Developing the cognitive and social aspects of military 'understanding capability'

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In recent years the UK military has increasingly emphasised the importance of 'understanding' as a key enabler of operational advantage. Over this same period, the UK military research and education communities have been supporting both the UK military and NATO in the development, education, training and practice of a range of 'understanding techniques'. These techniques enable commanders, staff, non-military partners and subject-matter experts to develop and articulate deeper understanding of complex and uncertain operational environments, through collaboration. Examples of such techniques include rich picture, context diagram, multi-perspective diagram, concept map, causal-loop diagram and key assumptions check. The techniques focus on cognitive and social processes of eliciting, framing, challenging and articulating complex knowledge and underlying assumptions. They complement, yet are distinct from, data analysis and information analysis techniques – indeed, they generate the frames (e.g. hypotheses) that both give such information meaning and context, and serve to direct further information collection. The techniques directly support the development of the cognitive and social aspects of 'understanding capability'. This paper describes example techniques, outlines their benefits and summarizes progress made in their contribution to 'understanding capability' within the UK military and NATO.

Introduction

Although the character of conflict has changed, the commander's requirement to understand the operating environment has endured. Almost 200 years ago, Clausewitz[1] wrote, "Wars must differ in character according to the nature of the motives and circumstances from which they proceed. The first, the grandest, and most decisive act of judgement which the Statesman or General exercises is to understand the war in which he engages and not to take it for something, or wish to make of it something, which… it is impossible for it to be". The changing character of conflict may be summarised as an increasing degree of complexity, reflected by a "congested, cluttered, contested, connected and constrained" operating environment[2], where wicked problems are the norm.

In recent years, the UK military has increasingly emphasised the importance of 'understanding' as key enabler of operational advantage. The origins of UK 'understanding doctrine' are discussed in UK Joint Doctrine Note (JDN) 3/11[3]. UK Joint Doctrine Publication (JDP) 04[4] defines understanding as "the perception and interpretation of a particular situation in order to provide the context, insight and foresight required for effective decision-making" and asserts that it is a "non-discretionary element of decision-making". The current emphasis on understanding has resulted from UK military commanders' recognition of a military tendency to rush into precise solutions to the wrong problem, without full

[1] von Clausewitz, K. (1832). *On War*.
[2] Development, Concepts and Doctrine Centre (2010). *Future Character of Conflict,* MOD, UK.
[3] Development, Concepts and Doctrine Centre (2011). *Joint Doctrine Note 3/11: Decision-making and Problem-solving: Human and Organisational Factors*. MOD, UK.
[4] Development, Concepts and Doctrine Centre (2010). *Joint Doctrine Publication 04: Understanding,* MOD, UK.

consideration for context. This has also been recognised by US commanders[5]: "Lesson 1: Understanding the Environment. In operations in Iraq, Afghanistan, and elsewhere, *a failure to recognize, acknowledge, and accurately define the operational environment led to a mismatch between forces, capabilities, missions, and goals*. The operational environment encompasses not only the threat but also the physical, informational, social, cultural, religious, and economic elements of the environment. Each of these elements was important to understanding the root causes of conflicts, developing an appropriate approach, and anticipating second-order effects".

Since JDP 04 was published in 2010, 'understanding' has also been recognised as a HQ capability, both with NATO and the UK, and this capability has been developed in at least two HQs: NATO Headquarters Allied Rapid Reaction Corps (HQ ARRC) and the new UK Standing Joint Force Headquarters (SJFHQ).

One practical element of 'understanding capability' that has been developed in recent years is the acquisition, tailoring and practice of a range of 'understanding techniques' for the primary purpose of enabling individuals and teams to frame shared knowledge and thereby provide knowledge structures into which (new or existing) information may be fitted. Besides their support for framing and their applicability within (collaborative) team settings, such techniques have also been selected on the basis that they are suited to making sense of *complex* operating environments and associated wicked problems. Further, they may be trained, practiced and mastered rapidly by commanders and staff officers operating under time-pressure and stress.

The purpose of this paper is to generate dialogue about the development of military 'understanding capability', specifically through the education, training and practice of such understanding techniques. It begins with a discussion of the cognitive and social aspects of military 'understanding capability', then introduces a sample of illustrative understanding techniques, providing an account of their origins and benefits, and summarises progress made in the contribution of such techniques to 'understanding capability' with NATO and UK military.

The cognitive and social aspects of understanding

In common usage, the word "understanding" may refer to either the process by which understanding is developed or the state of knowledge gained through that process. For the purposes of this paper, we are most interested in the process. This recognizes that military understanding at the operational level is concerned with complex, wicked problems and is, thereby, ongoing and nonlinear. Due to the complex and dynamic nature of the subject matter, there is no specific point at which a commander can claim that they have completed their understanding. Indeed, it is difficult to measure understanding of complex phenomena as a state of knowledge, even in retrospect (when some specific uncertainties may have been resolved and the validity of some assumptions have been assessed). The process of understanding enables commanders to develop sufficient insight and foresight to plan and execute effective action *at that point in time*, yet the development of understanding continues.

