Analytic Rigour in Intelligence

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(alphabetical)

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1 Executive Summary

Analytic rigour is central to intelligence work, but there has not been a widely accepted, well grounded account of what it is and how it might be improved.

We were asked to deliver a report covering (1) the nature of analytic rigour, (2) the factors impacting it, and (3) opportunities for enhancing it, with our findings to be based on existing academic and government literature, consultation with experts, and a survey of practicing analysts and managers. To this end we conducted three main processes:

1. A systematic Literature Review;
2. An Expert Panel process;
3. A Survey of staff in an Australian government agency;

We also conducted a review and synthesis of available government documents related to rigour.

We then further synthesised the results into the findings and recommendations in this report.

Findings

*Nature***.** Analytic rigour is best understood, in general, as conducting analytic work in a manner that is appropriately:

- **Logical**: observing principles of good reasoning and avoiding fallacies;
- **Objective**: being free from influence of values, desires, interests or belief systems;
- **Thorough**: tackling analytic work with completeness and attention to detail;
- **Stringent**: observing relevant rules, guidelines, principles or policies; and
- **Acute**: noticing and addressing relevant issues and subtleties.

We call these the "LOTSA" dimensions. Analytic rigour in intelligence can be further articulated by describing in more detail how these dimensions apply in various aspects of intelligence work. We use the LOTSA account to clarify concepts related to rigour such as analytic standards and structured analytic methods.

Factors. We identified many and diverse factors plausibly impacting analytic rigour, falling into six main categories: analyst attributes, resources, analytic processes, analytic culture, features of the organisation, and technology. We list and briefly describe these factors.

Opportunities. We define an opportunity to enhance rigour as a potential intervention that is relatively *attractive* when considering impact, cost, incidental effects, and timeframe. These are all difficult to estimate. Nevertheless we identified numerous opportunities in many areas: recruitment, staff development, resource provision, analytic processes, evaluation and feedback, collaboration, research, and technology. Just how attractive any one of these is to any given organisation will depend in part on their particular situation, so we have not further ranked them.

Recommendations

Our research supports some general recommendations:

1. Community-wide adoption of a definition of analytic rigour, such as the one provided here.
2. Ongoing implementation by organisations of selected opportunities for enhancing rigour.
3. Development and adoption of a sound method for evaluating rigour.
4. Strengthening of the national capability for research related to intelligence analysis, through support for a dedicated research entity.

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Overview

1. Executive Summary	One page summary
2. Introduction 3. Findings and Recommendations	A summary version of the whole report
4. The Nature of Analytic Rigour 5. Factors Impacting Analytic Rigour 6. Opportunities to Improve Analytic Rigour	Detailed accounts of our methods and findings for each of the main topics
7. Appendix A – Literature Review 8. Appendix B – Expert Panel 9. Appendix C – Survey 10. Appendix D – Standards	Detailed accounts of our methods and results for each of the main processes we undertook to gather material to be drawn upon in sections 4-6.

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- An Australian government agency with intelligence functions
- Justin Fidock, DSTG
- Emily Ebbott, Melbourne Defence Enterprise, University of Melbourne
- Members of the Expert Panel
- Respondents to the Survey of staff in an Australian government agency

Note for Public Release

This release contains references to, and some description of, a survey of an Australian government organisation. No survey data, or discussion of that data, is included. The information about the survey is included so that (1) readers will be aware of the full range of material informing our findings, and (2) future researchers will have an example of the kind of collaborative research that is possible.

2 Introduction

2.1 Background

Analytic rigour is at the heart of intelligence analysis. Rigour is a means by which agencies try to ensure that analytic outputs are as true or accurate as possible, and are credible to the customer.[1]

Although intelligence may be as old as human conflict, intelligence agencies as we know them today are recent inventions, emerging in the second half of last century. During that period there has been recurring concern inside major agencies with analytic rigour and how to improve it, though the issue was often treated under other headings, such as analytic standards or analytic tradecraft.[2]

Pressure to improve rigour has also come from the outside the agencies as a result of some notable incidents widely perceived as intelligence failures. In the U.S., this led to the creation of the Office of the Director of National Intelligence (ODNI) in 2004.

In the Australian context, a pivotal event was the 2017 Independent Intelligence Review. The review led to the establishment of the Office of National Intelligence (ONI),[3] whose responsibilities include "systematic and rigorous evaluation of the performance of the agencies [in the National Intelligence Community (NIC)]." This has raised the pressure on agencies to both maintain and demonstrate high levels of performance, adding to that coming from the office of the Inspector General of Intelligence and Security, which was established in 1986.

The 2017 Review's recommendations also aimed to "intensify the intelligence community's engagement with the Australian science and technology community, and with industry more generally, to facilitate innovation and the development of new capability."

2017 also saw the commencement of a scientific research project focused on intelligence analysis, based at the University of Melbourne. The SWARM Project, funded by the U.S. Intelligence Advanced Research Projects Activity under its CREATE[4] program, was a multidisciplinary, multi-institution effort to develop new methods for raising the quality of analytic reasoning, and to conduct research into related topics. That project evolved into the Hunt Laboratory for Intelligence Research, which has been gradually strengthening its relationships with agencies in Australia and elsewhere.

Based on interest within one Australian government agency in breaking new ground in analytic rigour, and taking advantage of the developing expertise in the Hunt Lab, the National Security Science and Technology Centre in the Defence Science and Technology Group initiated the current project.

2.2 Objectives

Our immediate and official objective is to deliver a report on enhancing analytic rigour in intelligence organisations, covering three topics:

1. The nature of analytic rigour;
2. Factors impacting analytic rigour; and

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[1] In this report we follow ICD 203 in referring to the intended user of intelligence outputs as the "customer."

[2] Marchio, Jim. "Analytic Tradecraft and the Intelligence Community: Enduring Value, Intermittent Emphasis." *Intelligence and National Security* 29 (2014): 159–83.

[3] Walsh, Patrick F. "Transforming the Australian Intelligence Community: Mapping Change, Impact and Challenges." *Intelligence and National Security* (2020).

[4] Crowdsourcing Evidence, Argumentation, Thinking and Evaluation, 2017-2019.

3. Opportunities to improve analytic rigour.

We base our findings on three processes: a Literature Review; an Expert Panel process; and a Survey of staff in an Australian government agency.[5]

As an academic research group working with the intelligence community, we also aim to:

- Provide the international intelligence community with an understanding of analytic rigour that is deeper, more systematic, more well-grounded, and more useful than those previously available;
- In particular, provide a *definition* of analytic rigour that will be widely adopted, and guide activities such as the drafting of analytic standards and the development of training programs; and
- Contribute to the academic literature in areas such as intelligence studies and epistemology.

We will not know whether these larger aims have been achieved for some time, because they depend on further work on our part, and on the responses of the intelligence and academic communities.

