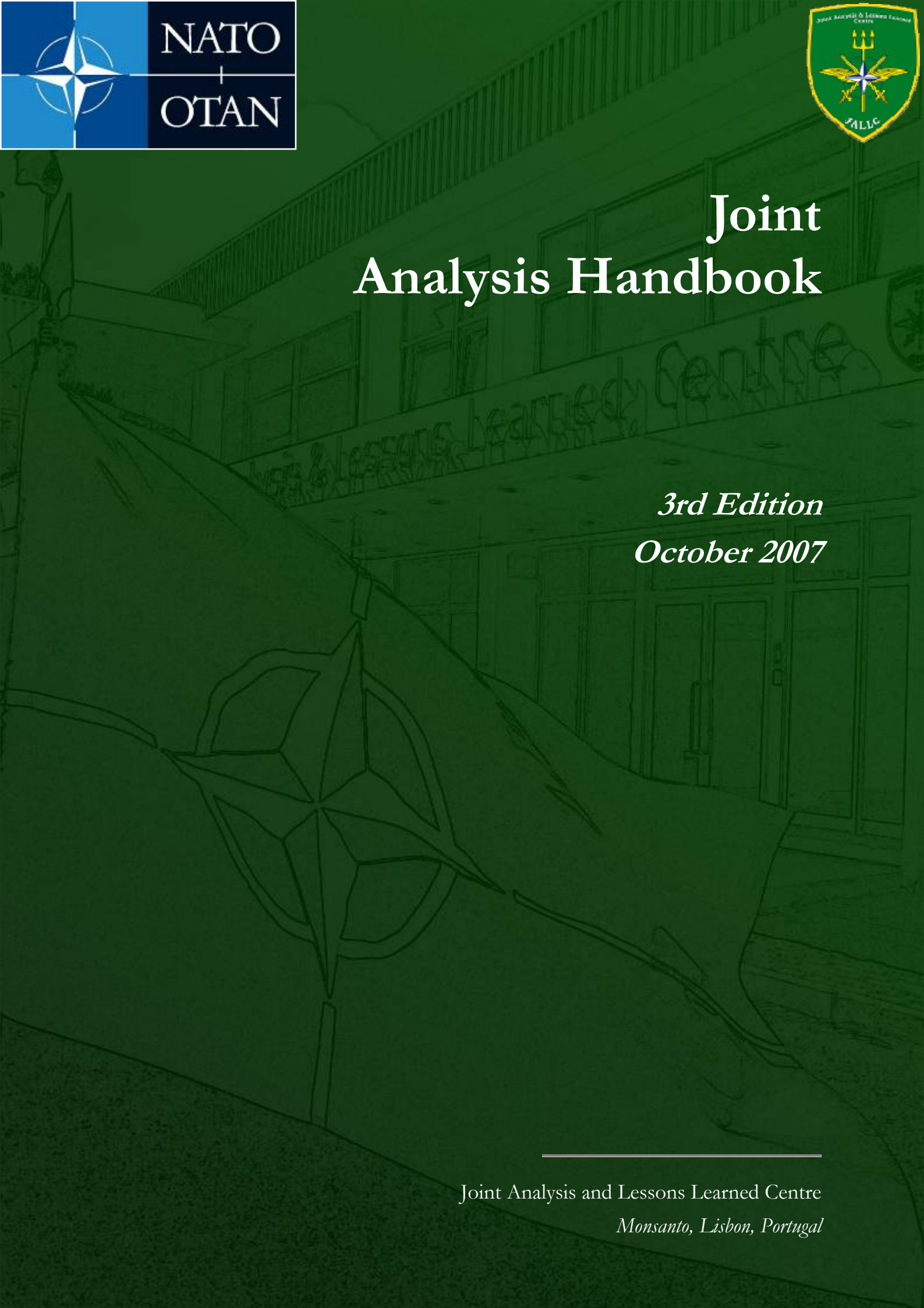

Joint Analysis Handbook

3rd Edition

October 2007

Joint Analysis and Lessons Learned Centre

Monsanto, Lisbon, Portugal

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Joint Analysis Handbook, Third Edition, October 2007

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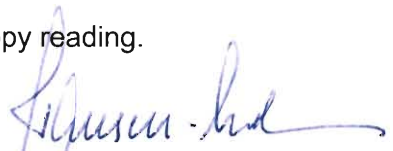
Foreword

I am proud to present the third edition of The Joint Analysis Handbook, a key contributor in achieving JALLC's vision.

The Joint Analysis Handbook is a lot more than just a plain guide to analysis—it is a guide that is carefully tailored to meet your needs. While its emphasis is on analysis in support of the NATO Lessons Learned process, I believe this guide is also an invaluable resource for any analyst, military or civilian, working in NATO, our member Nations or beyond.

Each new edition of the Joint Analysis Handbook incorporates the latest experience and expertise of my Joint Analysis staff. This edition is no exception. I hope you will find this high quality product so beneficial that you will want a copy with you permanently, whether in the office or in-theatre.

Happy reading.



Jørgen HANSEN-NORD
Brigadier General, Danish Army
Director JALLC

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Part 2
Tools and Techniques for Joint Analysis

"*Would you tell me, please, which way I ought to walk from here?*"

"*That depends a good deal on where you want to get to,*" said the Cat

"*I do not much care where,*" said Alice

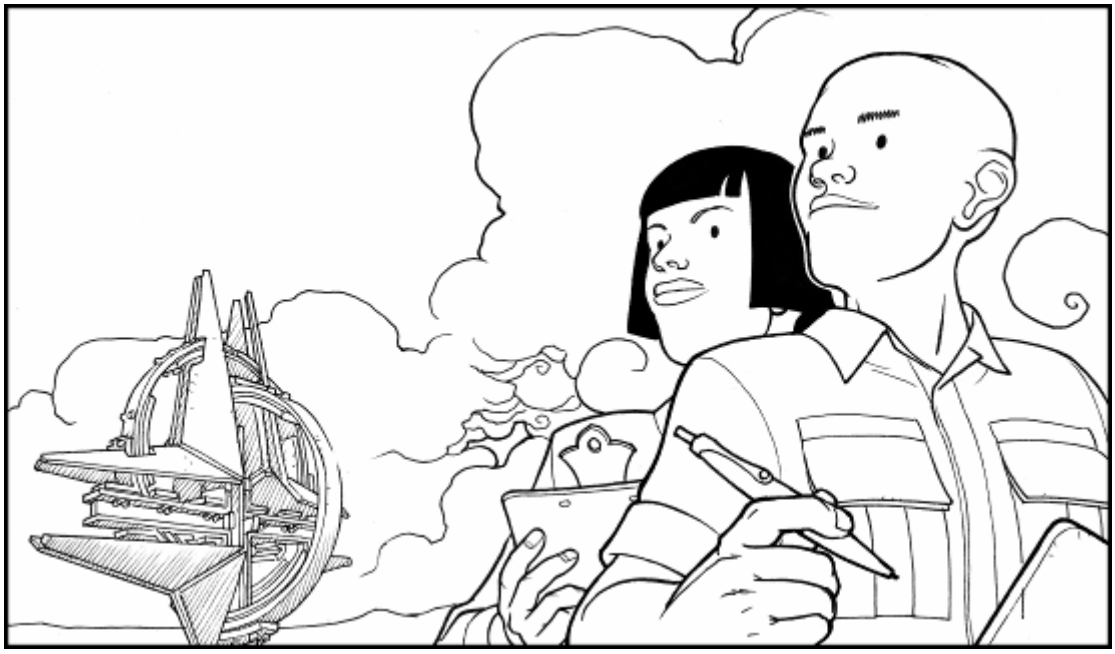
"Then it does not matter which way you walk," said the Cat

– Lewis Carroll's *Alice in Wonderland*

Joint Analysis Handbook

Part 1
Introduction to Joint Analysis

1
Introduction



Welcome to the Joint Analysis Handbook. This handbook provides guidance on how to conduct analysis in support of Lessons Learned (LL) processes. It is primarily designed to assist Lessons Learned Analysis Staff Officers with all aspects of conducting analysis, both in the office and when deployed to operations, training events, exercises or experiments.

The official definition of analysis in NATO is:

> *"The study of a whole by examining its parts and their interactions."*[1]

The focus of this handbook is on *Joint Analysis* which is the analysis approach typically employed by NATO's Joint Analysis and Lessons Learned Centre (JALLC) to support NATO's joint operational and strategic level LL processes.

The use of analysis is not new in the military. In fact, military organisations were one of the first to actively use analysis to support decisions and help improve their effectiveness. Analysis for this reason is historically referred to as Operational Research, Operations Research or Operational Analysis (OA).

As well as its use in support of LL processes, analysis provides decision support to NATO in other areas. These include:

- Day to day operations to help the Commander and Staff gain the best possible operational outcome. (Allied Command Operations OA Cells)
- Capability Development to help select the future direction of NATO capability (Allied Command Transformation (ACT) Capability Development Cell and Defence Planners)
- Concept Development to help develop new ways of working and technology to support the future of NATO (ACT Future Capabilities Analysis Team)
- Training to help identify and fill training requirements in the best possible way. (Joint Warfare Centre (JWC) and Joint Forces Training Centre (JFTC))

[1] AAP-6 NATO Glossary of Terms and Definitions, NATO Standardisation Agency 2007

Many of the principles, procedures, tools and techniques described in this handbook are applicable to these and other areas of analysis as well as to Joint Analysis.

This handbook is divided into two parts. Part 1 provides an introduction to *what* Joint Analysis entails and Part 2 provides more detailed guidance on *how* to do some aspects of Joint Analysis. Both Part 1 and Part 2 should be read initially. Part 2 can later be used as a reference document and consulted as required.

In Part 1, this introduction situates Joint Analysis within LL processes, suggests a way to break Joint Analysis down into five phases and provides some background on analysis. Each chapter that follows the introduction gives a detailed explanation of what each Joint Analysis phase involves. The final chapter in this part discusses what happens to completed Joint Analysis.

THE ROLE OF ANALYSIS IN THE LL PROCESS

LL processes can be thought of as the continuous application of the Boyd Cycle or OODA (Observe, Orient, Decide, Act) loop to NATO activity.

The OODA Loop (Figure 1) was first described by US Air Force Colonel John Boyd in the mid-1970s to explain how US fighter pilots in the Korean War held a significant advantage in terms of kill ratio over their adversaries, even though the US pilots were flying inferior aircraft by most measures of aeronautical performance. In many areas of competitive human activity, the theory is that if you can cycle through the OODA loop faster than your opponent, you have the advantage.

The logical first step in the loop is Observe. This step in LL processes is completed by the individuals involved in an activity. They record what they see, the *effects* of actions. These observations may either directly or indirectly prompt an Analysis Requirement.

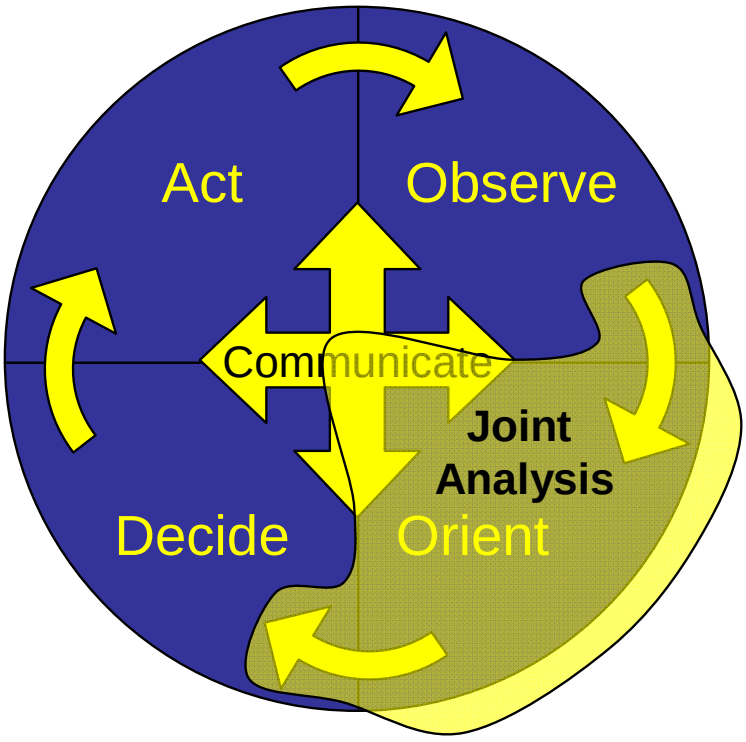


Figure 1 – Joint Analysis in the OODA Loop representation of a LL process

The next step is Orientation, where we try to diagnose and describe the *causes* of the observed effects, their *impact* and the *relationships* between them. This step relies on analysis.

The Decide step is where possible courses of action are developed to redress the causes of the observed effects and one particular course of action is selected and approved. This step must be completed by empowered decision-makers.

Finally, in the Act step, an appointed action body executes the course of action.

Note that it is quite possible, and even likely in a complex organisation such as NATO, that each step in the OODA loop (LL process) will need to be completed by a different individual or team. Every handoff introduces an opportunity for the LL

process to stall; therefore it is crucial for the success of a LL process that the handoffs between the steps are well orchestrated.

As shown in Figure 1, Joint Analysis fulfils and connects the Orientate step to the overall LL process. It allows us to:

- Understand the root causes of observations (Observe→Orient).
- Investigate the value of potential action plans (Orient→Decide).
- Appreciate when lessons are being learned that could benefit the wider organisation (Communicate).

Lessons Identified (LI) are frequently a desired outcome of Joint Analysis. If actions are taken to fix problems or ensure successes are repeated, LIs can become LLs that everyone uses to improve the way they do things. The process NATO uses to accomplish this is described fully in the Bi-SC Directive for LL (Reference A).

THE PHASES OF ANALYSIS

It is possible to break the Joint Analysis process into five phases of activity that make thinking about what needs to be done a bit easier. The key distinctions from one phase to another are the type of activity involved and the timeframe in which it is done. The activity in each phase leads to products that can be viewed as progressive building blocks, each contributing to and strengthening the next phase. However, it is important to keep in mind that while this is a helpful way to think about it, the phases are not entirely sequential in practice. They overlap and may sometimes need to be repeated. The transition between phases often needs to begin before all of the products of the current phase have been completed.

Figure 2 provides a representation of the phases. They are:

- *Clarify the Need* for analysis, understanding the Analysis Requirement (AR) establishing associated Analysis Objectives (AOs), and preparatory data collection.
- *Analysis Preparation:* detailed planning, office-based data collection and research, organisation and preparation *before* an exercise or deployment.
- *At the Event*, activity during the deployment at the operation, exercise or experiment, deployed data collection.
- *Post-Event Analysis* of the data including development of conclusions and, from these, recommendations.
- *Reporting* on the outcome of your AOs and documenting any lessons you have identified.

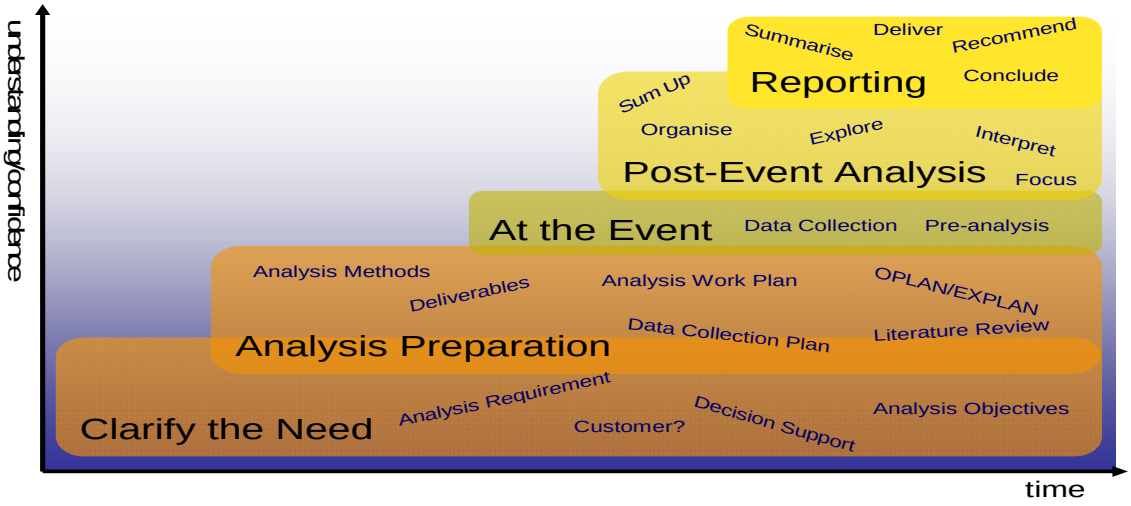


Figure 2 - The Phases of Analysis

The Value of Analysis

The rationale behind the phases is two-fold and is shown diagrammatically in Figure 3:

1. To develop an understanding of what is actually going on (findings).
2. To increase our confidence in our findings by having the supporting data and analysis.

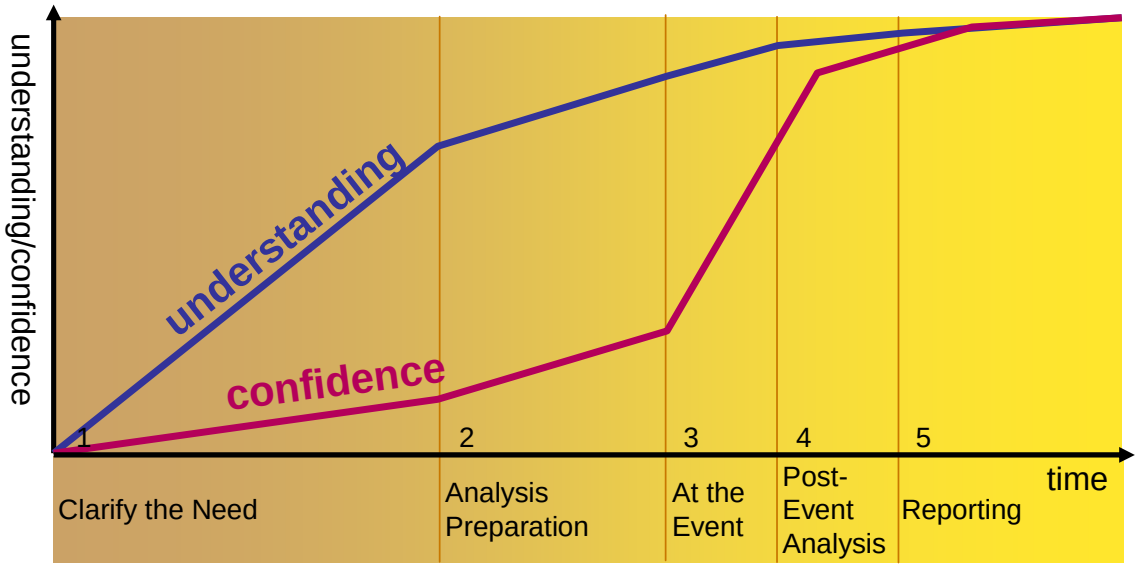


Figure 3 - Gaining Understanding and Confidence through the Phases of Analysis

Your understanding will build early on in the analysis, but it takes supporting evidence, such as is available at an event, to build up sufficient confidence in that understanding to take it forward. When you are briefing your findings to the customer and he asks, "*Where is your proof?*" you need to have a valid answer. That is the value of analysis, not to just develop findings, but to develop findings with proof that will hold up under the magnifying glass.

The following five chapters in Part 1 lead you through each of the phases of analysis in more detail. However rather than launching directly into these chapters we will consider what analysis entails and what we will need to learn about it.

THE NATURE OF ANALYSIS

> *"The JALLC acts as the focal point in NATO for analysis and the collection of lessons learned."*[2]

The Joint Analysis and Lessons Learned Centre (JALLC) is aptly titled. The key terms in the title are *analysis* and *lessons learned*. *Lessons Learned* are the desired end products. They are enduring improvements in our capability based on our past experiences. Lessons Learned are more than just fixing immediate problems, they are about making sure problems never happen again and that best practice is spread.

Analysis is a process used to thoroughly understand areas of activity identified to have potential for improvement. The results of analysis are used to support decisions that will result in enduring improvements, thus leading to a Lesson Learned. The relationship between these terms forms the basis not only for the JALLC's mission, but also for the work of all Lessons Learned Cells throughout NATO. We will focus on two points: what distinguishes analysis from evaluation and what analysis involves.

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[2] MC 510 Enclosure 3 Terms of Reference for the Director JALLC, 30 Apr 2004, NATO RESTRICTED.

The distinction between analysis and evaluation is so important that it can be viewed as the foundation of NATO's Lessons Learned approach. In fact, the differences are so great that they demand a philosophically different approach. To help clarify these differences, the definitions associated with both analysis and evaluation are included in Figure 4.

Notice that analysis involves taking something and looking at it in different ways to develop understanding of "essential features or meaning." At no point in the definitions and synonyms does the concept of attaching a value or rating come into it. This is in stark contrast to the definition of evaluation, where the "act of ascertaining or fixing the value or worth of" something is the basis of the activity.

To help clarify this distinction, think about the diving competition in the Olympics. A diver goes to the board, takes his/her stance and dives; a group of judges assign a value from one to ten based on the quality of the dive. This is a clear example of evaluation. The judges make an appraisal about the quality of the performance. Now, in analysis, we would look at the same dive, but rather than judging the individual performance, we would start breaking out other factors to understand *why* or *what contributed* to the fact that the dive was good or bad. For instance, we might collect data about the diving board and find that there is actually a problem with it—maybe it has a crack or has lost some of its springiness—or we might find that the diver has not trained for this particular type of dive.

Analyse (verb)

1. Examine methodically and in detail for the purposes of explanation and interpretation.[1]

Analysis (noun)

1. A detailed examination of something in order to interpret or explain it.[1]
2. The process of separating something into its constituent elements.[1]
3. The study of a whole by examining its parts and its interactions.[2]

***Synonyms*:**

Breaking Down, Dissecting, Classification, Examining, Studying, Reasoning[1]

Evaluate (verb)

1. To form an idea of the amount, number or value of; assess.[1]

Evaluation (noun)

1. Act of ascertaining or fixing the value or worth of.[1]
2. The structured process of examining activities, capabilities and performance against defined standards or criteria.[2]

Synonyms:

Measure, Criticise, Estimate, Appraise[1]

1. Concise Oxford English Dictionary, 11th Ed.
2. NATO AAP-6

Figure 4 - Analysis and Evaluation

Evaluating the dive to find out whether it was good or bad does not tell us how to repeat or avoid the same performance in the future; it tells us the quality of that particular dive. In contrast, analysing the dive would give us an understanding of issues that may need to be addressed when we decide what to do to help improve the performance on future dives.

Another important distinction between evaluation and analysis is what initiates each process. In NATO, evaluation takes place at every exercise, and is regularly carried out in on-going operations. Analysis is conducted when a better understanding of an issue is needed to support decisions. To return to our diving competition, evaluation takes place at every competition—it would not be much of a sport without a way to keep score. But analysis would be initiated when it became desirable to know more about why things happened the way they did; say, the average scores were noticeably different than a previous year's (faulty diving board, doping, inconsistent

judging) or in anticipation of changes in the structure of the competition (a new diving board was acquired or the event will be held outdoors for the first time).

Finally, evaluation usually requires a certain degree of subject matter expertise in the area being evaluated. Otherwise, how could you judge what is good or bad? Evaluating a dive requires expertise in diving. In contrast, analysis of diving can be conducted without the analyst being an expert diver, though analysts often call upon experts to help them better understand the data they collect.

This is not to say that analysts are not subject matter experts, analysis just requires a different type of expertise. Their area of expertise is *analysis* rather than a particular functional area (e.g., diving, intelligence, logistics, etc.). The biggest challenge for military analysts is maintaining an analytical focus and not slipping into evaluation. It is very tempting when analysing an area you are familiar with to begin critiquing the performances you witness during your data collection—in other words, to do evaluation. There are several forces that may "push" one towards evaluation and away from analysis; Table 1 highlights several of these and further contrasts analysis and evaluation.

The main point is to remember that the evaluators are key to helping people understand how well they are doing their actual work and the analysts are key to the successful identification of lessons that support decisions about the action necessary to ensure problems are resolved, and best practice is spread throughout the whole of NATO.

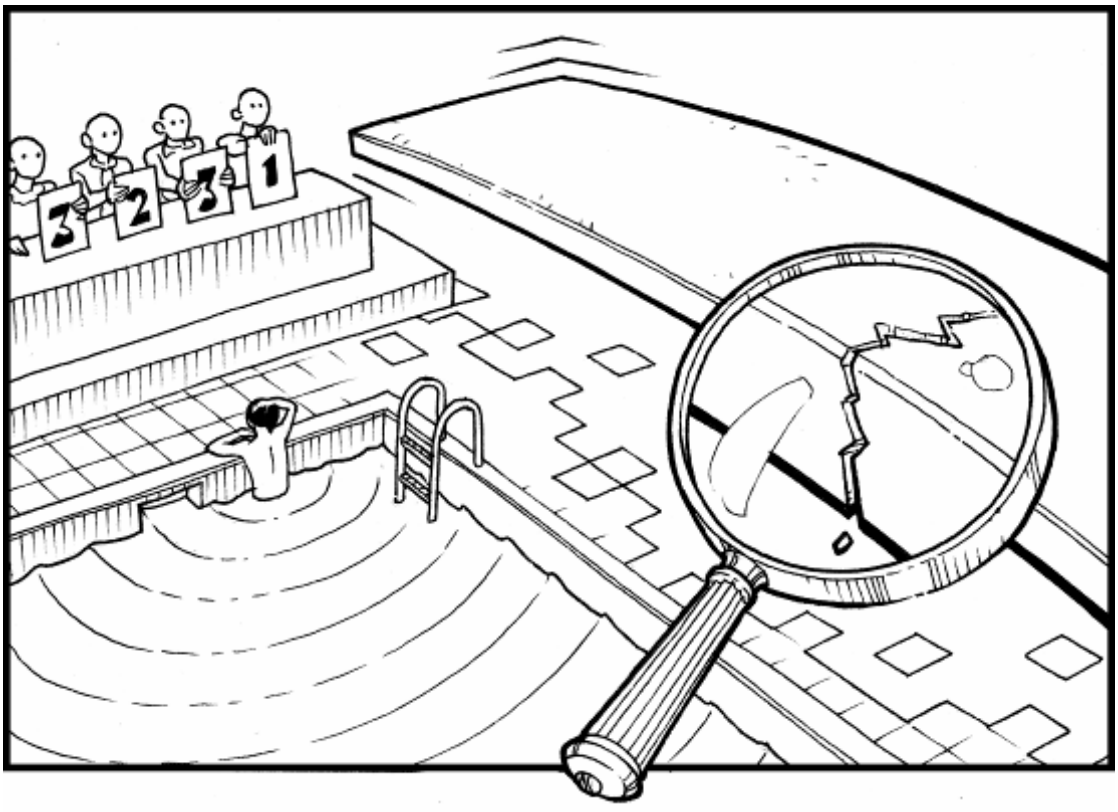


Table 1 – Evaluation versus Analysis

Evaluation	Analysis
It is what you "know". It is in your area of expertise.	You are often looking at things that are not in your normal area of expertise.
It is human nature (and sometimes fun) to judge others.	We are not there to make judgments. We are here to identify the contributing factors.
Usually "mission" or "scenario" dependent. You need to be immersed in the operational issues…where is the enemy, what are the specifics included in the "plan," etc. For example, if the opposing element was mistaken for a battalion when it was actually just a company.	Often the actual mission or scenario events are relatively unimportant. For example, we need to determine what contributed to faulty situation awareness (SA). That a company was mistaken for a battalion is fairly irrelevant. Understanding the reasons for the poor SA is our analytical challenge.
Evaluators get to "play in the weeds."	Analysts need to avoid the weeds and keep an eye on the big picture.
What you look for is easily observable. Usually looking at/for 1st order, surface effects. • Procedures used • Performance against standards • Timeliness • Errors • Adherence to standards/procedures • Omission of steps/procedures • Incorrect protocols • Adherence to best practices • What worked well? • Etc.	The initial observations are only symptoms. Your job is to find out the reasons behind them. Usually requires looking for 2nd, 3rd, or even 4th order causes. • Inconsistencies & Confusion • Trends & Patterns • Challenges • Proposed vs. real world • How things (technology, doctrine, etc.) can "set people up to fail." • Why did something work well? • Dynamic relationships and interactions • Etc.

LEARNING ANALYSIS

There are many tried and tested tools and techniques that can be used during analysis. Professional analysts are trained in how to use many of these and at least have an awareness of most of them. However, academic training is not enough to become a good analyst. In the same way that you really learn to drive after you have passed your test, an analyst's skills really develop once they start to gain experience in doing analysis.

As a staff officer, you are not expected to arrive fully qualified and ready to conduct analysis on your own. In fact, NATO employs a number of professional analysts—there is at least one professional analyst allocated to each NATO headquarters—to help analysis staff officers.

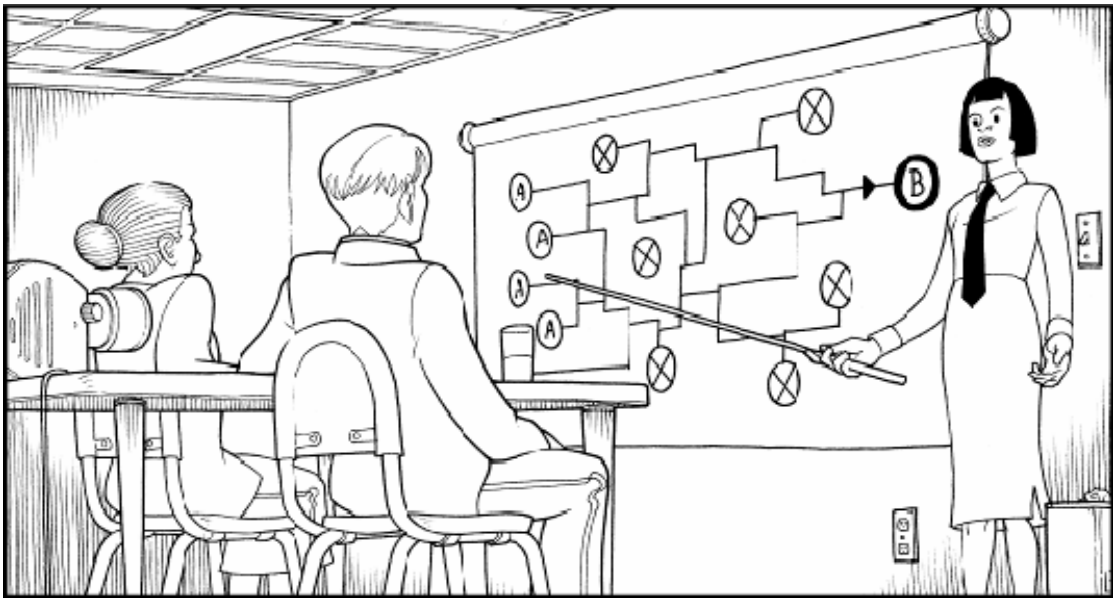
As well as advice from professionals within NATO, there are many opportunities for analysis training outside of the military. Analysis is practised in many different sectors and the majority of tools and techniques used in these other sectors are equally applicable in the military field. Many resources exist that will help you to find out more about analysis tools and techniques, their application in the military and analysis training opportunities. To find out more about analysis tools and techniques, their application in the military and analysis training opportunities, try browsing the following websites:

- OA Community WISE Page (NATO CRONOS) http://cww.lahd.nato.int/WISE/Current309/CGCommandG/Operationa/OACommunit
- Military Operations Research Society (MORS) (US based) www.mors.org
- Operational Research Society (ORS) (UK based) www.orsoc.org.uk

SUMMARY

- We do analysis to support decisions for improvement across the whole of NATO based on what we have learned from our experience. Analysis is an essential supporting element of the NATO LL Process.
- Joint Analysis can be thought of as consisting of five phases that progressively increase our understanding and our confidence in that understanding.
- Analysis is fundamentally different from evaluation in that it involves gaining a thorough understanding of the factors affecting a situation and not just observing and reporting performance.
- Analysis needs a toolkit and experience in using those tools. NATO employs professional analysts to help LL staff officers with analysis.
- This handbook offers analysis advice based on years of experience. Reading the rest of this handbook is the first step on your journey towards becoming a LL Analysis Officer.