Further, the process of developing understanding and the iterative processes of analysing, planning, executing and assessing operations occur concurrently and are inextricably linked.

[5] US Joint and Coalition Operational Analysis (2012). *A Decade of War*.

If the operating environment was merely complicated – and thereby completely analyzable – understanding could be posited as a step in a process model. It might, for example, fall between 'analysis' and 'planning' or, in terms of the OODA loop, could be described as the final part of orientation. Understanding complex environments *does not* simply flow from analysis, however. Instead, each of the iterative processes stated above contributes to understanding because each involves interpretation of information about the operating environment and dialogue between experts. For example, the act of designing an operation supports understanding because it is concerned with generating a collective and coherent response to a perceived operational problem, whereby shared assumptions about the problem and the response are naturally brought to the surface and tested.

Understanding is fundamentally a *human* process. People make sense of their environment, objectives and actions, and thereby understand. Information, tools and techniques enable people to understand but do not guarantee that understanding will be gained. Moreover, it has both *cognitive* and *social* aspects: individuals gain understanding, yet so do teams. In complex environments, teams with diverse knowledge, expertise, experiences and access to information invariably gain a richer and deeper understanding of situations and problems than any individual member of the team could hope to.

The concept of sensemaking[6] provides a good fit with the process of understanding. Sensemaking is a cognitive and social process. It is concerned with both the interpretation of information within shared knowledge constructs known as frames[7] *and* the way in which frames themselves change over time due to patterns in information and dialogue between actors. Thinking about systems[8] as a way of framing brings in elements of systems thinking, e.g. consideration of part-whole relationships, system boundaries, patterns of activities, flows and emergence. All of the following activities serve to support framing and are consistent with both sensemaking and systems thinking:

- Boundary setting and checking (what is the scope and nature of the environment that we are interested in?)
- Problem formulation (what is the character of the problem and what is its relationship with the wider environment?)
- Assumption surfacing and checking (what is the basis of our understanding and how can it be improved?)

Development of understanding capability within HQs

As a HQ capability, 'understanding' has many important elements. It concerns how *people* (individuals and teams) make sense of the operating environment, through dialogue, by framing and interpreting *information* and developing complex *knowledge*. Traditionally,

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[6] Weick, K. (1995). Sensemaking in Organisations. London: Sage. See also: Moore, David T. *Sensemaking: A Structure for an Intelligence Revolution*. National Defence Intelligence College, Washington DC, 2012; Weick, Karl E., Kathleen M. Sutcliffe, and David Obstfeld. "Organizing and the Process of Sensemaking." *Organization Science* 16, no. 4 (August 2005): 409–21. doi:10.1287/orsc.1050.0133; Sieck, W. R., Klein, G., Peluso, D. A., Smith, J. L., & Harris-Thompson, D. (2007). Focus: A Model of Sensemaking. (Technical Report 1200). United States Army Research Institute for the Behavioral and Social Sciences.

[7] e.g. shared mental models, frameworks, stories, hypotheses, norms. See Weick, K. (1995). Sensemaking in Organisations. London: Sage.

[8] See *Flood and Jackson, Creative Problem Solving – Total Systems Intervention, 2004 :* "The concept of 'system' is used not to refer to things in the world but to a particular way of organising our thoughts about the world. [..] so we consider the notion of 'system' as an organising concept".

‘understanding capability’ has been most closely associated with the Intelligence function within military HQs, yet there is a strong argument that it should integrate all HQ functions:

- Understanding is as much about people as information.
- The people involved in understanding include both those who *traditionally* are seen as ‘providers’ of information and intelligence, and those who are ‘consumers’ of that information and intelligence.
- The constituent processes of understanding (e.g. framing and dialogue) actually break down traditional notions of ‘providers’ and ‘consumers’ of information and intelligence because ‘consumers’ are not passive recipients of understanding, but are active participants in framing and developing understanding.
- Hence interactions between HQ functions must be reconsidered as collaborations.

To support the development of understanding capability, we need to focus on how commanders and staff think about the operating environment and how they engage in dialogue to further their understanding. Individuals and teams need to frame shared knowledge and fit data and information into those frames. This encompasses the following tasks:

- Sharing, appreciating, acquiring and developing perspectives (frames).
- Eliciting, characterizing and visualizing[9] knowledge, and filling knowledge gaps.
- Making connections between factors, actors, concepts etc.
- Highlighting and challenging assumptions.
- Articulating meaning (in the form of pictures, assessments and narratives).

Since JDP 04 was published, the UK military research and education communities have been supporting both NATO and the UK military in the development, education, training and practice of a range of understanding techniques. Such techniques enable commanders, staff and collaborating non-military subject-matter experts to engage in processes of framing and dialogue that are central to the development of understanding. The techniques provide direct support for the tasks highlighted above.