2.3 Method – Overview

Our approach has been to gather a body of insight on our three topics from experts in a variety of contexts, and condense, refine and augment those insights into a kind of collective wisdom. To implement this approach we undertook three major activities:

1. A systematic **Literature Review**, involving a comprehensive database search for scientific and other academic writings, and winnowing the results to identify the most useful works.[6] Then, when addressing each of our major topics (Nature, Factors, and Opportunities), we drew on the smaller set of works, plus government documents, to address key questions related to that topic.
2. An **Expert Panel** process involving 65 academics and intelligence practitioners from many countries in a month-long knowledge elicitation and deliberation exercise. To handle the challenge of articulating what our diverse experts collectively believed in relation to the three topics, we adapted the well-known Delphi Method.[7] Our version of the method progressed in three stages:
    i. **Generate**. Panellists responded to a survey inviting them to contribute up to five points on each of the three main topics, resulting in over 700 statements. We then synthesised these statements by sorting them into piles expressing similar ideas, and drafting a synthesised, shorter version expressing these ideas.
    ii. **Discuss**. The synthesised statements were loaded onto an online collaboration platform enabling the panellists to freely discussed the statements and other topics.
    iii. **Assess**. In a second survey, panellists indicated their level of support for the final set of statements, which had been shaped and informed by the discussion.

    The result was a "Collective View" revealing strong agreement on many issues.[8]

[5] We use initial capitals when referring to the three major processes we conducted as part of this project: Literature Review, Expert Panel, and Survey.

[6] For more detail see Appendix A – Literature Review.

[7] The Delphi Method was originally developed by the RAND Corporation. See https://www.rand.org/topics/delphi-method.html

[8] The Expert Panel process is described in more detail in Appendix B – Expert Panel, and the relevant portions of its results are reported in the corresponding sections in the body of this report. The integrated Collective View document was circulated to Expert Panel members, and may be available upon request.

3. **A Survey** provided to analysts and managers in an Australian government agency with intelligence functions. The main part of the Survey was the same as the first step of the Expert Panel process, generating a set of statements representing the themes emerging from the hundreds of points made by respondents.

To produce our findings, for each of the three main topics we merged the outputs from each of these three activities with our own insights and deliberations, shaping the results to address the interests of the Australian government agency and similar organisations. Each topic warranted its own approach.

1. For **the nature** of analytic rigour, we treated the core of the problem as that of providing an *explicative definition* of the term "analytic rigour." An explicative definition is one which tries to respect existing understanding and usage as much as possible. Unlike a dictionary definition, however, it tries to improve on the existing meaning by stipulating what the term should mean given the context and purpose of the definition. With a good explicative definition in hand, we then elaborated on the nature of analytic rigour by situating the concept in relation to a range of other important concepts, such as analytic confidence and analytic standards.
2. For the **factors** impacting analytic rigour, the challenge was to characterise the causal factors related to a complex variable (level of analytic rigour, treated as an aspect of analytic work) without being able to take advantage of the methods scientists and statisticians would normally (or at least ideally) use to identify and assess causal factors. Normal scientific methods were precluded by three considerations: (i) limited time and resources; (ii) the lack of quantitative information (data) about the levels and interactions of relevant factors in intelligence organisations, and (iii) the infeasibility of conducting most kinds of research on or within intelligence organisations due to security restrictions.[9] In this situation, the most rigorous approach we had available was an aggregated expert judgement approach – the careful elicitation, synthesis and refinement of expert opinion on the relevant causal factors. Fortunately, there is reason to believe that experts do have at least some insight into what the causal factors are.
3. For **opportunities** to improve analytic rigour, the challenge was to identify the most attractive interventions an organisation like the Australian government agency might undertake. We defined attractiveness as a composite of (i) the likely level of impact on rigour, (ii) direct cost, (iii) net value of incidental effects, and (iv) timeframe. With the possible exception of direct cost, these factors are all very difficult to estimate, and there is no function for combining them into overall attractiveness assessments. As with factors impacting rigour, our approach fell back on aggregated expert judgement.

These activities resulted in a recommended view of the conceptual landscape, a list of plausible factors impacting rigour, and a list of opportunities for organisations to consider.

The three activities – the Literature Review, the Expert Panel, and the Survey – generated a multitude of insightful perspectives on analytic rigour. Our account is one distillation of that raw material. We encourage anyone interested in pursuing the topic of analytic rigour in depth to explore that material (subject to access restrictions to some parts). Much of value in the material was necessarily "washed out" in the process of distillation, and any one contributor (e.g., an Expert Panel member) might fairly remonstrate that our account didn't adequately represent their perspective.

[9] For an illuminating discussion of this third problem, see Nolan, Bridget Rose. "Ethnographic Research in the U.S. Intelligence Community: Opportunities and Challenges." *Secrecy and Society* 2, (2018).

3 Findings and Recommendations

In this section we briefly recapitulate our findings with regard to the three main topics (Nature, Factors and Opportunities). We conclude with some general recommendations emerging from this project.

3.1 Findings

Broadly, we found:

- Analytic rigour is universally recognised to be central to intelligence.
- However, there has not been any explicit, widely-recognised understanding of analytic rigour and its place in the conceptual terrain (e.g., how it relates to analytic standards).
- Analytic rigour has not been adequately studied. The research to date has been piecemeal and has had little impact on policies and practices.
- Individuals, when asked, provide very partial and idiosyncratic accounts of analytic rigour, what causes it, and how it might be improved.
- However these perspectives can be aggregated and articulated in a rich, coherent, *collective* understanding, forming a starting point for more in-depth research and policy development.

With regard to our three primary topics, we found:

3.1.1 Nature of analytic rigour

Analytic rigour is conducting analytic work in a manner that is appropriately:

- **Logical**: observing principles of good reasoning and avoiding fallacies;
- **Objective**: being free from influence of values, desires, interests or belief systems;
- **Thorough**: tackling analytic work with completeness and attention to detail;
- **Stringent**: observing relevant rules, guidelines, principles or policies; and
- **Acute**: noticing and addressing relevant issues and subtleties.

We call these the “LOTSA” dimensions of analytic rigour.

Analytic outputs or products (e.g., reports) are rigorous to the extent that they reflect rigorous work. Analysts are rigorous to the extent that their work exhibits rigour.

The definition above covers analytic work in general. Analytic rigour **in intelligence work** is being rigorous in this sense in all aspects of intelligence work, including in particular those aspects which are distinctive to intelligence.

The **purposes of analytic rigour** are promoting truth, credibility, defensibility, transparency and accountability in intelligence work and its outputs.

Analytic rigour is just **one aspect of good intelligence**. Others include timeliness and customer relevance.

Analytic rigour is a **component of analytic confidence** in two senses. First, confidence in a judgement will depend on the level of analytic rigour involved in making it, as well as other factors such as quality of information. Second, good assessments of analytic confidence should themselves have analytic rigour.

Analytic rigour has a complex relationship with **analytic standards**. Standards are broader than rigour, i.e., they cover aspects of intelligence other than rigour. Meeting standards contributes to analytic rigour, and being rigorous helps analysts observe standards.

Analytic rigour also has a bi-directional relationship with **structured analytic techniques (SATs)**. These are in many cases intended to enhance rigour, and they are widely believed to have this effect, though this is controversial. On the other hand, analytic rigour is required for SATs to be used properly.