2
Clarify the Need



The first phase of analysis is to clarify the need for your analysis. This phase starts with a proposed Analysis Requirement (AR) and ends with one or more agreed Analysis Objectives (AOs). This phase is also when you start to build your understanding. There are three things that you will do during this phase that are fundamental to the success of your analysis. You will:

- Establish who your customer and stakeholders really are.
- Find out what the customer really wants and why they want it, i.e. clarify the customer's AR.
- Work out what you can realistically deliver within the constraints and restraints that exist, i.e. develop your AOs.

YOUR CUSTOMER AND STAKEHOLDERS

NATO's AJP-01[3] suggests that there are three primary tenets to joint command:

1. Singularity of command.
2. Clear chain of command.
3. Continuity of command.

These are as important in analysis as in any other military activity. Abiding by these tenets will increase your chance of completing a successful analysis and make your life much easier. Your customer and stakeholders do not have exact military equivalents, but there are some similarities between your customer and a commander, and your stakeholders and the entities in theatre that may influence or be influenced by your activities.

Singularity of command

It is not always clear from the proposed AR who the analysis customer should be. ARs come from the Observe step in the LL process but the customer should be one of the people or organisations responsible for the Decide step in the LL process. It is

[3] AJP-01(C) Allied Joint Doctrine, March 2007, NATO/PfP UNCLASSIFIED Releasable to EU.

common in NATO for the originator of the AR not to be the same person or organisation that needs to make a decision based on the resulting analysis.

You may start with many "customers" but you can only serve one master. Therefore, it is crucial that there is agreement regarding which of your "customers" will be *the* customer. Only *the* customer will have final say over the AR, be empowered to approve changes during the course of the analysis, and provide final feedback to you.

Clear chain of command

The other "customers" (who are likely to be affected by or have an interest in the analysis) are stakeholders. You are not obliged to satisfy your stakeholders' needs with your analysis unless your customer directs you to, but it is strongly advised. Keeping your stakeholders engaged will increase the chances that your analysis is accepted and that your recommendations are implemented. It will also make them more likely to be open to your data collection efforts, especially important since stakeholders are likely to be important sources of data.

Continuity of command

You need to work in partnership with your customer and stakeholders throughout. During this time you will build a working relationship with them that will allow you to really understand their needs and motivations. Keeping the customer and analysis team as constant as possible will help you to build good working relationships that will make your analysis task much easier.

YOUR CUSTOMER'S ANALYSIS REQUIREMENT (AR)

In a military context, it might be helpful to think of an AR as being equivalent to a requirement for an operation. Clarifying the customer's AR is similar to the act of formulating the overarching idea and intent for an operation described in NATO's operational planning process (Reference D). The AR should describe the desired end state and give the strategic objectives.

Note that in the same way that the commander's intent is fundamental to any operation, the customer's intent is fundamental to your analysis. You would be foolish to commit your forces to battle without taking time to fully understand your commander's intent and you would be equally foolish to commit your team to analysis without taking time to fully understand your customer's intent. The intent puts everything into context. The intent allows you to understand not just your instructions, but also *why* you have been given those instructions.

Take the opportunity to work with the customer to ensure his AR is appropriate for analysis. Too prescriptive and your analysis will be constrained to arriving at an answer that has been pre-determined by the customer and stakeholders. Too vague and you will be left guessing where to focus your analysis. You must help your customer to understand that analysis will provide him with better understanding to **assist in his decision making**; it is not a tool for assigning blame or a replacement for good decision making or planning.

In NATO, a need for analysis is identified when an AR is proposed. Proposed ARs are generic statements of areas where analysis is needed, such as:

- AR1: How can HQ Alpha improve the timeliness of its intelligence cycle?
- AR2: How can NATO improve its interaction with PfP and Contact Nations in order to assist these Nations in supporting NATO operations?

In the JALLC's, case proposed ARs are submitted to the Analysis Requirements List as part of the JJJ[4] Programme of Work. The formal process for this is described in

[4] JJJ = JWC, JFTC, JALLC.

the Bi-SC Directive for LL (Reference A). Other LL and analysis entities within NATO receive proposed ARs according to local procedures; often they will come directly from the Unit Commander.

A firm understanding of your customer's AR is the essential ingredient to allow you to complete your development of good AOs.

YOUR ANALYSIS OBJECTIVES (AOs)

In a military context, it might be helpful to think of the AOs as equivalent to operational objectives that need to be achieved for overall operational success. The operational objectives help to define the purpose of the task to be accomplished. In the same way that an operation may require multiple objectives, an AR may require multiple AOs. Developing your AOs is similar to the act of envisioning how the operation will unfold as described in NATO's operational planning process (Reference D).

Although the AR must ultimately drive your final AOs, you will need to make a start on developing your AOs before you are completely sure of your AR. You will actually cycle between clarifying the AR and developing the AOs, using progress on one to inform the other until your customer and you are completely satisfied that your proposed AOs are both achievable and will meet their need.

AOs state exactly what will be achieved from the analysis project. Sometimes it will be necessary to break down complex AOs into a number of Sub-AOs to help clarify the analysis tasks. Sub-AOs outline the areas of study that will combine to meet the overall AO. An AO may take many forms; some examples relating to the ARs above are included below:

AR1: How can HQ Alpha improve the timeliness of its intelligence cycle?

AO1: Identify the timeliness needs of different intelligence requirements.

AO2: Study the current intelligence cycle with a view to identifying coherent actions that will improve its timeliness.

Sub-AO2.1: Examine the impact of the process used on timeliness.

Sub-AO2.2: Examine the impact of the organisational structure in place on timeliness.

Sub-AO2.3: Examine the impact of the available technology on timeliness.

AR2: How can NATO improve its interaction with PfP[5] and Contact Nations in order to assist these Nations in supporting NATO operations?

AO1: Identify PfP and contact Nations' needs with respect to supporting operations.

AO2: Recommend means by which NATO could improve its interaction with PfP and Contact Nations.

Sub-AO2.1: Review NATO's current approach to meeting the PfP and Contact Nations' needs, including the content of NATO's policy and doctrine and its use of technology for communication.

Sub-AO2.2: Identify security constraints that would need to be overcome to improve communication and how this could be achieved.

AOs should be tangible, that is, when you read them you should be able to imagine the form that an answer will take. A good AO must also be clear, demonstrable and achievable according to the following descriptions.

- Clear: The AO should clearly state what the analysis will address and what the analysis task will accomplish.

[5] Partnership for Peace

- Demonstrable: The AO should state the need in such a way that it is possible to test a hypothesis based on theory, reasoned argument or empirical evidence. It must be possible to prove or disprove these hypotheses through some form of qualitative and/or quantitative measurement.
- Achievable: Whether –
    - Overall workload is broadly in line with the available manpower resources.
    - The travel and any specialised equipment requirements (e.g. communications equipment, laptop computers, personal digital assistants, measurement instruments, etc.) foreseen in support of the AOs are broadly in line with the available budget.
    - Subject matter experts (SME) are available to assist in the observation and analysis processes as required.
    - The necessary data can be collected, and the analysis needed to support the AOs is possible within the timeframe available.

You must have an understanding of the topic you have been asked to analyse and a great deal of analysis experience to reliably determine whether your AOs are good. It is strongly advised that you consult an experienced analyst for help at this point.

START BUILDING UNDERSTANDING

You should start to build your understanding of the topic through preparatory data collection and research. Data collection can be *active* or *passive*. Much of your data collection in this phase will be passive as you are still building an overall understanding of a topic area rather than collecting data to directly meet the AOs. Towards the end of this phase, your data collection will become more active as you start to address your AOs through executing aspects of your data collection plan that can be completed without deployment.

A key part of building your initial understanding, often underestimated in terms of its importance and the effort it requires, is to conduct a critical review of the reference material. You should look for and assemble any relevant reference material, and carefully review and annotate it for relevant information. SMEs are another useful source of information during this phase.

HELP IS AT HAND

Throughout this phase, a professional analyst can advise you on what analysis can and cannot be done and help to ensure that the AOs you come up with are both demonstrable and achievable. They can help you to avoid AOs that might pre-dispose you to doing evaluation rather than analysis, such as statements that have a "*yes*" or "*no*" answer or merely require going through a checklist.

They can also advise on your team composition (suggested roles to cover are detailed in the next chapter) and what deployment you may need to do to collect the data you need: All things that will go into your Analysis Project Order in the next phase.

3
Analysis Preparation

The second phase of analysis is characterised by an intensive period of data collection that will increase your understanding of your topic, allowing you to make a detailed plan for your analysis and ensure that you are able to make the most of any data collection opportunities you may get during deployment.

This phase occurs between developing the initial understanding of the analysis need and deployment to an operation, exercise or experiment. However, much of the data gathering and thinking you completed when clarifying the need will contribute to this phase and elements of this phase will continue throughout the deployment phase and into your post-event analysis.

During this phase you will develop plans regarding how your analysis will unfold. You will develop a list of questions that you want to find answers to. These will help you to establish exactly what you need to do in your analysis and let you write an analysis plan and associated data collection plan. SMEs should be consulted to ensure all of the issues they are aware of are considered during your planning. These activities are shown in together in Figure 5.

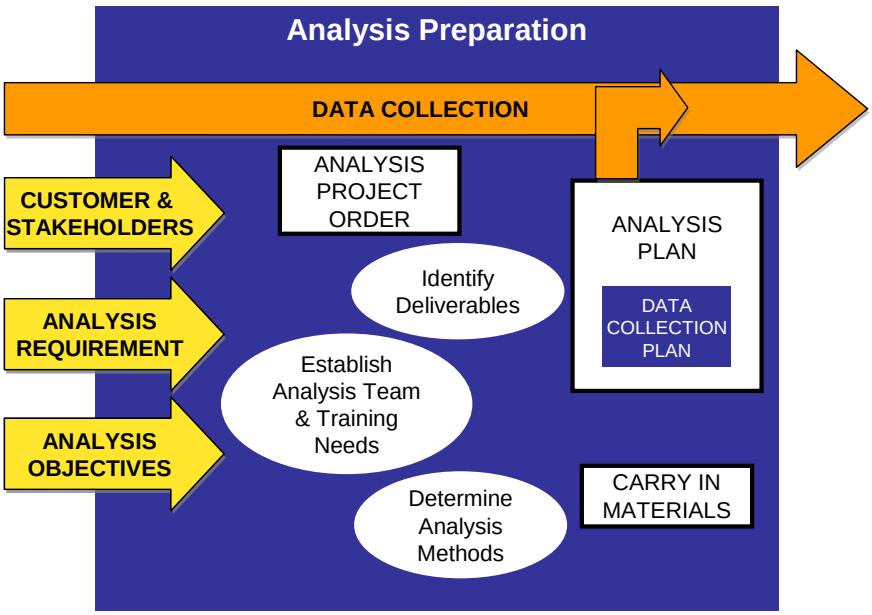


Figure 5 – Analysis Preparation Overview

In this phase you will also prepare any carry-in

materials that you will need to take with you during your deployment and will start to execute the part of your data collection plan that you can do from your home base.

At the end of this phase you will have a good understanding of the environment from which you are about to collect and subsequently analyse data. You will be confident that your background knowledge will hold credibility at the event and be well prepared to collect appropriate observations and data.

THE ANALYSIS PROJECT ORDER

Your *Analysis Project Order* is the main tool for controlling your analysis project. It states the composition of the analysis team, gives a broad indication of any deployment arrangements that will be necessary to support your analysis and gives a description, with due dates, of any *deliverables* that your analysis will provide to support your customer and stakeholder needs.

Your *Analysis Project Order* needs to be published as early as possible, in some cases at least 60 days prior to any deployment to meet national requirements. It is unlikely you will have a completely clear idea of exactly what data you need to collect this long before you deploy; however, you should be able to make a reasonable estimate of how many people you will need to deploy and which units/locations they will need to be in and when. By this point, you should also know what meetings and decisions your analysis will be used for, thus establishing required milestones on your analysis project timeline. You should include a list of deliverables in your order stating what they will be, when they are due and what they will be used for (if known). More advice on writing an *Analysis Project Order* can be found in Part 2.

ESTABLISH ANALYSIS TEAM AND TRAINING NEEDS

All analysis projects require three types of expertise for success.

- Domain/Subject Matter Expertise to help guide the identification of the proper questions that need to be answered and to help make sure your analysis remains true in the realities of the domain.
- Analysis Expertise to provide guidance on possible collection and analysis tools that could be employed to achieve the objectives as well as to help make sure your analysis stays on course with respect to achievability and demonstrability.
- Direction and Leadership Expertise to keep the project on track (time-wise as well as customer-wise) and to ensure coordination across the overall project as well among sub-teams (particularly when there are multiple AOs).

What is critical is that all three of these areas of expertise be brought to bear throughout your project. You can think of them as a 3-legged stool that your analysis project is sitting on, if any single leg is missing, it will fall over and you project will fall down too.

While the above are the underlying skills that you need in your team, you need to plan to use these skills in the following roles. The roles may all be satisfied by a single individual or may require a number of individuals. The size of the analysis team will generally depend on the complexity of the analysis task and the resources available.

- Project Manager: Takes overall responsibility for delivery of the analysis. In particular, is ultimately responsible for the contents of the final report and ensuring that the analysis is delivered on time and according to the customer's expectations for the nature of the end product.
- Data Collector/Observer: Collects data both passively and actively from a number of sources. Is likely to deploy to an operation, exercise or experiment to collect data.

- Analyst: Will analyse the data collected and pull them together in such a way that the AOs are met.
- Report Writer: Puts analysis into written form suitable for NATO publication.

There are also a number of advisory roles that should be augmented to the team if they do not already exist within it:

- Subject Matter Expert: Ensures analysis is set up and interpreted sensibly based on expert knowledge of the situation under consideration.
- Reach Back Support: Will remain "at home" to provide independent advice and support during the deployment.
- Professional Analyst: Provides advice on AO formulation, hypotheses development, analysis tools and techniques, data requirements and logical structure and flow of arguments presented in Analysis Reports.
- Editor: Ensures consistency of style and overall written quality of final analysis reports.

Once you have a clear idea of what your team looks like and what skills your task requires, you may find that your team members require certain specialised analysis training, such as training in the use of NATO's Observation Collection Program, in order to be able to fulfil their roles. This training should be planned for and undertaken prior to deployment.

IDENTIFY DELIVERABLES

Make sure you state in your *Analysis Project Order* and *Analysis Plan* what you will deliver from your analysis, to whom and when. Do not offer to provide recommendations before you finish the analysis, as it is impossible to ensure you are providing the right advice on incomplete analysis. Instead, interim deliverables should be lists of observations accompanied by discussion about the ongoing understanding that is building. Your interim discussion will often be enough to prompt any informed customer into action based on their own judgement and expertise, without the potential embarrassment that an ill-informed recommendation may cause. The *Quick Look Brief* described in the Bi-SC Directive for LL (Reference A) is an example of an interim deliverable that the JALLC may produce.

DETERMINE ANALYSIS METHODS

The analysis methods describe exactly how you plan to meet the AOs in the given timescales. In other words, how will you process your data in a way that will allow you to draw overall conclusions? For each AO you should:

- List the hypotheses that will be tested or the questions that must be answered.
- Outline the analysis methods that will be used to test the hypotheses or answer the questions.
- List the data required to support each AO along with where and how these data may be acquired.

More details about what you will do during the rest of your analysis are presented later in this part, particularly in the *Post-Event Analysis* chapter. A professional analyst will be able to advise you on the different analysis methods available to you and on the strengths and limitations of those different methods. Some useful analysis methods are outlined in Part 2.

THE ANALYSIS PLAN AND DATA COLLECTION PLAN

Your detailed *Analysis Plan* helps you to gather your thoughts about exactly what needs to be done, by whom and when. It is here that you will acknowledge the requirements of your customer and stakeholders, define the roles and responsibilities

of your analysis team members and any training they need, outline the methods you intend to use and establish exactly what data you need to collect both at home and on deployment. This way your plan serves as a record of all the things you established during your analysis preparation phase.

Your *Data Collection Plan* is a sub-plan within your *Analysis Plan* that helps you to make the most of your data collection opportunities. It establishes exactly what data needs to be collected and how you intend to collect your data. It should fall out of your Analysis Methods section. You need to establish which of your data requirements can be met through home-based data collection, which you need to meet during deployment to an event and whether any of the data requirements have already been met by previous studies or routinely available data.

You should contact those in charge of the event to which you will deploy, including sending them the Analysis Project Order, fine at the earliest opportunity in order to establish what opportunities there will be for data collection and, if possible, to work some additional opportunities into their plans. Part 2 gives some guidance on liaising with exercise controllers to get special arrangements introduced into the exercise to meet your specific needs. Usually it will not be possible to influence the activities in an operation to suit your analysis needs.

There will often be numerous logistical problems during deployment that will impede your data collection. Building a detailed plan of how you will collect data during your deployment is important—it is likely that you will get only one chance and you need to make the most of it.

THE CARRY-IN MATERIALS

Carry-in materials are things that you need to take with you to the event that you are deploying to. You are likely to require four main types of carry-in materials:

1. Briefs about what you are doing and why you are there.
2. Pre-prepared questionnaires, surveys, and interview questions and observation collection set-ups.
3. Special software, tools or technical equipment.
4. Background and reference material that may not be available at the event.

It is very likely that you will be asked to brief on why you are at the event and what you will be doing while there. It is essential to make it clear in your briefs that you are not there to evaluate but to look for evidence to support improvements in the way that NATO works. Preparing these briefs prior to deployment saves valuable time when you are deployed and gives you an opportunity to get help and guidance from your professional analysts, SMEs and your higher command.

For *Joint Analysis* projects, data collection during deployment will probably be by questionnaire, survey, observation or interview; however, quantitative data (e.g. number of emails sent each day, use of tools available to staff, unit location, etc.) may also be collected by automated methods. In many cases you will be able to prepare for these in advance. You can write your questionnaires, surveys and interview questions as soon as you know what you want to get out of them. You can also set up a framework in which to collect your data, by categorising it or organising it in a way that makes sense. The *Observation Collection Program* software, databases or spreadsheets can help with this or you may simply prepare standardised data collection sheets for your data collectors to fill in.

4
At the Event

This phase in your analysis has clear start and end points that correspond to the start and end dates of your deployment. This phase is often thought of as involving purely data collection, but in fact it involves much more. You must respond to changes that will affect what you can collect and regularly check what you have collected to ensure that you are getting what you need. It is your last chance to build up your confidence in the understanding that you started to build with your preparatory data collection. There are not always second chances and it is not easy to get it right but whatever happens, attending the event will always help with your analysis.

To avoid losing focus during your deployed data collection, arrange regular liaison with your team to discuss what you are finding. End-of-day meetings to discuss each team member's work can be crucial to identifying areas for further research and observation in upcoming days and provide ongoing feedback for thoughts and ideas. If you are the only one deployed to a particular location, use other members of your team or Reach Back advisors to help you remain focused on collecting what is needed. Do not forget to review your progress against your plans and your AOs. You will often be asked to provide regular updates on your work during your deployment. When you prepare these updates, use the opportunity to put your thinking in order.

The most common mistake during this phase is to slip into "evaluator" mode. This is very easy to do, as you will see plenty of things happening in your area of expertise that warrant evaluation. But this is not your role and focusing on these things can result in you returning home with a list of problems and successes without gaining any real understanding as to why they occurred. Things you record if you slip into "evaluator" mode may highlight areas where you need to do analysis to meet your AOs, but they may also distract you from the task at hand. Be aware of this.

Try to refrain from making recommendations during updates at the event. At this stage you can really only be confident in reporting your observations and your thoughts on the reasons for them and their implications. Ultimately, the understanding you build during your regular reviews, combined with your pre-

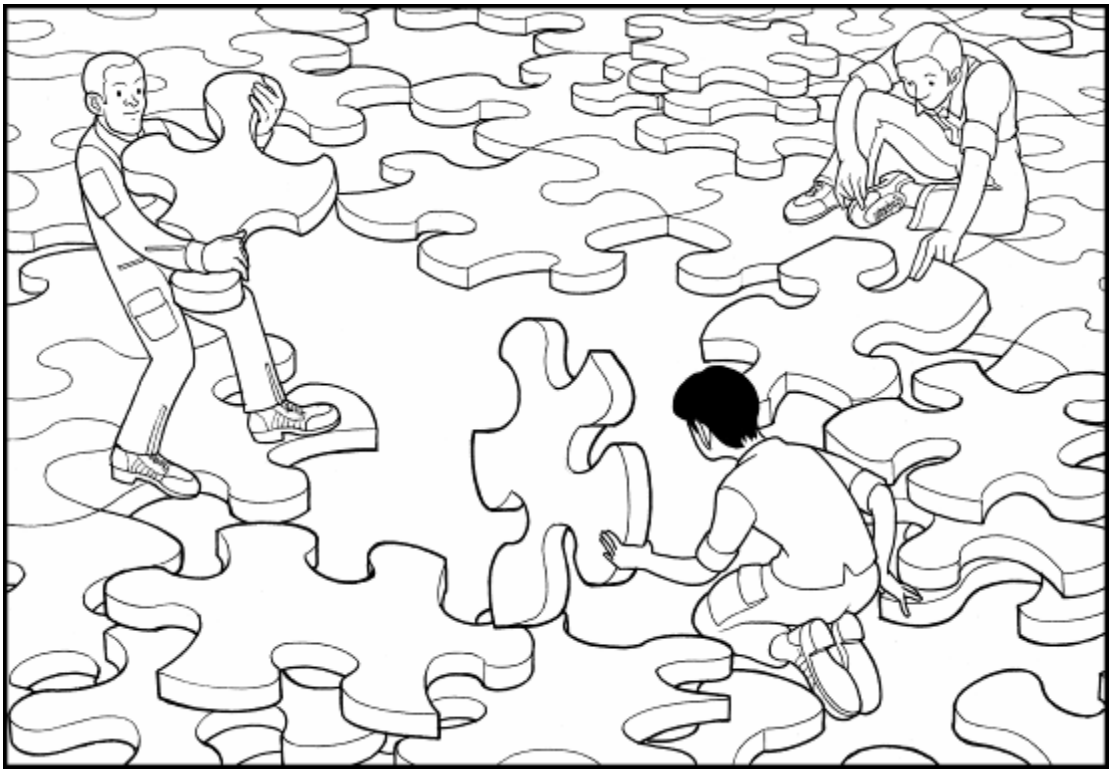
deployment preparation, will give you a good basis from which to conduct your post-event analysis.

There are a number of factors that will further complicate your deployed collection. Military events are far from ideal places to collect data. Often you will find yourself trying to collect in an uncomfortable physical environment. It is likely that the situation will change and you should be prepared to continually adapt your plans.

During this phase you will spend a lot of time trying to gather information from individuals, either through observing them at work or asking questions. This can be frustratingly difficult. It is essential to realise that the individuals from whom you demand time probably do not have the same priorities as you and may not realise what you are trying to achieve. Consequently, support to analysis is likely to be low, if not last, on their list of priorities. You should expect some resistance and perhaps some suspicion from these individuals when you request their time or assistance. You will often need their help on more than one occasion during your deployment so you will need to encourage them to choose to co-operate. Otherwise, someone you managed to speak to once is unlikely to make themselves available a second time. Your carry-in brief should be designed to encourage cooperation.

There are many tools and techniques available to assist you in your data collection task. More details on these can be found in Part 2.

5
Post-Event Analysis



The Post-Event Analysis phase is characterised by its focus on analysis, but this is not the only time that you will do analysis during your project; nor is analysis the only activity you will do during this phase. It is true that after the event you will have a specific period of time allocated for “analysis” but in reality, you should have conducted much of your analysis prior to this time. Your post-event analysis should focus on pulling together all of your earlier understanding and analysing the data you have collected so far. You may also find you need to do some extra data collection or can start writing some sections of your report during this phase.

This is one of the most creative and challenging phases and it is easy to stop at partial solutions rather than persevering and seeing them through to a complete, robust analysis. It is critical that you refrain from falling into the “evaluator” mindset. It is not enough to just generate results, you need to interpret them and sum them up. Imagine going to a doctor who only tells you your test results but not what they mean or what to do about them. You would not be very pleased. As an analyst, your customer is like your patient. They expect you to use your expertise to interpret your results and help them understand what to do next. When doing analysis (rather than evaluation) your aim is to find out **why**, you should not be satisfied to merely identify **what**.

The key elements of analysis are shown in Figure 6. During this phase, you need to work through **all** of these elements, constantly bearing in mind your ultimate aim.

There is a loose order in which the analysis elements should be completed, starting with *Organise* and working clockwise to end with *Summarise* but as your understanding develops, you may find the need to revisit steps you thought you had finished or to jump forward before you return to the step you were attempting. You should constantly review your progress towards your aim. Note that generating *recommendations* is not an element of analysis. Rather, any recommendations should fall out of your analysis as you identify the root causes of observations.

Figure 6 – Key Elements of Analysis

During this phase you break your data apart so that you can see what is really going on. Only once you have done this can you start to put it back together to tell the true story. This can feel uncomfortable but there is no need to panic. When you first break your data out, they will probably look something like a teenager's bedroom, a mess, but then, as you spend time looking at them and working with them, you will start to notice two socks that match or some kind of order to the CD collection. Eventually you will start to see all of the trends that seem so obvious to the teenager. Bringing together this mess into a new understanding is where the real value of analysis lies. **Error! Reference source not found.** illustrates this concept.

The rest of this chapter describes what each element of analysis involves and how your recommendations fall out.

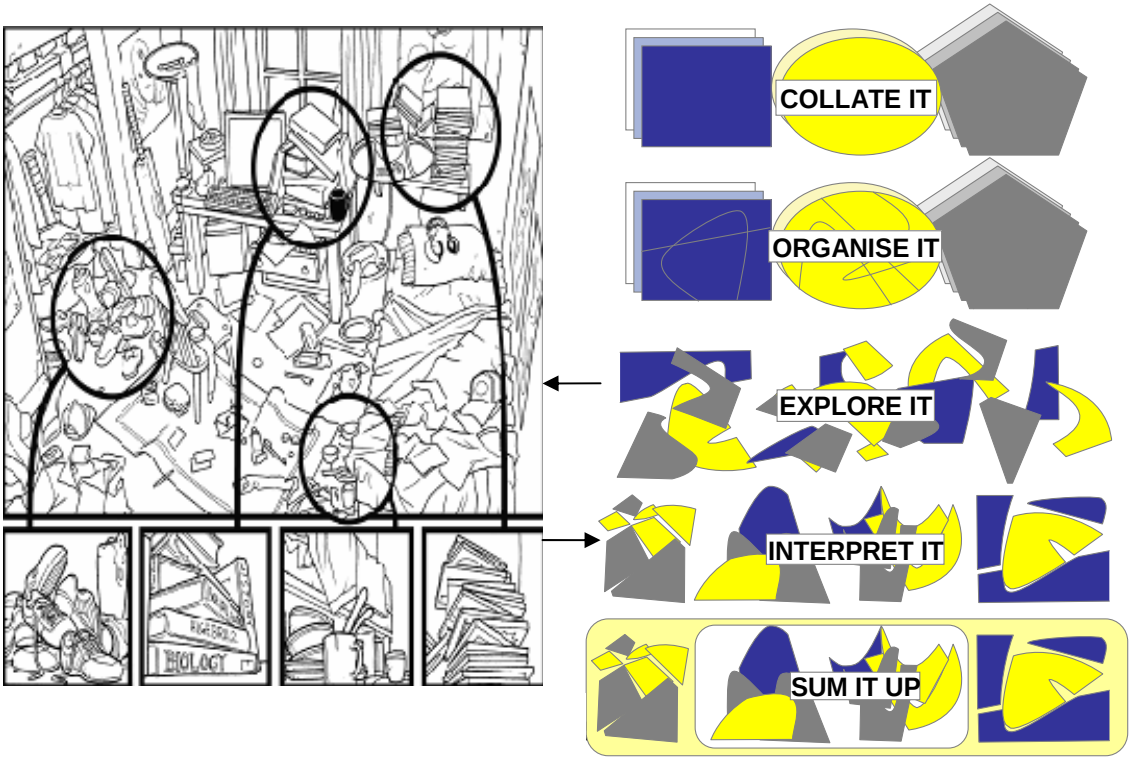


Figure 7. Finding the order in the system

ORGANISE

The first step in your analysis is to figure out what data you have collected. You need to start sorting out your data, putting them into some type of order; otherwise they will be completely unmanageable. If your data are disorganised, you cannot possibly know what you have and what you do not have; you will miss any trends in them and you cannot be confident in their quality. Organising your data will help with your initial analysis and prepare you for further analysis.

A good start when organising your data is to build an index of your data sources and record extra information about each of them that may help to explain what they contain. This will help you to remember what you have got and retrieve it easily later. The extra information you record may provide some explanation of the trends and anomalies you observe between your data sources during your exploration. Some examples of extra information to record in your index are in Table 2.