A selection of techniques and associated guidance was published in the HQ ARRC Understanding Techniques Aide Memoire[10] (UTAM) to aid the development of understanding within the context of the NATO planning process, as described in the Comprehensive Operations Planning Directive (COPD)[11]. Publication of the UTAM has meant that these techniques are now being practiced in both NATO and UK military HQs. More recently the techniques have also been adopted in military education and are being actively used on several of the UK military command and staff courses[12]. The next part of this paper presents and explains several selected illustrative techniques and discusses their utility.

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[9] This supports sensemaking, cf. Weick’s “how can I know what I think until I see what I say?” See Weick, K. (1995). Sensemaking in Organisations. London: Sage.

[10] NATO HQ ARRC (2014). *HQ ARRC Understanding Techniques Aide Memoire*, NATO.

[11] NATO SHAPE (2010). *Comprehensive Operations Planning Directive, Interim v1.0*. NATO, Belgium.

[12] Including the UK Joint Services Command and Staff College (JSCSC) Advance Command and Staff Course (ACSC).

Introduction to understanding techniques

Techniques for enabling understanding come from a range of overlapping disciplines, including critical thinking, problem structuring, systems thinking and intelligence analysis[13]. Functionally, the techniques address the tasks listed above. Further, the techniques:

- Work in both a cognitive and social context.
- Emphasise the importance of reflective practice rather than following a linear method.
- Are simple to use and quick to educate, train and learn.
- Can be combined as hybrid techniques that can be complementary to existing military processes.
- Are distinct from other techniques for analysing or visualising (big) data.

Classes of understanding techniques

The UTAM identifies three classes of understanding techniques:

- *Generating techniques* serve to elicit factors and other ideas that characterise aspects of the operating environment. Such factors and other ideas serve as the 'building blocks' of knowledge.
- *Connecting techniques* serve to make conceptual connections between these 'building blocks', through analysis and synthesis processes, to help deal with complexity and interconnectedness in the operating environment.
- *Challenging techniques* serve to challenge knowledge, focusing primarily upon the underlying assumptions (about the operating environment) upon which this knowledge is based.

As illustrated in Figure 1, techniques for generating, connecting and challenging understanding iterate in a flow of understanding activities. Figure 1 also highlights that as understanding is generated, connected and challenged, it needs to be articulated to those who were not intimately involved in these activities.

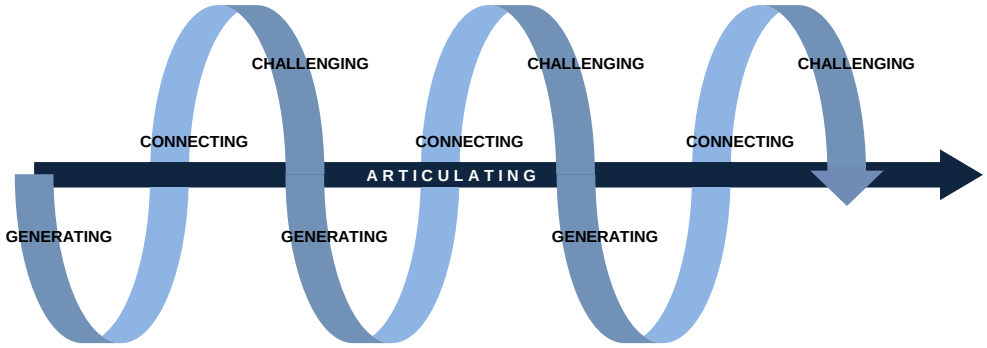

Figure 1: Generating, connecting, challenging and articulating understanding

[13] This is not an exhaustive list.

Illustrative selection of understanding techniques

The UTAM introduces twelve understanding techniques. Six of these techniques are explained, below, to illustrate the breadth of coverage of the aide memoire.

Technique	Class
Rich Picture	Generating
Multi-perspective Diagram	
Structured Brainstorming	
Context Diagram	Connecting
Concept Map	
Key Assumptions Check	Challenging

Table 1: Selection of understanding techniques in this paper

Rich Picture	
A **Rich Picture**[14] is a visual representation of an individual's perceptions of a complex issue or situation. It is drawn quickly using sketches, symbols or doodles, follows no formal syntax or format, and requires no artistic skill.	
How can it help? A picture paints a thousand words" – even a simple one. Rich Pictures are a visual way of relating your own knowledge and experience to a given situation through the identification of Factors and themes. They help you to make sense of complexity and understand your own perspective, assumptions and knowledge gaps. They are often used to generate Understanding content in a rapid manner. This supports the articulation of Individual Understanding and associated dialogue.	**How can I use it?** The key to drawing a Rich Picture is to "just draw" and not to think about presentational issues; a Rich Picture is simply a vehicle for expressing ideas. Team leaders should encourage every member of the team to produce their own rich picture (on A3 paper or bigger), explain their picture to the group and encourage questions. This is followed by facilitated dialogue, with a scribe capturing key Factors, themes and knowledge gaps. This can be done informally or using **Structured Brainstorming**. Factors, themes and knowledge gaps should be recorded for later exploitation.

