Disruptive Technology Assessment Game

‘DTAG’

Handbook

V0.1

Executive Summary

What is the DTAG?

The Disruptive Technology Assessment Game (DTAG) is a table-top seminar wargame, used to assess potential future technologies and their impact on military operations and operating environment.

How is it played?

There are four distinct steps in executing a DTAG experiment. The first two are part of the planning process, prior to playing the game.

Step 1: Identify Possible Future Technologies that are under development and are of interest to the military.

Step 2 – Create Ideas of Systems (IoS) cards from the technologies identified. Specific technologies, or combinations of technologies are combined with equipment to create new systems that could be employed by the military or by an adversary. These are described on cards.

Step 3 – Play the DTAG. Figure 1 summarizes the process. Red teams and Blue teams both plan courses of action in the context of a scenario & vignette. After the initial confrontation of plans, which establishes the baseline, the teams plan again with the addition of future technology from the IoS cards. The second confrontation highlights the effect that the technology has on the plans and the wargame outcome.

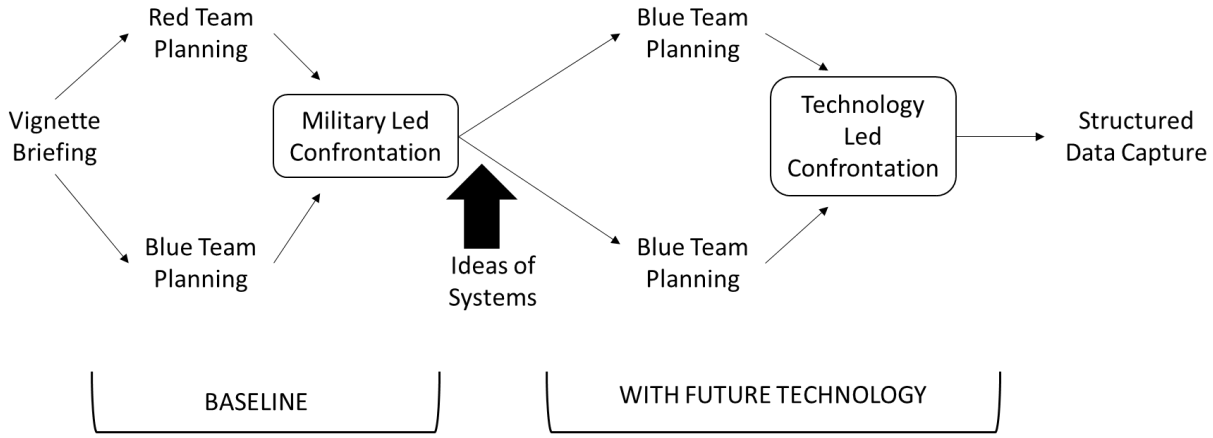

Figure 1: The DTAG Process

Step 4 – Assess the results of the wargame through questions and analysis of data captured.

Who plays it?

The DTAG unites Technology experts, Military and Analysts providing a broad perspective on the potential impacts of future technology on military operations. The approach allows for an element of unconstrained thinking and the wargame-like rounds encourage open communication opportunities.

Why should a DTAG be played, and when?

It is most useful when assessing technology that is a prototype or at early stage of development, or technology that is not in widespread use by the military. It can be used as part of a 'technology watch' program or for strategic decisions regarding which technology areas to focus on for investment or additional research.

How does the DTAG differ from a CDAG?

The Concept Development Assessment Game (CDAG) was inspired from the format of the DTAG. Whereas the DTAG focuses on assessing the impact of future technologies, the CDAG focuses on assessing conceptual documents. DTAGs are often adversarial (Blue vs Red team) whereas CDAGs are often played by Blue teams only.

Example Applications

A DTAG was successfully run to assess the impact of Autonomous Systems on military activities and how these systems may be countered.

For more information see the DTAG website or contact Sue Collins: sue.collins@act.nato.int or (757) 747 3121.

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Chapter 1 – Introduction

Aim of the DTAG Handbook

This handbook is intended to be a guide for use by analysts, experimenters or any staff who are considering designing a Disruptive Technology Assessment Game (DTAG). The handbook describes points to consider when designing a DTAG.