Table 2 - Extra Information to Record

Extra Information to Record	Why record this?
When it is from	Earlier data may contain different values than the same data collected later on, especially if the operational situation changed between the two collections
Where is it from	Whoever recorded the data will have put their own ideas into them as well as the official word. Interview answers will be influenced by who was being interviewed and who was doing the interview, especially based on their expertise and training and the job they were trying to perform. Different units will have different experiences that shape the way they do things.
What is it about	You will find your exploration easier if you note which of your data sources relate to which AOs, hypotheses or questions.

It is likely that your data will start all mixed up within each source and in a variety of formats that are not easy to compare or perform statistical analysis on. In order to see exactly what is in your data, it is handy to put it into a common format. Again, as you reformat, it is useful for later if you mark your data with which topic they relate to, if they seem to support or disprove your hypotheses and which questions they might help to answer. Some common formats to use are listed in Table 3.

Table 3 - Common Formats for Data Organisation

Format	Useful when
Annotated Paragraphs	Textual data are clearly structured but key points need to be extracted, e.g. published documents
Mind Maps	Textual data are loosely structured and key points need to be formed through re-organisation, e.g. interview transcripts/notes
Spreadsheets	Numerical data are required to generate statistics or charts, e.g. questionnaire responses, measurements
Databases	Vast numbers of data points have similar structure, either text or numeric, e.g. repeated observations

EXPLORE

Once you know what you have available to you, you need to start figuring out what it is showing you. Exploring your data items may involve putting them in different piles, running statistical methods on them, creating different models or representations of them; all so you can start to see patterns and trends. In certain respects, this is not too different from exploring a new neighbourhood, including occasionally getting lost.

In a new neighbourhood, you are looking for things of interest and trying to find how you can get back to them next time. In exploring your data you are also looking for things of interest:

- This measurement is always high except on Wednesdays;
- Most people asked agreed strongly with the statement;
- Nobody in unit A seemed to have the foggiest idea what was going on!

Finding out what caused those things of interest tells you how to repeat them, or more likely with LL analysis, avoid them next time. To do this you must look for causal relationships in your data like:

- On Wednesdays there was always a one hour power cut, the thing measured needed power;
- The few who did not agree strongly, agreed weakly so we can be pretty confident that everyone from this background agrees with the statement. However, the weak agree-ers were less experienced than those who strongly agreed so maybe it is not as true for less experienced staff;
- There were no written instructions provided to unit A. Other units knew what was going on and they had all received written instructions so the key seems to be provision of written instructions.

There are a vast number of tools and techniques you can use to assist with your exploration. You should have already decided on some useful tools during the planning of your analysis in the analysis preparation phase. Now that you have all of your data, it may be worthwhile contacting a professional analyst for further advice on what it may be possible to do.

One of the simplest ways to find trends and anomalies is by visual inspection of your data. Use the notes you made when you organised your data to look at them in different ways that allow you to see emerging trends by AO, hypothesis or question. There is a lot of value in this technique but it is easy to miss something or put your own bias on it using this method alone. Part 2 contains details on some additional tools and techniques that can be used to further investigate the trends and anomalies you find in your initial inspection.

Anomalies you spot are potentially your most enlightening results but there are two obvious traps to avoid when you find an anomaly:

1. Getting so excited at the result that you forget to check the evidence behind it thoroughly.
2. Being so certain of the trends you have found that you immediately dismiss any anomalies as errors or as something so event specific that it can be ignored.

Either way, when you find an anomaly, make sure you check your evidence carefully, look for other supporting or disproving evidence and consult an SME to get an independent opinion of what might be going on. Remember, you need to be completely confident in the results that you present.

At the end of your exploration, you will have a number of results that you then need to interpret.

INTERPRET

Interpretation entails drawing conclusions based on the results of your data exploration. In order to draw conclusions you must have a thorough understanding of what your results imply, both within the context of the event you were involved in and more widely across NATO. Your conclusions should provide a concise summary of what your results tell you.

Your SME and professional analyst can help you draw conclusions. The analyst is experienced in taking a muddle of results and grouping them together in such a way that conclusions can be drawn. Your SME will make sure that you have not missed some obvious explanation for your results that you could only know about if you were an SME. Together, they can help you to draw logical and sensible conclusions from your results.

Start by drawing conclusions relating to your initial questions and hypotheses. You should be able to state whether the evidence supports or disproves your hypotheses. Then look for additional conclusions emerging from your exploration.

Be careful to check that each conclusion you make is well supported by the data. You may find that you need to collect more data to ensure this or you may find that you have to weaken your conclusion to make it consistent, e.g. change the word “will” to “may”. A conclusion that cannot be supported by the data is not a valid outcome of analysis.

Note that conclusions are not recommendations and should not be a statement of what should be done. They are statements that enlighten someone as to what the real issues that need to be dealt with are and may outline the pros and cons of different solution approaches.

SUMMARISE

The last step in the post-event analysis is to articulate where you are—where all of this analysis has taken you—to summarise your verifiable conclusions.

At this point you will have a number of conclusions relating to your hypotheses, sub-AOs or questions that you asked. Your intention was always to build an understanding of each of these to help you to answer the overarching AO. Now is the time to bring it all together into an overarching summary.

It helps to use some of the brainstorming techniques scattered throughout Part 2 with your whole team to discuss how your conclusions relate to each other and combine to give you the overall understanding that your customer requested.

KEEP FOCUS

During this phase, always keep in mind what you are supposed to be looking for: keep your AOs in mind; review your hypotheses; ask yourself:

- What am I trying to achieve by studying the data?
- What answer is needed?
- What hypotheses do I need to test in order to get this answer?

Regularly stop to review your progress and this will help you to avoid panic and to maintain focus in your work. Do not forget that you are working to complete AOs and ultimately meet an AR. You may not have looked at your AR and AOs for a while, but they are still your ultimate goal. If for any reason you find are not able to fulfil your AOs, make sure you have clear justification for why this is the case.

RECOMMEND

Finally, now that your analysis is complete, you may be able to make recommendations based the conclusions you reached. Recommendations must say what to do and not just what effect needs to be achieved. “*You need to keep the tea hot*,” is a statement of the effect needed; it does not say what needs to be done to achieve that effect. If your recommendations look like the problem restated as a solution then you may have fallen into the “evaluation” trap, where reporting the problem is the requirement. This is not enough when you are doing analysis. You should have learned enough from your analysis to be able to recommend to the customer one or more potential courses of action that will deal with the issue by

addressing its fundamental causes. In some cases you may also be able to recommend an action body to take responsibility for completing the course of action.

Examples of good and bad recommendations in relation to a hypothetical issue follow:

- Hypothetical Issue: LL Analysis is sub-standard.
- Bad Recommendation: People should do their job properly.
- Good Recommendations: LL analysis officers should be given more training in analysis methods. LL analysis officers' job descriptions should specify professional analysis qualifications as a minimum requirement.

Often it will be appropriate to provide a selection of recommendations for an issue since the choice of which recommendation to proceed with may rely on factors outside of the scope of your analysis and should be firmly left to the customer. In these cases, you should provide the customer with enough information about the pros and cons of each recommendation for him to make an informed choice on which course of action to take.

Finally, you want NATO to learn from your analysis and so your recommendations need to focus not only on how to fix the problem at hand but also on how to prevent the problem occurring again, possibly in other situations. Think about what needs to be done in the short-term, mid-term and long-term. These may be quite different. Look for solutions across the DOTMLPF-I lines of development (see Part 2) to make sure you have considered every possible option for a robust solution. For example:

- Result: Doctrine in area A is out of date and causing problems with execution.
- Recommendation: Update doctrine in area A **and** Review doctrine in related areas for relevance **and** Put in place regular review cycle for doctrine in these areas.

6
Reporting

The result of all of your analysis effort to date is a thorough understanding of the situation and hopefully the answer required to meet the AR. But now what? You could sit there smugly gloating over your new understanding, or you could try and do something useful with it.

When writing for your customer and stakeholders, you need to remember that you are almost certainly going to have a deeper understanding of the problems and issues than they do. Having spent months acquiring your understanding of the topic, getting it out in a way that makes sense to someone else is not easy. However, it is essential that you are able to communicate your deep understanding of the subject effectively. Producing analysis products is one way to do this.

Analysis products may take many forms, from detailed Joint Analysis Reports to Quick Look Briefs/Immediate Value Reports or entries in a LL database or spreadsheet. Useful analysis products will satisfy the AR in an easily understood and timely manner.

You should always plan to produce at least one analysis product to meet the AR and communicate your understanding to your customer. You should have been thinking about the structure and contents of this product from the very beginning of your analysis.

In addition, you may wish to or be required to produce other analysis products to answer additional questions that may be more relevant to others. You may be approached with a question, or more often you will have found something unexpected that nobody will ask for, as they will not know exactly what you have discovered. As a responsible analyst you should make every effort to ensure that your insight and understanding reaches the people who can really make a difference using the results obtained.

Regardless of whether an analysis product is planned from the start of your analysis or is an emergent requirement, it should always be prepared keeping the audience in mind.

JOINT ANALYSIS REPORTS

There are three main issues to consider as you write your report.

1. Who is your audience?
2. What points do you need to get across to this audience?
3. What is the best format to use to get these points across?

The first and second issues are related. The first is important because anyone writing a report that is unreadable by the target audience may as well throw their work away. You need to write it using terminology and language that will make sense to the reader. In other words, you have to translate the findings from analytical language into military language in a way that will keep the reader's attention and not result in any misunderstandings. This is easier said than done and will usually require that you rephrase your main points (the second issue above) several different ways until you can get your points across so your audience not only understands but will want to help move these from the lessons identified status to lessons acted upon and learned.

Writing an analysis report is analogous writing an academic essay or research paper. Your analysis objective is the essay question, and your answer will involve a thesis which back up with evidence. You should present your evidence in a logically structured argument and, like a lawyer presenting a case, you should provide evidence to address any relevant objections or counter-arguments. A clear and logical report will have the greatest impact.

The third issue concerns the actual look and feel of the report itself. There may be a generic template for reports at your organisation[6] that provides guidance on the report's structure and format. These templates should be flexible enough to allow the report to capture the essence of the results and not try to force your results into a predetermined structure when it does not make sense to do so.

LLDB ENTRIES

Sometimes it is appropriate to write up your analysis in the form used in the Lessons Learned Database (LLDb). You may have findings in a Joint Analysis Report that meet the criteria for entry into the LLDb and may be included in the report in the exact format they would take in the LLDb. This is also a simple and convenient format for presenting certain detailed analysis results.

NATO LLDb entries must be formatted using the following headings:

Title: A short but explicit statement encapsulating the essence of the lesson in such a way as to give a reasonable indication of content

Observation: The observation is a summary of what prompted an analysis. The observation can describe a success (best practice) or a failure (problem) and should be limited to one theme. To be valid, it must be a statement of fact.

Discussion: The discussion provides evidence that supports the validity of the observation and then goes on to discuss both the reasons why the observation occurred and the consequences of the observation (be they positive or negative). It also considers the pros and cons of different recommended courses of action.

[6] JALLC uses an Analysis Report Template, which is available to other organisations on request.

Conclusion: The conclusion is a summary statement that describes the overall issue raised by the observation and discussion. It follows logically from the different aspects developed in the discussion.

Recommendation: The recommendation(s) follow logically from the discussion and conclusion and provide actionable advice on what must be done to repeat the success or to avoid the problem in the future. Ideally, an action body will also be proposed with any recommendation.

7
What Now?

So, you have completed the analysis: what now? Hopefully all of your efforts will make a difference, an improvement to NATO. You may not realise it, but you will already have made a difference. Your negotiation with the customer over their real requirement at the beginning will have helped them to understand the situation a bit more. Your interactions with others both at home and on deployment will have helped them to also understand the issues better. In fact, people you have interacted with during the course of your analysis may already be starting to make changes based on the issues you brought to their attention. In addition, there are formal routes for action based on LL Analysis.

The Bi-SC Directive for LL (Reference A) explains the process by which recommendations from Joint Analysis Reports and the LLDb can be assigned to an action body that will ultimately take responsibility for developing and implementing agreed action plans. Action will also take place at a local level. Analysis products will be distributed widely and, where strategic level intervention is not required, commanders receiving analysis products will implement their own improvements based upon them.

However, publishing your analysis report and products is not the end of it all; your responsibility continues in three ways.

Firstly, you hold a vast amount of understanding and knowledge above and beyond what you were able to convey in your analysis products. Expect people to contact you asking for more information to help them to make their decision on whether and how to act. This again is why it is so important that during your analysis you build your confidence in your findings as much as possible.

Secondly, remember, analysis does not make decisions; it merely provides understanding and information to assist in making them. You need to find out what difference your analysis has made by going back to the customer and the people you

worked with at a later date. It is suggested that you do this approximately six months after the publication of the report to review what progress has been made against the points that were raised. This will not only allow NATO to measure the value of its analysis capability but also give you a warm, fuzzy feeling that you have done something useful.

Finally, you need to review what you learned about doing analysis during your task. What worked well? What did not work? Did you learn any lessons of your own that you can share with the NATO analysis or Lessons Learned communities to help everyone improve their future analyses?

Analysis to support the NATO LL Process is part of a continuous cycle. There are always new opportunities arising where analysis could be used help NATO to understand and improve.

Congratulations! You are now well along the way in your training as a LL Analysis Staff Officer.

Joint Analysis Handbook

Part 2
Tools and Techniques for Joint Analysis

1 Introduction

This part of the Joint Analysis Handbook will guide you, step-by-step, through some key parts of your first analysis. It is presented as a series of easy to follow 'How to…' guides offering a straightforward approach to completing your early analysis projects and a valuable reference for the future.

The 'How to…' guides are snapshots of how to use the analysis techniques in your analysis toolset for particular activities within joint analysis. As you become a more experienced analyst, you will become more familiar with the contents of your analysis toolset and will probably want to look up how to do a particular technique rather than following the guides in the order presented here. An index of the analysis techniques covered with their related set of 'How to…' guides is provided at the end of this section for this purpose.

While this part will allow you to satisfactorily complete your early analyses it is no substitute for analysis experience. You are always advised to discuss your work with others and preferably other experienced analysts whenever possible. This will always improve your work, no matter how experienced you are yourself!

The ‘How to…’ guides are as follows:

2. Clarify the Need – How to…

2.1 Start building understanding

2.2 Pin down the Analysis Requirement (AR)

2.3 Develop hypotheses

2.4 Split up your analysis

2.5 Develop Analysis Objectives (AOs)

2.6 Influence the design of an experiment or exercise

3. Analysis Preparation – How to…

3.1 Manage analysis project files

3.2 Write an analysis project order

3.3 Write an analysis plan

3.4 Build a data collection plan

3.5 Prepare interviews

3.6 Prepare questionnaires

4. At the Event – How to…

4.1 Arrange and conduct interviews

4.2 Administer questionnaires

4.3 Make in-theatre observations

4.4 Record your in-theatre data collection

4.5 Review your ongoing work

5. Post-Event Analysis – How to…

5.1 Write up initial observations

5.2 Diagram your data

5.3 Prepare your data for basic data analysis

5.4 Do basic data analysis

5.5 Recognise the need for advanced data analysis

5.6 Recognise the need for mathematical modelling

5.7 Review and refocus your analysis

5.8 Derive recommendations

6. Reporting – How to…

6.1 Write Joint analysis reports

6.1 Construct a logical argument

6.2 Write LLDb entries

6.3 Proofread and incorporate improvements

2
Clarify the Need

2.1 HOW TO... START BUILDING UNDERSTANDING

WHY DO IT?

When you are initially faced with a new AR, you will need to update yourself on the current situation regarding the topic you have been asked to analyse. Good background knowledge of your analysis topic will give you credibility with your customer during discussions on the AR and Analysis Objectives and reduce the risks of accidentally planning analysis that duplicates or conflicts with previous or ongoing work.

WHAT IS REQUIRED?

A proposed AR or suggested topic area.

WHAT WILL YOU GET?

Enough understanding of the topic you will be analysing to intelligently negotiate the customer's AR and your AOs and to envision how your analysis will unfold. A list of potential stakeholders.

STEP-BY-STEP

Gather relevant information

All reference information relevant to the analysis topic should be identified and gathered. Available information may include:

- Planning documents and guidelines.
- NATO or Multinational doctrine, publications and manuals.
- NATO standardisation agreements (STANAGs).
- SC, Bi SC and JFC directives.
- Documentation supporting the operation, exercise or experiments such as the CONOPS, OPLANs, SUPLANs, EXSPEC, and EXPLAN.
- Standard operating procedures.
- Software/systems to assist in the operational planning or tactical decision process (ADAMS, TOPFAS).
- Previous lessons learned.
- Previous analysis reports.
- Your colleagues.
- Internal libraries.
- Experimental tactics.
- Open-source literature including journals such as the relevant *Jane's* publications.
- Internet.

Many potential data are hidden in unformatted electronic briefings, signals, and working papers. Finding the desired needle in the middle of an electronic haystack can be very difficult if the data set is large. Electronic search engines such as the

Verity engine or *Google Desktop* available on the NATO unclassified systems or the *AltaVista* search engine on the NATO Secret network can help make the process easier by allowing searches on key words.

A useful NATO specific search engine is the *Hummingbird* Document Management System (DMS), located on NATO's HQ Intranet page[7]. This system allows guest users to search through thousands of NATO documents by various criteria—title, publication date, subject, etc—and view documents classified *NATO Restricted* and below. You can submit access requests from within the DMS system if you wish to view higher classification documents. The search feature is somewhat complex and requires practice, but the DMS staff is very helpful and eager to provide assistance.

Once you have assembled the available reference material, you should carefully review the references and make appropriate notes. The notes should include an index of all items relevant to the AOs for ease of retrieval and browsing at a later stage. Techniques such as bookmarks, comments, named ranges and/or hyperlinks are recommended for electronic documentation. Most word-processing software, including *Office* and *Acrobat* have built-in electronic comment and bookmark features. Learn these features and use them—they will make your analysis work easier. Post-It notes are extremely useful for indexing hardcopy documentation.

It is recommended that you maintain an overall index of all gathered reference documentation. One method is to create in the root folder of the reference material an Excel workbook with a simple table using the following columns[8]:

Enclosure Number	Document Title	Author	Date	Remarks	Hyperlink

Alternatively, this can be done in a mind map or a manual system using index cards.

Review gathered information to identify your customer and stakeholders

List the stakeholders for your analysis based on the information you collect during the literature review, your own and your team's expertise. Determine the stakeholders' relationships to each other and the roles you expect them to play during your analysis. Stakeholders may hold one or more of the following roles:

- Beneficiary of your analysis – needed to guide your analysis towards a useful end product,
- Partner in analysis – needed to provide expertise to your team, usually by contributing temporary team members,
- Data provider – needed to provide you with data either proactively or by supporting your team's own data collection,
- At risk organisation – could potentially be disadvantaged or embarrassed by your analysis results.

Map out the relationships among your stakeholders and between your stakeholders and your customer so that you can plan the best way to engage them all in your analysis.

[7] http://hqweb.hq.nato.int on CRONOS.

[8] An MS Excel workbook that will automatically generate an index of links to all files located in a computer folder and its sub-folders can be found in the Analysis Tools section of the JALLC website.

Review gathered information for relevant issues relating to your analysis topic

Relevant issues may be:

- Politically sensitive areas,
- Areas that are currently undergoing change or update,
- Areas that have been analysed before or where LL already exist,
- Different stakeholders' views or positions.

Present this information to your customer so that they are aware from the outset what potential influences exist on your analysis and are able to guide you as to how they would like those influences to be dealt with. For instance, they may ask you to steer clear of a politically sensitive area or they may ask you to focus on updating a previous piece of analysis for their needs. This is not an opportunity for your customer to dictate the results of your analysis, but is merely a chance for him to focus your efforts on the parts of the analysis that will really make a difference and help you to start your analysis with a reasonable set of assumptions.

WATCH OUT!

This is a preparatory task. The completion of this task does not complete your analysis. At this point the focus is on breadth rather than depth of understanding. Your full analysis will develop the depth as required. You are collecting ideas, not throwing any away, you need to be careful not to arrive at conclusions yet—it is too early!

2.2 HOW TO... PIN DOWN THE ANALYSIS REQUIREMENT (AR)

WHY DO IT?

The Analysis Requirement (AR) is the foundation upon which your analysis is built. It is possibly the most critical aspect of your work. You can think of the AR as your requirement for an operation. In the same way that you need to conduct a mission analysis to determine *operational objectives*, you also need to conduct an AR analysis to identify your specific *Analysis Objectives* (*AOs)*. It is the AR that provides the framework from which you develop your AOs. Having a clear analysis requirement can make your life easy, a vague one can make it miserable.

WHAT IS REQUIRED?

A proposed AR, a list of potential stakeholders.

WHAT WILL YOU GET?

A refined AR, a single agreed customer that your final product will be aimed at and enough understanding of the implications of the AR—such as the intent behind it and the planned use of the analysis product—to proceed.

STEP-BY-STEP

Initiate discussion with your customer

Introduce yourself as the analysis project manager to the appropriate people in your customer's organisation. Explain that you need to discuss the AR so that you can understand their analysis intent and give them an idea of what the analysis is likely to be able to do for them.

Create list of questions that you need the customer to answer

You need these to establish their intent. At a minimum you should ask why the customer submitted the AR and what they plan to do with the outcome of the analysis. Preferably, set up a face-to-face meeting to run through these questions; otherwise telephone or email will have to do.

Consider the customer's analysis intent alongside the stakeholder list

Identify which stakeholders you still think may benefit from your analysis. Contact these stakeholders to find out their requirements from your analysis and the role that they would like to play during your analysis.

Set up a meeting

Bring your customer and stakeholders together to discuss the AR. Identify any areas of conflict and try to resolve these at this meeting so that there is no confusion over what you are required to do.

Ask your customer to state their final AR

This is what you developed together during the previous steps.

Review the final AR

Ensure you understand what is needed, that what is needed is neither too prescriptive nor too vague and that you believe you can achieve what is needed. Otherwise, revisit some of the steps in this task to iron out any difficulties.

WATCH OUT!

This task is more complex than most people realise, do not move on until you are completely comfortable with the customer's statement of their final AR. Any confusion or uncertainty at this point could create problems later in your analysis. Getting this task right is the insurance policy that means your customer will support you throughout and that your analysis will be likely to be used.

Is the JALLC the appropriate member of NATO's lessons learned or analysis community to address this request? For example, is it more concerned with a conceptual issue that might be better addressed by SACT? At what "level" is this issue? Tactical/Operational Units or HQs; J(F)C; Bi-SC; the Military Committee; the NAC? Is it more tactical and immediate and possibly best handled at the unit level by the J3/J7?

EXAMPLE

One example of a set of questions that you could ask the customer as part of this task is given in Figure 7.

Analysis Requirements Worksheet Instructions:

This worksheet is designed to help us at the JALLC better address your Analysis Requirement (AR). To do this we need to have a thorough understanding of the thinking that lies behind the requirement so we (you and the JALLC) can craft a viable and meaningful AR that is fully understood by both parties. This worksheet is designed to walk you through three steps:

1. Stating your initial AR as you currently envision it.
2. Asking you to clarify some of the reasons why you see this requirement as being important. In other words, we are hoping to get a better idea of the intent or goals.
3. And finally, having you take another look your initial analysis request and asking you to reword it to make sure it captures all aspects of your intent.

With this level of understanding we will be in a good position to craft an AR that is agreed upon and understood by all and that will more directly fulfil the intent behind your request. We sincerely thank you for spending the extra time to complete this worksheet.

Analysis Requirements Worksheet Questions:

1. Please describe your analysis requirement:

2. Please respond to the following questions:

a. Why is this analysis topic important for you? Why are you nominating it as an AR?
b. What do you hope to achieve with the findings that come out of the analysis?
c. What decisions, judgments or actions do you see the findings being used to influence?
d. What will *you* do with the information/findings we provide?
e. What do you need to find out from the analysis for you to consider it a "success"? What would not be helpful for you (i.e., what do you already know)?
f. Are there any hidden or other agendas behind this analysis request?
g. Will the findings only have an impact within a certain frame of time…are they "time critical?" If so, what is this "window."
h. Are there any sensitive or controversial issues we should know about that, if not handled properly, could result in the analysis becoming discounted? In other words, are there any "minefields" out there?
i. Is there "buy-in" concerning this analysis question…who else thinks it is important?

Please review your initially stated Analysis Request/Requirement from above to make sure it captures your overall intent and goals.

If there are any revisions, please enter your rewritten request/requirement here:

Figure 7 - AR Worksheet

2.3 HOW TO… DEVELOP HYPOTHESES

WHY DO IT?

The *Concise Oxford English Dictionary* defines a hypothesis as:

> *"A supposition or proposed explanation made on the basis of limited evidence as a starting point for further investigation."*

Developing your initial hypotheses will help you to arrive at clear, demonstrable and achievable AOs. In understanding the Analysis Requirement (AR), the customer may have provided you with one or more outline hypotheses that your analysis will need to investigate. You may also have thought of some of your own hypotheses. Your Analysis Objectives (AOs) must be written so that these hypotheses will be tested during the course of your analysis.

WHAT IS REQUIRED?

An AR, a creative mind!

WHAT WILL YOU GET?

Hypotheses that will help you to develop your AOs.

STEP-BY-STEP

Developing a hypothesis involves several steps:

1. Identifying key questions,
2. Identifying variables and the ability to measure them,
3. Identifying Measures of Merit,
4. Formulating the hypothesis.

Key Questions:

The key questions are developed by thinking about what needs to be addressed in the AOs and in light of the reference material review. SME's are valuable in helping you to build your initial set of questions.

Variables:

In order to test your hypotheses you will need to establish what variables are implied by them and how you plan to measure them. In analysis, the term *operationalisation* refers to the procedures or operations used to observe or measure a specific concept. It is the process of translating specific research concepts into observable phenomena that are measurable. These measurable phenomena are termed variables.

A variable is an element, attribute, characteristic or component of the problem or system that can take more than one value. A listing of the variables relevant to the analysis objectives accomplishes several purposes:

- It serves as a guide for gathering the data to address the analysis objectives.
- It can indicate the complexity of the problem and help to determine the methods to be used in the actual analysis.
- It can help to prevent any important elements in the problem from being overlooked.
- It can provide a guide to developing alternative methods of analysis.

There are qualitative and quantitative variables.

Qualitative Variables

Qualitative variables are divided into *nominal* or *ordinal*:

- Nominal: Nominal variables are named categories. For example: gender, male or female (and possibly hermaphrodite!); eye colour: blue, green, brown, and red. By definition, nominal variables are discrete in the sense that there must be a finite number of values.
- Ordinal: Ordinal variables are like nominal variables but there is an inherent order. An example of an ordinal variable is air travel classes: First, Business, and Economy. We know that First is better than Economy but not precisely by how much.

Quantitative Variables

Quantitative variables are variables to which a numeric value can be attached. Variables can be either discrete or continuous. A discrete variable can take on only particular values, usually whole number or integer values. An example of a discrete variable is the number of goals scored in a soccer match; 0, 1, 2, 3 etc., but 1.5 is not possible. A continuous variable can assume any value; for example, temperature can be 30.6754°C, 23°C, etc. Another important distinction between quantitative variables is whether they are *interval* or *ratio* variables:

- Interval: An interval variable has an arbitrary zero value and therefore the ratios between two numbers are not meaningful; what is meaningful is the difference between two numbers. Temperatures as measured on the Celsius or Fahrenheit scales are interval values: 10°C is 50°F and 20°C is 68°F. The difference in temperature (i.e. the interval) is meaningful (10°C or 18°F) but the ratios of the two numbers are not (20°C/10°C = 2 compared to 68°F/50° = 1.36). 20°C is not twice as hot as 10°C.
- Ratio: On a ratio scale, intervals between points on the scale are consistent and meaningful, but the zero point on a ratio scale is not arbitrary and indicates the absence of the attribute being measured. Age, distance, and money are a few of the many examples of natural ratio scales. The Kelvin temperature scale, unlike the Fahrenheit and Celsius scales, is a ratio scale. Its zero point (known as Absolute Zero; 0K = -273.15°C = -459.67°F) is not arbitrary since it is the point at which no molecular activity exists. So 546.30K could be described as twice as hot as 273.15K.

Dependent and Independent Variables

When doing an experiment, the experimenter makes a hypothesis and then carries out an experiment to prove or disprove the hypothesis. Within an experiment, the experimenter varies conditions (the independent variables) and measures the effect (the dependent variables). An example: we hypothesise that drinking beer makes a human gain weight. The experiment would be to take two samples of humans, weigh them, make one group drink 1, 2, 3, 4…8 pints of beer per day (the *treatment*) while the second (*control*) group drinks equivalent amount of water. At pre-determined time intervals, we weigh the members of the two groups. The number of pints of beer consumed is the independent variable while the individual's weight is the dependent variable (because we are assuming that the weight gain is dependent on beer consumption).

It is necessary to think about and define both how to measure each variable of interest and what scales are to be used in the measurement process. The variables that are actually measured or recorded are called *direct* variables.

Variables can be derived from observations or measurements. For example, assume that the analysis objective is to "*determine the effectiveness of a new mine hunting*

sonar"; an important variable is the mine detection probability of the sonar. We cannot measure the detection probability directly but we can determine it by laying a known number of mine targets and then measuring the number that are detected during a single pass by the sonar.

In analysing the relationship between a dependent variable and qualitative independent variable(s), the analyst may need to make use of coded variables (also called dummy variables). Coded variables are transformations of direct variables. An example is the coding of a nominal variable such as sex into 0 for male and 1 for female (sometimes such a variable is called binary or dichotomous because it can only have 2 values). Other times the coding may be such that ordinal data are coded as integer values; for the example of air travel classes, assign 1 to first class, 2 to business and 3 to economy. When coding data this way, consecutive integer values are used.

Measures of Merit:

Measures of Merit (MOM) are a means of providing a quantitative basis for decision-making. The following definitions are used, based on the Code of Best Practices for C2 Analysis (Reference C) [9]:

- Measures of force effectiveness (MOFE), measure how a force performs its mission or the degree to which it meets its objectives.
- Measures of Effectiveness (MOE), measure the impact of a system(s) within the operational context.
- Measures of Performance (MOP) measure internal system structure, characteristics and behaviour.
- Dimensional Parameters (DP) measure the properties or characteristics of the inherent physical system.

The properties required of a MOM are:

- It must be quantitative.
- It must be measurable or estimable from data or other available information.
- A significant increase in MOM value must correspond to a significant improvement in achieving the objective of the decision making process.
- It must reflect both the benefits and the penalties of a given course of action or selection of a system.

At the tactical level, doctrines, tactical publications or associated computer based tactical decision aids sometimes provide the MOM. In this situation, the analysis should concentrate on the parameters required as input to calculate the MOM. During the analysis planning stage, the analyst should conduct sensitivity analyses to determine the important parameters; obviously, the determination of these parameters is of the highest priority during data collection.