3.1.2 Factors impacting analytic rigour

Analytic rigour is affected, directly or indirectly, by many factors, in six main categories.

Table 3-1: Factors impacting analytic rigour.

	Enhances	**Harms**	**Neutral or unclear**
Analyst attributes	Generic analytic skills Intelligence-specific analytic skills Reflective mindset Commitment	Cognitive biases and capacity limits	Domain knowledge Experience
Processes	Adherence to analytic tradecraft standards Information evaluation Collaboration Coordination and review	Group-level biases	Use of SATs Clear and effective communication
Resources	Support from specialist staff	Time pressure	Information quality, quantity and availability
Culture	Culture of constructive challenge Intellectual safety Supporting and valuing of analysts	Politicisation Epistemological misconceptions	
Organisation	Cognitive diversity Training	Lack of systematic evaluation Secrecy and security requirements Lack of evidence base for processes	Incentive structures poorly aligned with objective of rigour
Technology		Inefficiencies in generic and legacy technologies Poorly-designed analysis-specific technologies Inefficiencies due to poor integration of systems	

3.1.3 Opportunities to enhance analytic rigour

The following potential interventions represent significant opportunities, noting that the timeframe for expected impact varies widely.

Table 3-2: Opportunities to enhance analytic rigour.

Recruitment	Strengthen recruitment for analyst attributes related to rigour Strengthen recruitment for cognitive diversity
Staff development	Provide rigour-related training for analysts, including refresher and advanced training Provide rigour-related training for supervisors and managers
Resources	Increase proportion of analysts' time available for focusing on rigorous thinking Strengthen staff support for analysts
Processes	Strengthen the evidence base for rigour-related analytic processes Introduce numerical expression of uncertainty Improve information and source evaluation methods Strengthen record keeping and source connection Use multiple methods or approaches in handling analytic challenges
Evaluation and feedback	Strengthen feedback processes, including peer review Implement systematic organisation-wide evaluation and benchmarking Refine KPIs and incentives to drive rigour Strengthen visible leadership support for analytic rigour
Collaboration	Improve team-level collaboration Improve collaboration between organisations Improve collaboration with outside experts
Research	Conduct or support research into: • Impact of current methods and practices • Methods for evaluating rigour • Expression of uncertainty
Technology	Improve or adopt technologies for: • More efficient and effective collaboration • Automating low-level analytic tasks • Building AI into the workflow • Supporting use of SATs • Internal 'crowdsourcing'

3.2 Recommendations

Our research for this project has led to the following general recommendations:

1. Community-wide adoption of a definition of analytic rigour

Our research revealed a lack of any widely accepted, well-grounded conception of analytic rigour everywhere we looked. While this was expected to some degree, the extent of the problem was surprising given the centrality of rigour to intelligence.

We therefore recommend community-wide adoption of an authoritative definition of analytic rigour. Adoption might be effected in a manner similar to the promulgation, by the UK Professional Head of Intelligence Assessment (PHIA), of their Professional Development Framework.[10] As would be expected, we tender our definition as suitable for this purpose.

2. Interventions to enhance rigour

This report lists a range of potential interventions to enhance analytic rigour. The attractiveness of each of these will vary from one organisation to another, depending on factors which are often specific to the organisation and typically not visible to outsiders. Rather than recommend any particular interventions, we make an overarching proposal that every organisation consider which of these interventions is most attractive, and proceed to implementation. Organisations could also consider interventions not listed by us but which may be attractive in light of the rest of our report.

3. Development of a sound evaluation method

To our knowledge there is currently no sound (reliable, valid and practical) means of evaluating rigour in analytic work or products. This lacuna will obstruct progress on improving rigour. It will mean, for example, that there is no rigorous way to assess whether a particular intervention succeeds in enhancing rigour, or whether an organisation is succeeding in raising its overall level of rigour over time. There has been some promising initial work (see s.4.8, Measuring rigour), and this report provides some foundational insight, particularly on the nature of rigour. However, developing a sound evaluation method is a serious challenge. We recommend that the intelligence community initiate a major effort to address this problem.

4. Strengthening national capability for research related to intelligence analysis

Our research in preparing this report revealed how little is really known about analytic rigour in intelligence. We now have a better conceptual grasp on the nature of analytic rigour, but as noted, we have no sound way of measuring it. We have some sense of the range of factors influencing it, but little detailed knowledge of the impacts and interactions of these factors. We are aware of many interventions which plausibly could improve rigour, but have no quantified understanding of their benefits.

Compounding matters, analytic rigour is just one aspect of analytic work. We suspect that similarly little is known about many others. Compared with other disciplines such as medicine or even business, intelligence appears to have received surprisingly little scientific attention.[11]

[10] Professional Head of Intelligence Assessment (UK). Professional Development Framework for All Source Intelligence Assessment (2019).

[11] See Mandel, David R. “Intelligence, Science and the Ignorance Hypothesis.” PsyArXiv. January 20, 2021.

Given the importance of intelligence for Australian national security, this problem should be addressed. This requires a sizeable, well-managed intelligence research capability. Australia does have some relevant capability, but it is thinly distributed across many organisations in academia, government and industry, and not well coordinated. The existing research capability should be strengthened and consolidated. To this end, we recommend establishing or supporting a research entity focused on intelligence analysis, with three primary roles:

1. Delineating scientific research needs and priorities;
2. Synthesising relevant research from around the world; and
3. Conducting research addressing the highest priority issues in the Australian context.

A properly resourced and trusted national research entity would have at least three important advantages:

1. It would be able to assemble, coordinate and sustain the requisite deep multidisciplinary expertise;
2. It would work in close collaboration with intelligence organisations and with other researchers, including those at the Defence Science Technology Group, enabling multi-way transfer of knowledge and expertise; and
3. It would have means of handling the unique security-related challenges of doing research on, with and within intelligence organisations, including clearances, secure facilities, and appropriate internal policies and procedures.

Models for such an entity either exist already in other countries, such as

- The Laboratory for Analytic Sciences at North Carolina State University
- The Applied Research Lab for Intelligence and Security at the University of Maryland
- The Centre for Research and Evidence on Security and Threats in the UK

or have been proposed (e.g., a National Institute for Analytic Methods in the US[12]).

[12] Rieber, Steven, and Neil Thomason. "Creation of a National Institute for Analytic Methods: Toward Improving Intelligence Analysis." *Studies in Intelligence* 49 (2005).

4 The Nature of Analytic Rigour

In this section we present the account of analytic rigour that has emerged from our Literature Review, Expert Panel process, and Survey. We:

- Describe our approach to the challenge of articulating the nature of analytic rigour;
- Present our new definition of the concept, and relate it to prior accounts;
- Situate analytic rigour, thus defined, in relation to neighbouring concepts such as analytic standards;
- Discuss related topics, such as the purposes of analytic rigour, and its measurability.

4.1 Method – Nature

We treat the core challenge as that of providing the best possible *definition of the term* "analytic rigour." Such a definition would provide the clarity needed to elaborate on the nature of rigour, thus defined, and to explain its relationship with other concepts.