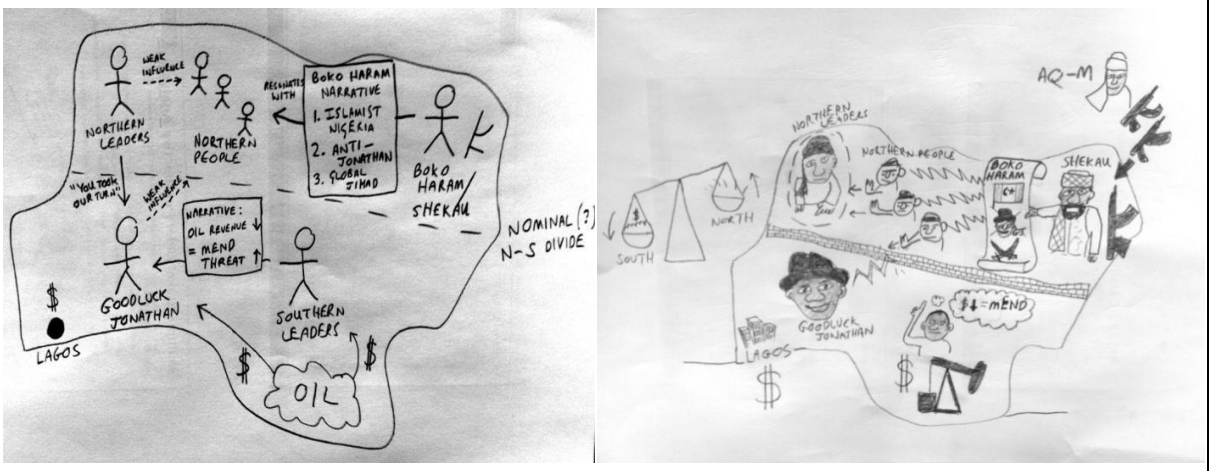

Figure 2: Rich Pictures – simple and graphical examples

[14] Checkland , P. & Scholes, J (1999). *Soft Systems Methodology in Action*. John Wiley & Sons. UK.

Structured Brainstorming	
Structured Brainstorming[15] helps teams to generate factors or other ideas in *quantity*. It provides sufficient structure for team members to rapidly articulate individual ideas in response to an issue, question or topic. It encourages dialogue to enable the team to generate yet more ideas, and maintains pace by discouraging the team from evaluating the ideas too early and hence potentially discounting them unnecessarily[16]. Structured Brainstorming is different from other generating techniques because its main focus is how *team interaction* is managed, rather than the specific characteristics of the *content* that is generated. It aims to get the most out of the team by harnessing the expertise, knowledge and creativity of its members. Since it is agnostic to the type of content it generates, it needs to be used in the context of other techniques or HQ processes.	
How can it help? Structured Brainstorming is particularly useful at the beginning of Understanding activities because it helps to generate a lot of content in a rapid fashion. Once that content has been "brought into the open" it is a lot easier for the team to develop collective understanding. There are seven rules that guide Structured Brainstorming sessions: 1. Be specific about the purpose and the question, issue or topic. Because Structured Brainstorming is used in combination with other generating techniques, the purpose and question, issue or topic should originate from that technique or method. 2. Every idea is worthwhile: even those which might initially appear to be outlandish or incoherent. 3. Suspend judgment by holding the following quotes in mind: "we won't evaluate each other's ideas" and "we won't censor our own ideas". 4. Facilitate the contribution of ideas and associated dialogue. Give people time to make their contribution and ensure that the dialogue is used as a catalyst for new ideas rather than critiquing existing ideas. 5. Take advantage of the diversity of knowledge and expertise in the team. Use Structured Brainstorming to elicit ideas from across the team members. 6. Allow time for establishing the rules and the steps of Structured Brainstorming; for the team to consider, frame and contribute ideas; and for associated dialogue. 7. Record and visualize content so everybody has access to it. Do this during the brainstorm so that people can see the content developing.	**How can I use it?** Structured Brainstorming is most effective if used in teams of five to seven (excluding the facilitator)[17]. There should be no less than four and no more than twelve in the team. It includes three steps: *Step 1.* The facilitator poses one or more questions for team members. This frames the brainstorming session. *Step 2.* The facilitator asks team members to consider and write down ideas in response to the questions (post-it notes are helpful) and provides a period of time for this to happen. The facilitator convenes the team and asks each team member, in turn, to offer one idea. The team member reads it aloud and sticks the post-it to a wall or other surface. Other team members listen and suspend judgment. Other team members are encouraged to use ideas already shared as inspiration for further idea generation. After every participant has offered one idea, the facilitator asks the first team member to offer a second idea, and so on until all ideas have been exhausted. After all ideas have been exhausted, the facilitator establishes a group dialogue to examine the ideas in further detail. It is possible to modify or change ideas at this point, with the permission of the originator. *Step 3.* The facilitator should keep the brainstorm going even when there are pauses and should not talk during this period. After two or three long pauses (of a few minutes), the facilitator calls the brainstorming session to a close.