Formulate the Hypothesis

The final hypothesis should be testable and simple, and should take the form of: "The independent variable has a quantifiable/qualifiable effect on the dependent variable under specific circumstances." It should also be falsifiable, meaning you can conceive of a circumstance that would disprove the hypothesis.

[9] Note the definitions of MOE and MOP here are very different from the use of these terms in the evolving NATO approach to campaign assessment. Be careful not to become confused and not to confuse your analysis audience. Check with a professional analyst if you have doubts.

With your AOs and associated hypotheses formulated, you now have a good idea what sort of activities you will have to perform, and what kind of data you will need, to prove or disprove them, leading to the next step in the analysis process: Analysis Planning.

EXAMPLE

Overall:

Let us take as an example an analysis objective: "Examine the effect of *using UAVs*[10] *on the Common Operating Picture (COP)*".

We start by identifying the *key questions*. The following questions may be relevant:

1. When are the vehicles available for deployment?
2. When are the vehicles airborne?
3. Where and when are the data received?
4. How are the data processed?
5. How are the data transmitted to the HQ?
6. What is the mechanism for displaying the data on the common operational picture?

Then we establish what *variables* are implied by these questions. Take question 1 for example, variables relating to this question are: % time available, days or times when regularly not available, reasons for unavailability.

Returning to developing the hypothesis itself, the independent variable is the use of UAVs, the dependent is the quality of the COP. The hypothesis would be: "*Using UAVs improves the COP.*" This statement is simple and it is testable, the easiest test being to judge the quality of the COP when UAVs are employed and when they are not. When formulating the hypothesis, you must keep in mind what kind of tests you will actually be able to perform and what limits you may face (you won't be able to actually ride around in a UAV, for example). This may lead you to add qualifiers, such as: "during daylight," or, "when equipped with System X."

Finally, by carefully defining the MOMs, you establish precisely what constitutes an improved Common Operational Picture. This is vital, because in scientific analysis, subjective judgements are not valid. You must have an objective way of measuring the effects you are observing. If you haven't established beforehand what constitutes a good or a bad COP, you will not be able to convincingly state that UAVs have improved it.

MoM:

For example, in Anti-Submarine Warfare (ASW) how well an ASW screen around a military essential unit detects/deters a hostile submarine would be a MOFE. How well each individual unit performs within its allocated sector would be a MOE. How well the individual ASW sub-systems on board the unit (acoustic/non-acoustic detection, classification, etc.) perform would be MOPs, while system characteristics and specifications (such as sonar source level) are DPs.

2.4 HOW TO… SPLIT UP YOUR ANALYSIS

WHY DO IT?

Part of the information you need to develop AOs is an idea of how you intend to break down your thinking during your analysis.

[10] Unmanned Air Vehicle

WHAT IS REQUIRED?

A well defined and understood AR and knowledge of ways of thinking about military activity.

WHAT WILL YOU GET?

A way of breaking down your analysis into manageable chunks.

STEP-BY-STEP

Establish what you need to focus on

Consider your requirement from a number of different perspectives. There are a number of tried and tested ways of describing organisational and particularly military activity that you can potentially use to subdivide your analysis task and contribute to defining your AOs. NATO Tasks List, DOTMLPF and Process/ Organisation/ Technology are expanded below. Others that have been used by the JALLC are: Staff functions (J1 to J9, J Eng), Essential operational capabilities (Reference I), Military functions, Level (political, strategic, operational, tactical), Applicability (frequent, occasional, rare) and Import (mission critical, mission desirable, mission useful).

WATCH OUT!

While you will need to split up your analysis task into manageable chunks, you must not forget to examine the interrelationships between the chunks that you study as these are often the areas where the greatest issues and best improvement opportunities lie.

In any separation of your analysis into individual areas of study, remember to consider how you are going to reunite them in your final analysis.

EXAMPLE

Organisation, Process, Technology, Tasks and Time (OPT^3)[11]:

JALLC experience has demonstrated that the separation of operational level teamwork problems into organisational, process, technology, task and time issues is one of the most effective joint analysis methodologies. The challenge is to capture the dynamic interrelationships and interactions of these issues. Frequently teams fail to plan for these relationships and this provides rich grounds for analysis. Your AOs may focus on all or some of the OPT^3 spectrum and the interrelationships within it.

DOTMLPF-I:

The eight components of DOTMLPF-I are: Doctrine, Organisation, Training, Materiel, Leadership, Personnel, Facilities and Interoperability. DOTMLPF-I is a way of describing the essential elements of capability development. All capabilities can be described in terms of their DOTMLPF-I and so if your requirement is based around a capability, DOTMLPF-I may be the system for you!

Table 4 provides some useful questions to help see things from different DOTMLPF-I perspectives. Your AOs may focus on all or some of the DOTMLPF-I spectrum.

[11] See www.teamdecisions.com for description of OPT, the forerunner to OPT^3.

Table 4 - DOTMLPF-I Questions

Doctrine	Is there existing doctrine that addresses or relates to the issue? Joint? Service? Agency? Are operating procedures in place that are not being followed? Could procedures, at least in part, correct the issue or lessen its impact? If no doctrine or procedures are in place, do new doctrine or procedures need to be developed and implemented which provide either a complete or partial solution to the issue?
Organisation	Where is the problem occurring? In what organisations is the problem occurring? What is the mission/management focus of those organisations? Primary and secondary missions? What are the organisational values and priorities? Does the organisation have the resources (people, equipment, procedures) available and in place to deal with the issue? Is the organisation properly staffed and funded to deal with the issue? Are commanding officers/senior management aware of the issues? Is the issue already in some type of organisational issue list? If so, why isn't the issue being resolved? Who exactly is aware of/impacted by the issue?
Training	How are training results being measured and monitored? Is the issue caused by a lack of competency or proficiency on existing systems and equipment? Is the issue caused, at least in part, by inadequate or a complete lack of training? Does training exist which addresses the issue? Is the training being delivered effectively and in a timely manner? Was the issue discovered in an exercise? Do personnel affected by the issue have access to training? Is command/management supporting and/or enforcing the training effort? Is training properly staffed and funded?
Material	Is the issue caused, at least in part, by inadequate (outdated) systems or equipment? What current systems are in the Family-of-Systems where the problem is occurring? What functionality would a new system provide that currently does not exist? What increases in operational performance are needed to resolve the issue? Is the issue caused by a lack of competency, proficiency or maintenance on exiting systems and equipment? Can increases in performance be achieved without development of a new system? If so, how? Who would be the primary and secondary users of the proposed systems or equipment?
Leadership	Is the issue caused, at least in part, by inability or decreased ability to cooperate/coordinate/communicate with external organisations? Do the senior officers understand the scope of the problem? Does the command have resources at its disposal to correct the issue? Is leadership being trained on effective change management principles? Has the command properly assessed the level of criticality, threat, urgency, risk, etc. of the operational results of the issue? Is the senior leadership team aware of the drivers and barriers to resolving the issue within its own organisation? Has senior leadership identified inter-service or agency cultural drivers and barriers that hinder issue resolution? Do the issues affect a headquarters' ability to conduct (joint) operations?

Personnel	Is the issue caused, at least in part, by inability or decreased ability to place qualified and trained personnel in occupational specialities? Are there enough personnel present to handle the workload? How can you measure that? Do job/billet descriptions accurately reflect the actual tasks? Do personnel meet the requirements of the job descriptions? If issue resolution is likely to involve new material, systems, or equipment, are different occupational speciality codes needed to properly staff new systems? Primary users. Maintenance personnel. Support personnel. Do new training programmes need to be developed for newly recruited personnel?
Facilities	Is the issue caused, at least in part, by inadequate infrastructure? If so, was the issue a result of aging/wear? New engineering that didn't meet the need? Battle damage/threat? Was the issue caused by lack of proper environmental controls? Was the issue caused, at least in part, by inadequate roads/trails? Main supply routes? Force bed down? Facilities operation and maintenance? Hardening? Field fortification support?
Interoperability	Is the issue due to problems with interoperability? If so, what type of interoperability? Is the technology interoperable? Are the processes and procedures interoperable? Is it a human interoperability problem?

NATO Tasks List (Reference H):

The NATO Tasks List (NTL), governed by Bi-SC Directive 80-90, is a way of categorising all NATO activities down to the detailed task level. It is designed as a menu of capabilities, including mission derived tasks and provides common terms of reference for exercise and operations for the determination of required capabilities. It can therefore also provide a useful way of organising dividing your analysis into distinct AOs.

2.5 HOW TO... DEVELOP ANALYSIS OBJECTIVES (AOs)

WHY DO IT?

Analysis Objectives (AOs) drive your analysis towards fulfilling the Analysis Requirement (AR). You must develop AOs from the AR in order to plan your analysis, define an achievable endpoint for your analysis and manage your customer's expectations of what your analysis will provide to meet their need.

WHAT IS REQUIRED?

A well defined and understood AR and analysis and subject matter expertise.

WHAT WILL YOU GET?

Clear, demonstrable and achievable objectives on which to focus your analysis effort and an appreciation of what tasks will be necessary to achieve these objectives.

STEP-BY-STEP

Write AOs and derive tasks

They should be clear, demonstrable and achievable. AOs should include an action and an endpoint. Using certain words in the AO implies different tasks that need to be completed during the analysis. Table 5 gives some indication of what words imply.

Table 5 - AO wording and its implications

The words…	Imply…
• Identify	You will conduct a complete but unstructured survey of the available information in order to generate a list of relevant issues/items.
• Assess	You will develop an assessment framework that characterises the issue you were asked to address. Collecting data to fill your framework will allow you to give an overall judgement about the situation. Remember, analysis is not assessment of individual or team performance but assessment of procedures, technology or policies may be involved.
• Evaluate	You will develop an evaluation framework that characterises the issue you were asked to address. Collecting data to fill your framework will allow you to make an overall calculation about the situation. Remember, analysis is not evaluation of individual or team performance but evaluation of procedures, technology and policies may be involved.
• Effectiveness • Adequacy • Suitability • Sufficiency • Efficiency	You will complete the following steps: a. establish an ideal situation/best practice to compare against b. establish measures of merit that provide a good description of the system under study c. establish levels of acceptability versus unacceptability and any grey areas for the measures d. establish the current situation This will be the case for any term that alludes to the how useful something is.

Check everything is aligned

Check your that tasks align to your AOs, and your AOs align to the customer's AR, and seek the customer's approval.

Your AOs are your central focus from now on so they must be aligned both with the AR and the tasks you have derived. Spend some time thinking about whether this is the case. If you are uncomfortable with anything at this stage, delay progress and repeat earlier steps in the overall analysis process until you are completely satisfied. You need to explain to your customer how you believe meeting your AOs will meet their AR and you should be sure that your customer has really understood your explanation before you allow them to agree your AOs.

WATCH OUT!

This task is iterative, you will probably find you reach the end and revisit earlier steps a number of times before you and your customer are completely satisfied that the agreed AOs are clear, demonstrable and achievable.

This task is more about building understanding and a good working relationship between your analysis team and the customer than the actual act of writing AOs.

It is not unusual for customers to agree to AOs that do not meet the minimum criteria of a good AO. Your customer is usually not an analyst and is often not aware of the trouble this can cause later. It is your responsibility as the analysis expert not to let this happen.

This task becomes easier with experience but is never easy. Consulting a professional analyst during this task will really help you to get a good start to your analysis.

Remember that the SMEs' area of expertise is very narrow, that is why they are good, but they are not experts at conducting the analysis. They may encourage you to focus only on issues that are known and important to them rather than what may be important to your customer. You have to make the final decisions.

2.6 HOW TO… INFLUENCE THE DESIGN OF AN EXPERIMENT OR EXERCISE

WHY DO IT?

Many times the analytical objective is to test the benefits of an innovation in practices or equipment. In those cases the analyst must carefully consider how the results will prove the benefit, or otherwise, of the proposed innovation. In principle, the analyst should be intimately involved in the design of the experiment or exercise. However, practice does not always follow principle. This is particularly true in the case of exercises. These almost always have purposes wholly apart from the Analysis Objectives (AOs). No matter what the situation, the analyst must carefully consider the design of the experiment or exercise to determine the extent to which the event supports the intended analysis.

WHAT IS REQUIRED?

AOs (and hypotheses), a point of contact in the exercise or experiment

WHAT WILL YOU GET?

You may be able to get agreement from the exercise or experiment organisers to change the way the exercise or experiment will be played in order to support data collection for your AOs.

Insight into the way the exercise or experiment that will assist you in planning your data collection to maximum effect.

STEP-BY-STEP

List the hypotheses you need to test at the event and how you intend to demonstrate them

The strongest method of demonstrating a connection between the innovation and improvement over existing practices or systems is the use of control groups. In this method, a control group and a test group undertake the same tasks simultaneously. The control group uses existing methods and systems while the test group uses the innovation. The analyst determines improvement by comparing the results obtained by the two groups. It is important that both groups labour under the same conditions. While a properly conducted experiment using control groups provides the strongest possible evidence of benefit (or lack thereof), it is by far the most expensive technique and practical considerations most often rule out its employment for military applications.

The next strongest means of demonstrating the benefits of the innovation is to compare results with that of a known standard or baseline. For example, if past

exercises have demonstrated that it takes a certain period of time for a system to perform a task in a given environment to a specified standard; the experiment could evaluate the effectiveness of a new system by measuring the amount of time required for the new system to attain the same level of performance under the same conditions.

Finally, the weakest proof of improvement is that afforded by professional judgment. While this method is not invalid, in order to be convincing, the effect provided by the innovation must be large enough that it leaves no doubt that the innovation, and not the vagaries of chance, is responsible for the improvement.

Examine the MEL/MIL activities

Examine the MEL/MIL activities to ensure it will stimulate the types of behaviour called for to demonstrate the hypotheses. Structured exercises and experiments often utilize a Master Events List (MEL) or Master Incidents List (MIL). When the event in question uses a MEL/MIL the analyst should carefully examine it to ensure that it will stimulate the types of behaviour called for by the AOs. A good practice is to crosswalk each MEL/MIL with the questions required to address the AOs and determine which questions the MEL/MIL will aid in answering.

If the coverage of the MEL/MIL does not appear to be adequate, work with the exercise designers to introduce new MEL/MIL into the exercise.

Identify which events during the exercise or experiment need to be scrutinised

What do you need to observe in order to gather information to support the AOs? If there is a requirement to analyse information flows, the MEL/MIL should be carefully scrutinised and particular events selected so that these events can be monitored and traced through the C2 structures and organisation.

WATCH OUT!

This section is only applicable to exercises, training events and experiments since it is extremely unlikely that the military analyst is able to alter an operation in order to address an AO.

If you find yourself examining a published list of MEL/MIL activities, it is often too late to make changes to the exercise or experiment. If this happens, you must be realistic about what your analysis can achieve within the constraints of the list and adapt your plans and objectives as required.

3
Analysis Preparation

3.1 HOW TO… MANAGE ANALYSIS PROJECT FILES

WHY DO IT?

Analysis projects call upon and generate a large amount of information. An effective information storage system is essential to ensure that you and your team can find what you need when you need it, you can sensibly share the information with your analysis team and you have an audit trail for your analysis.

WHAT IS REQUIRED?

Electronic or physical storage space, ideally, a shared network drive accessible to your whole project team.

WHAT WILL YOU GET?

The ability to quickly and efficiently access the information you need when you need it and a permanent and organised record of your analysis.

STEP BY STEP

Set up a file system

One effective information storage system is to use five sub-directories: Management, Operational Documents, Reference Documents, Work Ongoing and Reports. Documents within these sub directories will be further divided as needed.

Management: The Management sub-directory should contain all documents relating to the planning and the execution of the analysis task: analysis plans, orders and taskers, as well as correspondence on issues such as transportation requests, personnel availability, budgetary issues, etc. As a general rule documents in the Management sub-directory should have a sponsor officer who may protect the documents with passwords.

Exercise/Operational Documents: The Operational Documents sub-directory should contain all the documents gathered of an exercise or operational nature, such as plans, orders, reports and returns, etc. These documents can be arranged according to their source HQ or organisation. All documents in the Operational Documents sub-directory should have their properties set to *read only* in order to ensure integrity.

Reference Documents: The Reference Documents sub-directory contains those documents that support the analysis but are not of an exercise/operational nature, e.g. country profiles, publications, references, etc. All documents in the Reference Documents sub-directory should have their properties set to read only in order to maintain integrity.

Work Ongoing: The Work Ongoing sub-directory should be subdivided further to have a directory for each Analysis Objective (AO) or issue. For each AO or issue a cross-reference sheet should be maintained which hyperlinks all documents that have been received related to that issue. All data collected in support of AOs should be stored in a separate subfolder in this directory. This will also be the area where reports and presentations are retained while in draft.

Reports: The Reports sub-directory should have copies of all outputs, whether it is a formal document, presentation or letter. Documents should be further sub-divided

into those that have been approved for external release. All documents in the Reports sub-directory should have their properties set to read only in order to ensure integrity.

Use the file system

As you locate, create or update files, place the most up-to-date copy in your project file.

Archive the files.

At the end of an analysis project all files used should be archived. If space is limited the bare minimum that should be archived are the Analysis Project Order, the Analysis Plan, the documents that were referenced in the analysis report and the analysis report.

WATCH OUT!

As much of the documentation associated with an analysis activity as possible should be stored electronically so that is easily accessible to your entire team.

Add a version number and last updated date to documents you create so that you can be sure you are using the correct version.

Store the exact version of any external documents you refer to in your project files just in case the version you used becomes unavailable or is updated.

EXAMPLE

3.2 HOW TO… WRITE AN ANALYSIS PROJECT ORDER

WHY DO IT?

The Analysis Project Order is an order to conduct an analysis project that directs the actions to be taken by the analysis team and informs operation, exercise or experiment participants of needed support for the agreed AOs. Specifically, it concentrates on the management of external and internal resources. It is essential to all analysis projects as it provides the authority for the project to proceed. Writing the Analysis Project Order is the responsibility of the analysis project manager.

WHAT IS REQUIRED?

You must have completed ‘How to… Pin down the AR’ and at least have a clear idea of what is needed from your analysis and have envisioned how you will achieve it.

WHAT WILL YOU GET?

Early warning of your analysis plans to those whose support you need, hence a much higher chance that you will get their full support.

Clear direction on what deliverables will be required and when they are due.

STEP-BY-STEP

Estimate manpower and budget

Write up an estimate of manpower and budget. Items to be considered when estimating the amount of manpower effort and expertise required to accomplish the analysis include:

- The number of observers needed to execute the AO.

- The manpower required to carry out reconstruction (if necessary) and the analysis within the allotted time.
- The manpower resources needed to support the planned analysis organisation.
- Items to be considered when estimating the budget include:
    - Travel costs for staff required to attend planning meetings, conferences and make site visits, including visits to other HQs and commands outside of the area of operations.
    - Travel costs for observers deployed to the operation or exercise.
    - Travel costs for attending the post-exercise discussion, after-action reviews, and command debriefs.
    - Costs that may be incurred in collecting records.
    - Any equipment purchases required, for example charts, maps, GPS receivers, etc.
    - Per Diem costs for NATO civilians.
    - Travel and subsistence costs for augmentees and subject matter experts.
    - Any necessary contractor support.

Finally, it should be remembered that NATO budgeting policy is that “costs lie where they fall”.

The personnel requirements for the analysis need to be consolidated into a deployment plan. If augmentation is necessary, the PM should approach the external agencies and request the appropriate augmentees. The deployment plan should include the movements of the augmentees, including the periods that they are required at the home base.

The project manager must ensure that receiving commands, units and sites have agreed to the deployment of the analysis staff and other observers and that the relevant administration has been carried out. This will include notification of the observer’s identification and security clearance details, date of arrival, date of departure and travel and accommodation arrangements.

It is important to ensure that agreement is reached for observers to have access to the relevant operational spaces and, if necessary, be provided with CIS facilities and communications appropriate for the classification level of the data to be processed and transmitted (e.g. access to NS WAN, Internet, etc.). Some national commands and units impose restrictions on the nationalities or the gender of observers that they will accept.

Often these issues will be agreed in a Memorandum or Understanding (MOU) between commands and addressed for a specific project in the Analysis Project Order. JALLC has standing MOUs covering deployments to several frequent operations, including ISAF and KFOR.

Draft the analysis project order

An analysis project order should contain the following information:

- A brief description of the analysis requirement highlighting the need and the overall mission.
- The agreed AOs, if already developed.

- An outline plan of the analysis phases, including the schedule and the due date(s) for the interim (if required) and final analysis report(s).

  Phase 1: Clarification of Need.

  Phase 2: Analysis Preparation.

  Phase 3: Deployed Data Collection.

  Phase 4: Post-Event Analysis.

  Phase 5: Reporting.

- Specific tasks of the analysis authority and participants to support the analysis effort, including:
  - The support requirements for the analysts/observers.
  - Data collection requirements for the analysis.
  - Arrangements for the recovery of records from participants, including pre-processing of data by national authorities, if appropriate.
  - Publications required in support of the analysis.
  - The command relationships of the analysts/observers.
  - The communications and CIS support requirements of the analysts.
  - The analysis team manning and their location and deployment plan.

For real-world operations, it is recommended that the Analysis Project Order follow the format of an OPORD as described in the GOP (Reference D). The analysis officer drafting the plan should not follow the GOP rigidly, but rather use common sense and make amendments or omissions as considered necessary. JALLC uses a template developed from the GOP and STANAG 2014 (Reference E), modified specifically to direct analysis projects. The JALLC template can be found in the JALLC SOP on Analysis Project Management (Reference S).

For exercises and experiments, the Analysis Project Order will be included as an annex to the Exercise Plan (EXPLAN) Part 3 as directed in the Bi-SC Exercise Directive (Reference F).

Staff it thoroughly

Staffing should occur both internally by the analysis team and externally with the relevant external commands and agencies before final publication.

WATCH OUT!

The Analysis Project Order should be issued as soon as possible to provide maximum lead-time for the project. In some cases, the specific AOs may not already have been developed by the time the order needs to be issued. In these cases, including the AR instead may be enough.

3.3 HOW TO… WRITE AN ANALYSIS PLAN

WHY DO IT?

The analysis plans are internal documents that serve to refine each AO. They contain the detail of what you and your team will do during your analysis

WHAT IS REQUIRED?

A good understanding of the customer's intent, agreed AOs and an outline idea of how you envision your analysis happening.

WHAT WILL YOU GET?

Plans for all of your work that will allow you to implement and monitor your analysis to achieve a final analysis product to specification and deadlines.

STEP-BY-STEP

Produce a separate work plan for each AO

Include the following information:

- Aim/purpose of the AO.
- Methodology – the methods to be used in the analysis.
- Detailed data collection plan including comprehensive instructions to observers.
- Equipment needed to support data collection and observation plan.
- Post-event analysis tasks.
- Complete reference list for the AO.
- Updated estimates of the resources (manpower, equipment, travel, contractor support) required to complete the planned activity.

Outline the deliverables and deadlines

What will be the actual products of your analysis and when do you need to complete them by? Provide a short summary of what you will include in each deliverable.

Draw up a list of risks

Risks are things that could happen to prevent you from delivering what is desired to the agreed timescales. Write a short plan for what you plan to do to avoid each risk happening and what you plan to do to reduce the impact of the risk if it does happen.

WATCH OUT!

General Helmuth Graf von Moltke said, "No campaign plan survives first contact with the enemy". The same is true with analysis plans. Plan to review and revise your analysis plan at regular intervals during your analysis or risk getting to the end having diverged so far from your original plan that you are no longer able to fulfil your AOs.

3.4 HOW TO… BUILD A DATA COLLECTION PLAN

WHY DO IT?

The data collection plan is a sub-plan within your analysis plan. You need to build a data collection plan to allow you to make the most of your deployed data collection and to ensure you collect data relevant to your analysis and do not get distracted during your data collection.

WHAT IS REQUIRED?

An analysis methodology and agreed AOs; Mindmapping, spreadsheet and project management software.

WHAT WILL YOU GET?

A data collection plan including enough information to prepare the required interviews/questionnaires and lists of who, what, where and when you hope to collect data.

STEP-BY-STEP

Think of every possible question you may need to answer

A brainstorming technique, such as context breaking, with brainstorming software tool such as Mindmanager, may help you to do this. At this point you should not restrict yourself to only the obvious questions. Every idea may later be relevant. You can use the key questions and hypotheses you generated when you developed your AOs as a starting point.

Cross reference your questions with your AOs/ analysis plan.

Export your questions to a spreadsheet such as Excel and cross reference each question or set of questions against your AOs.

Cast questions that you do no expect to contribute to your analysis plan or objectives aside and continue from this point with only the questions you plan to answer with your data collection.

Plan how you will answer your questions.

Possible sources of data to answer your questions may be:

- Documentation: within NATO or publicly available.
- Databases: including the NATO Lessons Learned Database.
- Observation: by others or your team at an event.
- Interviews: when detailed information is needed from a small number of people usually determined by your available resources.
- Questionnaires: when outline information is needed from a large number of people (usually over 20).

Interviews, questionnaires and observation are likely to be time and location dependent. Use project management software or a sophisticated mind mapper to plot your data collection plan on a timeline.

Review your plan to ensure you do not have unreasonable logistics demands, that questions that rely on answers to other questions come in the right order and that observation or questions that need to be repeated are. Try to co-ordinate your data collection requirements with those of other data collectors in theatre, although beware of associating too closely with evaluation teams as people will assume the data will be used in the same way.

WATCH OUT!

Introduce redundancy wherever possible as the reality on the ground will probably prevent you from following your plan precisely. Make sure you know what your priorities are and ‘hit’ them first.

EXAMPLE

Context breaking is a group discussion method with emphasis on trying to break out of the conventional frame of reference in order to generate ideas. Each of the

contexts or attitudes in the box below can be a roadblock to creativity and should be presented at the start of the discussion:

➢ There is a right answer.	➢ That's not my area.
➢ Everything is logical.	➢ Avoid ambiguity.
➢ There are rules to follow.	➢ Don't be foolish.
➢ Be practical.	➢ To err is wrong.
➢ Play is frivolous.	➢ I'm not creative.

During the discussion, participants are not allowed to display any of these attitudes, and other participants must point it out when it happens. This technique helps to promote original thinking and to solicit ideas from *all* members. You can record your discussion in mindmapping software such as MindManager[12].

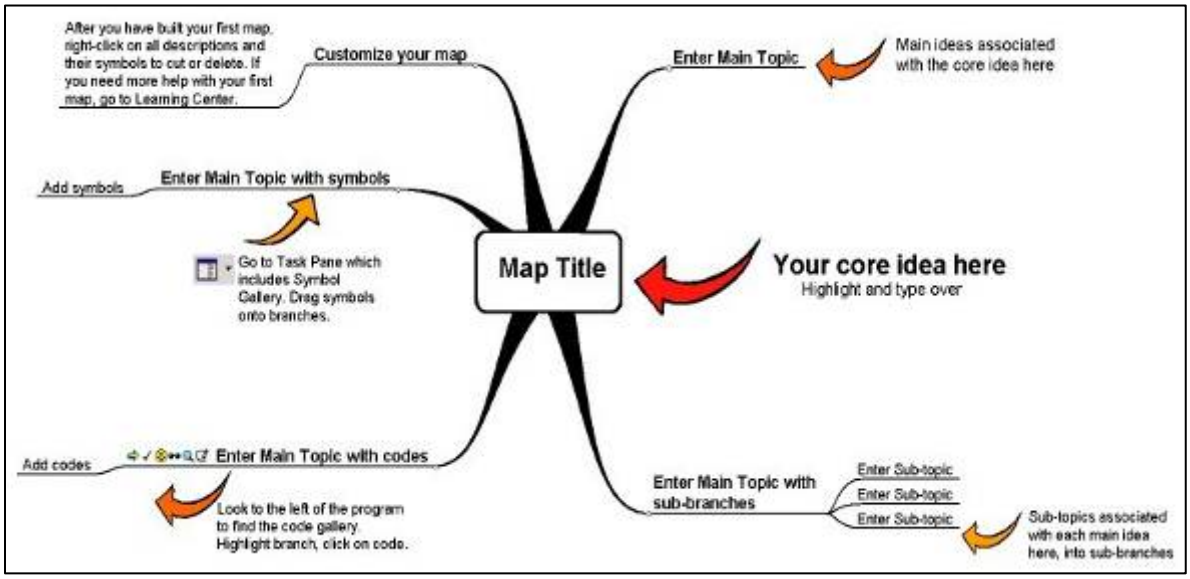


Figure 8 – *MindManager* Example

3.5 HOW TO… PREPARE INTERVIEWS

WHY DO IT?

While there are generally a number of ways to determine and document what happened, interviews of key participants are often to the only way to determine why decisions were made. Pre-event planning for interviews should identify the key decision-makers and the staff that provide input into the decisions of interest. These are the people you need to consider interviewing.

WHAT IS REQUIRED?

A data collection plan listing the questions you need to find answers to.

WHAT WILL YOU GET?

A plan of who you want to interview and how you will conduct each interview.

STEP-BY-STEP

As you can see in Figure 9, preparation is a large part of successful interviewing.

[12] Reprinted with permission of Mindjet GmbH.

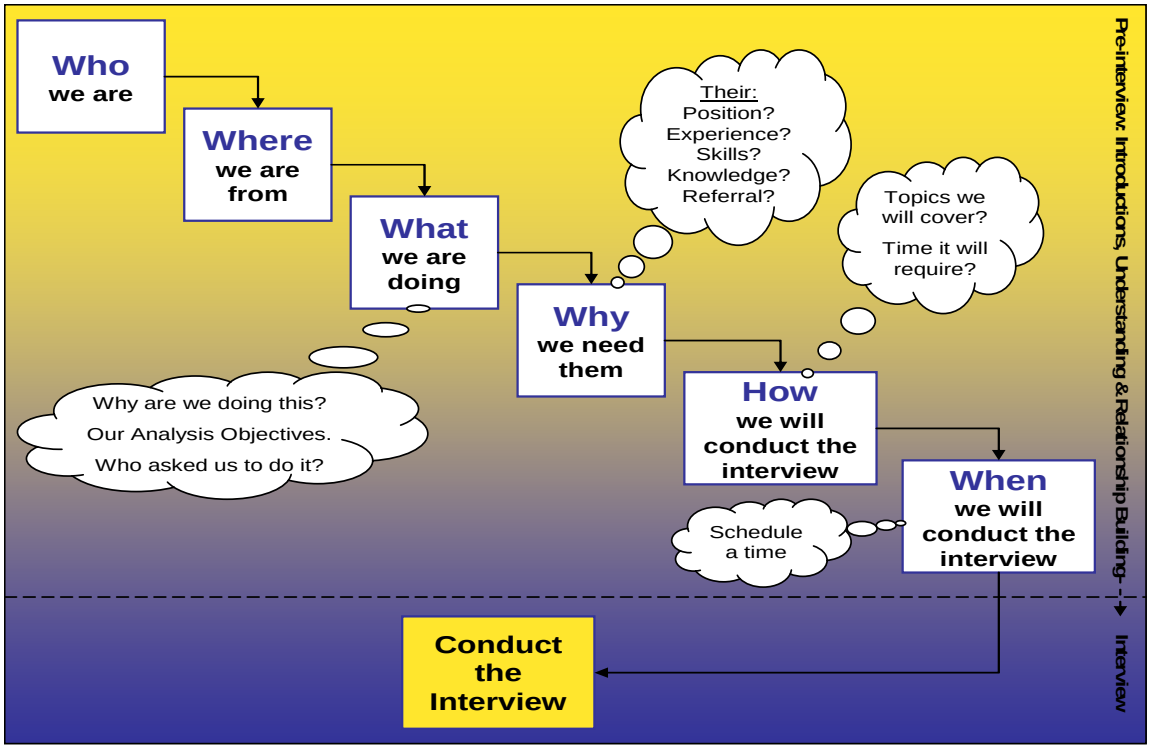


Figure 9 - The interview preparation process.