4.1.1 Definitions

What is involved in providing a good definition? This is a longstanding topic in philosophy. Some of the resulting theory is encapsulated in a summary article in the Stanford Encyclopedia of Philosophy. In the terms given there, our task is to provide an *explicative* definition, characterised as follows:

> An *explication* aims to respect some central uses of a term but is stipulative on others. The explication may be offered as an absolute improvement of an existing, imperfect concept. Or, it may be offered as *a "good thing to mean" by the term in a specific context for a particular purpose*.[1]

Thus, to provide an explicative definition, we must clarify three things: the context, the purpose, and the criteria for determining whether our proposed definition is indeed a "good thing to mean."

The **context** for our definition is intelligence analysis as conducted in government organisations in countries such as Australia and its Five Eyes partners.

The ultimate **purpose** of the definition is improving the quality of intelligence work. A good definition can help achieve this purpose by helping guide various activities, including:

- Recruitment of analysts with relevant skills or traits;
- Development of standards and guidance;
- Refinement of training programs;
- Improvements to evaluation and feedback processes;
- New initiatives aimed at enhancing analytic quality; and
- Ongoing support for, and evaluation of, existing initiatives.

To achieve the purpose, the definition should meet the following **criteria**:

- Be clear, succint, coherent, and memorable;
- Stick closely to existing usage, i.e., to the greatest extent possible, express what intelligence professionals already have in mind when using the term;
- Be general or abstract enough to cover analytic rigour in all its manifestations and variations;
- But also concrete enough to be useful in practice;

[1] Gupta, A. (2019). Definitions. *The Stanford Encyclopedia of Philosophy* (Winter 2019 Edition); our emphasis.

- Clarify the conceptual landscape, i.e., help us understand how analytic rigour relates to other concepts such as analytic standards or analytic quality; and
- Help us understand the causal relationships around rigour – i.e., what increases or reduces it and what impact rigour has on other things like accuracy or workload.

4.1.2 Concepts and dimensions

Generally speaking, terms correspond to concepts; definitions of terms articulate or describe those concepts. In providing an explicative definition of the term "analytic rigour," we are recommending a particular version of the concept that people should have in mind when they use the term. Some understanding of the nature of concepts generally can help guide us in this explicative task.

There are various theories about the nature of concepts, and the cognitive science community has no settled position on this topic.[2] Any theoretical framework we adopt will be supported by some and contested by others, and will have unresolved issues. Bearing that in mind, we recommend the "conceptual spaces" framework developed by cognitive scientist Peter Gärdenfors.[3] In this framework, concepts are understood as regions in similarity spaces, where a similarity space is defined by the "quality dimensions" of objects. For example, a red apple and a pink apple are closer (more similar) to each other than either is to a green apple in the colour similarity space defined by the dimensions hue, saturation and brightness. The concept of red, or redness, is a region in the hue-saturation-brightness similarity space; the concept of green is a different region in the same space. An object is more red, or less red, depending on how its colour is situated in the red region.

In the Gärdenfors framework, concepts corresponding to *properties* (such as redness) are regions in a particular type of similarity space, a *domain*. Domains are defined by sets of related[4] quality dimensions. Clearly, the hue-saturation-brightness space is a domain. The colour domain is defined by concrete psychophysical dimensions, but domains can also consist of sets of abstract, non-sensory dimensions.

Analytic rigour is a property. Thus, from this perspective, the key challenge in explicatively defining "analytic rigour" is that of delineating the rigour domain, i.e. the most useful set of related abstract quality dimensions for a rigour similarity space. The definition we propose below specifies such a set.

4.2 Process results - Nature

Our definition is grounded in insights derived from our Literature Review, Expert Panel process, and Survey of intelligence practitioners. Before proceeding, however, we note that outside intelligence, the term "rigour" has various meanings. The one most relevant to this project is

> *Strict sense or interpretation; precision, exactness; (in later use also) the quality or condition of being highly detailed, accurate, and thorough*.[5]

Other meanings include severity or strictness, harshness, inflexibility or rigidity, austerity, and hardship. Rigour thus has both positive and negative connotations. Below we will see this reflected in

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[2] On this topic also, the *Stanford Encyclopedia of Philosophy* provides a good introduction: https://plato.stanford.edu/entries/concepts/

[3] Gärdenfors, Peter. *Conceptual Spaces: The Geometry of Thought*. Cambridge MA: MIT Press, 2000; and *The Geometry of Meaning: Semantics Based on Conceptual Spaces*. Cambridge MA: MIT Press, 2014

[4] Gärdenfors unpacks the notion of relatedness required for domains in terms of *integral* versus *separable* dimensions. *Geometry of Meaning*, ch.2.

[5] *Oxford English Dictionary*, "rigour" meaning I.6 - https://www.oed.com/view/Entry/165946

the idea that analytic rigour is essential for good intelligence work, but can be overdone. Rigour must be applied appropriately in context.

The **Literature Review** revealed that:

- While the notion of rigour arises frequently in discussions of intelligence, it has received surprisingly little attention in its own right, and in the discussions it is not clearly delineated from related concepts such as quality of intelligence, or tradecraft standards.
- There has been no widely known and endorsed account of what analytic rigour is.
- There have however been some notable efforts to unpack the concept. These are the work by Zelik and colleagues, and more recently by the Laboratory of Analytic Sciences.

The **Expert Panel** process revealed that experts have very different "takes" on analytic rigour. That is, when asked to articulate their own perspectives, each expert comes up with an account which may be quite insightful, but is clearly also partial and idiosyncratic, when seen in the context of all other accounts. At the same time, there is a strong underlying consensus among the experts. When the most common themes emerging from all the individual takes are extracted and presented back to the experts for their reaction, they show a high level of agreement. For example, they agree very strongly that "Thoroughness or completeness in analytic work, including information considered, and possibilities explored" is an element of analytic rigour, even though most didn't make this point in their own description of rigour.

For more detail about the findings from the Literature Review and the Expert Panel, see the relevant appendices.

4.3 Our definition – "LOTSA" rigour

Drawing on the above, we define "analytic rigour" as conducting analytic work in a manner that is appropriately:

- **Logical**: observing principles of good reasoning and avoiding fallacies;
- **Objective**: being free from influence of values, desires, interests or belief systems;
- **Thorough**: tackling analytic work with completeness and attention to detail;
- **Stringent**: observing relevant rules, guidelines, principles or policies; and
- **Acute**: noticing and addressing relevant issues and subtleties.

We call these the "LOTSA" dimensions of rigour.

Analytic rigour is fundamentally an attribute or quality of analytic work, the activity involved in producing analytic outputs. We call this *process rigour*. Derivatively, analytic rigour can be an attribute of an output (e.g., a briefing or a report); this is *product rigour*. Product rigour is often a poor reflection of process rigour. One reason is that some constraints on analytic products, such as brevity, can limit the display of the process rigour behind the product. Another reason is that doing rigorous thinking, and articulating rigorous thinking in a written output, are two different activities, each requiring its own skill. An analyst may fail to reveal the actual level of rigour in their thinking due to weak drafting skills.