[15] Heuer, R. J. & Pherson, R. H. (2011). *Structured Analytic Techniques for Intelligence Analysis*. CQ Press, DC.
[16] Evaluating ideas is important but this is done *after* Structured Brainstorming.
[17] Heuer, R. J. & Pherson, R. H. (2011). *Structured Analytic Techniques for Intelligence Analysis*. CQ Press, DC.

Context Diagram

A **Context Diagram** provides a means of visualising and assessing, from a selected actor's perspective, whether factors can be controlled, influenced or must simply be treated as constraints.

How can it help? Context Diagrams help individuals and teams to map knowledge about a selected actor's sphere of control and influence within the operating environment. The team must be explicit about the actor perspective from which the Context Diagram is being populated. Whilst Context Diagrams are usually employed to understand one's *own* sphere of control and influence, it is perfectly reasonable to consider other actors, e.g. NATO, the International Community, hostile or other actors.

How to use it. Factors may be quickly plotted onto the Diagram and then their position is challenged and refined by the group to confirm that factors have been plotted in the correct place. A common bias of teams is to over-estimate their control and influence over Factors, resulting in many Factors being positioned near to, or at, the centre of the Diagram. These Factors should be scrutinised, and repositioned if necessary.

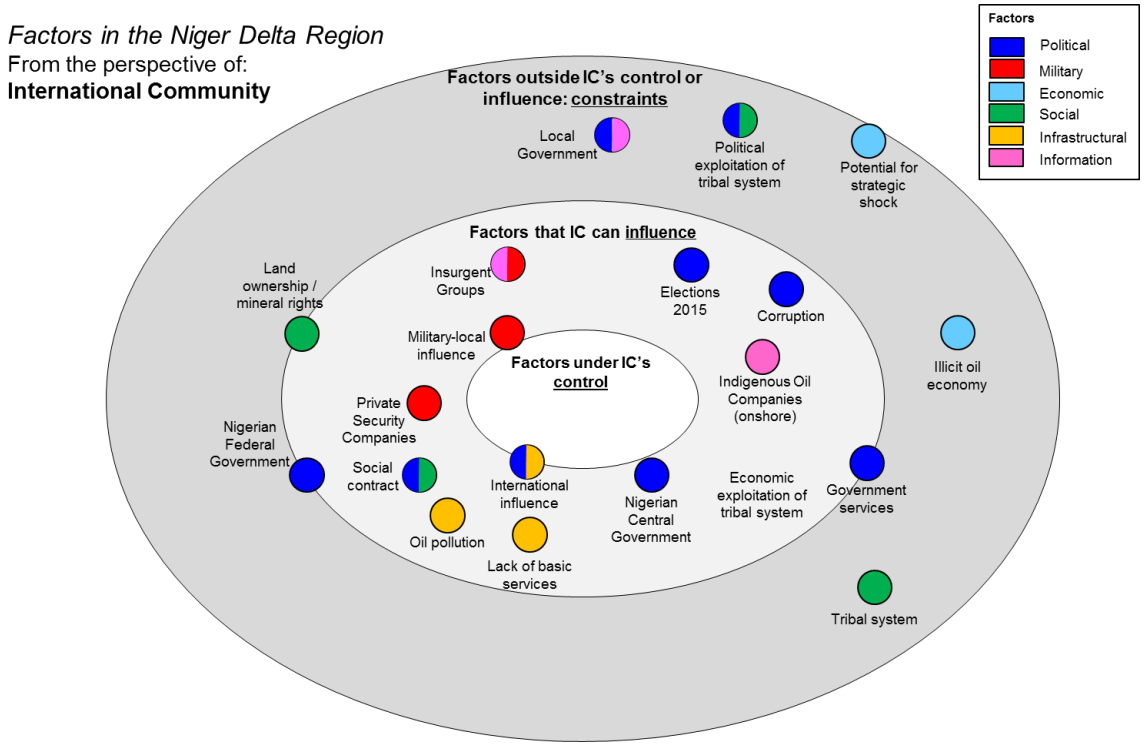

Figure 3: Context Diagram – example

Multi-perspective Diagram	
A **Multi-perspective diagram** conveys knowledge about different actors' perspectives on a specific issue: how they see it, how it affects them and what their interests might be. The original version of multi-perspective diagrams was introduced by Gareth Morgan[18].	
How can it help? It encourages individuals and teams to consider how different actors perceive a specific issue and help to identify where common interests – or indeed, conflicts – might be exploited. They also challenge assumptions that other actors share the same perspective as you.	**How to use it**. Decide upon a focal issue (typically a key element of the operational problem) and place it at the centre of your diagram. Next, identify a diverse set of actors whose perspectives on the issue matter to the operation – and place them around the outside of your diagram. Exploiting the knowledge and expertise within the team, assess how each actor might perceive the focal issue and what they might do about it – and annotate your assessment on a link from actor to issue. Analyse the result: how diverse/similar are the various actors' perceptions and what does this mean for the operation? Where are your major uncertainties and what do you need to find out? Repeat for different issues to generate a set of diagrams, as required.