The DTAG was developed by a multi-national team of researchers through NATO's Science and Technology Organization in 2010. The original method is described in the SAS-062 and SAS-082 reports[1]. This handbook aims not to replace these reports but to summarize them in a more accessible manner.

If you have any suggestions for amendments to the handbook please contact sue.collins@act.nato.int.

Introduction

The international defence community often wants to obtain common understanding regarding technologies that might have a significant effect on the future operating environment. These so called "disruptive technologies" may impact the nature of future threats, required military capabilities, and therefore affect long term planning. The need to bring together the technological and the military perspective can be organized in an interactive process – the DTAG – which leaves room for a general discussion of methodological as well as military/technological observations.

A Disruptive Technology is a technological development which changes the conduct of operations (including the rules of engagement) significantly within a short time and thus alters the long-term goals for concepts, strategy and planning. Examples may include the use of autonomous drones instead of trucks to deliver supplies, or 3-D printing of weapons on demand.

The DTAG is an effective analytical method for assessing the potential impact of future technology on military activities. It is a table-top wargame, bringing together military planners, technology experts, and scientists. The technology is depicted on cards, and is assessed within an operational context provided by a scenario and vignettes. Despite its name, it requires no specialized technology systems or simulation software.

When to use a DTAG

The DTAG is best played when assessing technology that is in the early stages of development and is not yet in common use in society or by National military forces. It is

[1] Accessible from www.sto.nato.int

not appropriate to test specific effects of already-developed technology e.g. it should not be used to calculate the range of weapons systems.

The DTAG is best played in the context of a larger research project or campaign of work. The results of the DTAG can then inform this campaign.

The format of the wargame is simple and can be adapted for other uses.

What to use a DTAG for

A DTAG can be a very effective method when studying the impact of future technologies on military activities (e.g. course of action planning, military operations). A variation of the DTAG is where, instead of focusing on technologies, the focus can be on more generic capabilities that are enabled by technology e.g. improved force protection enabled by rapid hardening technologies.

A DTAG can be used to prioritize a broad set of technologies or capabilities. For example, research may show that a vast range of technologies will be available for commercial use in the future, however the defence community cannot afford to invest in all of the technologies (or their counter-measures). The DTAG can be played in order to prioritize the investments on the small number of technologies that will have the biggest impact on the military, or to prioritize the investments in capability that counter technology used by adversarial forces.

Why use a DTAG?

A DTAG can reduce the risk of failure of a technology or capability-focused project, by using the technology / capability in a theoretical, low-risk environment before further investment.

A DTAG requires minimal technology or facilities; it simply requires meeting rooms and people. Technology is represented on cards, so does not need to be available, or even invented yet. Therefore a DTAG can be conducted at relatively low-cost.

Chapter 2 – Game Set Up

There are some important considerations in the process of setting up a DTAG:

- Identify Possible Future Technologies
- Create Ideas of Systems (IoS) from the Technologies Identified
- Identify team players and roles
- Create a scenario / vignettes
- Create a planning template
- Develop a data collection and analysis plan
- Venue and room set up

Identify Possible Future Technologies

The first step is to identify potential technologies that are under development and may be of interest to the military. This can be done through workshops with technology experts or research, e.g. using open-source information such as newspapers, technology magazines or the internet. Many NATO Nations also have experts who research potential future technologies, and NATO ACT consider this through the Strategic Foresight Awareness project.

The outcome of this step is to describe each potential technology in a common format, including a description of the technology, possible uses and limitations. The technology does not have to be available as a demonstration; therefore future technology not yet developed can be used. In previous DTAGs, a Technology or T-Card was created, as in Figure 2. In other DTAGs, the technology was described in a report, and the only cards created were IoS cards (see next step).