Rigour can also derivatively be an attribute of a person. A rigorous analyst is one who usually does rigorous work; similarly for an analytic team, unit, or organisation.

Analytic rigour is always a matter of degree; perfect rigour is generally unreachable, but good analysts will apply the greatest level of rigour feasible and appropriate in their circumstances.

4.3.1 The LOTSA dimensions

Logicality is making inferences or judgements in accordance with general principles of good reasoning i.e., the "laws of logic." The nature of good reasoning is a complex topic, and is under continual development by logicians, epistemologists, and cognitive scientists. Currently there is no single agreed upon set of principles of good reasoning, but there are many sets of rules or guidelines covering various kinds of reasoning.

Logicality can be seen as avoiding reasoning errors rather than as positively conforming to the laws of logic. Common reasoning errors are known as fallacies. There are many guides to fallacies and reasoning errors available as books, websites, etc.; they vary considerably in quality and utility.[6]

Objectivity is basing inferences and judgements only on relevant information and good reasoning. Like logicality, objectivity is often easier to understand negatively, i.e, as avoiding lapses in objectivity. A lapse is allowing inferences or judgements to be shaped by certain kinds of irrelevant considerations, particularly the values, desires, interests, and ideologies of the analysts themselves, or others such as managers, customers or politicians. Complete objectivity is an ideal, and generally cannot be attained in intelligence work,[7] but some level of objectivity is always achievable.

Thoroughness is tackling all aspects of analytic work with an appropriate level of completeness and attention to detail. In intelligence analysis, thoroughness can be manifested in many aspects of analytic work, including:

- The proportion of available or obtainable information considered, and information gaps identified;
- The number of alternatives explored, and the depth of exploration;
- The possibilities of deception and adversarial intent considered;
- The extent to which assumptions are identified, challenged or defended;
- The range of objections considered; and
- The uncertainties and limitations articulated.

Stringency is observing "the rules" insofar as these are relevant to the quality of analysis.[8] Stringency includes being *diligent* (observing the rules wherever they apply), and *exacting* (observing them in each case in a careful, precise manner). Here the term "the rules" is used broadly to refer to:

- Requirements specified by legislation, agreements, or policies (e.g., record keeping);
- Requirements or expectations attached to a role;
- Fulfilling user/customer requirements;
- Guidelines or procedures for good analytic work; and
- The steps involved in structured analytic methods.

Acuity in ordinary parlance is "sharpness or keenness of thought, vision, or hearing."[9] Acuity in analytic work is noticing and addressing issues relevant to thinking effectively about the topic:

---

[6] The Hunt Lab has worked with an Australian government agency to develop advanced training using the "avoiding errors" approach, tailored to the intelligence context and focusing on the reasoning errors most relevant to intelligence analysis. https://huntlab.science.unimelb.edu.au/home/research/aar-training/

[7] Marrin, Steven. "Analytic Objectivity and Science: Evaluating the US Intelligence Community's Approach to Applied Epistemology." *Intelligence and National Security* 35, no. 3 (2020): 350–66.

[8] Analytic work is subject to rules whose focus or concern is not quality of analysis but other important considerations, such as security.

[9] https://www.lexico.com/definition/acuity

similarities, differences, connections, patterns, parallels, gaps, assumptions, preconditions, implications, or consequences. Lack of acuity manifests as sloppiness or obliviousness.

Acuity is aided by using language with clarity, consistency, and precision; or in other words, avoiding vagueness, ambiguity, equivocation, obfuscation and idiosyncratic usages. These problems can degrade communication, but they also impede analytic *thinking*, since higher-level thinking involves articulating abstract or complex thoughts in language, whether external (writing, speech), or in internal monologue.

Acuity can be boosted by building a more sophisticated conceptual repertoire and skilfully deploying that repertoire to gain greater insight into a situation. For example, a strategic analyst might describe a country as increasingly *polarised*. Another analyst might understand that polarisation can describe many different patterns of alignment.[10] The second analyst can make more nuanced and accurate claims.

4.3.2 Analytic rigour in intelligence analysis

The LOTSA dimensions characterise rigour in analytic work in general. Analytic rigour *in intelligence analysis* means "being LOTSA" when doing intelligence analysis. This will manifest as a distinctive kind of rigour insofar as intelligence analysis differs from other kinds of analysis. Thus we can elaborate on the special nature of rigour in intelligence analysis by describing in detail what Thoroughness (for example) consists in in various distinctive aspects of intelligence analysis.

To do this, we need an account of analytic work highlighting its unique character. Developing such an account was outside the scope of this project, but we can draw on important prior work by Zelik and colleagues. In a series of papers appearing from 2007-10,[11] they present an account of analytic rigour as *the extent to which an analytic process exhibits the following eight critical attributes*:

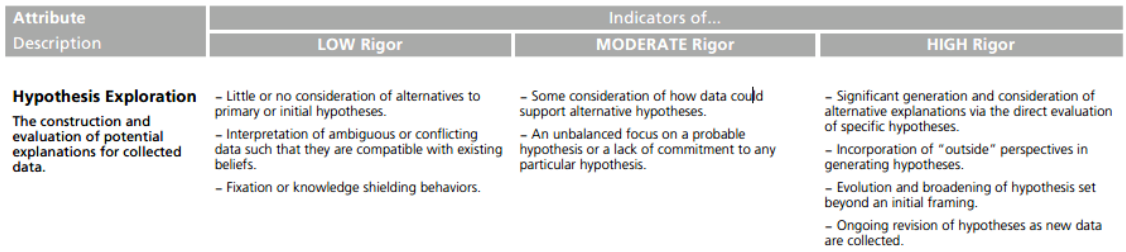
[10] These have been called spread, dispersion, coverage, regionalisation, community fracturing, distinctness, divergence, solidarity, size disparity, and association. Each of these can be mathematically defined, and shown to be independent of the others. Bramson, A. L., et al (2013). Measures of polarization and diversity. Sandia National Lab.

[11] Zelik, Daniel, Emily S. Patterson, and David Woods. "Measuring Attributes of Rigor in Information Analysis." In *Macrocognition Metrics and Scenarios: Design and Evaluation for Real-World Teams*, 65–84. Aldershot, UK: Ashgate, 2010; Zelik, Daniel, Emily Patterson, David Woods, K Mosier, and U Fischer. "Understanding Rigor in Information Analysis." In *Proceedings of the Eighth International NDM Conference*. Pacific Grove CA, 2007; Zelik, Daniel, David D Woods, and Emily S Patterson. "The Supervisor's Dilemma: Judging When Analysis Is Sufficiently Rigorous." In *CHI 2009*. Boston MA: ACM, 2009.

Table 4-1: Eight attributes of analytic work identified by Zelik and colleagues.