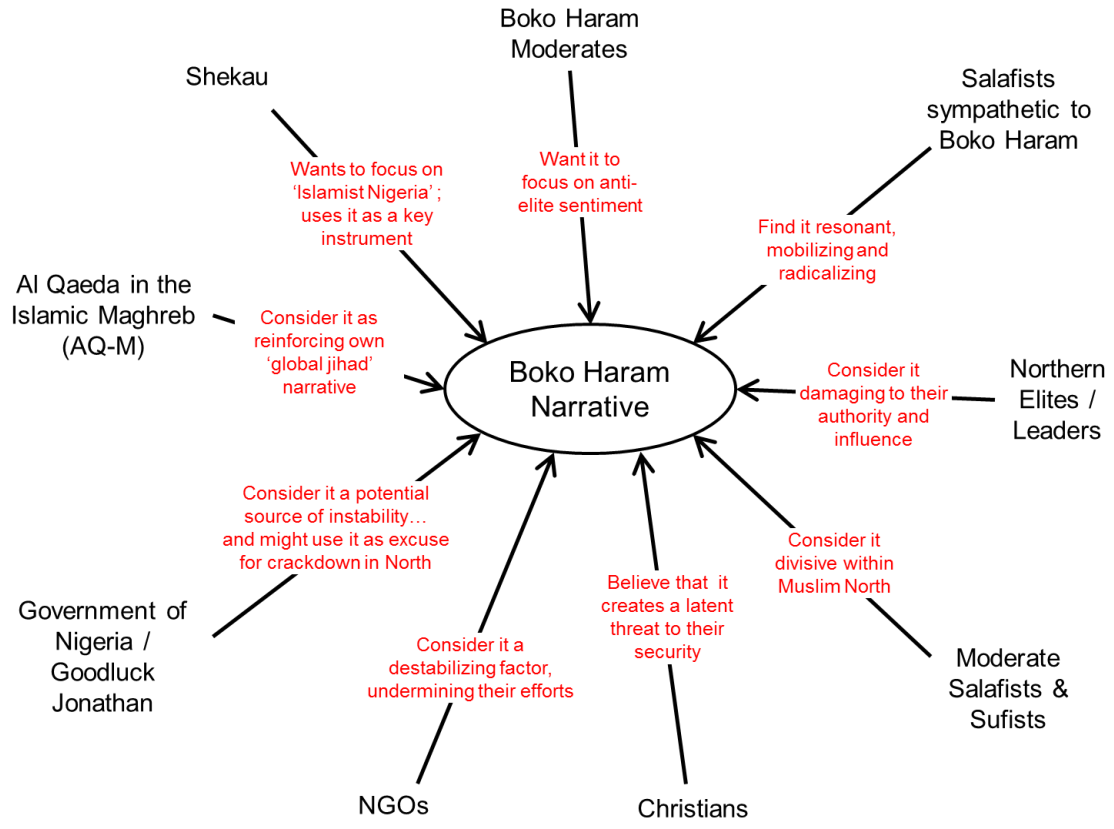

Figure 4: Multi-perspective diagram – example

[18] Morgan, G. (1997). *Imaginization: New Mindsets for Seeing, Organizing and Managing*, (new management edition). Berrett-Koehler, San Francisco, CA.

Concept Map

A **Concept map** is a means of representing relationships between factors and actors in the operating environment and telling the story of the key issues and dynamics at play.

How can it help? A concept maps can be used to explore how an individual or team thinks about relationships between concepts associated with a central issue (for example, 'the security situation', 'the social contract', or 'the oil economy') – and to tell stories of how the operating environment works as a system. It can provide teams with the ability to explore the perceptions, beliefs and grievances of specific actors. It can also be used to identify leverage points where a specific action or series of actions can have a wider effect – through which problematic issues can be addressed. A concept map conveys the relationships between concepts explicitly and can be 'read' as a set of linked arguments.

How to use it. Chose an issue or system to explore, then identify those actors and factors most closely associated with the issue or system. Add the actors and factors to the map, connect them with arrows and label the arrows with 'linking words' describing current and standing relationships. (These linking words form a sentence with the actors that they connect). Review and amend the map as required: does it help to articulate issues and dynamics? Does it tell a story? It is suggested that 10-25 actors and factors is reasonable – and avoid cluttering the map with arrows.