Identify your interviewees

Obtaining multiple perspectives is often crucial and can be particularly important in unravelling command and control issues between various levels of command. For example, if you want to establish how well ROE were understood, interviews from participants involved at the strategic, operational and tactical levels would be required to work out how understanding of ROE varied as it was transmitted down the chain of command.

Choose an interview type

There are three types of interview: structured, semi-structured and unstructured. You need to choose which type seems most appropriate to collect the data you need from the individual you are interviewing. Every interview will be different, every person you interview will be unique and there is always something you can learn.

- Structured interviews use standardised questionnaires that are identical for each interview. However, rather than simply requesting that the interviewee fill in the questionnaire, you guide the interviewee through the questions. Use "How to… Prepare questionnaires" to develop questionnaires for your structured interviews.
- In semi-structured interviews, you have a list of themes or questions to be covered although these may vary from interview to interview. This is usually the format followed by television chat shows.
- Unstructured interviews are informal discussions. There are no pre-determined lists of questions. Unstructured interviews are most useful when you need to explore general issues. They allow you the flexibility to explore breadth or depth, depending on what is of interest. They can be somewhat difficult to conduct properly and for an inexperienced interviewer a semi-structured interview may be a preferred option.

Table 6 summarises the advantages and disadvantages of the different interview types.

Table 6 - Advantages and Disadvantages of interview types

Type	Advantages	Disadvantages
Structured	High control Minimal variability Question response analysis possible Easier to estimate duration Easily managed	Feel (are) scripted No opportunity for discovery Only get answers to what was asked
Semi-structured	Topic/Issue consistency Opportunities for deepening Opportunities for discovery Topic response analysis possible More comfortable/relaxed	Less controlled, introduces more variability since questions may not be identical Requires more focus by interviewer to manage/guide direction Requires time management
Unstructured	Can elicit completely unanticipated information No constraints, anything is OK Extremely casual Requires little management	Comparative analysis is difficult Least consistent (topics/areas)

Produce an interview guide

An interview guide is similar to a terrain map. It will provide you with a high level overview/framework of what you need to cover in the interview. These should be "bullets", not too detailed or specific and focussing on no more than 4 main topics to avoid muddle. This will help you to see more easily when the interview has gone off in a wrong direction.

Your guide should not be a complete list of your specific questions but just give you a few initial ideas about possible questions to use to *start* the interview off. While writing out your specific questions in advance can be helpful, it can also be dangerous: you run the risk of asking just these specific questions and, more importantly, not listening to their responses. This means you may miss out on the opportunity to insert more relevant questions based on the issues you learn about during the interview.

Similarly, the guide should not be a write-up of specific things you are going to say, it should not be a written "speech". It is very impersonal if you sit and read your introduction (or anything else) to the interviewee.

Save Time

Attempt to keep each interview to no more than 30 minutes. This will avoid exceeding both your and your interviewees' useful attention span and reduce the temptation to wander during the interview, thus wasting time.

Regardless of how long it is, the time available for the interview will never feel like enough. It is a challenge to make the most of the limited time you will have with your interviewees. It can help to complete some of the preparatory steps before the actual

"official" interview takes place. These "preliminary steps include (but are not limited to):

- Introducing the interviewing team
- Explaining what you are doing, why you are doing it, who asked you to do it…
- Starting to establish a good relationship with the interviewee (one of your most powerful interviewing tools!):
- Helping them feel comfortable and reducing their suspicions:
  - Answer any questions they may have about you.
  - Discuss with them any questions (or criticisms) they may have about your organisation.
  - Clarify how you will use and attribute their statements.
- Explain why speaking with them can be very helpful in your analysis…what value they will be adding to your analysis.
- Communicate that you are *not* there to evaluate their individual performance or expertise…that you are looking at things from a larger, NATO-wide level and that there is critical information you are sure you can gain from having discussions with them.

WATCH OUT!

Even unstructured interviews require planning, you must be sure of what you hope to achieve in order not to waste someone's time with no clear purpose.

When you are explaining things to them, you are doing the talking and you are not listening to them talk. So, the more you can convey to them before the interview, the more "quality" time you will have to ask them the questions that will support and improve your analysis.

3.6 How to… Prepare Questionnaires

WHY DO IT?

Questionnaires, or surveys, are useful when the analyst must determine the opinion of large numbers of participants. Questionnaires can collect data on attitudes, beliefs, behaviour and attributes.

- Attitude relates to how the respondent feels about something (e.g. "How do you feel about the following statement: The FRAGO always reflects the commander's intent?").
- Belief is what the respondents believe to be true or false (e.g. "Is the FRAGO always in the correct format?").
- Behaviour is what the respondent does (e.g. "How many hours per day do you spend on average in developing FRAGOs?").
- Attributes characterise the respondent (e.g. age, years of military experience, etc.).

Questionnaires are appropriate under the same conditions that structured interviews would be used (see How to… Prepare interviews).

WHAT IS REQUIRED?

A data collection plan with the questions you need to find answers to.

WHAT WILL YOU GET?

A plan of who you will target with questionnaires and a questionnaire ready for distribution, either by interview, paper or online.

STEP-BY-STEP:

The overriding consideration in questionnaire design is to make sure you ask the *right* questions i.e. your questions will accurately tell you what you want to learn. Keep it short and simple. Ask yourself what you will do with the information from each question and if you cannot give yourself a satisfactory answer, leave it out. Avoid the temptation to add a few more questions just because you are doing a questionnaire anyway. If necessary, place your questions into three groups: must know, useful to know and nice to know. Discard the last group, unless the previous two groups are very short.

Preparing your questionnaire is a five step process:

- Select your sample (the selection of people you plan to issue your questionnaire to).
- Write an introduction.
- Design your questions and answers.
- Write your questionnaire (paying attention to questions and answer order and layout).
- Pre-test your questionnaire.

Select your sample

There are two main components in determining whom you will interview:

- Deciding what kind of people to interview. Researchers often call this group the target population. If you conduct an employee attitude survey or an association membership survey, the population is obvious. If you are trying to determine the likely success of a product, the target population may be less obvious. Correctly determining the target population is critical. If you do not interview the right kinds of people, you will not successfully meet your goals.
- Deciding how many people you need to interview. Statisticians know that a small, representative sample will reflect the group from which it is drawn. The larger the sample, the more precisely it reflects the target group. However, the rate of improvement in the precision decreases as your sample size increases. For example, to increase a sample from 250 to 1,000 only doubles the precision. You must make a decision about your sample size based on factors such as: time available, budget and necessary degree of precision.

In most cases you will want your sample to be "*Randomly selected*" so that the measurement of the sample provides a fair representation—i.e. a random sample—of the total population. There are a fair number of technical hurdles to be overcome in order to support this assertion. Analysts without experience in sampling techniques should seek professional advice from a qualified operational analyst or statistician when planning to use questionnaires.

Write an introduction

Start with an introduction or welcome message. State who you are and why you want the information in the questionnaire. A good introduction or welcome message will encourage people to complete your questionnaire.

Design your Questions and Answers

There are three basic types of questions: Multiple Choice, numeric open end and Text Open End (sometimes called "verbatims"). Examples of each kind of question follow:

Multiple Choice:

List: the answers have no order and only one answer should be selected

What sex are you?

___ Male

___ Female

Category: the answers have no order and many answers may be selected.

Which of these series do you watch?

___ Friends

___ Seinfeld

___ The Simpsons

Rating or Agreement: the answers have an inherent order,

How would you rate this product?

___ Excellent

___ Good

___ Fair

___ Poor

On a scale where 10 means you have a great amount of interest and 1 means you have none at all, how would you rate your interest in each of the following topics?

___ Domestic politics

___ Foreign affairs

___ Science

___ Business

How much do you agree with each of the following statements?

strongly agree—agree—disagree—strongly disagree

___ My manager provides constructive criticism

___ Our medical plan provides adequate coverage

___ I would prefer to work longer hours on fewer days

Text Open End:

How can our company improve working conditions?

_____

Numeric open end:

How much did you spend on food this week?

_____

Bear in mind the following when

- Do not put two questions into one. Avoid questions such as "Do you buy frozen meat and frozen fish?" A "Yes" answer can mean the respondent buys meat or fish or both. Similarly with a question such as "Have you ever bought Product X and, if so, did you like it?" A "No" answer can mean "never bought" or "bought and disliked." Be as specific as possible. "Do you ever buy pasta?" can include someone who once bought some in 1990. It does not tell you whether the pasta was dried, frozen or canned and may include someone who had pasta in a restaurant. It is better to say "Have you bought pasta (other than in a restaurant) in the last three months?" "If yes, was it frozen, canned or dried?".
- If you want only one answer from each person, ensure that the options are mutually exclusive. For example:

  In which of the following do you live?

  ___ a house

  ___ an apartment

  ___ the suburbs

  This question ignores the possibility of someone living in a house or an apartment in the suburbs.
- Make sure your questions accept all the possible answers. A question like "Do you use regular or premium petrol in your car?" does not cover all possible answers. The owner may alternate between both types. The question also ignores the possibility of diesel or electric-powered cars. A better way of asking this question would be "Which type(s) of fuel do you use in your cars?" The responses allowed might be:

  ___ Regular petrol

  ___ Premium petrol

  ___ Diesel

  ___ Other, please state

  ___ Do not have a car
- If you use a rating scale be sure the labels are meaningful. A question phrased like the following will force most answers into the middle category, resulting in very little usable information:

  What do you think about product X?

  ___ It's the best on the market

  ___ It's about average

  ___ It's the worst on the market
- If you have used a particular scale before and need to compare results, use the same scale. Four on a five-point scale is not equivalent to eight on a ten-point scale. Someone who rates an item "4" on a five-point scale might rate that item anywhere between "6" and "9" on a ten-point scale.
- Allow a "Don't Know" or "Not Applicable" response to all questions, except to those in which you are certain that all respondents will have a clear answer. In most cases, these are wasted answers as far as the researcher is concerned, but are necessary alternatives to avoid frustrated respondents.

For the same reason, include "Other" or "None" whenever either of these are a logically possible answer. When the answer choices are a list of possible opinions, preferences or behaviours you should usually allow these answers.

Arrange your questions and answers

There are two broad issues to keep in mind when considering the order in which you present your questions and answer choices:

- How the order of questions and answer choices can encourage people to complete your questionnaire.
- How the order of questions and answer choices could affect the results of your questionnaire.

The order of your questions can affect the results in two ways:

- Mentioning something (an idea, an issue, a brand) in one question can make people think of it while they answer a later question, when they might not have thought of it if it had not been previously mentioned.
- Habituation is a problem that applies to a series of questions that all have the same answer choices. It means that some people will usually start giving the same answer, without really considering it, after being asked a series of similar questions. People tend to think more when asked the earlier questions in the series and so give more accurate answers to them.

Ideally, the early questions in a questionnaire should be easy and pleasant to answer. These kinds of questions encourage people to continue. Grouping together questions on the same topic also makes the questionnaire easier to answer.

Always include a question at the end entitled "Other Comments" to allow respondents to offer casual remarks. Sometimes these are worth their weight in gold and cover some areas you did not think of, but which respondents consider critical.

Unless you need to know the answer to sensitive questions (such as age, sex, income or education) to check whether someone is a suitable respondent, place these questions at the end of your questionnaire. These questions put people off answering your questionnaire and it is better if you can get them to answer your most important questions before you introduce them.

The order of Multiple Choice answers can also affect the answers given. People tend to pick the choices nearest the start of a list when they read the list themselves on paper or a computer screen. People tend to pick the most recent answer when they hear a list of choices read to them.

The order of Multiple Choice answers can also make individual questions easier or more difficult to answer. Whenever there is a logical or natural order to answer choices, use it. Always present agree-disagree choices in that order. Presenting them in disagree-agree order will seem odd. For the same reason, positive to negative and excellent to poor scales should be presented in those orders. When using numeric rating scales higher numbers should mean a more positive or more agreeing answer.

Format your questionnaire

You want to make it attractive, easy to understand and easy to complete. If you are creating a paper survey, you also want to make it easy for your data entry personnel. The following formatting tips may help:

- Keep your answer spaces in a straight line, either horizontal or vertical. A single answer choice on each line is best. Place answer spaces on the right

hand edge of the page. It is much easier for a field worker or respondent to follow a logical flow across or down a page. Using the right edge is also easiest for data entry.

- Leave sufficient space for handwritten answers. Lines should be about half-an-inch (one cm) apart. The number of lines you should have depends on the question; three to five lines is usual.

Pre-test the Questionnaire

The last step in questionnaire design is to test a questionnaire with a small number of respondents before issuing it or conducting your main interviews. Ideally, you should test the survey on the same kinds of people you will include in the main study. If that is not possible, at least have a few people, other than the question writer, try the questionnaire. This kind of test run can reveal unanticipated problems with question wording, instructions to skip questions, etc. It can help see if the respondents understand your questions and give useful answers. If you change any questions after a pre-test, you should not combine the results from the pre-test with the results of post-test interviews.

WATCH OUT!

Be aware of the desire to please. Respondents sometimes have a strong tendency to exaggerate answers. It is sometimes their perception that their answers are somehow being graded and so they often give "correct" answers rather than what they really believe. Always treat "favourable" answers with caution.

You are strongly encouraged to consult with a qualified operational analyst or statistician during the design of the questionnaire and subsequent data analysis.

REFERENCES

http://www.surveysystem.com/sdesign.htm. This is the Survey Design chapter from The Survey System's Tutorial, revised July, 2000. It is reproduced here as a service to the research community. Copyright 2000, Creative Research Systems.

http://www.tgsa.edu/online/cybrary/lwedekin.html. Designing Survey Questions. Accessed 10 October 2001.

4
At the Event

4.1 HOW TO… ARRANGE AND CONDUCT INTERVIEWS

WHY DO IT?

Once you have prepared your interview, there are still some key things you need to bear in mind about arranging and conducting the interviews that will increase your success. These include attendee composition, recording the interview and scheduling the interview.

WHAT IS REQUIRED?

You should have completed "How to… Prepare interviews" and so know who you want to talk to and what you want to talk to them about.

WHAT WILL YOU GET?

Successful interviews that give you the information you want and make efficient use of both your and the interviewee's time.

STEP-BY-STEP:

Schedule the interview

Schedule the interview close to the event. Human memory both fades and distorts with time. To record the thinking at the time of the decision, the information needs to be gathered as close to the time of the decision as possible.

It is important that we are sensitive to the fact the interviewees have a lot of other priorities and demands on their time. Their own chain of command will be making a lot of critical demands on their time and our questions and our analyses objectives will be near the bottom on their list of immediate priorities. When you set up the interview, make sure you are very clear and realistic about:

- How much of their time you will require for the interview.
- How many times you will need to talk with them (some individuals you may need to talk to more than once).

Setting up the actual interview usually requires that you check back with the interviewee on multiple occasions before they will be able to commit to a specific day and time. Do not let this frustrate you.

The interviewers and interviewees

You need to bear in mind both the team you take to the interview and the interviewees and others you allow to attend. Do not confuse "people who want to sit in on the interview" with "people you need to make the interview a success."

Ideally your interview team should consist of two; one to lead the interview and one to concentrate on recording the answers and monitoring that the interview stays on track. Think of the roles of a two person interview team as being similar to a helicopter crew's roles of "Pilot Flying" and "Pilot Not Flying" including the use of very rigid protocol for switching roles. Table 7 summarises the roles in a two person interview.

Table 7 - Roles in a two person interview.

First interviewer: Lead	Second Interviewer: Recorder and Monitor
Asks the questions	Records the data
Does most of the talking	Takes extremely detailed notes
Redirects interviewee back to main topic	Tends to the tape recorder (if one is used)
Determines overall direction of the interview	Monitors and tracks what topics have been covered and those that have not been covered
Decides when to 'swap' roles with the 2nd interviewer	Listens for points/issues that should be further pursued. Keeps track of his/her own questions to ask when the interview is handed over by Lead. When "control" of the interviewed is handed-off by Lead: • Goes back to fill in any gaps noticed in the earlier part of the interview. • Follows up with any additional questions • Returns control to the original Lead unless agreed otherwise.

It is acceptable to have three interviewers on your team if the third person takes a completely passive role so as not to distract or over complicate the interview. One interviewer is also acceptable if the person is confident he can take good notes while conducting the interview.

Military rank should not be the main factor that determines who leads an interview. However, in a military environment, rank does play a role, especially in the perceptions of most interviewees, and it is important that the interview team discuss and agree upon how they will handle this before the interview. Some ideas:

- Having the ranking officer conduct the initial introductions at the beginning of the interview is always a good idea. However, you may want to have the individual who is most familiar with the AOs lead the actual interview. If your second interview team member is not very familiar with the AOs at the beginning, they will usually be able to assume the lead role after sitting in as monitor and recorder on just a few interviews.
- If the interviewee continually directs their answers to the non-lead interviewer (whether because of rank, nationality, sex or any other reason)…consider switching the lead to this person. This needs to be a conscious "hand-off of control" that should be discussed among the team before the interview takes place.

Conduct and record the interview

Start the interview with an introduction. Try to keep the entire introduction to two or three minutes if possible. Include the following, but do not ramble on:

- Thank them for giving you the time (acknowledge that you realise they are very busy)
- Reiterate to them how long it will take (and stick to this unless they "allow" you to go longer).
- Introduce the team members (they should already know what organisation you represent)

- Very briefly, introduce what you would like to discuss in a very high-level overview. Examples might be “How you are employing Reach back?” “How the NBC-JAT has integrated itself into the DJTF HQ?”
- Let them know why you need to speak with them: is it because of their job/role, their expertise/experience, their perspective is important; you were referred to them as a person to ask, etc.
- Let them know if their comments will be attributable or anonymous.
- Let them know again how long it will take.

During the discussion the lead interviewer will need to control the interview flow and direction. However, be careful because too much control may stifle the discussion and too little can let it go off in directions that will not help you with your analysis. It is also important to avoid getting drawn into discussing issues yourself. It is the interviewee’s ideas you need to hear, not yours.

You should employ the following interview techniques[13].

Listening:

- Sit or stand still where you are.
- Look at the speaker, make a note of non-verbal communication.
- Listen for basic facts and main ideas.
- Listen for attitudes, opinions, or beliefs.
- Do not interrupt the speaker.
- Use positive, non-verbal communication to prompt the speaker.

Paraphrasing:

- Repeat your understanding of their comments in your own words; ask the speaker if what you have said is correct and ask for any clarifications.
- Make sure key points by the speaker are captured.
- Check to verify understanding.
- It can be useful to summarise discussions onto flip charts (etc.) and points during the discussion. This allows participants to correct any misunderstandings, and also to discuss ideas disconnected from the original speaker. This may allow them to be more honest and/ or critical.

Probing:

- Open probe: Questions that begin with how, what, which, when, and who. These are effective in encouraging responsiveness and reducing defensiveness.
- Compare and contrast: Questions which ask the other person to look for and discuss similarities or differences. These types of questions help the responder to develop and express ideas while allowing the interviewer to steer the direction of the interview.
- Extension: A question that builds on information already provided.
- Clarification: Questions designed to get further explanation about something already said.
- Laundry list: Techniques where the interviewer provides a list of choice options to the interviewee. This encourages the other person to see beyond a single choice and to state a preference.

[13] Partially drawn from material from Higginbotham, J.B., and Cox, K.K. (Eds.) (1979) *Focus Group Interviews: A Reader*. Chicago: American Marketing Association.

- Imagining: Any question which allows the individual to imagine or explore an alternative reality by giving themselves a different viewpoint or perspective.

Note taking:

- It is important to capture the information from the interview as accurately as possible.
- Material from an audio recording can be used later to fill in gaps.
- But ALWAYS assume the audio recorder will screw up.

Remember interviewing is a skill and practice makes perfect!

WATCH OUT!

The most difficult challenge is to keep yourself out of it. If you fail to do this, you will not have a successful interview. What *you* think does not help you…you need to know what your *interviewee* thinks. You can get what you think anytime!

Hold your own thoughts until after you have completed the interview. Expressing your ideas and opinions can influence their answers.

Remember that you will often need to talk to an individual on several different occasions. In other words, the interview is not "completed" until after the LAST time you talk to them.

You are doing analysis, not evaluation of their performance. If you find yourself critiquing their performance or work, you have probably slipped from analysis into evaluation.

If you ask for 15 minutes, ALWAYS wrap-up the interview within that time period. Never go longer unless they tell you it is OK and they have time to spend.

Write down what they say, not your interpretation of what they say. There are subtleties in the words they choose to use. Do not substitute your words for theirs. It can change the meaning of what they said.

You can only "quote" an exact quote. Make sure you can distinguish later which of your notes are exact statements and which ones are more general notes about what they said. Quotes can be very powerful tools in your final report, so the more you have the stronger your report may be. Keep an eye out for potentially quotable comments and ask the interviewee during the interview if they mind being quoted on what they said.

Interviewees may try to please you with their answers and prefer to provide you with a random answer to questions that are outside of their sphere of expertise or area of responsibility rather than admitting they do not know about it. These answers can be distracting to your analysis.

If you find yourself thinking of the next question you are going to ask and they are still discussing the last one, you are not listening. You are no longer being an interviewer and you are not collecting data. Also, if you are not listening, you are not writing down what they said either.

If they say something that does not make any sense, write it down exactly but let them keep talking. You can go back to it later for clarification.

DO NOT interrupt them.

DO NOT argue with them.

If your question takes longer to ask than it takes for them to answer, you probably did not ask a good question.

A general rule of thumb is that the person being interviewed should be the one talking at least 80% of the time. The person asking the questions should only be talking 20% of the time.

EXAMPLE

Here we give an example of the second interviewer listening for points/issues that should be further pursued:

Early in a response the interviewee uses key "flag" word but continues for a couple more minutes before finishing their point. A key "flag" word is one that will usually reveal a significant amount of additional and relevant information if it is probed deeper (i.e., if you follow up with a question such as "Why was it difficult?" etc.). These are words you want to listen for since a lot if important data is often "hidden" underneath them. Some common examples are: "usually", "critical", "difficult" or "important". Often several minutes can pass with much additional information and points being offered by the interviewee; it is very possible the interviewee will not think more about what the situation might involve when "usually" does NOT happen. Moreover, the lead interviewer might not pick up on the need to probe further on this matter. The second should make a note at the time, and later on, when the lead asks the second about questions or follow-ups, the second should conduct the probing with the interviewee on these flagged items.

4.2 HOW TO… USE THE NS WAN TO ADMINISTER QUESTIONNAIRES

WHY DO IT?

Questionnaires can be administered on paper or electronically. The NS WAN provides an electronic means to administer questionnaires. Electronic means are the quickest, cheapest and easiest way to distribute, collect and code questionnaire data.

WHAT IS REQUIRED?

Prepared questionnaires.

WHAT WILL YOU GET?

Electronic questionnaire returns.

STEP-BY-STEP

MS Outlook e-mail client may be used to send the questionnaires to the intended respondents.

WISE enables CRONOS users to design, develop and manage their own web sites, applications, content and security permissions in real time. Analysts working within NATO should be familiar with WISE because it is used by all NATO commands and HQs to build their web sites and to act as a tool for information management and knowledge management. WISE provides a plethora of tools (called objects) to help build web pages and some of these may be useful for data collection.

4.3 HOW TO… MAKE IN-THEATRE OBSERVATIONS

WHY DO IT?

Observation is frequently used at the operational level to collect primary data.

WHAT IS REQUIRED?

A data collection plan and an analysis project order for attendance at an event.

WHAT WILL YOU GET?

Firsthand insight into the reality of what happened. Raw data and measurements that would not otherwise have been collected.

STEP-BY-STEP

Decide on mode of observation.

Observation can be carried out by the researcher not revealing their purpose during the observation data collection i.e. they become either an "anonymous participant" (a "spy") or an "anonymous observer". Generally, military analysts do not adopt this approach since all participants will be made aware of the analyst's role in the operation, exercise or experiment.

Military analysts generally adopt the role of "observer as participants", which means that they participate in the event solely with the purpose of making observations. Another possible approach is called "participant as observers"; where the analyst making observations becomes part of the staff of the organisation under study. In NATO, the latter is part of the function of the internal command or HQ J7 lessons learned teams and the associated process to allow staff to enter their own observations.

Decide on a structured or unstructured approach.

Observation can be either structured or unstructured. Unstructured observation is where the observer attends the operation, exercise or experiment and their role is to witness what is going on, take notes and provide insights into the processes that are taking place. Structured observation is where a data collection plan (a coding schedule) to be used by all the observers is developed prior to the actual observation process. Structured observation is generally a more effective and efficient approach than unstructured observation. Structured observation also has the advantage that the detailed coding schedule may permit self-completion by the actual participants.

4.4 HOW TO… USE OCP TO RECORD DEPLOYED DATA COLLECTION

WHY DO IT?

During your deployed data collection you will come across a large amount of data, some of it relevant to your analysis, some of it important but outside of your scope and some of it irrelevant and unimportant. A structured and shared data repository can help you to keep track of what you have and what you still need. The Observation Collection Program (OCP) can be that tool.

WHAT IS REQUIRED?

The latest version of the OCP software.

WHAT WILL YOU GET?

There will be some order to the data you collected during deployment that helps immensely when you get back and try to work with it. You will have an audit trail for all of the deployed data your team collect. The exchange of information permits other analysts to make comments on observations and can provide new insights and new lines of investigation. All the observations can be exported to a MS Word file.

STEP-BY-STEP:

OCP is a NATO-designed database tool to aid an analysis team's data collection while deployed. It provides a structured format for collecting observations, is particularly useful for collection at the operational level, and is designed to facilitate

the production of the report. It should be used in all military analysis activities that require the use of observers for data collection.

OCP can be used over a network, allowing geographically separated analysis team members to operate using the same data, and has a comments feature, which facilitates recording discussions of observations as they are inserted into the database.

OCP contains a number of root tables containing the data categorisations listed in *How to… Split up your analysis*. These tables permit the observer to assign categorical information to the observations at the time of entry in order to facilitate later analysis and summation of the observation data.

The program also enforces an audit trail back to the observer originally making the observation and subsequent comments by other observers or peers.

Establish the structure for collecting observations prior to the data collection.

Prior to the operation, exercise or experiment, you should set up the OCP to link the entry of observations to AOs, sub-objectives, phases and other useful categories. Building a structure for gathering observations prior to the actual data collection period facilitates synthesis of multiple observations during the analysis phase and this feature of OCP makes that much easier.

Ensure each observer has ready access to a computer with OCP installed.

The installation file can be downloaded from the JALLC CRONOS site. JALLC IT personnel can provide guidance on installing, setting-up and using OCP.

Use OCP as the central tool for entering all data collected on deployment.

Put all of your preparation to good use.

WATCH OUT!

OCP may not always be the correct tool for recording your deployed data collection, you should choose a tool that is appropriate for your analysis methodology.

You will need someone on your deployed team who is familiar with installing and setting up the software, especially if you intend to employ it at multiple locations over a network.

REFERENCES

The latest version of the OCP software is available on the JALLC CRONOS website:

(http://nww.jallc.nato.int/NATOwide/Documents/Analysis%20Tools/OCP_5/) and is accompanied by support documentation.

4.5 HOW TO… REVIEW YOUR ONGOING WORK

WHY DO IT?

When deployed at an event, it is easy to lose focus on achieving your AOs. People sometimes try to use you as a means to vent their frustration over tactical and internal issues that are not your concern. It is also easy to find yourself slipping into evaluator mode. Regular reviews should prevent this from happening and ensure you make the most out of your deployed data collection opportunity.

WHAT IS REQUIRED?

An analysis plan including data collection plan. Recently collected data.

WHAT WILL YOU GET?

More focussed analysis that capitalises on the latest information you have received.

STEP-BY-STEP:

Ideally these steps should be carried out as a team and may also involve Reach Back to team members who did not deploy. If you are deployed alone try to find someone in-theatre to bounce your ideas off of, even if they do not know much about your tasking.

Review your data collection and analysis plans

Consider whether the data you have collected is consistent with your plans or whether you have failed to collect the data you required or collected extraneous data. It may help to use a structured thinking method to assist with this step.

- Where your data is consistent with the plan, take time to consider whether, now that you actually have it in your hands, it actually meets your needs. If it does not you may need to refocus your collection efforts.
- Where you are short of data, think about whether it will be possible to collect this data at a later time: if so, add the recollection task to your data collection plan; if not, think about the consequences for your analysis and adjust your analysis plan as required. If this lack of data will have a large impact on your analysis you should alert your customer that you may not now be able to deliver what was agreed. Discussing problems with the customer early gives you time to adjust your analysis to best meet their needs within the limitations you are facing.
- Where you have too much data, think about whether it can be of use or whether to discard it for the purposes of your analysis. Even if you discard it, it may still be useful to others and you should make an effort to find out who could use it, to ensure it is not lost completely and your efforts have not been wasted.

End-of-day discussions with your team during the event can be extremely helpful in consolidating what you have learned, sharing ideas and exploring the data collection from new angles. Even if you are each working on different AOs, there will probably be overlap in the data that each person has collected. These discussions can really help organise your own thoughts and provide great insight into aspects you may not have considered. The *Six Thinking Hats* method is a technique that supports this type of thinking (see Example).

If you are deployed alone, you need to find someone to discuss your ideas with regularly, whether it is a neutral confidant at the event or someone back at your home organisation.

Work out the impact of your data on your plans

Can you proceed as you planned or do you need to make changes? If you need to make changes, are they major or minor? Do you need customer approval for the changes?