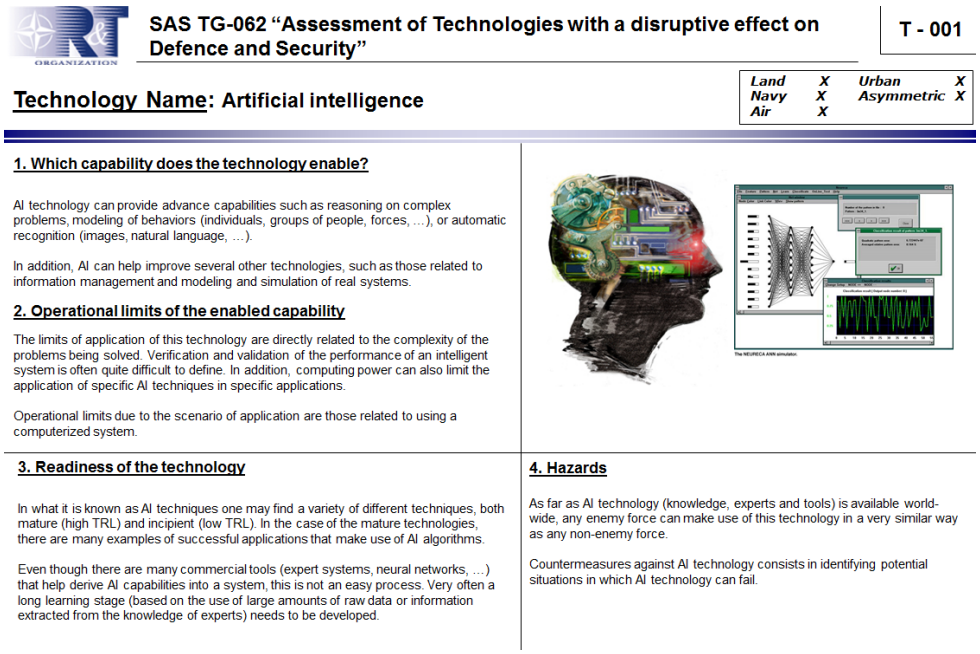
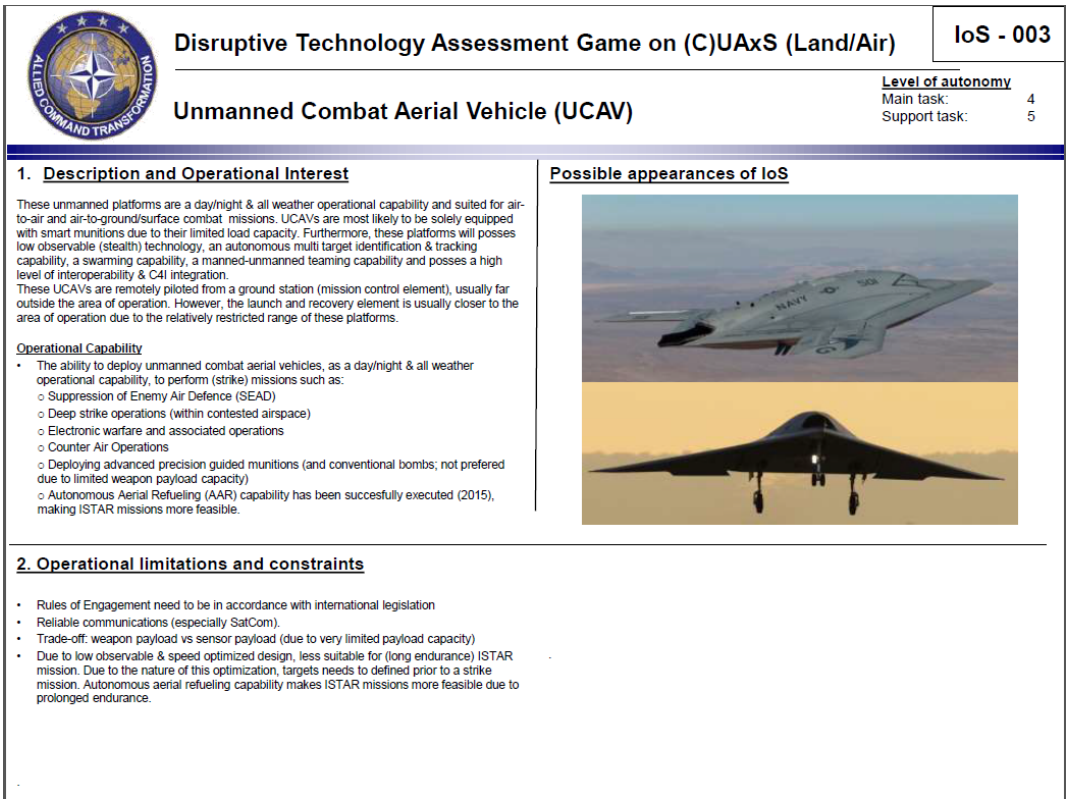


Figure 2: Example of a Technology Card

Create Ideas of Systems (IoS) Cards from the Technologies Identified

Based upon individual and combinations of technologies, a number of higher level 'Ideas of Systems' cards are generated. These use future technologies, combined with existing or future equipment, to create new systems that could be employed by the military or by an adversary in an operational setting. These systems are theoretical but should also be feasible within the timeframe being considered.