Hypothesis Exploration	Generating and considering alternative hypotheses in explaining data.
Information Search	Actively searching for relevant information.
Information Validation	Validating information through corroboration and cross-validation.
Stance Analysis	Evaluating information with respect to the stance or perspective of the source.
Sensitivity Analysis	Considering and understanding the assumptions and limitations of an analysis.
Specialist Collaboration	Actively seeking out and incorporating the perspectives of domain experts.
Information Synthesis	Going beyond collating information to provide insights resulting from integrating the information.
Explanation Critique	Obtaining, and incorporating insights from, critiques by others.

For each of those attributes, they provide "indicators" of low, medium or high rigour. **Figure 4-1**, drawn from a table in one of their papers, illustrates this by listing indicators of levels of rigour with regard to one attribute, "Hypothesis Exploration."



Attribute / Description	Indicators of... LOW Rigor	MODERATE Rigor	HIGH Rigor
Hypothesis Exploration The construction and evaluation of potential explanations for collected data.	– Little or no consideration of alternatives to primary or initial hypotheses. – Interpretation of ambiguous or conflicting data such that they are compatible with existing beliefs. – Fixation or knowledge shielding behaviors.	– Some consideration of how data could support alternative hypotheses. – An unbalanced focus on a probable hypothesis or a lack of commitment to any particular hypothesis.	– Significant generation and consideration of alternative explanations via the direct evaluation of specific hypotheses. – Incorporation of "outside" perspectives in generating hypotheses. – Evolution and broadening of hypothesis set beyond an initial framing. – Ongoing revision of hypotheses as new data are collected.

Figure 4-1: One of eight "attributes" of analytic work, Hypothesis Exploration, and the indicators of Low, Moderate and High rigour in that attribute. Excerpt from a table contained in Zelik et al., Measuring Attributes of Rigor in Information Analysis. The full table is reproduced in Appendix A – Literature Review.

For example, *little or no consideration of alternatives to primary or initial hypotheses* indicates low rigor in Hypothesis Exploration, while *evolution and broadening of hypothesis set beyond an initial framing* indicates high rigour.

This table is the basis of Zelik et al.'s "Rigor Metric," in which analytic work is scored for its level of rigour on each of the eight attributes. We discuss the Rigor Metric further below (s.4.8).

In our view, Zelik et al.'s attributes and table of indicators constitute detailed and insightful descriptions of *what being LOTSA looks like* for various aspects of intelligence work. Currently, their indicators are only a partial account of analytic rigour in intelligence work, but they do illustrate the kind of effort that needs to be applied to fully elaborate the topic.

Conversely, a general view of analytic rigour, such as our LOTSA account, explains why these indicators indicate the levels they do. Providing *little or no consideration of alternatives to primary or initial hypotheses* is failing to be Thorough in Hypothesis Exploration. *Ongoing revision of hypotheses as new data are collected* indicates high rigour because it is what is required by Logicality (more specifically, observing a broadly Bayesian approach to abductive reasoning).

This framework explains another important feature of analytic rigour in intelligence work – that it can manifest differently in different types or areas of intelligence work.[12] The LOTSA dimensions are universal, but what it means to be LOTSA will depend on the type of analysis being done. Thus, Acuity in geospatial intelligence,[13] when described in detail, will mean being perceptive of different things and in different ways than Acuity in, say, counter-espionage.

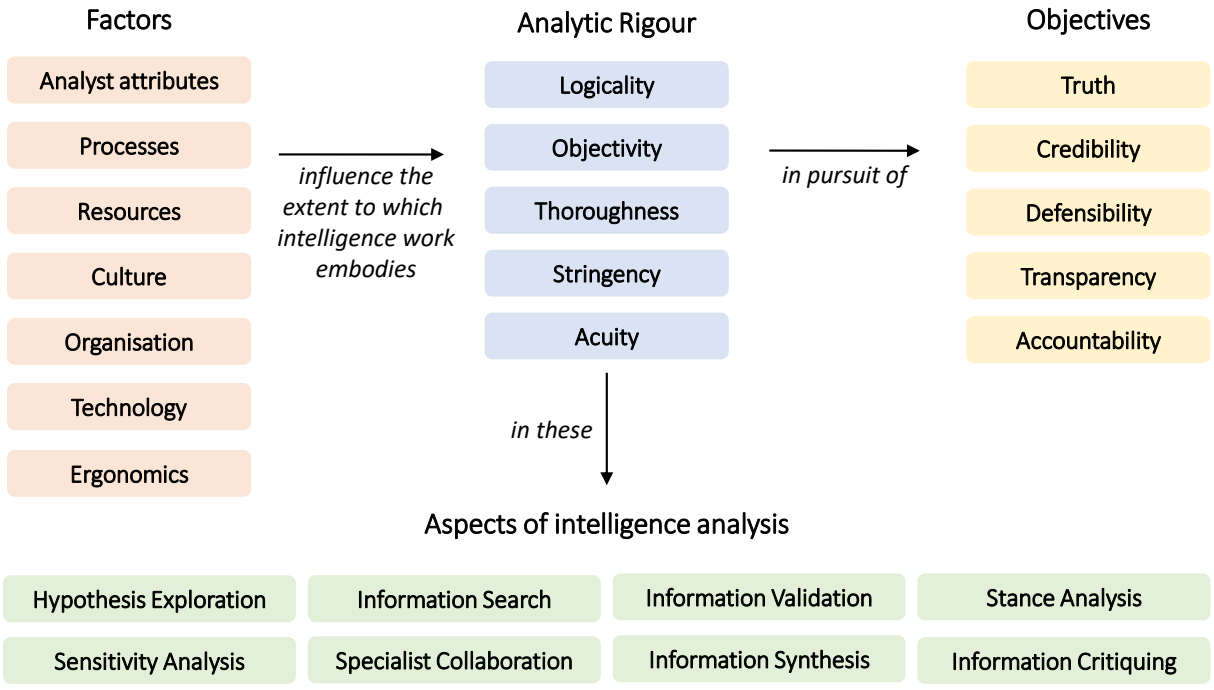


Figure 4-2: A partial map of the conceptual landscape of analytic rigour in intelligence work. Each "Factors" box corresponds to a category of causal factors. This map draws on (but does not endorse) a particular breakdown of intelligence work into "aspects" (attributes, activities), as provided by Zelik and colleagues.

4.4 Purposes or objectives of analytic rigour

Analytic rigour as defined may seem to need no justification, but there is value in articulating exactly why rigour is so important. Rigour is conducive to, and even necessary for, a range of critical attributes of intelligence in a democratic society: truth, credibility, defensibility, transparency, and accountability. These attributes are closely related but subtly distinct.

Truth. First and foremost, analytic rigour increases the level of truth (correctness or accuracy) in judgement.[14] Insufficient rigour – being illogical, biased or influenced, perfunctory, sloppy, and/or obtuse – leads inevitably to errors, often unwitting. This sweeping claim is difficult to prove in the abstract, but its plausibility is manifest whenever we drill down to particular aspects. For example, failure to be *Thorough* in the specific respect of considering the possibility of deception obviously reduces the chance of correcting a mistaken interpretation of a situation.

[12] The Expert Panel showed strong agreement that "The nature of analytic rigour depends on context (e.g., different types of intelligence work)."