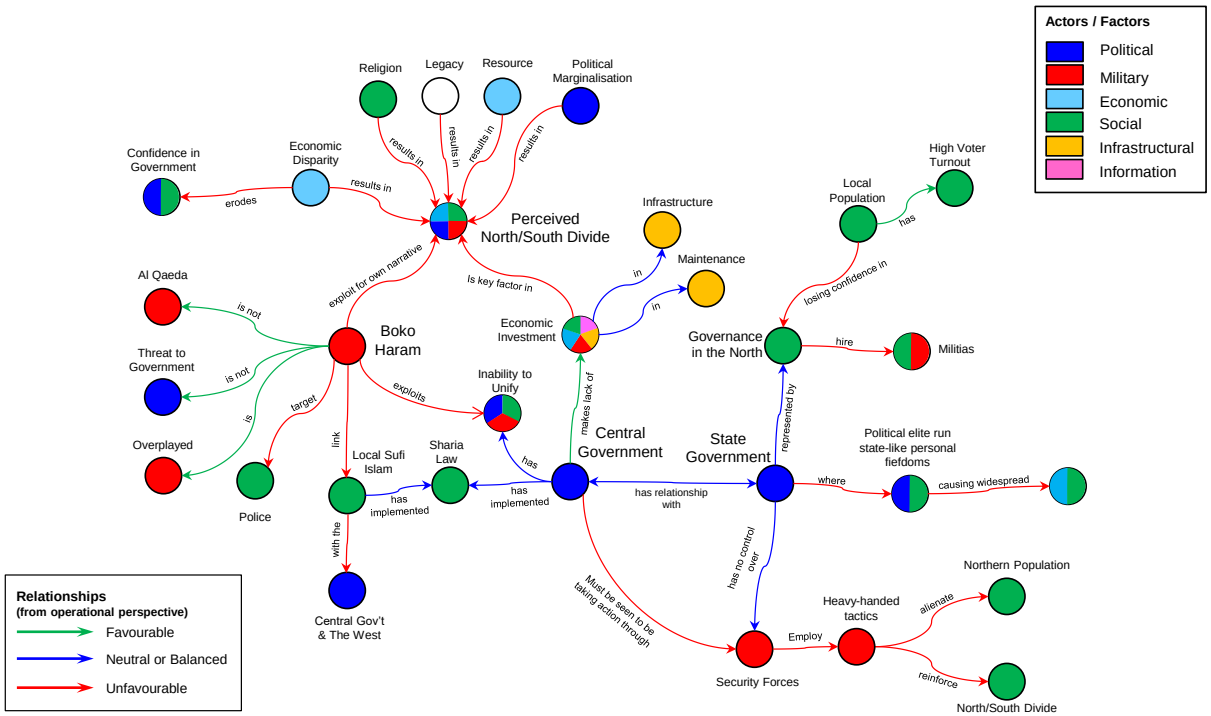

Figure 5: Concept map – example

Key Assumptions Check

Key Assumptions Check is a systematic technique for identifying and challenging assumptions, and thereby enhancing understanding. It begins by eliciting assumptions underlying a piece of analysis, storyline or narrative. Once these assumptions are 'out in the open' then can then be characterised as one of three types:

- **Solid** without caveats. Reasonable given the available evidence and unlikely to fail due to further evidence. It is therefore likely to stand even if the situation changes.
- **Caveated** – solid but with some caveats. Reasonable given the available evidence but may fail if the situation changes and specific evidence is identified. Therefore sensitive to circumstances.
- **Unsupported** or questionable – the "key uncertainties". Not reasonable given the available evidence because there is already evidence that is contrary to the assumption. This indicates that the assumption already fails for the current situation.

Solid and caveated assumptions may be retained. Caveated assumptions – or rather the evidence that may lead to their failure – must be monitored. Unsupported assumptions must be removed or replaced, which necessarily means revisiting the understanding work that produced the original analysis, storyline or narrative.

How can it help? The Key Assumptions Check can help by:

- Stimulating challenge to an analysis, storyline or narrative, with the aim of enhancing understanding;
- Exposing the logic underpinning an analysis, storyline or narrative, and determining if this logic is faulty;
- Uncovering hidden relationships and links between key concepts (factors, trends, sources or drivers);
- Identifying those pieces of evidence that would lead to the failure of assumptions
- Helping commanders and staff to anticipate circumstances that would otherwise surprise them.

How to use it? Begin by identifying the content (an analysis, storyline or narrative) that requires challenging. It is best conducted by a team that includes one or more members of staff who were involved in the development of the content and one or more staff who were not involved and can act as 'challengers'. There are four steps:

1. Review the content. Because many assumptions are hidden, it is advantageous if the staff who developed the content actually explain the analysis, storyline or narrative in detail[19]. A rule-of-thumb is that this explanation should be richer than the content reflected in the relevant understanding products.
2. Identify as many assumptions as possible in both the understanding content and the explanation provided by the staff. The 'challengers' may ask the *what, who, where, when, how* and *why* questions to uncover greater detail. If these two activities generate more assumptions than can be managed[20], then the team should focus attention on those assumptions that the analysis, storyline or narrative depends upon the most[21]. A rule-of-thumb is to identify ten assumptions to deal with immediately[22].
3. Challenge each assumption, asking why it 'must' be true and whether it remains valid if the situation changes. Characterise each assumption as solid, caveated or unsupported.
4. Refine the list of key assumptions to contain only those that are solid and caveated. For every caveated assumption, identify those developments in the situation – and associated evidence – that might lead to its failure. Develop these pieces of evidence as indicators, to be handled by future intelligence collection. Also consider the impact of the unsupported assumptions on the analysis, storyline or narrative and revisit the earlier understanding work if the credibility of this content is at risk.