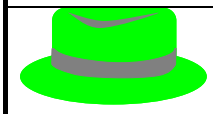
Revise your data collection and analysis plans to fit your evolving needs

Update your written plan so that you always have a written record of what changed, why and what the customer thinks about the changes.

EXAMPLE

The Six Thinking Hats method is used to explore different points of view on an idea or in this case on your data. It supposes the existence of six hats in different colours, each one representing a different way of thinking (see Table 8). When you figuratively put on one of the hats, it is mandatory to think only in that particular way. If you change your hat, you also have to change your way of thinking. Each person selects a hat and ideas are discussed. Hats are then changed until everyone in the group has worn all six hats. At the end of the session, the participants record their ideas and apply them to solving the problem. Considering your AOs using the *Six Thinking Hats* method will allow you to start a preliminary analysis based on the data you have collected so far and to generate ideas for adapting your plans to take new information into account.

Table 8 - Six Thinking Hats

Hat Colour	Meaning	Way of thinking
 White	***Information***	What information is available today to help you study this case? What information would you like to have? How could you get the information you think is useful and necessary to make a decision in cases like this?
 Red	***Feeling***	What is your intuition? How do you feel about this? You do not have to explain your feelings; you just have to transmit them to the other participants.
 Black	***Caution***	What should we be careful about? What are the disadvantages? What are the potential problems? What are the difficulties surrounding this question?
 Yellow	***Benefits***	What benefits does this idea have? What are the positive points? How is it possible to put this idea to work?
 Green	***Creativity***	How can this idea be improved by eliminating the existing problems and failures? How can we overcome the difficulties pointed out by the black hat? What alternatives do we have?
 Blue	***Thinking management***	Can you summarise the ideas that were exposed before? Can you get to one conclusion? What should be done next? Which hat should be next?

5
Post-Event Analysis

5.1 HOW TO… WRITE UP INITIAL OBSERVATIONS

WHY DO IT?

Writing up your initial observations as soon as you get back from deployed data collection allows you to check the validity of your data with Subject Matter Experts (SMEs) before you get too far into the analysis, to present a Quick Look Brief or Immediate Value Report and identify areas that you need further data or analysis to support. Initial write ups also provide a professional analyst with the information they need to support your analysis.

WHAT IS REQUIRED?

Raw data, word processing software, concept mapping software, Observation Collection Program (OCP) or any other tool you used to collect your data.

WHAT WILL YOU GET?

Raw data and thoughts presented written in a logical order that can be understood by others and serve as a permanent record of your data collection.

STEP-BY-STEP

Extract all of the observations that seem important.

Map out everything you relating to each observation.

Map out everything you know and everything you think about each observation. Concept mapping can be used for this. In this method you explore an issue by writing a summary of each idea relating to the issue in an oval separated from its alternative idea (if one exists) by an ellipsis (…). The ideas are then linked to each other according to whether one logically leads to the next. The resultant map can be used as the basis for providing a logical description of everything you know relating to an observation. An example concept map is included below in Figure 10.

Write up individual observations

The LLDb format of Title, Observation, Discussion, Conclusion and Recommendation can serve as a useful guide when doing this. Explanations of what these fields mean can be found in Chapter 6 of the first part of this Handbook.

Do not concern yourself with including evidence in your initial observation write up. If you have evidence put it in but if you do not have evidence, just write the statement anyway and highlight it as something to look at in your ongoing analysis.

The use of the OCP during the data collection is particularly useful for this approach because when you export your OCP data into MS Word, the observations are already formatted in this way.

Review the logic in your write up

Ensure that each point in the discussion is related to the observation, each conclusion has been discussed and justified and each recommendation follows directly from a conclusion.

WATCH OUT!

If you are not used to technical writing (in English), this task can be very time consuming and challenging. However, writing up your initial observations is unlikely to complete your analysis. Analysis is more than just a list of observations.

EXAMPLE

Figure 10 - A sample concept map exploring the observation that there were long queues at the X-ray

Figure 11 is an example of an initial write up of the observation in Figure 10. Look for how the write up follows the structure of the diagram. Stars (*) in this text show where analysis and data will need to be inserted later to substantiate this observation.

Observation: There were long queues at the security x-ray machine.

Discussion: Long queues at the security x-ray machine (* how long?) are causing passenger frustration with air travel in a number of ways. They are leading to:

- Increased costs to airlines that are being passed on to passengers. For instance, when queues at x-ray make passengers late (* any reports of this?), flights can run off schedule leading to an increased chance that the aircraft will be held in a stack and the airline will incur extra fuel costs (* is there a relationship between queuing time at x-ray and fuel costs?). Long queues also reduce the time that passengers can spend in the airport shopping (* how long are people spending?) thus reducing the revenue of these shops (* do people who spend more time shopping really spend more?) and increasing the landing fee incurred by airlines (* is this relationship true?).
- Increased total journey time for passengers (* by how much?), partly through the time they spend in the queue at the security x-ray machine but also due to other passengers holding up the aircraft because of their queuing time at the security x-ray machine.
- Higher levels of anxiety about missing flights as opposed to a welcome routine at check in (* do people really feel this?).

Ideally, queuing time at x-ray should be less than 3 minutes (* why, would this remove the problems?). One possible solution to reduce queuing time at the security x-ray machine may be to deploy more staff but there are no more staff so this is not

possible (* really?). It was observed that staff seemed to be standing idle half the time (* evidence?) so it may be possible to increase the efficiency of staff use (* probably outside the scope of this analysis to investigate).

It is perceived that if long queues at x-ray continue they will ultimately lead to an increase in the airport's reputation for inefficiency (* what is its current level?), particularly if passengers miss their flights as a consequence and a decrease in the airport's reputation for safety and security (* what is its current level?).

Conclusion: Long queues at the security x-ray machine lead to passenger frustration with air travel and reduced reputation for the airport. It is possible that they are a consequence of inefficient staff use and this should be investigated as a possible solution. Ideally queuing time at the security x-ray machine should be reduced to less than 3 minutes.

Recommendations: Investigate staff utilisation at the security x-ray machine to identify measures that could be taken to reduce the security x-ray machine queuing time to below 3 minutes.

Figure 11 - Initial write up of the observation

5.2 HOW TO… DIAGRAM YOUR DATA

WHY DO IT?

When you have gathered a mass of data on a similar topic diagramming it is the easiest and fastest way to start exploring it. Diagrams of your data are ideal as a basis to discuss your findings within and external to your team and in many cases can later be inserted directly into your final report. You should always attempt to visualise aspects of your data at least once during your analysis planning and again as soon as you get back from deployed data collection as this will help you to consolidate your understanding – if you can not diagram it, you probably do not understand it properly!

WHAT IS REQUIRED?

Raw data, a whiteboard/large piece of paper or visualisation software.

WHAT WILL YOU GET?

Diagrams of your data.

STEP-BY-STEP

Choose a data visualisation technique

Some options and how to apply them are: Influence diagrams, Cause and Effect diagrams, Reconstruction, Process diagrams, Organisation diagrams, Information Flow diagrams, Decision Tree diagrams, Venn Diagrams, your own creation as required!

Apply your chosen technique to your data

Adapt the technique as required to best fit your data and information requirement.

Table 9 - Suitability of some visualisation techniques

Technique	Description/Use
Influence Diagram	Influence diagrams are particularly useful in assisting you to identify the logical relationships that exist within your data and for mapping the logical thought process that underlies decision making.
Cause and Effect Diagram	The cause and effect diagram is also called the *Fishbone c*hart because of its appearance or the *Ishikawa c*hart after the man who popularised its use in Japan. It is used to: • Focus attention on one specific issue or problem. • Organise and display graphically the various theories about what the root causes of a problem may be. • Show the relationship of various factors influencing a problem. • Reveal important relationships between possible causes. • Provide additional insight into process behaviours. • Focus the analysis on the causes, not the effects or symptoms.
Reconstruction and Visualisation	Computer reconstruction and visualization are appropriate for tactical (and sometimes operational) analysis involving units or platforms. For example, assume an exercise involves units manoeuvring about the battlespace. The reconstruction determines the location of each unit and its relevant actions at points in time. Visualization refers to plotting the information onto a chart or map. Reconstruction and visualization are most appropriate for answering questions like “What happened?” or “Did the enemy penetrate the defensive perimeter without being detected?” Determining why events took place most often requires other techniques. *Narrative* reconstruction is appropriate at all levels of analysis and can include annotated timelines of events and descriptions of observed processes. Time-based narrative reconstructions are particularly useful when analysing the interaction between parallel processes. For example, a consolidated timeline is useful in understanding the timing of decisions taken by the Joint Force Commander with respect to the actions of forces and information reported by a Component Commander.
Process/Information diagram (flow chart)	Process analysis is used to decompose a macro-process or project into less complicated sub-processes to make the overall process more manageable and understandable by describing only a limited number of steps at any one stage.
Organisation Diagram	An organisation diagram can be used to show the C2, coordination and communication links between organisational entities. Entities are represented in boxes and linked with lines or arrows. More senior organisations are usually represented at the top of the page to show the hierarchy in place.

Technique	Description/Use
Decision Tree Diagram	A *Decision Tree* is a chart of decisions and their possible consequences, (including resource costs and risks) used to create a plan to reach a goal. Decision trees are constructed in order to help with making decisions. In analysis it is often useful to attempt to recreate the decision tree to better understand why particular decisions were made.
Venn Diagram	A *Venn* diagram represents how different groups overlap in their membership. It can be useful in representing how organisations or functions overlap.

Influence Diagram

Influence diagrams use shapes called nodes and arrows called arcs, which enable the diagram to function as a graphical representation of a system.

Nodes represent system variables. A rectangle depicts a decision—something that the decision-maker can affect directly. Ovals and rounded rectangles are used to represent deterministic and stochastic (chance) variables, respectively. A hexagon depicts the objective node—a quantity to be optimised (either maximised or minimised, depending on how it is expressed). Decision theory prescribes that the decision maker seeks the decision that maximises the expected utility.

Lines with arrows (called arcs) represent influences. Arrows into a deterministic or objective node indicate that the destination node is a function of the origin nodes. An arrow into a chance node expresses that the probability distribution on the chance node is conditioned on the values of the origin node. An arrow into a decision node is an information influence: it indicates that the value of the origin node will be known when the decision is made, and thus may affect that decision. The absence of a direct arrow between two nodes expresses the belief that the variables are independent of each other. An influence arrow does not necessarily represent a causal relationship from one variable to another. Influences can express evidential relationships that need not be physical relationships.

A reasonably priced software package that is designed specifically to support influence diagramming is *Decision Explorer* (an example of this software in use is in the How to… Write up initial observations section of this handbook).

EXAMPLE: Influence Diagram

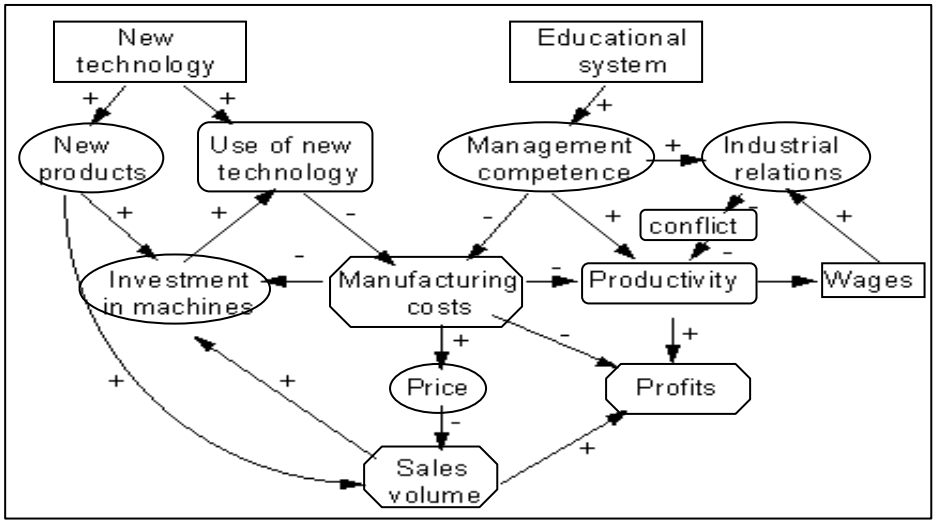


Figure 12 – Example Influence Diagram

Cause and Effect Diagram

The following 8-step procedure is used to develop a fishbone diagram:

Step 1: Clearly identify and define the problem, symptom, or effect for which the causes must be identified.

Step 2: Place the problem or symptom being explored at the right, enclosed in a box—the head of the fish.

Step 3: Draw the central spine as a thick line pointing to it from the left.

Step 4: Identify the major categories of possible causes (not less than 2 and normally not more than 6 or 7). Causes may be summarised under categories such as: Process, Organisation, Technology, Customer, Environment or Information.

Step 5: Place each of the identified major categories of causes in a box or on the diagram and connect it to the central spine by an angled line.

Step 6: Within each major category ask: "Why does this condition exist?" similar to the *Five Times Why* technique outlined below.

Step 7: Continue to add causes to each branch until the fishbone is completed.

Step 8: Once all the bones have been completed; identify the most likely root cause(s).

EXAMPLE: Cause and Effect Diagram

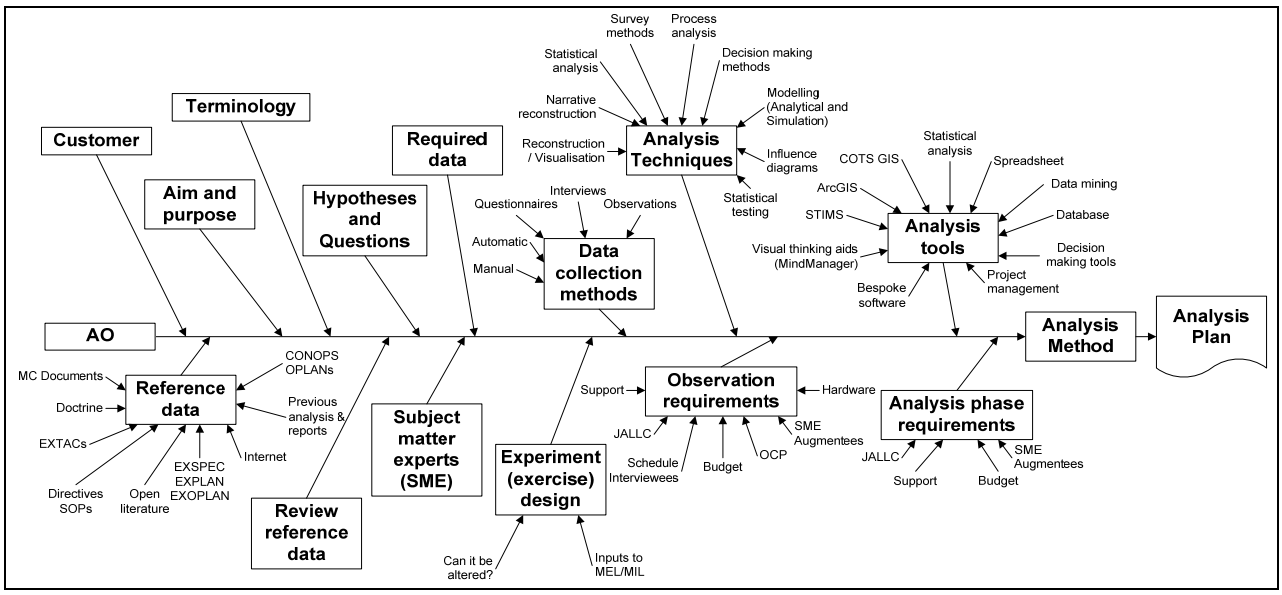


Figure 13 – A fishbone diagram demonstrating how to arrive at an Analysis Plan

Reconstruction and Visualisation

Originally, analysts did the reconstruction and analysis using paper logs and quartermaster techniques on charts or overlays. Today, GPS and computer tools such as the Shipboard Tactical Information Management System have greatly streamlined the process. The JALLC has had experience in the use of a few specialised programs for reconstruction/visualisation. Their details follow, but this list is by no means exhaustive:

- Shipboard Tactical Information System (STIMS): STIMS is an automated reconstruction and visualization tool. The program accepts navigation, contact and attack data from ships, submarines and aircraft; STIMS uses the data to reconstruct tracks for each unit. The analyst views the results via a variety of hard-copy outputs and an interactive display that shows the movement of

units along the reconstructed tracks overlaid with contact and attack information.

- GPS Utility (GPSU) and MapSource: The commercial *Garmin* product *MapSource* is available with *BlueWater* nautical charts and provides facilities for the visualisation of track data. It allows the interface of a PC directly with *Garmin* GPS receivers to download stored GPS tracks. Another product that has been used to support track visualisation is a small shareware tool called GPSU. This can be freely downloaded from the Internet. It is a simple tool but is surprisingly capable; for example, track data can be overlaid over any standard raster image (gif, jpg, png etc.).
- ArcGIS: ESRI *ArcGIS* is a commercial-off-the-shelf geographical information system (GIS). ArcGIS has been selected to support geographical mapping within NATO commands. Its main function is to allow the production of maps and to assist in the analysis of geographical data—e.g. where are the villages in Afghanistan that are more than 100 km from large population centres and are located at an altitude of more than 1500 metres? ArcGIS is a very powerful but complex tool that needs some investment in training before it can be used effectively. An ArcGIS specialist should be consulted if the analyst wishes to use the system.
- SIMDIS: SIMDIS is a set of software tools that provide two- and three-dimensional interactive graphical and video display of live and processed simulation, test, and operational data. SIMDIS has evolved from a US Naval Research Laboratory display tool for the output of missile models to a US government off the shelf (GOTS) product for advanced situation awareness and visual analysis. SIMDIS has multiple modes of operation including live display, interactive playback, and scripted multimedia, together with the capability to manipulate processed data and to visualise the results as charts, graphs and pictures. SIMDIS has a significant user base with over 4000 current registrations within the US and international defence community. It is available licence-free to accredited defence users.

Common sources of information for narrative reconstruction are operations logs such as the daybook of the Battle Watch Captain in an operations centre, regular Situational Reports and Joint Operations Centre event logs. Project management software is most useful for diagramming this type of information as it has the ability to construct timelines and Gantt charts.

EXAMPLE: Reconstruction and Visualisation

The JALLC has used MapSource to track helicopters in a SAR exercise and then visualise the track data for post mission analysis and GPSU to support the analysis of unmanned underwater vehicle naval mine hunting/surveillance trials.

A Gantt Chart of events could look like:

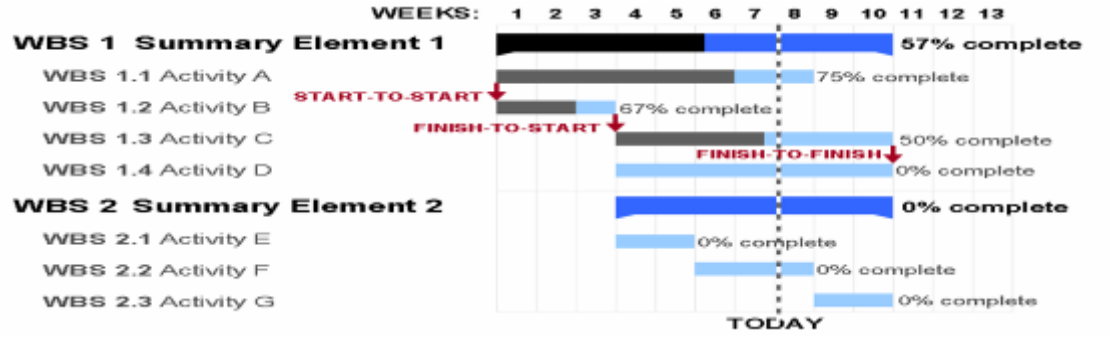


Figure 14 – An example Gantt Chart

WATCH OUT! Reconstruction and Visualisation

When using reconstruction the analyst must take into account potential sources of error in the reconstruction including:

- Inserting new points by calculation or estimation (interpolation) between known positions.
- Differences in clocks between reporting units.
- Lack of information on white (non-exercise, non-military) and grey (non-exercise, military) units within an exercise or operations area.

When conducting a narrative reconstruction from manually recorded sources and attempting to construct a unified timeline, the analyst should take into account that the priority of participants is on influencing events of the operation, not on recording data in logs. As a result, participants make most entries time-late and do not always record the times accurately. Collection of data by dedicated observers can help improve the quality of data used for time-based narrative reconstructions.

Flowcharts

There are two basic concepts that describe all systems: information and processes. Information provides us with knowledge and the way that things are organised (e.g. printed documentation, verbal communications, computer databases, etc.). A process is defined as something that operates on information and transforms it, either by changing existing information or by creating new information. Therefore, processes cannot stand-alone; they must have an input or an output or, generally, both. One particularly useful tool to visualize process and information flows is a flowchart.

To create a flowchart, a standard set of symbols is needed. The meaning of the symbols can vary from one organisation to another. Figure 15 illustrates a set of the most common flowchart symbols and can be used as a template if necessary. An example of a flowchart to support a proposed tactical process for naval mine warfare is given in Figure 16. A *cross-functional* flowchart can be used to illustrate which part of a particular organisation performs particular activities.

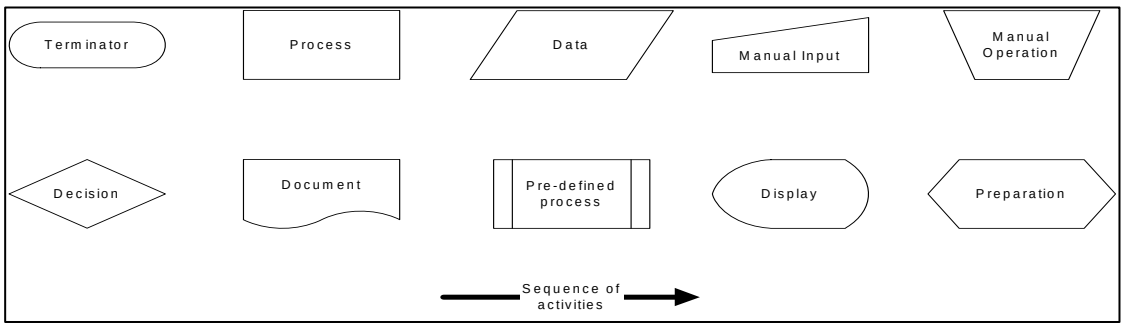


Figure 15 – Flow Chart Symbology

WATCH OUT! Flowcharts

Flowcharts are one of the most useful visualization tools since most military analysis tasks involve some form of process analysis. Understanding how to build and interpret flowcharts is a fundamental requirement for any military analyst.

EXAMPLE: Flowcharts

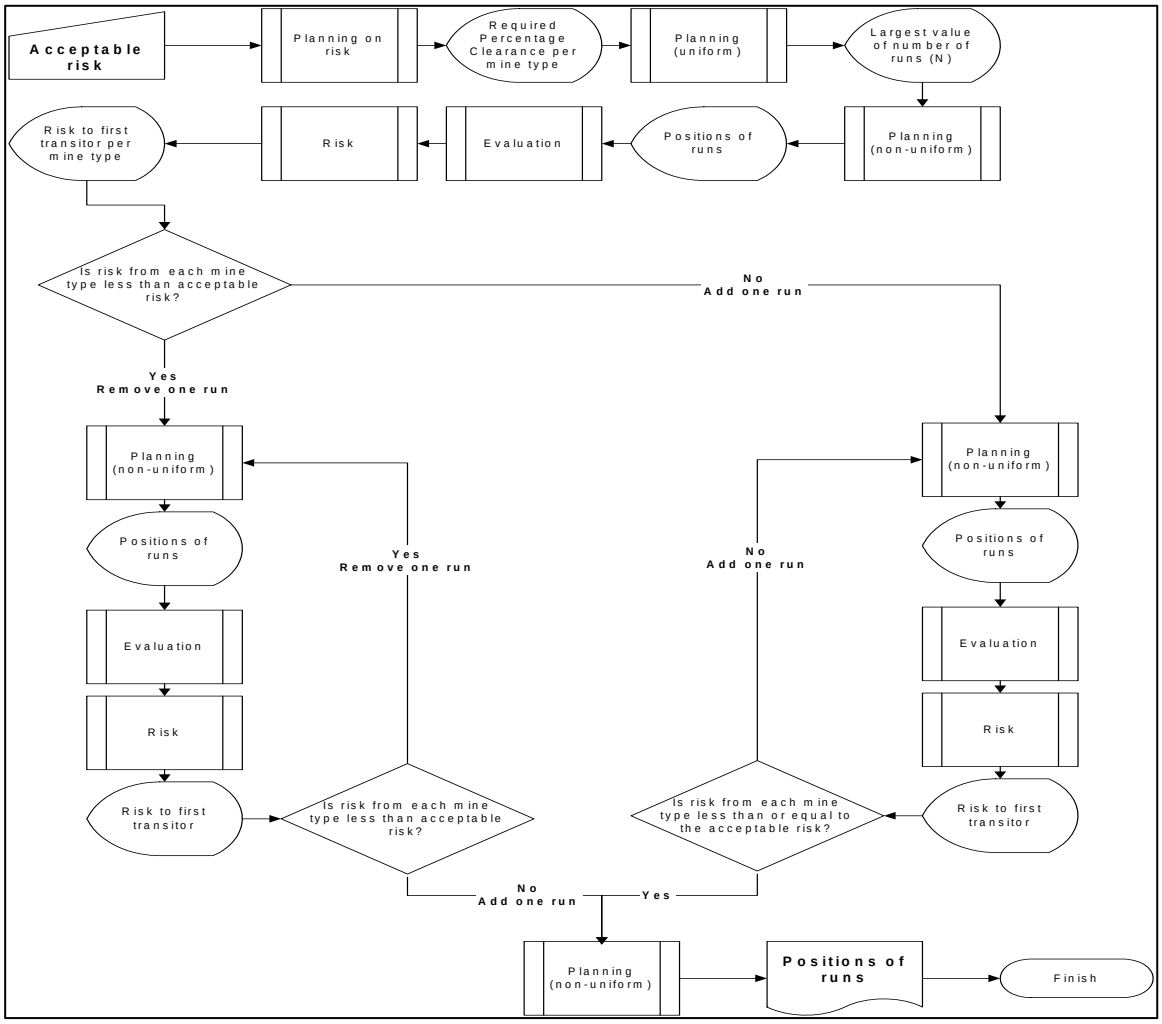


Figure 16 – Example Process Flowchart

EXAMPLE: Organisation Chart

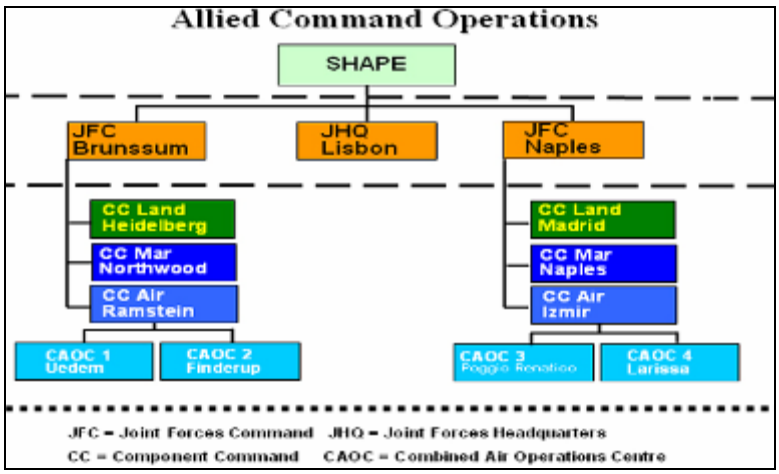


Figure 17 - Example Organisation Diagram: ACO Command Structure May 06[14]

[14] From: http://www.nato.int/shape/about/structure.htm. Last updated 15th May 2006.

EXAMPLE: Decision Tree

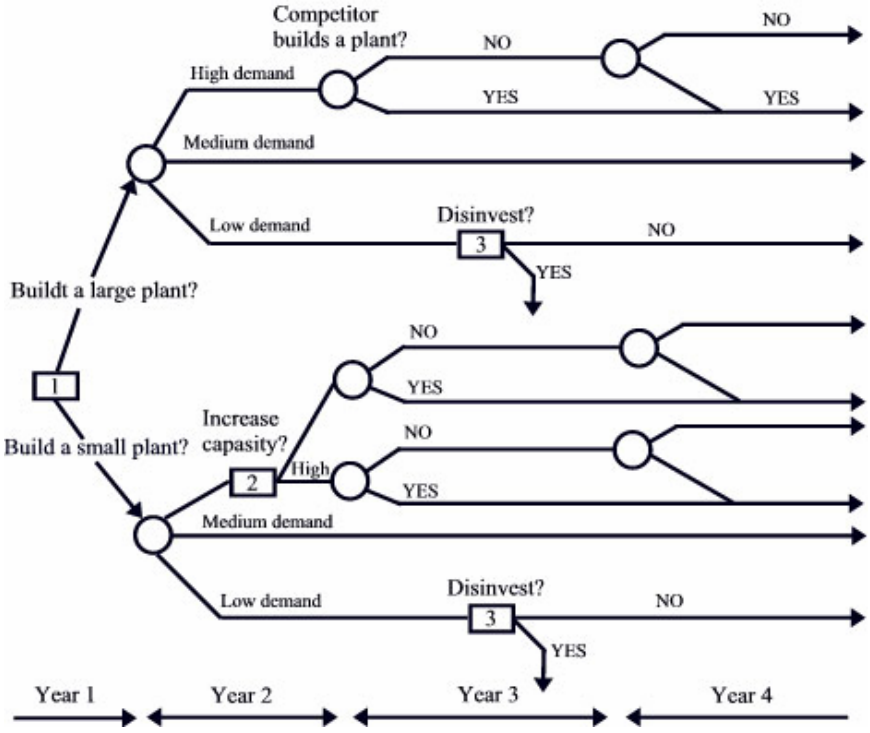


Figure 18 - Example Decision Tree[15]

EXAMPLE: *Venn Diagram*

This *Venn Diagram* shows instantly which nations are members of the EU and NATO and which nations are only members of one or the other of these international organisations in September 2007.