[13] For an overview of geospatial intelligence see https://www.defence.gov.au/ago/geoint.htm

[14] We acknowledge that some types of analysis, of long-term future scenarios, for example, may focus on possibilities and plausible futures, rather than accurate prediction, per se. 'Being LOTSA' will also promote this type of thinking, for example in thoroughly exploring possibilities, causal links, trends, etc.

Credibility. Truth often can't be assessed at the time of production or delivery of an intelligence output. Analytic work achieves impact not by by virtue of its truth but rather by being *credible*, i.e. rationally compelling or believable. Analytic rigour generally helps establish credibility, at least to the extent that the rigour can be visible in what the customer sees (e.g., a written product).

Defensibility. Rigour promotes truth, but can't guarantee it. When errors occur, as they inevitably will, the erroneous judgements should at least be defensible. In general, having applied appropriate analytic rigour in reaching those judgements should be sufficient for defensibility. This can be unpacked by focusing on particular dimensions of analytic rigour as we have defined it. For example, a high level of stringency (observing relevant rules appropriately) will clearly support defensibility.

Transparency. Transparency in this context is making the rational basis for judgements available for scrutiny. Analytic rigour can contribute to transparency by forcing a more explicit and detailed articulation of the thinking that led to judgements. Transparency, to the extent possible given constraints such as security concerns, is valuable for a number of reasons. It helps managers understand the quality of the thinking, which may help improve quality via targeted feedback. It helps customers form their own judgements about the quality and usefulness of the intelligence provided to them. And it will help auditors form judgements about the quality and defensibility of assessments.

Accountability. Finally, analytic rigour supports accountability, which we take to be the ability to establish, to internal and external audit authorities, that actions are appropriate.[15] Rigorous thinking will help intelligence organisations make accurate judgements as to the appropriateness of actions prior to taking them, and substantiate that appropriateness if required (as already noted).

4.5 How much rigour is optimal?

Analytic rigour is, unequivocally, a good thing. But can there be too much of it? Overzealous pursuit of rigour has potential downsides. It can

- delay outputs;
- consume resources which might be better spent elsewhere;
- be demoralising and create personal friction when demands for rigour devolve into pedantry;
- be in tension with creativity and insight;[16] and
- lead to "over proceduralisation," where detailed step-by-step procedures intended to secure rigour, particularly for junior or less skilled analysts, interfere with the fluid expertise of advanced analysts.[17]

To avoid such problems, analytic rigour should be applied appropriately in context, balancing the benefits of more rigour against the costs of taking it too far. This may seem platitudinous, but we are unaware of any previous attempt to provide more helpful guidance.

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[15] "Accountability is … broadly comprised of two components: "rendering account," which is the provision of information, and "holding to account," whereby a judgement is made about the appropriateness of behavior, based on this and other information. Furthermore…the actions of the intelligence and security agencies are usually appraised according to their perceived efficiency, effectiveness, and ethics." Gaskarth, Jamie. *Secrets and Spies: UK Intelligence Accountability after Iraq and Snowden*. Washington D.C.: Brookings Institution Press, 2020.

[16] Klein, G. Critical thoughts about critical thinking. *Theoretical Issues in Ergonomics Science*, 12 (2011) p.211. "The busywork of tracking assumptions and uncertainties may lead analysts to see their job in a passive way, as accountants rather than as detectives."

[17] Hutchins, Edwin. *Cognition in the Wild*. Cambridge, Mass.: MIT Press, 1995.

We suggest that the concept of ALARP might be co-opted for this purpose. ALARP, or "as low as reasonably practicable," is a key principle in risk management. It means that for any given risk, measures should be taken to mitigate the risk up to the point where the costs involved in any additional mitigation become grossly disproportionate to the benefit.

Applying ALARP to the level of rigour in intelligence analysis, we need to consider: what is the risk? In broad terms, because the primary purpose of rigour is truth or accuracy, the immediate or proximal risk is that of error (viewed in light of its potential further consequences). So the ALARP principle would be to pursue analytic rigour to the point where the risk of error has been made as low as reasonably practicable.[18] This idea might be further developed by drawing on the considerable work previously done on ALARP.[19]

4.6 Relation to other concepts

4.6.1 Quality of intelligence

Analytic rigour is one important aspect or dimension of intelligence work. Good intelligence is rigorous, but it has various other qualities. Mark Lowenthal, for example, argues that good intelligence is timely, tailored, digestible, and clear.[20] Analytic rigour is a virtue in its own right, but it also contributes to other virtues, such as defensibility.

4.6.2 Analytic confidence

Analytic confidence is broadly the degree to which an analyst believes that he or she possesses a sound basis for a judgement, whether a primary judgement (e.g., X is a member of group Y) or an assessment of uncertainty (e.g., The probability that X is a member of group Y is low).[21] So, for example, an analyst might have *high confidence* that that Jones *is unlikely* to be security risk.

Analytic rigour is a component of analytic confidence in two senses. First, the level of analytic confidence one should have in a judgement will depend (among other things) on the level of analytic rigour in the formation or justification of that judgement.[22] Second, an assessment of analytic confidence should itself be rigorous. Organisations have introduced guidelines or procedures to help drive rigour in this regard.[23]

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[18] David Omand, Director of GCHQ 1996-7, has made a similar point in relation to counter-terrorism strategy See *Securing the State*. Oxford, UK: Oxford University Press, 2014. "The aim [in counter-terrorism] has to be to take sensible steps to reduce the risk to the public at home and to our interests overseas, on the principle known in risk management as ALARP, to a level 'as low as is reasonably practicable'." (p.93).

[19] E.g., Redmill, Felix. "ALARP Explored." Technical Report CS-TR-1197, Newcastle University Computing Science, 2010.

[20] Lowenthal, Mark M. 2015. *Intelligence: From Secrets to Policy.* Los Angeles CA: SAGE/CQ Press. p.198

[21] This is based on the definition provided in Friedman, Jeffrey A., and Richard Zeckhauser. "Analytic Confidence and Political Decision-Making: Theoretical Principles and Experimental Evidence from National Security Professionals." *Political Psychology*, 2017.

[22] The Expert Panel endorsed this proposition (77% Agree or Strongly Agree).

[23] For example, the UK Home Office has produced Intelligence Analysis Guidance: Probability and Confidence Levels in Intelligence Assessments.

4.6.3 Analytic standards

Rigour and standards have a complex and even messy relationship, compounded by the fact that there are various sets of standards with substantial differences among them, and that standards are sometimes only loosely articulated. In Appendix D – Table of Analytic Standards we present a table listing all standards found in various documents we were able to obtain, and revealing both the similarities and the considerable differences between the approaches.

