED ADDITIONAL READING**

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