Figure 3 shows an example of an IOS-Card.



Disruptive Technology Assessment Game on (C)UAxS (Land/Air)

IoS - 003

Unmanned Combat Aerial Vehicle (UCAV)

Level of autonomy
Main task: 4
Support task: 5

1. Description and Operational Interest

These unmanned platforms are a day/night & all weather operational capability and suited for air-to-air and air-to-ground/surface combat missions. UCAVs are most likely to be solely equipped with smart munitions due to their limited load capacity. Furthermore, these platforms will posses low observable (stealth) technology, an autonomous multi target identification & tracking capability, a swarming capability, a manned-unmanned teaming capability and posses a high level of interoperability & C4I integration.
These UCAVs are remotely piloted from a ground station (mission control element), usually far outside the area of operation. However, the launch and recovery element is usually closer to the area of operation due to the relatively restricted range of these platforms.

Operational Capability

- The ability to deploy unmanned combat aerial vehicles, as a day/night & all weather operational capability, to perform (strike) missions such as:
  - Suppression of Enemy Air Defence (SEAD)
  - Deep strike operations (within contested airspace)
  - Electronic warfare and associated operations
  - Counter Air Operations
  - Deploying advanced precision guided munitions (and conventional bombs; not prefered due to limited weapon payload capacity)
  - Autonomous Aerial Refueling (AAR) capability has been succesfully executed (2015), making ISTAR missions more feasible.

Possible appearances of IoS

2. Operational limitations and constraints

- Rules of Engagement need to be in accordance with international legislation
- Reliable communications (especially SatCom).
- Trade-off: weapon payload vs sensor payload (due to very limited payload capacity)
- Due to low observable & speed optimized design, less suitable for (long endurance) ISTAR mission. Due to the nature of this optimization, targets needs to defined prior to a strike mission. Autonomous aerial refueling capability makes ISTAR missions more feasible due to prolonged endurance.

Figure 3: Example of Idea-of-System Card

Headings can be tailored for each event, but should be consistent across the IOS cards for a single DTAG. Headings to consider for each IOS Card include:

Description and Operational Interest	• Main components. • Operational capability concerned by the IoS. • Conditions of use (targets, threats, etc.). • Expected effects. • Possible indirect impacts on other operational capabilities or doctrines. *(Does the adoption of the IoS make other systems useless, ineffective or more effective?)*
Supporting Technologies	List of the technologies that contribute to the operational performance of the IoS. For each technology: • Brief description. • Current readiness level. • Availability (0 – 5 years, 5 – 10, 10 – 20, later). • Reference to the technology card, when it exists. • Compatibility of the technologies.
Limitations	Limitations of use of the system and supporting technologies.

Critical Points	• Major risks in projected development plan.
Affordability	• Expensive, medium or cheap technology.
Acceptability	Society acceptance, ethical considerations
References	• Technical-operational studies more or less related to the IoS. • Studies helping to assess the relevance of the IoS.

Identify team players and roles

The DTAG organizers should consider what teams are required to play the DTAG, as well as the type of expertise to be on each team. At minimum there is normally 1 Blue team, 1 Red team, a Moderator and Analysts.

The table below shows the typical roles in a DTAG:

Role	**Duties / Activities**
Blue Team Players	Each Blue team, typically 6-10 people will represent 'friendly forces' e.g a NATO planning team. During the DTAG they will plan a course of action (firstly with current capabilities, then secondly with the IoS cards)
Red Team Players	The Red team represent adversarial forces. They also plan their course of action, and have access to the cards to show how an adversary may use technologies to disrupt the Blue team.
Game Moderator	This person controls the game process, timings, enforces rules, and moderates the confrontation sessions
Military advisors	Military Group Members are responsible for the development of the scenario and vignettes that are played. During the game, they present the scenario/vignettes, supporting the players in the planning phase and lead the military led confrontation.
Technology experts	Technologists are responsible for reviewing the IoS-Cards. During the game, they present the IoS-Cards, support the players in the second planning phase and lead the technology led confrontation.
Analysts	Analysts are responsible for the analytical process: The role of the Analysts during the DTAG is on capturing data and ensuring consistency of data collection. Generally two analyst per player team, plus one overall lead, is required.