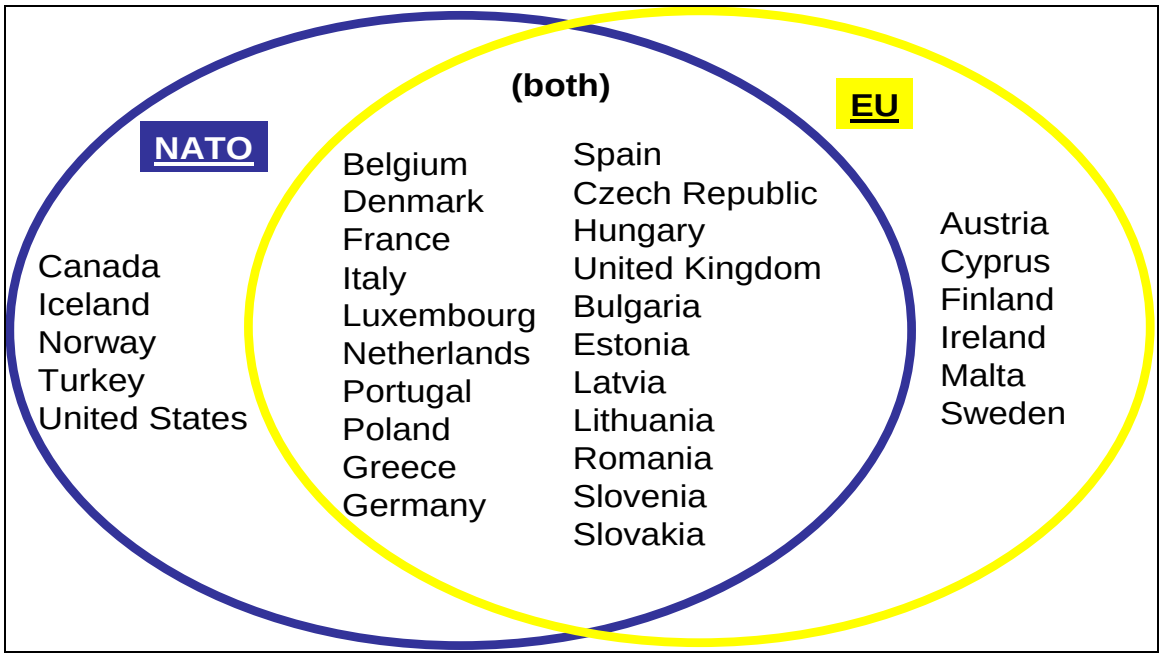


Figure 19- Example *Venn Diagram*: NATO and EU membership September 2007

[15] From: http://www.valuesim.no/valuation/tree_structure.html. Accessed September 2007.

5.3 HOW TO… PREPARE YOUR DATA FOR BASIC DATA ANALYSIS

WHEN TO DO IT?

When you have questions about whether there are trends in your qualitative data.

WHAT IS REQUIRED?

Raw data, Spreadsheet package

WHAT WILL YOU GET?

Data formatted for Basic Data Analysis

STEP-BY-STEP

Usually quantitative (numeric) data is instantly suitable for basic data analysis but you will need to convert your qualitative (textual) data to quantitative data before you can do basic data analysis on it. There are 2 main ways to do this:

Count your qualitative data

Divide your data into a categorisation system for which you have an interest in the numbers or proportions that occur in each category. You may need to devise your own categorisation system to do this but before you do so, do some research to see if someone has already created one that suits your needs – it will save a lot of time and brain power.

Good categorisation systems will allow you to divide your data so that it falls into many of the categories and all of your data can be placed into at least one category. If your data is already numerical and you have a lot, you should group it into bands.

Set up your categories in a spreadsheet and record how many of your data points fall into each category. If necessary, further divide your data by times / organisations / areas so that you can compare these different groups.

Code your qualitative data

Coded variables are transformations of direct variables. An example is the coding of a nominal variable such as sex into 0 for male and 1 for female (sometimes such a variable is called binary or dichotomous because it can only have two values). Other times the coding may be such that ordinal data are coded as integer values; for the example of air travel classes, assign 1 to first class, 2 to business and 3 to economy. When coding data this way, consecutive integer values are used. Another example of data coding is a "traffic light" system used to indicate the status of an activity: red, yellow, green; assign 1 to red, 2 to yellow and 3 to green, or vice versa depending on your particular requirement.

5.4 HOW TO… DO BASIC STATISTICAL ANALYSIS

WHEN TO DO IT?

Basic statistical analysis is used whenever you want to summarise numerical data including frequency counts. You should use it to summarise the answers you recorded from interviews and questionnaires as well as observations you made or were given of something over time or in different situations.

WHAT IS REQUIRED?

Prepared Data (see How to… Prepare Data for Analysis), Spreadsheet Package.

WHAT WILL YOU GET?

A better understanding of what is in your data, statistics for your data, diagrams of your data (see How to… Present Data in your Report), preparation for Advanced Data Analysis (see How to… Do Advanced Data Analysis).

STEP-BY-STEP

Find the average

The term average means the usual or ordinary level, amount or rate. There are three types of average you can calculate, the mean (often called average or the expected value), median or mode. Table 10 describes these fully.

Find the spread

The spread refers to how much variation there is in your data. Are all of your results very similar or are they very different? There are three types of spread you can calculate, the range, the interquartile range or the standard deviation. Table 10 describes these fully.

Visually represent it

Pictures speak a thousand words. There are a number of commonly used charts that may be appropriate for visualising your data including bar charts, histograms, line charts, pie charts, box and whisker. See Table 11 for when to use each of these. However, do not just stick to these, use your imagination!

Test for significance

In the event that you see some kind of trend in your data, you should form a hypothesis that describes what you think you can see in your data and test it to see whether what you see is strong enough to be quoted as an interesting result and is not just a chance occurrence. If you have not done this before, seek advice from a statistician or professional analyst. Table 12 lists some common tests and when they are appropriate.

Interpret

Once you have completed the above steps you should consider what they tell you about your data (the situation you are analysing). Were they what you expected? If not, why not? (check for errors in your calculations as this can be a common reason why the results of basic data analysis do not add up) What was going on that may have given you unexpected results? If they are what you expected, why? Was your original understanding correct or have you learned something new?

Exactly what you do in each step will depend on what type of data you have. The different types are: Categorical, Ordinal Textual, Ordinal Numeric and Continuous.

- Categorical (i.e., nominal): You know the number of data points in each category and you can not sensibly put the categories in increasing or decreasing order. This will come from Multiple Choice questions and some Text Open End questions or observations.
- Ordinal Textual: You know the number of data points in each category and there is a sensible way you can arrange the categories in increasing or decreasing order. This will come from rank/agreement scale questions and some Text Open End questions (see How to… Prepare questionnaires) or observations. Data from questions that ask individuals to rate items on a numerical scale such as from 1-5 is included in this data type.

- Ordinal Numeric: You know the number of data points in each category and your categories are whole or ranges of numbers from a continuous range such as years of military experience (e.g. less than 5 years, 5 to 10 years, etc) or periods of time.
- Continuous: You know the exact value of each data point and they are all numeric and from a continuous range of possibilities such as ages or times (but take care as whole numbers may be given and therefore the data is not truly continuous e.g. you would probably give your age in a questionnaire as 37 not as 37.67545).

WATCH OUT!

Only analyse data from the same population at the same time. If you ask the same question at different times to different groups, analyse data from each of the times/groups separately, do not group all of your data into one analysis. To compare the data from different 'populations', you will need to do some Advanced Data Analysis (see How to… Recognise a need for Advanced Data Analysis).

Do not quote the mean or standard deviation for data that is not continuous or ordinal numeric.

Do not quote anything apart from the mode for categorical data.

Always choose a chart that reflects as much of the information in the data as possible or make up your own if none of the standard ones is suitable.

Getting the results you expect does not ***prove*** you are right, it merely ***supports*** your ideas. Unexpected results are more valuable than expected results as they ***prove*** you were wrong and they lead you to thoroughly question what is going on to explain why they arose. **Question Everything!**

The recommendations provided here are only recommendations; you must use your judgement as to which methods best suit your data. It may be the case that the particular emphasis you want to highlight is clearer in a different type of graph than those recommended here. Discussing your approach with a professional analyst is sensible at this point.

Table 10 - Calculating basic statistics

To find the	Uncategorized Data	In Excel use	Categorised Data
Mean	Add up all items and divide by the number of items	=AVERAGE(…)	Add up the product of the middle of each category and the number of items in that category and divide by the number of items
Median	Line up all items in order from lowest to highest and take the item that is in the middle of the list (or the mean of the two middle items)	=MEDIAN(…)	Line up all categories in order and take the category that 50% of the items are the same as or below
Mode	The item(s) which occur the most	=MODE(…)	The category/ies with the most data in
Range	= Maximum value – Minimum Value	=RANGE(…)	= Maximum category with data in – Minimum category with data in
Interquartile Range	= Value (or mean of values) that lie 75% of the way through the data sorted lowest to highest – Value (or mean of values) that like 25% of the way through the data sorted lowest to highest	=QUARTILE(…,3)-QUARTILE(…,1)	= Category in which 75% of data lie or are in lower categories – Category in which 25% of data lie or are in lower categories
Frequency distribution	Number or proportion of data items that fall into different range intervals	=FREQUENCY(…)[16]	Number or proportion of data items that fall into the different categories
Standard Deviation	= $\sqrt{\frac{\sum_{i=1}^{N}(x_i-\bar{x})^2}{N-1}}$, where N is the number of items, x_i are the item values and $\bar{x}$ is the mean of the data	=STDEV(…)	As for uncategorized but take x_i to be the middle of the category the data point is in

Table 11 - Which chart when?

Chart Type	Recommended when…	Chart Type	Recommended when…
Pie	Your data is categorical	Histogram	Data is in continuous ranges
Box & Whisker	You only want to see the average and spread of the data, details are not important	Bar	Data is in categories with order and you want to see the full details of it

[16] Note that the Excel FREQUENCY function is an *array* function and needs to be used carefully: consult Excel Help.

Table 12 - Which Non-Parametric[17] Significance Test?

Significance Test	Use when…
Chi-squared	You have only one data sample. Your hypothesis splits your data into two or more categories, you have a theory on the number of subjects, objects or responses which fall into these categories, and your sample size is high enough that the expected value for each range of data is greater than 5.
Binomial	You have only one data sample. Your sample size is low and your hypothesis allows you to split your data into two categories and you have a theory on the number of subjects, objects or responses which fall into the 2 categories.
Kolmogorov-Smirnoff	You have only one data sample. Your sample size is low, and your hypothesis splits your data into two or more categories, you have a theory on the number of subjects, objects or responses which fall into these categories.
Wilcoxon One-sample Signed Ranks Test	You have only one data sample. Your sample size is low and your hypothesis splits your data into three or more categories and you are looking for a significant difference from a median value assuming the distribution of possible results is symmetric.
Wilcoxon Two-sample Signed Ranks Test	You have two related (paired) data samples e.g. between survey results taken at the start and end of an exercise, completed by the *same* respondent. Your sample size is low and you are looking for a significant difference between the two data samples.
Mann-Whitney U Test	You have two unrelated (independent) data samples. Your sample size is low and you are looking for a significant difference between the two data samples.

The result of a statistical test is a probability *p*. When interpreting the results of significance tests, the Table 13 may be used to describe the relative strength of the supporting evidence for your findings based on the magnitude of the probability *p*.

Table 13 - Significance testing

Value of *p*	Description
$p>0.1$	No real evidence
$0.1\geq p>0.05$	Little evidence
$0.05\geq p>0.025$	Suggestive evidence
$0.025\geq p>0.01$	Sufficient evidence
$p\leq 0.01$	Strong evidence

WATCH OUT!

There are many significance tests that can be used with varying amounts of what is termed "power-efficiency". It is best to consult an experienced practitioner before deciding which is the best test to use. The issue is further complicated by the correct use of one- and two-tailed tests.

[17] Non-parametric means that no assumptions are made about the way the underlying data is distributed.

EXAMPLE

The following examples show how to analyse questionnaire/interview data from different types of questions. Data from Text Open End questions can be analysed in the same way as Multiple Choice or Rating/Agreement Scale question data, depending on how you prepare it for analysis. Data from Numeric open end questions can be analysed in its raw form or in a frequency table as show below.

Categorical (from Multiple Choice or Text Open End questions, or observations):

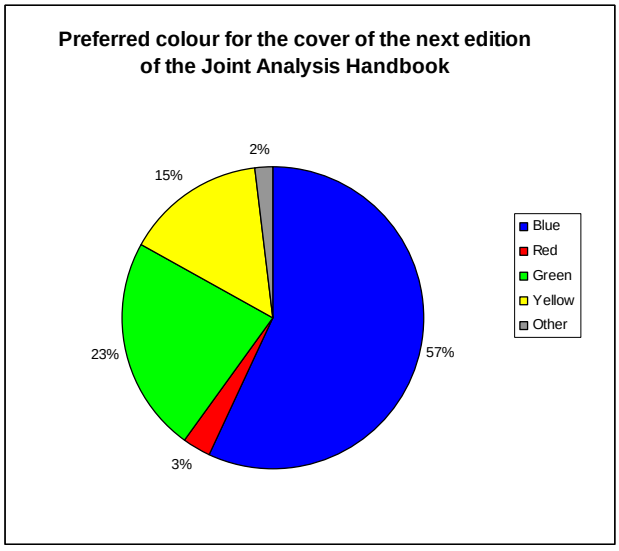
100 people were asked what colour they think the cover of the next edition of the Joint Analysis Handbook should be.

The results were:

Category	Number of Responses
Blue	57
Red	3
Green	23
Yellow	15
Other	2

The following basic data analysis was completed:

- Average. The only average that makes sense for this data is the Mode as the data has no order. The Mode is 'Blue' as this is the category that received the most votes.
- Spread. This data has no order so it does not make sense to calculate spread.
- Visualisation. The pie chart is most appropriate. The graphic is made more striking by colouring the segments according to the categories they refer to. Clearly over 50% of respondents preferred 'Blue'.



- Significance. It would be unwise to try to test this data for significance as the number of categories and lack of order in the categories make the test complex and there is a clear preference for 'Blue' out of all of the options.
- Interpretation. It is clear from the pie chart that most people, when asked what colour they would like the cover of the next edition of the Joint Analysis Handbook to be opted for Blue. We should probably stick with blue.

Ordinal Textual (from Rating/Agreement Scale, Text Open End questions or observations):

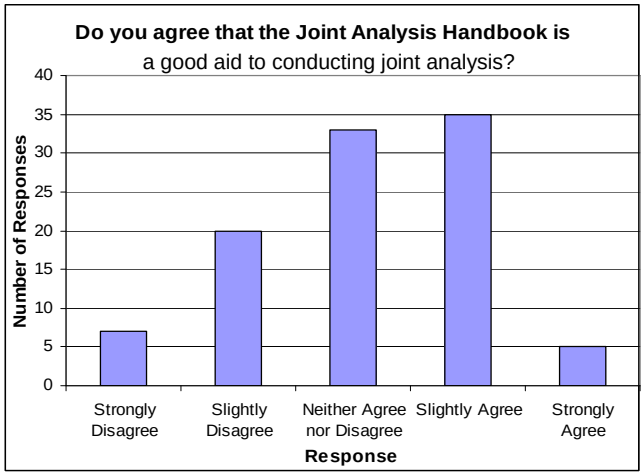
100 people were asked to indicate their feeling about the following statement: "The Joint Analysis Handbook is a good aid to conducting joint analysis."

The results were[18]:

Category	Number of Responses
Strongly Disagree	7
Slightly Disagree	20
Neither Agree nor Disagree	33
Slightly Agree	35
Strongly Agree	5

The following basic data analysis was completed:

- Average. The Median of this data is the category in which both the 50th and 51st responses lie when the responses are counted in order from lowest to highest. Therefore the Median is neither 'Neither Agree nor Disagree'. The Mode of this data is the category which had the highest number of responses. This is 'Slightly Agree'. These measures show that on average, there is only just slight agreement with the statement.
- Spread. The Range of this data is from 'Strongly Disagree' to 'Strongly Agree' as there were responses in both of these extreme categories. The Interquartile Range of this data is from the category with the 25th response (in order or category): "Slightly Disagree" to the category with the 75th response (in order of category): "Slightly Agree". These measures show that the responses are varied across all categories and slightly concentrated on the middle categories.
- Visualisation. A bar chart is most appropriate. Clearly the data are quite centrally distributed; there is not much of a lean towards either agreement or disagreement.



- Significance. In this example, we are interested in whether people significantly show preference for the statement. Since we expect more than five answers in each category we can use the Chi-square test. Our alternative hypothesis is that the answers show some preference and our null hypothesis is that individuals on average neither agree nor disagree with normal distribution (standard deviation as observed). The p-value of the chi-squared test under these conditions is 0.17 which is higher than the maximum value of 0.1 required for 'little evidence' given in Table 13.
- Interpretation. There is no real evidence to suggest people showed strong agreement or disagreement with the statement that Joint Analysis Handbook is a helpful aid to conducting joint analysis. On average people neither agreed nor disagreed with the statement and only a small number of people showed strong agreement or disagreement. We're probably doing OK ☺

[18] This sort of data categorisation is frequently referred to as 'Likert' data, named after the person who developed them, Dr Rensis Likert, whose family name can be traced back to the old Latin noun 'licer' meaning 'geeky statistical dude'.

Ordinal Numeric (from Numeric open end questions or observations):

This is when your categories are ranges of numbers. In this case you can use the centre value of each numeric range to calculate the mean and standard deviation and produce a histogram as visualisation. Parametric[19] Significance Tests may be appropriate; Table 14 provides a mapping of parametric tests to the non-parametric tests detailed in Table 12.

Table 14 – Non-parametric and parametric tests equivalency

Type of data	Non Parametric Significance Test	Parametric Significance Test
One sample compare to another fixed value	Wilcoxon One-sample Signed Ranks Test	Student's one sample t-test
Two samples of related (paired) data	Wilcoxon Two-sample Signed Ranks Test	Student's two sample paired t-test
Two unrelated (independent) data samples	Mann-Whitney U Test	Student's two sample t-test

Continuous (from Numeric open end questions or observations):

For this you leave your data in its raw form and calculate the mean and standard deviation and produce a histogram as well. Parametric Significance Tests can often be used (Table 14).

REFERENCES

To find out how to do these tests, search for them on http://mathworld.wolfram.com/ or refer to a text book; Reference N is recommended.

5.5 HOW TO… DO ADVANCED STATISTICAL ANALYSIS

WHY DO IT?

Advanced statistical analysis allows you to look for trends in numerical data. You should use advanced statistical analysis to support hypotheses that relate one variable to another, comment on trends over time, or group data points together according to their similarity.

WHAT IS REQUIRED?

Numerical data set where each data point has at least two values associated with it, e.g. an individual's answer to the same question before and after the event, the time taken for delivery, length and priority of different messages. Knowledge of advanced statistical analysis methods and, depending on the method, a spreadsheet package or other specialised statistical software.

WHAT WILL YOU GET?

Evidence in support of or against your trend hypotheses and an understanding of new trends that may require further investigation.

STEP-BY-STEP

The following is a list of some advanced statistical analysis methods and their use.

[19] Unlike non-parametric tests, parametric tests make certain assumptions about the way the data is distributed. The Normal or Gaussian distribution is usually assumed, but other distributions, such as binomial for probabilities, may be appropriate.

Decide whether you need to use any of these methods or similar ones

Table 15 - Some Advanced Statistical Methods

Method	Use …
Significance Testing	When you want to find out whether 2 or more sets of data really have different means or just appear to be different (i.e. the difference is in the noise).
Regression Analysis	When you want to find out what the relationship between one or more variables is. Answers the questions: Are they related? How strongly are they related? Is the relationship positive or negative? How does one variable vary with the others? It has many flavours… Simple linear regression is for one dependent and one independent variable where the relationship between them is assumed to be linear; i.e. a straight line if a scatter diagram were drawn. Multiple linear regression is for more than one independent variable. Non-Linear regression is for a non-linear relationship between the dependent and independent variables. Non-Linear means that some type of curve is expected on a scatter plot of the data. Non-Linear usually involves transforming the variables to be linear and then applying the appropriate linear regression techniques. Non-Linear regression can include logarithmic, polynomial, power and exponential relationships between the dependent and independent variables. Binary/dichotomous non-linear regression includes logistic regression and probit regression, which are used when the dependent variable can only assume one of two states, sometimes referred to as a binary or dichotomous variable.
Principal Component Analysis	To reduce multi-dimensional data to fewer dimensions by combining many variables into one. Allows you to plot multi-dimensional data on a two-dimensional graph. Mathematical combinations of variables can often be translated into real world meaning.
Cluster Analysis	To reveal the underlying groups in your data.
Time Series Analysis	You want to analyse how your data is changing over time. Are there seasonal trends? Is there an upward or a downward trend? Is it chaotic?

Consult a professional analyst

Or use a text book as a last resort to get advice on whether you have chosen the right method and how to apply it.

Apply the method

WATCH OUT!

Looking up any of the above methods in a text book will give you a step-by-step guide to applying them, but advanced statistical analysis is sometimes more of an art than a science and there are many subtleties to the methods that only experience and academic rigour can work around – always seek the advice or assistance of a professional analyst when using these methods.

Always double check your application of these methods, particularly when the results are surprising. The temptation is to assume you have made a new discovery and get carried away reporting your findings before you have thoroughly checked your

calculations. In most cases like this, you will find you made a mistake and the correct result is as expected.

Relationships found using advanced statistical analysis do not prove causality. For instance if you compare students' test scores in mathematics and English, you may find that students with high mathematics scores also have high English scores, but that does not mean that being good at mathematics causes a student to be good at English. In fact, in this case, common sense tells us that both scores are probably a consequence of a third variable, the student's intelligence. It is not always this obvious; ensure you get an SME to review your interpretation of your results prior to reporting.

EXAMPLE

Examples of each method's findings:

Significance Testing: Suppose you ask the same set of people how much they know about a topic before and after their training and you want to know whether the knowledge has improved. A Significance Test would show whether the average level of knowledge is *significantly* higher after training than before. Significantly in the statistical sense means that the difference is extremely unlikely to be noise in the data and is therefore likely to be due to a change in the answers. For this situation, if you asked the same people before and after the training period, you would end up with *paired* data and therefore a paired test is appropriate (Table 12 and Table 14).

Regression: Suppose you collect data on successfully tracked contacts and the sensor mix in use at the time and you want to know which sensors have the greatest influence on successful tracking. Treating the sensors as binary variables, either in use or not and using logistic regression would tell you how much of the variation in successful tracking is caused by each sensor.

Principal Component Analysis: Suppose you collect individual's views on ten different statements and want to plot the individual views on a chart. Principal component analysis would give you formulae for adding up an individual's views to give two composite view scores that will let you plot the individuals on a scatter diagram.

Cluster Analysis: Suppose you collect individuals' views on ten different statements and want to know whether the individuals fall into groups with similar viewpoints. Cluster Analysis would identify these groups if they exist and tell you which individuals are in each group.

Time Series Analysis**:** Suppose you collect data on a regular basis about the amount of fuel used and you believe it has increased over time. Time Series Analysis would tell you whether there is an underlying upwards trend or whether your belief was wrong.

5.6 HOW TO... IDENTIFY THE NEED FOR MATHEMATICAL MODELLING

WHY DO IT?

Models (including simulations) mathematically represent some part of the real world. The analyst can use models and simulations to either organise existing data into meaningful information or to predict the future. Identifying the need for mathematical modelling is important as it will affect your choice of data collection. If you have not used mathematical modelling before, you will need support from a professional analyst.

WHAT IS REQUIRED?

Data about the system and Analysis Objectives (AOs).

WHAT WILL YOU GET?

Prediction and characterisation of the system you model.

STEP-BY-STEP

Decide whether you need to use any of the methods listed below

Table 16 provides a list of some mathematical modelling methods and their use. Consider your AOs and data to decide which is the most appropriate for your analysis task.

Table 16 - Some Mathematical Modelling Methods

Method	Use …
Linear Programming	Linear programming typically deals with the problem of allocating limited resources among competing activities in the best possible way.
Queuing Theory	Queuing Theory deals with the range of waiting line/queuing problems.
Weapon System Effectiveness	Weapon System Effectiveness deals with operational availability as well as reliability and maintainability aspects of the weapon systems.
Simulation	Simulation can be broadly defined as a method of duplicating a real-world operation by other than formal analytic techniques.
Decision Theory	Decision Theory deals with the problem of decisions that must be made with varying degrees of knowledge about the conditions under which an operation or action will take place.
Analytic Hierarchy Process	Analytic Hierarchy Process is a special version of a decision-making problem and appropriate when you have lack of data.
CPM/PERT	CPM/PERT are project management techniques, which have been created for industrial and military establishments to plan, schedule and control complex projects.
Network Analysis	Network Analysis can be used to identify critical points or people in technical and social networks and the structure of these networks.

Consult a professional analyst to find out if other methods may be appropriate

There are too many potential mathematical modelling methods to mention them all in this handbook. A professional analyst should be able to advise you on whether any methods not listed here would be suitable for your analysis.

WATCH OUT!

It is important for the analyst to remember that models and simulations are abstractions of reality, not reality itself. Therefore, before using a model or simulation, the analyst should be satisfied that the assumptions made by the model or simulation are appropriate for answering the questions posed by the AOs.

EXAMPLES

- During World War II, U.S. and British operations researchers used a mathematical model to organize intelligence and operational data into an estimate of the operational search rate experienced by ASW planes hunting for German U-boats in the Bay of Biscay. Changes in the search rate alerted the operators to changes in German tactics and equipment and provided a means for measuring the utility of changes made by the Allies as well. This is an example of using models to organise data into useful information.

- In designing a surveillance plan, the planners/analysts may use a simulation to predict the likelihood of detecting and identifying the contacts of interest within the assigned area. This is an example of using a simulation to predict the future.
- Linear Programming: Allocation of search effort over different search areas in order to maximize search effort.
- Queuing Theory: Communication call centres where your call is queued.
- Weapons System Effectiveness: Guns malfunctioning during exercise.
- Simulation: War games both manual and computerised.
- Decision Theory: Proper selection of Course of Action for rescue operations.
- Analytic Hierarchy Process: Decisions where only the relative importance of factors is known (do you consider factor A to be more important than factor B), elicited by asking SMEs.
- CPM/PERT: Planning for the Pakistan Earthquake support operation.
- Network Analysis: Messaging networks.

5.7 HOW TO… REVIEW AND CONSOLIDATE YOUR ANALYSIS

WHY DO IT?

During your analysis you will find yourself working on a number of distinct areas at a time, all contributing to the Analysis Requirement (AR), but none meeting it in its entirety. Reviewing your analysis is required to remind yourself of the link between the individual elements you have been working and the AOs, and therefore to the overall AR. Consolidating your analysis is the act of joining it up into one story that answers the AOs and ultimately meets the customer's AR as a whole.

WHAT IS REQUIRED?

Completed or partially completed analysis, AOs, AR.

WHAT WILL YOU GET?

An overarching answer to your AO that will form the central theme for your reporting. A feel for where extra data collection and analysis may still be necessary to meet the AOs.

STEP BY STEP

This task is like a synthesis of your analysis that draws it all together under one unifying theme to answer the AO.

Concept map the elements of your analysis

This is described in How to…Write up initial observations above but instead of mapping raw ideas, this time you will be mapping the high level findings from your analysis.

Write up a summary of your concept map

EXAMPLE

Suppose your AO was to analyse the effectiveness of a unit in order to identify areas of shortfall and during your analysis you had developed a number of observations about what was working well and what was not working well. In this task you would consider all of your observations together and make an overall judgement of the effectiveness of the unit. Then all of your observations would be reported in relation

to their impact on the overall effectiveness and the customer would get a sense of how important each observation was to the overall effectiveness of the unit.

WATCH OUT!

This task is like taking a step back from your analysis and looking at the big picture. It can be immensely helpful to involve someone independent during this task because when you have worked hard on a topic, it is often hard for you to detach yourself from the detail without help. This is a good task in which to involve a professional analyst as they will be experienced in logically pulling ideas together.

5.8 HOW TO… DERIVE RECOMMENDATIONS

WHY DO IT?

Once you have completed your analysis and arrived at evidence based findings you are ready to derive recommendations. Recommendations are specific statements of what action should be taken. It is useful if your recommendations include a proposed action body.

WHAT IS REQUIRED?

Completed or partially completed analysis, Analysis Objectives (AOs).

WHAT WILL YOU GET?

Sensible and defendable recommendations and proposed action bodies.

STEP BY STEP

For each analysis finding list the obvious recommendations

Obvious recommendations are often suggested to you during your data collection. Make sure they are supported by your analysis and if they are not, do not blindly regurgitate[20] them in your work. You may include unsupported recommendations in your discussion so that you can explain why they are not supported by your analysis.

Look for non-obvious recommendations

Revisit the DOTMLPF-I categorisation system (see How to… Split up your analysis) and for every finding, think about whether you need to add recommendations in any of the categories you have not already covered.

Some tools for thinking may facilitate you in developing new recommendations.

One useful method for thinking through this step is Standing In The Future. This is a very simple concept for generating ideas and is similar to the Phoenix Scenario (described next). However, in this method the group is divided into teams, each of which writes an article dated 3 years in the future. The topic of the article is how the problem was solved. The team needs to design the headline, and talk about the steps that were taken, who the key players were, and what strategies led them to this breakthrough. They are writing the article as if they were standing in the future looking back. A nominated team member reads the story out to the whole group. Ideas that arise for the discussion of each story should be captured.

The Phoenix Scenario is a method used to capture ideas. The name of the method comes from the legend of the phoenix rising from the ashes and the idea is to remove all prejudice by beginning conceptualisation from scratch. It aids in building understanding of where final ideas came from. The method involves dividing a group into teams of two to three people and then tasking each team to design a process,

[20] Regurgitate: *verb* repeat (information) without analysing or comprehending it.

the organisation to support the process, and the required technology from a clean sheet of paper. Approximately three hours should be allowed for this activity. Each team should present their results for discussion by the whole group. The Phoenix Scenario is useful for developing new processes or courses of action.

Look for relationships between recommendations

For instance, do any recommendations need to be completed before the others can start? Do all of the recommendations need to be completed for an improvement or would some do? Do your recommendations have a priority order?

Check your facts

Your recommendations are the part of your analysis that will receive the most attention. Take the time to finally think through their consequences and satisfy yourself that they are the right things to recommend.

Contact your proposed action body to find out whether your recommendation is appropriate. Are they the right people? Are they already involved in similar action? Are there any constraints/restraints that will prevent them from performing the action? Is there anything that can contribute to your analysis in support or against your recommendations? All these issues need to be known before the recommendation can be completed.

Find out whether what you have recommended is popular or unpopular, who is it supported by? Lots of people? Senior people? If it is unpopular, why? Are these reasons justified or not? Presenting this information will lend weight to your recommendation and increase the likelihood that it is acted upon.

WATCH OUT!

Your recommendations should not be restricted to what you were told should happen, as this may not always be correct in the light of your analysis. Be creative and do your research to ensure the recommendations you propose are viable and appropriate.

Make sure you have got your facts straight before you finalise your recommendations.

Failing to check your facts and to contact the proposed action body prior to publication of the report is likely to lead to embarrassment and a reduced chance of your recommendations being accepted.