[19] This is known as "telling the story the long way". It requires openness, discipline and patience, yet is worth the effort if it illuminates some aspect of the content that is undocumented.

[20] This is particularly the case for storylines and narratives that deal with plausible future outcomes.

[21] These are called 'load-bearing' assumptions; their failure has a relatively large impact on the credibility of the analysis, storyline or narrative.

[22] This is more practical than identifying all assumptions first. Once the 'top 10' assumptions have been dealt with, then the technique can be revisited.

Applying understanding techniques

In this final part of the paper, we highlight some early lessons from applying techniques within two HQs: NATO HQ ARRC and the UK Standing Joint Force Headquarters (SJFHQ).

The intended context of use for the techniques was, in both cases, a limited intervention into existing HQ activities. Comprehensive Preparation of the Operating Environment (CPOE) is an ongoing understanding activity that typically begins with an initial, deliberate phase, conducted prior to planning. Its purpose is to support the commander's (and wider HQ's) understanding of the character of the operating environment and the operational problem. The initial, deliberate phase of CPOE is less subject to time- or decision-pressure than subsequent activities.

Table 2 indicates the techniques that were trained and used during two distinct CPOE activities.

Technique	**HQ ARRC 'understand' study period (CPOE), February 2014**	**Exercise JOINT VENTURE 16 CPOE, April 2016**
Rich Picture	✓	
Multi-perspective Diagram	✓	✓
Context Diagram	✓	✓
Concept Map	✓	✓
Actor Map[23]		✓

Table 2: understanding techniques trained and used at HQ ARRC & SJFHQ CPOE activities

The techniques required integration into the parent CPOE activity. That is, they needed to be put to a specific purpose so that they would be recognised as effective. Critically, the techniques were tailored so that they could be used very quickly, in ad hoc collaborations, using readily available equipment (typically whiteboards and pens), and produce a tangible, exploitable output. All of the above reflects both the limited nature of the interventions and the way in which staff work was organized within the HQs.

The first exposure the staff had to the techniques was a brief training period during CPOE itself. Following the training, the techniques were made available to CPOE team leaders (typically SO1 level), with expert facilitation offered by the research team.

Within HQ ARRC, the techniques were adapted, by the staff, to make use of existing CPOE tools, such as the PMESII taxonomy, used to aid analysis of the operating environment. For example, HQ ARRC staff colour-coded factors within context diagrams (see Figure 3 and Figure 5) to reflect PMESII dimensions. This integration of PMESII with the techniques was taken forward by UK SJFHQ.

Both HQ ARRC and the UK SJFHQ considered the techniques to have benefitted the CPOE process. The research team received positive feedback from all ranks involved, from 1* (HQ ARRC) and OF-5 (SJFHQ) down to SO2.

Further, the techniques were applied further 'downstream' with similar success: within planning at HQ ARRC (context diagram to support Mission Analysis) and within execution through a Red Team at SJFHQ (a range of techniques including rich picture, context

[23] This was trained as a specific instance of a concept map, with all nodes representing actors and link types constrained to those describing actor-actor relationships.

diagram, cognitive map[24] and laddering[25]). Indeed, although the techniques were intended to be applied within the relatively deliberate CPOE process, they have been geared for rapid use and, *assuming that participating staff have practiced the techniques*, it is perfectly possible that they could be used in highly dynamic situations.

Across both HQs, however, there was variation in the adoption of the techniques by the staff. It is the assessment of the research team that such limited interventions did not change thinking approaches of military staff; instead, they provided tools for those members of the staff who were already attuned to systems thinking and the visual representation of problems and situations.

Summary points about the understanding techniques

The understanding techniques enable individuals and groups to make sense, and develop understanding of, complex environments and support them in dealing with wicked problems[26]. They are simple to use (involving mainly a whiteboard and pens), practice and master. They are easily integrated with existing HQ processes (e.g. PMESII colour coding). They are (for the most part) not novel and have been used in other contexts (e.g. project management) for years with great success.

The two limited interventions outlined above were an important initial step in establishing military understanding capability within HQ ARRC and SJFHQ. The next step is to educate and train a broader range military staffs to adopt and regularly practice understanding techniques in individual and team contexts. The longer-term purpose, however, is to identify and develop a cadre of military systems thinkers who can map techniques to their own purposes and generate hybrid and novel techniques and approaches, as appropriate for the complex operating environment. Establishing a culture of reflective practice through using the techniques and enabling broader understanding will help to support shared understanding with experienced staff able to facilitate cross-agency collaborations.

Acknowledgments

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[24] Not discussed in this paper although similar to a concept map; see the UTAM for further details

[25] Not discussed in this paper; see the UTAM for further details.

[26] Support comes from the flexibility, ease and speed of use of the techniques. This enables groups to frame and reframe their appreciation of such problems. This is critical given the ambiguous and dynamic nature of wicked problems.

[27] Note that Figures 2 and 4 were generated, by the authors, based upon open-source material.