Create a scenario / vignettes

In a DTAG the overall scenario should be relevant to the research subject, e.g. set in the same timeframe as the technologies (often a future timeframe), and set in a location where the technologies will typically be used.

Each round of the DTAG requires one vignette. The start of one vignette is not affected by the outcome of the previous vignette.

The scenarios / vignettes can be very simple; a few powerpoint slides describing the situation is often enough.

Develop a Template for Blue / Red team Planning Sessions

During the DTAG each player team will be asked to plan, using the IoS cards, in the context of a scenario & vignette. By giving them either a template (e.g. in PowerPoint) or a specific set of questions to answer, this helps with consistency of planning.

Plan for Data capture and Subsequent Analysis

This should be planned for in advance. See Chapter 4 for more details.

Room Requirements and Set-Up

The game play requires three rooms in close proximity with each other. One large room is used for the plenary presentations and the confrontations. Two smaller rooms are required for planning parts of DTAG for the Red and Blue teams respectively.

In all rooms, computers with projection capabilities are provided. Ideally the computers should be networked for the data collection tools, but this is optional. Also posters with an overview of the IoS-Cards and tactical maps of the scenarios are put on the walls of every room. Flip-charts or white boards are provided in the rooms for both teams.

A fourth room, if available, may be useful as a temporary meeting room for the core organizers of the DTAG.

Chapter 3 – Execution of Game Play

Introductions

Normally a DTAG starts with a period of introductions. This consists of short presentations giving the scope of DTAG by the game moderator, an introduction to the scenario by a member of the Military Group, followed by overviews of the IoS-Cards and the analytical framework by a technologist and an analyst respectively.

A DTAG is designed to assess Ideas of Systems. It is not intended to evaluate the military planning skills of the players. Therefore it is important to emphasise the following golden rules to the participants:

- Provide military perspective for the success of the DTAG;
- The DTAG is technology-centred not military-centred;
- The Red and Blue teams are NOT in competition; and
- Maintain an unbiased and objective perspective and do not jump to hasty conclusions.

On this introduction day, it is often a good idea to have a 'dry-run' of a vignette for training purposes, or at very least time for the teams to get to know each other.

Game Play

After introductions and a dry-run, the DTAG follows a structured process, as shown in Figure 4. The process is typically repeated as many times as there are vignettes (e.g. 3 vignettes = 3 days game play = 3 repetitions of the process).

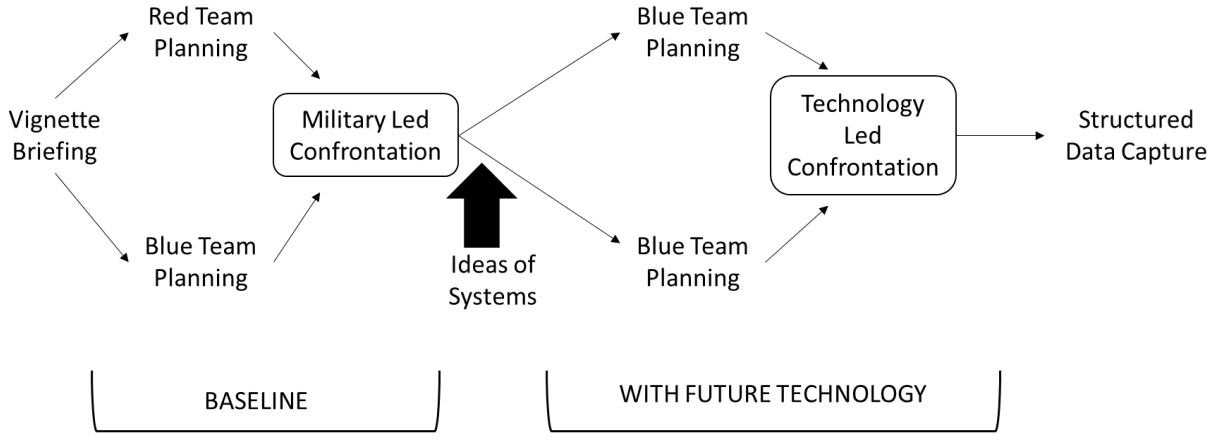


Figure 4: The DTAG Process

Briefing of a Vignette

Firstly the vignette is briefed in plenary, either by the game moderator or the military lead. Any required political, intelligence and media guidance is given. The vignette brief should include a tasking to each team (e.g. a typical task is 'develop a course of action in order to plan to achieve this given task'). It should also include the current capabilities available to the teams (e.g the ORBAT). This step typically takes 10-15 mins.