Make your recommendations specific. Very broad statements are rarely useful as most of the time the customer already knows what he needs to fix. If you can not make it specific, then it is not an outcome of your analysis and it is not appropriate for you to report it as such. You should use the understanding you built up during your analysis to recommend how it should be fixed.

Do not be tempted to force recommendations out of thin air. Sometimes an observation or a finding (conclusion) is just that and while it is relevant to report it in the analysis, it will not spawn any recommendations.

6
Reporting

6.1 HOW TO…WRITE JOINT ANALYSIS REPORTS

WHY DO IT?

The importance of writing a good report cannot be overstated, because as good as the analysis results may be, they are worthless if you can not successfully communicate them to others. Reporting is more than just writing things down, it is about conveying your message.

WHAT IS REQUIRED?

Complete or very nearly complete analysis and derived recommendations.

WHAT WILL YOU GET?

A permanent record of your analysis findings and associated recommendations.

STEP-BY-STEP

Specify your target audience and the stated purpose of the report

A report is a means to convey a message to an audience. You must decide who you are writing for and what your message is before you start planning to write, as it will affect everything: which parts of your analysis you report, how long the report should sensibly be, and how much detail or evidence you need to present. In some cases, it may be necessary to produce more than one report to convey different messages to different audiences.

Plan the structure of your report

The following gives a good outline to consider when writing your report, but keep in mind that **"no one size fits all"**. It is essential to plan a structure for your report that will convey your message. Work up a draft structure *before* you start writing. It is a good idea to use something like *MindManager* to help you group your thoughts. (See How to… Build a data collection plan). The structure and logical flow of the report are essential to its quality. It is not enough to just write good English.

Introduction: The introduction explains why the analyst is writing the report and provides a brief outline of the contents. The introduction should cover the following topics:

- The purpose of the report including who requested/tasked it;
- The report layout;
- The AR and AOs;
- The analysis methodology and approach used.

Background: This section should cover everything you need to explain to your reader so that they can understand the analysis that you have done. For instance, state the things that you assumed in your work, e.g. if you analysed a process and are going on to discuss issues with it, use this section to explain the ideal process that you compared everything to. If you feel that extensive background material is required for some members of your intended audience, it may be best to provide that material in an annex and refer the reader to its existence. The background should also contain a section presenting the factors that may have adversely or positively affected the outcome of your analysis.

Results: This section presents, discusses and interprets the results of the analysis. The following issues should be presented:

- Context: a clear, concise series of statements detailing relevant environmental factors and conditions surrounding or significantly contributing to the fact, issue or area, constraints during collection or time restrictions.
- Why it happened: a discussion of the analysis carried out along with the proximate causes of the observed effects that lead to the overall conclusions or findings.

One good way to organise this section is along the lines of the AOs. If the operation, exercise or experiment has multiple AOs and each requires a fair amount of discussion, consider making each its own chapter. If you used the Observation Collection Program (OCP) to organise data collection during the event, then an alternative approach to organising the discussion chapter is to present summaries of the OCP observations organised according to the primary AO they address. (OCP is described in more detail in the section on How to… Use OCP to record deployed data collection in this handbook) If the AO being addressed is sufficiently broad that a number of separate themes emerge during the analysis phase, then each theme can be given a separate chapter. A short summary section at the end of each theme chapter may be a good idea.

Conclusions: (Findings): The conclusion section presents the interpretation and summary of the results and tells the customer of the important findings or implications of the analysis. Ensure that the conclusions reference the relevant paragraphs in the discussion as supporting evidence. A frequent error made by inexperienced analysts is that the conclusions are actually written as recommendations (something *should be done*).

Recommendations: Used as required. Each recommendation must be supported by and reference the conclusion(s) upon which it is based and provide a succinct list of recommended actions suitable for a decision-maker to consider. It is sometimes useful to present the conclusions and recommendations under the DOTMLPF-I headings (see How to… Split up your analysis). Depending on the style and content of your report, an overall Conclusions and Recommendations chapter or section may be more appropriate.

References: If there are many references, it is generally appropriate to place the references as a separate section of the document at the end of the main body.

Annexes: The purpose of an annex is to supply important background information that supports the reader in understanding the main body and to provide for the long-term storage of information that may be of use in the future. Helpful information may include a glossary of terms, raw (or nearly raw) data such as responses to questionnaires, and details of any mathematical modelling done. Make sure you refer to the existence of your annexes as a source of further information in your main body. If you do not then your reader may never know that they are there. Consider publishing large annexes separately from the main report. In the case of very large annexes, electronic publishing on a CD or similar media, or posting to a web site, may be the best option.

Executive Summary: Write this last even though it will appear first in your report. The Executive Summary is a summary provided for the Flag/General Officer who, in all likelihood, does not have time to read the entire report. The Executive Summary seeks to inform the reader on the real significance of the report and to encourage the reader to seek out the further supporting information in the main body of the report. The Executive Summary should be 1-4 pages in length and no longer than 10% of the report body. It should be written with clarity and highlight the major conclusions and recommendations. The Executive Summary should cover the following topics:

- The agreed AOs.

- The major conclusions concisely stated. Minor issues and conclusions should not be included in the Executive Summary as they may distract the busy reader from the key issues.
- Focused recommendations from the conclusions given in the Executive Summary.

Write clearly, simplicity is king!

Use simple, ordinary words whenever possible. This is especially important for non-native English speakers, whether author or reader. For example, *commence* and *begin* have the same meaning; but, begin is much simpler to read and understand. The slight nuance in meaning between the two words is unlikely to be important. Writing with impressive words makes the reader's job more difficult. Consider the difference between these two sentences.

> Subsequent to NATO's implementation of the subject doctrine, it is incumbent upon you to advise your organisation to comply with it.
>
> After NATO starts using the new doctrine, you must tell your people to comply with it.

Write in active voice sentences. They are easier to understand, have simpler structures and help your reader connect the actor with the actions. The time to use passive voice is when the actor is either unknown or unimportant. For example, "*When we arrived, the gate was locked*," is appropriate if we do not know who locked the gate or do not care.

Do not avoid personal pronouns. Trying to avoid personal pronouns leads to more complex sentence structures and (by suppressing the actor) tempts you to overuse passive voice. A commonly given reason for avoiding personal pronouns is to set an objective tone for the text. The more likely outcome is to confuse the issue. For example, compare these sentences:

> It is recommended that NATO change the doctrine. (Who is making the recommendation—the authors or some outside experts?)
>
> We recommend that NATO change the doctrine. (Much, much better since it clearly identifies the authors as the source of the recommendation.)

Write in concrete terms. Use examples, stories and comparisons to illustrate your points. Consider the examples in this section. We could have eliminated them without losing any meaning, but the examples help to illustrate the meanings and give concrete examples for the suggestions.

Do not use an analysis report to promote an agenda or offer opinion. Keep it objective and factual. Conclusions and recommendations must be thoroughly supported by the facts and arrived at with logic the reader can easily follow. Likewise, do not make insinuations or try to couch sensitive subjects in euphemism. Instead, clearly state what you want to say, and be prepared to back it up with facts. Remember, it is a scientific report, not a newspaper editorial.

<u>Layout:</u>

Write in short paragraphs. Long paragraphs make it harder for your reader to extract the information he or she is after. If your paragraph contains lists or multiple examples, use bulleted lists or sub-paragraphs to break up the text.

When laying out your text, let your word processor's predefined styles do the work for you. They have been designed by experts and will produce a more pleasing result than you will with the space bar, tab and carriage return.

Use the layout of your document to draw attention to your main points. Judicious[21] use of bullets, sub-paragraphs, text boxes and tables and figures can greatly add to the visual appeal and ease of understanding of a document.

Bulleted Lists:

Bulleted lists and subparagraphs help emphasize examples and make it easier for readers to find each item in a list. Some general rules:

- Prefer subparagraphs to bulleted lists when you are writing one or more complete sentences for each item.
- Do not mix sentences and sentence fragments in the same list.
- Do not use punctuation at the end of the phrase if you are using sentence fragments.
- Use a parallel structure for the items in a list. For example, in this list each item starts with a verb in the imperative form.
- Use more than one bullet or subparagraph at a time unless you need to emphasise an example.

Figures and Tables:

Illustrations, diagrams, data tables and even text boxes can be very effective in presenting or elaborating on complex ideas. If large or complex, consider placing them in an annex.

Use an application designed for creating drawings and manipulating pictures such as *Microsoft PowerPoint* or *Visio* for pictures rather than the drawing facility of the word processing software, and a spreadsheet like *Excel* or the built-in features of *Word* to create tables. Do not include the figure caption or title in the PowerPoint/Visio version. Use the word processing software captioning function for that instead.

Stylistic considerations for figures include:

- Design figures to be read from top-to-bottom and left-to-right, the same way we read English.
- Be generous with white space within the figure.
- Use short phrases, symbols (such as % or &), and abbreviations to keep labels within the graphic short. Labels need not be complete sentences.

Insert figures following their first mention in the text. Ideally the figure will appear before the next paragraph. Depending upon the size of the graphic and the flow of text, sometimes the figure will not fit on the same page with the referring paragraph. In those instances, the figure should appear at or near the top of the next page.

Format your report according to internal procedures.

Each NATO command or organisation should have internal procedures for document production, including style layout and staffing procedures. This may also include templates for analysis reports. JALLC has a Writing Procedures SOP and a well-developed Analysis Report Template that can be shared with any other interested organisations.

There is no single NATO publication that governs NATO-wide writing and formatting standards. The following internal directives from other headquarters can provide general guidance and insight into how various NATO bodies prepare staff work. Some may be directly applicable to your organisation or command.

- International Military Staff, SOP-1 Ed 13 – *Staff Procedures*, dated January 2005. Annex A is a style sheet for IMS written products. This SOP is purely internal to the IMS.

[21] Judicious: *adjective* having or done with good judgement; sensible.

- STANAG 2014 – *Formats for Orders and Designations of Timings, Locations and Boundaries*. Current Edition is nine, dated 17 October 2000. Essential guidance for drafting operational plans and orders.
- ACO, *Guidelines for Operational Planning*. Current version is Revision 1, dated 01 August 2005. Chapter 7 lists formats for operational planning documents (OPORDs and OPLANs).
- ACO Directive 35-4, *Preparation of Correspondence*. This directive applies to SHAPE and all ACO commands.
- ACT SOP 502a *Internal and External Correspondence* and *502b Documentation other than Correspondence*. These SOPs are applicable internally to HQ SACT and provide useful information, as well as document templates, for preparation of written products.

WATCH OUT!

Report writing is difficult. It becomes easier with practice, but as with many other aspects of analysis devoting a lot of time to planning the structure of your report will save you a lot of time and pain later. Writing with no plan of how you expect to convey the most important messages will almost certainly end in a mess.

While a picture says a thousand words, figures and tables are not a substitute for clear explanation. Whenever you include a figure or table, you must direct your reader to look at the important parts of it in a way that supports your point.

Remember that it is **your** report and needs to convey **your** message in the best possible way. Write the report in the way this is best achieved.

EXAMPLE

Previous JALLC analysis reports can be found on the JALLC NS WAN site (http://nww.jallc.nato.int) and show a variety of ways to present Joint Analysis.

REFERENCES

The following is, with the exception of the first item, an arbitrary list of references on using the English language. Each one has merits and certain are, in our opinion, essential guides that every writer of English should have next to the keyboard.

- *The Concise Oxford English Dictionary*, 11th Edition. The official English language Dictionary of NATO.
- *Roget's International Thesaurus*, 6th Edition, Harper Collins, 2001. Every writer should have a thesaurus available.
- *The Elements of Style*, 4th Edition, by Strunk and White – this pocket sized book is a must have for all writers, and is especially easy to use for non-native speakers. (Reference O). An electronic version is available at http://www.bartleby.com/Strunk-W
- *Defence Writing Guide*, published by the UK Ministry of Defence is an excellent reference for military writing standards. (Reference P)
- *The Naval Institute Guide to Naval Writing*, by Robert Shenk, is another excellent source for military writing and formatting. (Reference Q)
- *The Associated Press Stylebook*, is a comprehensive A to Z listing of standards of English usage for journalism (differs somewhat from military usage) plus an extensive bibliography for further references and a short summary of media law. (Reference R)

6.2 HOW TO…CONSTRUCT A LOGICAL ARGUMENT

WHY DO IT?

The purpose of writing an analysis report is to inform your audience of your conclusions and recommendations. Logical arguments are necessary to demonstrate that your conclusions and recommendations make sense. Flawed logic can damage the credibility of your report, even when you have your facts straight, and make it difficult or impossible for the reader to understand your message.

WHAT IS REQUIRED?

Your analysis findings, conclusions and recommendations and supporting data.

A draft outline and/or *MindMap* of your analysis findings and how they relate to each other.

WHAT WILL YOU GET?

A logical, easy-to-read and credible report.

STEP-BY-STEP

State a thesis giving the "answer to the question"

Any logical argument starts with a statement of what you intend to explain and briefly how you will explain it (your thesis). In the case of a Joint Analysis report your theses should be responses to your customer's Analysis Requirement and/or your Analysis Objectives. In many ways, the AR/AOs are like essay questions and your full analysis report is like an academic essay or research paper to answer them.

You should always state your thesis at the beginning of a logical argument to prepare readers to view all of the analysis results that follow in the context of whether they support your thesis or not. This will make your results more meaningful to your reader and help them to remember your results. To appreciate this idea, think about how easy it is to remember directions when you can relate them to a map compared to how difficult it can be when you have no prior knowledge of the area.

Stating your thesis at the beginning focuses you on providing appropriate evidence to support it and identifying inappropriate evidence that should be left out.

Construct an argument

A simple approach to presenting a logical argument is the *Five Paragraph Essay*. A *Five Paragraph Essay* is structured as follows:

- The first paragraph is used to state the thesis and introduce the main ideas that will be used to support it, normally three, but they can be two to five. Fewer ideas indicate you have too little evidence and therefore a weak argument. Too many ideas, and your argument will be too long for most readers to follow easily.
- The following three paragraphs are used to provide details for each of the three main supporting ideas.
- The final paragraph is used to summarise the case and state the conclusions that can be drawn from the argument.

In a good argument your main supporting ideas will be joined up in a way that logically supports the thesis and leads to the conclusion. You can use deductive or inductive reasoning to join your ideas up.

Deductive reasoning presents a line of reasoning that leads to a 'therefore' conclusion. For example:

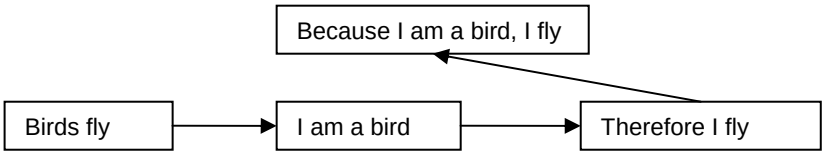


Figure 20 – Deductive reasoning

Deductive reasoning is usually the type of reasoning you use when you explore your data looking for findings.

Inductive reasoning defines a group of facts or ideas to be the same kind of thing and then makes a statement about that sameness. For example:

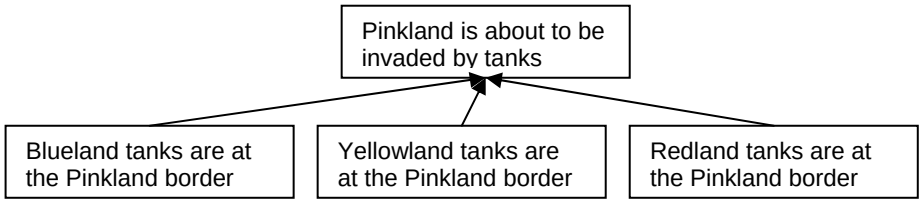


Figure 21 – Inductive reasoning

Inductive reasoning is less natural than deductive reasoning. It requires creativity to group ideas as well as to infer their significance. The conclusion will depend on the data and assumptions in place. Here it is assumed, among other things, that Blueland, Yellowland and Redland are Pinkland's enemies and are amassing their tanks outside the Pinkland borders.

Generally, it is easier to read and understand a document where the ideas are joined using inductive reasoning. This is one reason why constructing logical arguments in writing is so difficult—it requires you to translate the straightforward deductive reasoning you used to arrive at your conclusions into inductive reasoning that will make your findings clear to your reader.

Use layers to present complex arguments

The Pyramid Principle (Reference B) describes a powerful method for clearly presenting complex arguments in writing by using a hierarchical approach. Essentially it involves using many levels of the *Five Paragraph Essay* approach to present your data in an easy to understand way.

You put the most important idea—your thesis—at the top of a pyramid and then layers of supporting ideas and evidence spread out beneath your thesis. You can include as many ideas as you need to fully explain your findings (see Figure 22).

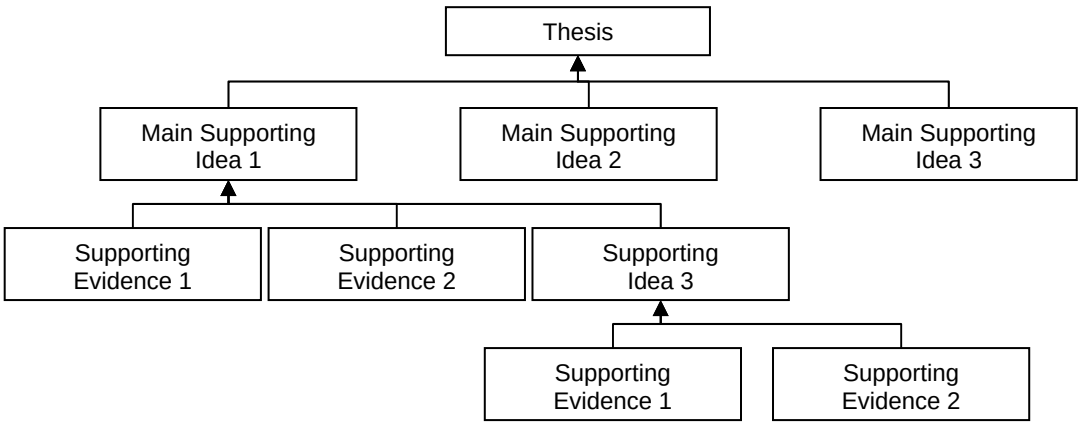


Figure 22 – Logical arguments using the Pyramid Principle

Address any counter-arguments

Readers will naturally think of their own explanations for your results or recommendations when they read your report and if their ideas do not match yours (they can think up counter-arguments) then they will be inclined to dismiss your report.

It is essential to the credibility of your work that you address as many possible counter-arguments to your logic as possible. It is always the case that only one counter-example is needed to undermine your findings. For instance, suppose you conclude that "all inefficiencies were caused by poor training" and so you recommend "improving the training will prevent all inefficiencies". Then only one example of a well-trained officer being inefficient would undermine your finding and suggest that improving training will not prevent all inefficiencies because it is not the only root cause of the inefficiencies—you have missed something.

The best way to identify possible counter-arguments to your logical arguments prior to publishing your report is to ask for comment on your draft from as many relevant individuals as possible. You should incorporate responses to valid comments in your report so that you pre-empt queries from others who think along the same lines.

WATCH OUT!

While a good outline and/or *MindMap* is crucial for organising your thoughts and your report, you will still need to translate the relationships represented in them by lines, arrows, bubbles, and bullet points into sensible, English prose. Good command of connecting words like, *however*, *nevertheless*, and *because* will greatly help you make these translations. An outline or MindMap is rarely intelligible to anyone other than the author and merely cutting and pasting elements from them will result in a similarly unintelligible report.

You will have collected a lot of specific data during your analysis project and there will be a strong urge to attempt to include each and every interview quote, opinion expressed or statistic in your report. Do not do this! Data that is not directly relevant to one of your arguments makes your report longer and more complicated than necessary and distracts attention away from your key findings, thus reducing the effectiveness of your report. Data items that do not make it to the final report are not wasted, they have helped you to build your overall understanding of the topic.

Any factual errors in your report will invalidate your analysis results, so they cannot be tolerated at all.

EXAMPLE

Previous JALLC analysis reports can be found on the JALLC NS WAN site (http://nww.jallc.nato.int) and illustrate a variety of ways to structure and present logical arguments.

REFERENCES

The US Naval War College publishes a *Writing and Style Guide* that describes how to write graduate-level academic research papers. The principles it presents are exactly and directly applicable to writing joint analysis reports. It can be found on the Naval War College internet website at:

http://www.nwc.navy.mil/academics/course/jmo/overview.aspx

The Pyramid Principle, by Barbara Minto describes a powerful method of presenting strong, logical argument in writing. (Reference B)

6.3 HOW TO…WRITE LLDB ENTRIES

WHY DO IT?

The NATO LLDb is the only NATO-wide repository of observations, lessons identified and lessons learned from NATO activity. Writing up an observation, lesson identified or lesson learned from your analysis ensures it gets visibility at the Bi-SC level and is available to other commands. It is also a very useful way of reviewing whether your recommendations are really supported by your analysis. Sometimes it is appropriate to write up your analysis in the form used in the Lessons Learned Database (LLDb). You may have findings in a Joint Analysis Report that meet the criteria for entry into the LLDb and may be included in the report in the exact format they would take in the LLDb. This is also a simple and convenient format for presenting certain detailed analysis results, but does have limitations.

WHAT IS REQUIRED?

Word processor, concept mapping software.

WHAT WILL YOU GET?

A standalone write up of your findings suitable for entry into the NATO LLDb.

STEP-BY-STEP

Follow the steps in How to… write up initial observations

This time, ensure that you format your observations using the following headings:

Main Applicable Objective (Title): This should encapsulate the essence of the lesson in such a way as to give a reasonable indication as to content. A short but explicit title will make it easier to use when presented through the LLDb.

Observation Description: A short description of what happened or the observed effect. The observation can describe a success (best practice) or a failure (problem) and should be limited to a single problem or issue.

Discussion: The discussion explains why the observed issue happened and describes the causes of the observed effect. Reasons for success or failure are mentioned and the circumstances are discussed.

Conclusion: The conclusion is a summary statement that describes the real issues raised by the observation and discussion. It follows logically from the different aspects developed in the discussion. New issues or factors that are not contained in the discussion must not be introduced in the conclusion. The conclusion should be reviewed to ensure that it is not actually a recommendation.

Recommendation: Provide advice on what must be done to repeat the success or to avoid the problem in the future. The recommendation should follow logically from the observation, discussion and conclusion. New issues or factors that are not directly or indirectly addressed earlier must not be introduced in the recommendation.

Support your statements in your discussion

Insert evidence arising from your data collection and analysis to support the statements in your discussion. Ensure there are no unsupported statements. If you do not have hard data to support your statements, a thinking technique like Five Times Why may allow you to generate convincing evidence for your statements from judgement and opinion. Five Times Why is a very simple technique to try and determine the original causes of observed effects or problems. It consists of asking the question *why?* as many times as possible. Most problems are solved in less than five iterations.

The technique can be used on an individual or group basis and it consists of:

Step 1: Clearly state the problem.

Step 2: Answer the question “Why has this happened?”

Step 3: Write down the answer to this question.

Step 4: For the answer given you should again ask *why* and so on and so on.

Review your entry for logical consistency

For each entry, start from the recommendations and work back through the entry to find the conclusion that the recommendation logically follows from and then the discussion that logically leads to the conclusion. Fill any gaps in your logic before you submit it to the LLDb. It can help at this stage to use concept mapping software to map out the path your discussion takes to reach your conclusion and recommendation.

Enter it into the NATO LLDb

The classified NATO LLDb is hosted on an NS WAN server physically located at the JALLC. The role of the NATO LLDb is to support management of the Lessons Learned Process. It is used to track the staffing of observations and LIs from operations, training, exercises and experiments through to development of the remedial action plan and to monitor action plan progress. The LLDb supports the review of observations, by allowing all NATO users to comment on the inputs to promote discussion of issues raised. Action plan milestones are recorded in the LLDb and the Action Body reports progress against them. There are both unclassified internet and classified NS WAN databases.

NATO LLDb Link: http://jallc-lldb.jallc.nato.int/

WATCH OUT!

Make sure your language is consistent throughout. Using different wording to state the same things might show off your vocabulary but it is very confusing to constantly restate the same idea in a different way.

While the LLDb entry format is a good way of presenting a single, fairly simply issue, this layout is too structured to do justice to more complex issues made up of many interrelated ideas. The format is therefore normally inappropriate for most formal analysis reports.

6.3 HOW TO… PROOF READ AND INCORPORATE IMPROVEMENTS

WHY DO IT?

Most organisations employ some form of quality control process. This process is not something you can rely on to fix your errors, but something whereby an independent eye will be cast through your work to ensure it is understandable and logically consistent.

WHAT IS REQUIRED?

A draft write up, at least one but not too many independent reviewers.

WHAT WILL YOU GET?

A high quality product approved for release.

STEP BY STEP

Conduct Basic Checks

Consistency and clarity are essential. Thoroughly read through your report and ensure that all names are stated in the same way and consistently with AAP-6. For instance, JFC Brunssum should not be JFC B. It is your responsibility to get this as correct as possible prior to handing in your document for review. Make sure all

acronyms are expanded on their first use and included in a complete glossary. Ensure references are given in the required format. Use consistent capitalisation. Be precise, if you say ISAF, do you mean COM ISAF or ISAF HQ or what? If you say NATO, do you mean ACO, ACT or NATO HQ? Sloppiness like this will make it hard if not impossible for others to understand your work.

If English is not your first language, try and find a friendly native English speaker to help you get your sentences right. However, beware, good English does not imply a good report, it is only one aspect required; others being the logical structure and the content (which hopefully you got right in the last phase!)

Review the logic

All bulleted lists should be of the same type, i.e. if they are actions, they should all be actions, if they are suggestions they should all be suggestions, mixing suggestions with causes, for instance, is extremely confusing for the reader and should never be used.

Often when you write, you will end with a summary, conclusions or recommendations or all three. These work much better when they are written in the same paragraph order as they appeared in the discussion. If you have a particular conclusion or recommendation that you think is more important than the others, then your discussion should be structured to ensure this point is touched on first.

Every sentence should state a verifiable fact or be a logical consequence of other sentences. All verifiable facts should be linked to a logical consequence sentence or paragraph, otherwise, they are superfluous and an unwanted distraction for the reader. Less is more.

No recommendation should exist without a conclusion to motivate it and discussion leading to that conclusion. Again it is important that you use consistent language, choose words that say what you mean and stick to them. It will reinforce the message. Changing words may make you sound like you have a great vocabulary but makes it infinitely harder to read and understand for anyone else.

Incorporate Improvements

Everybody you show your document to will have a different opinion of what you should write, what is good and bad about it and what you should not write. People do not comment just to make your life miserable. If someone makes a comment on your report, you should listen and try to understand why it troubled them. Do not dismiss it, do not blindly accept it, use it as an opportunity to improve your work. Only accept what makes sense, only dismiss what does not. Maintain control of your document and make the changes yourself. Do not forget, it is your document. YOU must be confident in what is eventually published.

Distance yourself from your draft and do not get emotional. You will have pored hours of your life and stressed a lot in getting to the draft but now you have to take a step back and be brutal, deleting or rewriting whole sections may be required to finally arrive at a high quality end product. In some cases what gets deleted or rewritten may have been very high quality work by itself, but in the context of the final report, it may not fit.

WATCH OUT!

It is your responsibility to ensure your document reaches quality standards and it is in your best interests to perform some basic checks prior to submitting it for review. This will speed up the review process. Equally, when you hand your document in for review, your role is far from complete, it is your responsibility to incorporate suggested improvements from the review or justify why you believe the suggestions are not valid.

The document review process can be very time consuming, plan at least 4 weeks to complete the review for an analysis report and up to 8 weeks if you are new to analysis or not fluent in the language you are trying to write in.

When seeking feedback, more is not necessarily better. Quality is better than quantity: only request feedback from people you really believe have something to contribute. Everyone you ask will try to put their own ideas into your work and the more feedback you get, the harder it can be to resolve it and incorporate it.

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Action Body	Organisation tasked to implement or facilitate the implementation of an approved action.
Active Data Collection	Data collection directly relating to the AO. Usually involves direct interaction with the system being analysed. E.g. interviews, observations. Predominantly takes place during the deployment phase of analysis although can start much earlier.
Analysis	The study of a whole by thoroughly examining its parts and their interactions.
Analysis Objective (AO)	An analysis objective is a clear, demonstrable and achievable tasking that identifies is derived from the analysis requirement. It will have a tangible output.
Analysis Requirement (AR)	A generic statement of the desired end state and strategic objectives of analysis that identifies the customer.
Conclusion	Similar to a finding, a statement that summarises the real issue. For instance, 'all of these problems seemed to stem from the fact that our procurement process is too slow.'
Customer	A person/ organisation that the analysis is sent to directly support in their decision making. Not always the person/ organisation who proposed the AR.
Evaluation	In the military field, the structured process of thoroughly examining activities, capabilities and performance against defined standards or criteria.
Finding/ Result	A concise statement based upon observations, data or information.
Hypothesis	A supposition or proposed explanation that can be tested and is made on the basis of limited evidence as a starting point for further investigation.
Joint Analysis	An analysis approach, typically employed by JALLC, used in support of joint operational and strategic LL processes.
Lesson Identified	An observation for which a remedial action has been developed and an action body to carry out the remedial action proposed.
Lesson Learned	Results from the implementation of a remedial action that produced an improved performance or increased capability.
Observation	Noted phenomena prior to analysis, diagnosis or interpretation.[22]
Operational/Operations Research/Analysis	The application of advanced analytical methods to help make better decisions.
Passive Data Collection	Data collection indirectly related to the AO, with the aim of building overall understanding of the system. Generally it does not involve direct interaction with the system being analysed e.g. review of reference documents. This predominantly takes place prior to the deployment phase of analysis although it can also be necessary at other times during analysis.
Qualitative	Relating to or measured by quality i.e. things that can be categorised. Usually textual or numbers based on judgement.

[22] Note that this definition of observation is different from that given in the Bi-SC Lessons Learned Directive 80-6 dated 23 July 2007, which distinguishes between 'raw' and 'mature' observations; the definition here is similar to that given for a 'raw' observation.

Quantitative	Relating to or measured by quantity. I.e. things that can be counted or measured numerically.
Recommendation	A statement of specific actions that are recommended to address the issues raised in the conclusions/ findings. May include suggested timelines and action bodies. ‘Conduct a review of the procurement process with a view to identifying ways to speed it up’
Remedial Action	A possible action that serves to rectify a fault or to improve conditions.
Stakeholder	A party who is likely to be affected by or have an interest in the outcome or conduct of the analysis.
Validation	Determines if the issue that was originally observed has been successfully rectified by the remedial action carried out in accordance with the action plan.
Variable	A variable factor or quantity.

NOTES