Team Course of Action – without IoS cards

Blue and Red teams develop their plans in separate rooms, using current capabilities and doctrine. Tools for planning can involve simple maps, a white-board, or powerpoint slides. The focus is on achieving the given tasks and preparing to present in the next stage. Often subject-matter experts (e.g. on the technology) are available to provide advice.

Military-Led Confrontation

In the military led confrontation, each team presents their plan or proposed course of action. The other teams get a chance to respond, or ask questions. Then there is a general discussion around the plans, including identification of risks and vulnerabilities.

There is no action…counter-reaction…counter-reaction that you see in other wargames, and there is no need for an assessment of which team won (i.e. no need for simulation or stochastic play).

The outcome of this phase provides a baseline against which the effects of new technological systems can be compared.

Team Course of Action – with IoS cards

The planning phase is then repeated, with the same vignette, tasking and ORBAT. The main difference is the introduction of new technology via the Idea-of-System cards, available to either team. Blue teams can use the technology to strengthen their plan, Red team can use it to disrupt Blue's plan now they have knowledge of it.

Technology-Led Confrontation

Both Blue and Red team present their new plan in the plenary. They should focus on the changes to the old plan, the reasons why and how they intend to use IoS-Cards. The technologists challenge the teams and lead a plenary discussion, focusing on perceived difficulties, threats and benefits of the new technology systems.

In the technology confrontation, the updated plans, as well as perceived difficulties, threats and benefits of the new technology systems are discussed by both teams.

Data Collection Session

Finally the analysts issue questionnaires and lead discussion in order to capture data. Usually these questionnaires at minimum discuss which cards were used, and the perceived effect of using the cards. See the next chapter for more details.

Optional: Brainstorming session

Discussions between military players and technology experts can often lead to new and creative ideas. Explicit brainstorming sessions can be incorporated for ideas of new IoS cards. This session can be held at the end of the DTAG event, or it can be incorporated into the planning (teams brainstorm new courses of action, they then use those cards as part of their plan).

Post Game - Assessment of results

A typical DTAG will generate a lot of discussion and data that needs to be assessed post-experiment. The output of the assessment is normally a prioritized list of the most important or most disruptive technologies. This can aid investment decisions on which types of future technology to focus, or on what counter-measures to develop.

Overall Schedule

A typical DTAG schedule looks like this:

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
AM	Introductions	Vig. 1 Baseline planning	Vig. 2 Baseline planning	Vig. 3 Baseline planning	Wrap-up, initial assessment
PM	Dry-run	Vig. 1 planning with IOS	Vig. 2 planning with IOS	Vig. 3 planning with IOS	

Chapter 4 – Data Collection and Analysis

The analysis of a DTAG should aim to achieve the overall objectives of the game, therefore each DTAG will take a slightly different approach. Some suggestions for data collection and analysis are below:

Data Collection

Previous DTAGs have relied on three forms of data collection:

- Analyst notes resulting from observations, asking questions;
- Team presentations (i.e. the presentation that each team brief detailing their plan);
- Team questionnaires to be filled out at the end of each vignette. Typical questions for these questionnaires are below:

Questions for Data Collection Session after each Vignette

Why did your team use this IoS-Card?

Did this IoS card change your Course of Action plan for this vignette?

What were the operational benefits of this IoS in this vignette?

What limitations were there for this IoS-Card, e.g. operational or technical?

Which assumptions did you make when applying this IoS card?

Provide suggestions for improvement for each card.

Were countermeasures used against this IoS card? If yes, which countermeasures?

Did you use this card in combination with any other card? Which ones?

Which combat functions was the IoS card used in? (More than one can be chosen.)

- Command & Control?
- Fire Power?
- Protection?
- Intelligence, Surveillance & Recce?
- Service Support?
- Communications and Networks?
- Countermeasures?

Do you foresee any legal or ethical limitations for using this IoS in this vignette?

Does this IoS effect DOTMLPFI aspects? In what way?

TNO developed bespoke DTAG software called TARTAN, used specifically to capture and record these questions listed above.

Analysis

Evidence Sheets

In order to conduct an assessment of each IoS-Card, the information from each use of each IoS-Card can be gathered and summarised into a single IoS Evidence Sheet. These Evidence Sheets follow a set format and bring together information from all the breadth of the data collection. Each sheet covers the following areas:

- A summary table showing which vignette the card was used in, by which team (Red or Blue), for which Combat Functions and the Effect on Tactics, Techniques, Procedures, Doctrine and Structure from each use of the IoS
- Uses. A summary the different purposes of use the IoS card seen across all teams and vignettes;
- Limitations. Limitations to the potential use of the IoS card;
- Countermeasures. Any countermeasures used or suggested during the DTAG;
- Improvements. Suggested improvements from the DTAGs; and
- Other Issues. This covers any other issues that may have been discussed, for example legal issues.

Impact Assessment

The aim of this area of the analysis is to understand the impact the IoS card has in an operational environment. For example, it will distinguish between IoS-Cards that have wide utility but are limited in effect, and those IoS-Cards that can have a high impact but have a limited utility.

For each vignette, the impact of each IoS used, for either side can be assessed. A simple scale of impact might consist of high, medium, low and no impact.

Technology Assessment

There are two parts to this analysis:

1) IoS Driven – This aims to identify the technologies of importance to the high impact IoS-Cards. It considers both essential IoS and those that are more generally useful.

2) Technology Driven – This analysis looked for trends in the technologies underpinning the IoS-Cards under consideration. For example, specific technologies or technology areas that are of importance across many IoS-Cards.

The output of this will be a list of technologies to add to a ‘technology watch’ list, classified by; act now, consider further, continue to watch.

Annex A: Risk Evaluation Matrix

The following table captures the threats to trustworthiness of findings of a qualitative DTAG event.

	Ability to Use the Research Object	Ability to Obtain Results	Ability to Generate Useful Conclusions
Research Object (RO)	**RO not workable:** does hardware and software work? Are concept or system cards available and appropriate for event?	**RO-Event Interaction:** If groups are being compared, is the RO the same across groups? Will the RO change during the event and is this change documented?	**RO credibility:** Is the RO realistic and technically or factually correct, within the scope of the event? Can the RO be related to other capabilities, issues or events?
Players	**Player non-use:** Do the players have the training and TTP to employ the RO? Do they understand the scenario or setting? Do they understand the event context?	**Player-Event Interaction:** If groups are being compared, are player differences controlled or accounted for? Are changes in players over time documented? If groups are not compared, are players selected to maximize creativity or exposure to the RO?	**Player credibility:** Are players appropriate in the broader context of the intended conclusions? Are they representative of potential stakeholders affected by the RO? Do players have appropriate experience?
Results	**Effect:** are the research questions or event objectives linked directly to the RO?	**Biases:** Are player perceptions and characteristics captured prior to the event, if necessary?	**Result metrics:** Do the metrics, performance measure, or data points, support drawing conclusions?
Trial	**RO not exercised:** Does the scenario and event design allow the RO to be fully employed?	**Trial consistency:** Are event conditions the same across groups, if required? Do event conditions affect the results and is this documented? Are mid-event changes to the	**Event credibility:** Are the scenarios related to the broader context?

		scenario or event design documented?	
Analysis	**Analysis interference:** Does the analysis affect how the RO is employed in the event?	**Biases:** Are analyst perceptions and characteristics captured prior to the event? **Philosophy:** Is the philosophy of the event clear: controlled comparison and testing, creative idea generation, or intense scrutiny of a document? **Protocols:** Are data collection protocols created and used consistently? **Data Collection:** Is data collection consistent across analysts and across groups, if necessary? Are any differences accounted for in the design? Are data collection methods documented?	**Analysis Trustworthiness:** Are appropriate qualitative research protocols followed, including but not limited to: extensive documentation of data and methods; peer, stakeholder, and player review of synthesized data and conclusions? Are limitations of conclusions considered post-event? Are triangulation methods used?