Nevertheless, the relationship can be summarised in the following points:

1. Though closely related, standards and rigour are different in kind. Standards are expectations, whereas rigour is execution.
2. Standards have wider scope than rigour. We noted above that rigour is only one aspect of good intelligence. Standards set expectations about good intelligence generally, and thus cover rigour, but also cover other things.
3. Meeting standards should generally contribute to analytic rigour.[24] For example, meeting the PHIA standard *Independent* ("Ensuring assessments are free from external and/or political influence") will automatically help ensure Objectivity, because being free from external and/or political influence is part of Objectivity, as we define it.
4. Conversely, being rigorous will help analysts meet standards. This is obviously true where standards and rigour have the same focus, but will often also be true where the connection is less direct. For example, the PHIA standard *Relevant* will be better met when analysts apply greater rigour in assessing what customer needs are and whether their work is meeting those needs.

4.6.4 Structured Analytic Techniques

Analytic rigour also has a complex relationship with SATs. The standard view in the intelligence community is that SATs help analysts achieve rigour;[25] that is, using SATs is not being rigorous *per se*, but *proper* use of SATs will generally enhance rigour.

This view has recently come under increasing attack. Critics have pointed out that there has been little attempt to evaluate whether SATs do in fact lead to better analysis, and the few studies that have been done generally find little benefit. Criticism on theoretical grounds suggests that SATs are often poorly designed and may even harm analysis in certain respects.[26] Even a well-designed SAT might be poorly utilised.

One thing is clear, however. There must be rigour in the use of SATs for that use to have any benefits for analysis. Like any tools, SATs can be abused; proper SAT use is logical, objective, and so forth. Thus, the relationship between rigour and SATs is inherently circular: rigorous use of good SATs may enhance analytic rigour.

4.6.5 Critical thinking

The relationship between analytic rigour and critical thinking is multifacted because "critical thinking" has various meanings. Narrow definitions equate it with basic logic, thus (partially) aligning

[24] Expert Panel: 81% Agree or Strongly Agree

[25] See for example, Heuer Jr, Richards J., Richards J. Heuer, and Randolph H. Pherson. *Structured analytic techniques for intelligence analysis*. CQ Press, 2010..

[26] Chang, Welton, Elissabeth Berdini, David R. Mandel, and Philip E. Tetlock. "Restructuring structured analytic techniques in intelligence." *Intelligence and National Security* 33, no. 3 (2018): 337-356.

it with Logicality. Critical thinking is then *part* of analytic rigour; being rigorous includes thinking critically, among other things.

On broader definitions, critical thinking is generally truth-oriented or truth-conducive thinking.[27] On these definitions, analytic rigour and critical thinking are roughly equivalent.

In the humanities and social sciences, critical thinking is often conceived of as involving, among many things, active questioning and challenging (for example, not taking things at their face value), maintaining a sceptical and open disposition, and thinking reflectively and deliberatively to form a judgement or make a decision.[28] This overlaps with analytic rigour.

However, in the humanities, the term "critical" (as in the "critical humanities") and critical thinking are also used to mean something like understanding systems of knowledge and power in society, and challenging those systems, particularly where they are seen to be oppressive. On this conception, analytic rigour and critical thinking or "criticality" are independent.

4.6.6 Creativity and insight

A simple view is that rigour, on one hand, and creativity and insight on the other, are separate and complementary aspects of good thinking. In fact, rigour and creativity or insight are interdependent. For example, one aspect of thoroughness is critically evaluating an adequate range of alternative hypotheses. It takes some level of imagination, grounded in experience-based intuition, to quickly come up with alternatives that are both strikingly different to one's preferred view, and plausible enough to take seriously. Similarly, creativity or insight need rigorous evaluation to help determine which new ideas or angles have real value.[29] However, a disturbing possibility is that too much rigour can harm insight.[30]

4.6.7 Deception and adversarial intent

Taking deception and adversarial intent into account is a crucial aspect of intelligence work. This sets intelligence analysis epistemologically apart from most of science, though there are other fields where it is also important (e.g., criminal law). What is the relationship with rigour? In our view it is best expressed as follows: to be analytically rigorous in intelligence work involves (in part) being logical, objective, thorough, stringent and acute with regard to the possibility of deception and adversarial intent.

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[27] In a paper for an IARPA workshop on critical thinking, one of our team offered a short definition of critical thinking as *the skilful deployment of general thinking methods conducive to good judgement*. He then distinguished multiple dimensions of critical thinking, levels of sophistication of methods, and grades of expertise in using methods. See van Gelder, Timothy. Dimensions of Critical Thinking. Workshop on Measuring Critical Analytic Skills for Intelligence Analysts, McLean VA. (2012) http://bit.ly/dimct

[28] Davies, Martin. "A model of critical thinking in higher education." In Higher education: Handbook of theory and research, pp. 41-92. Springer, Cham, 2015.

[29] As artist Francisco Goya famously said: "When abandoned by Reason, Imagination produces impossible monsters: united with her, she is the mother of the arts and the origin of their wonders."

[30] Klein, G. (2011) "Critical thoughts about critical thinking", *Theoretical Issues in Ergonomics Science*, 12(3) page 211. "The busywork of tracking assumptions and uncertainties may lead analysts to see their job in a passive way, as accountants rather than as detectives."

4.6.8 Timeliness

The tensions between time constraints/pressures, which can negatively impact on analytic rigour, the need to be timely (for intelligence to be useful to policy and decision-makers), and whether timeliness is a part of analytic rigour or a separate aspect of good intelligence analysis, received much discussion in the Expert Panel discussion forum and in our research team.

Timeliness as an analytic standard is universally stressed in analytic tradecraft documents and legislation.[31] In our view:

- Generally, rigour and timeliness are different features of good intelligence;
- Rigorous work, by its nature, is time-consuming;
- As discussed below, timeliness can reduce rigour when time is short – conversely, an excessive concern for rigour can harm timeliness; and
- To be as rigorous as possible in a given situation, analysts must take the timeframe into account and allocate their efforts accordingly.

4.7 Relation to other accounts of analytic rigour

Our Literature Review identified only two substantial prior efforts to describe the nature of analytic rigour. In this section, we outline the relationship between each of those efforts and our LOTSA account.

4.7.1 The Zelik et al. Rigor Metric

We described the Zelik et al. approach to analytic rigour in some detail above (s.4.3.2). To recap, they define[33] analytic rigour as the extent to which analytic work exhibits the eight critical attributes listed in Table 4-1. They go on to provide a table of indicators of whether an analytic work is low, moderate or high on each of these attributes; that table is the core of their Rigor Metric.

Superficially, the Zelik et al. account of analytic rigour seems very different to our LOTSA definition. There is no overlap between their eight attributes and our five LOTSA dimensions. Our view, however, is that the two approaches complement rather than conflict with each other. They can be reconciled in two ways.

First, we should understand them as being pitched at two different levels of analysis. Our LOTSA definition is at a higher, more general or abstract level; it applies to analytic work generally. The Zelik et al. account is more specifically descriptive of rigour in intelligence work. As they note, this specificity raises the question of the broader relevance of their account of rigour. As they say:

> Perhaps the most prominent issue still left unresolved is determining how well the findings of this intelligence-based research generalize to other areas of information analysis.

[31] In the U.S., for example, timeliness it is a legislated requirement of intelligence analysis in the Intelligence Reform and Terrorism Prevention Act of 2004 (section 1019).

[33] "The Rigor Metric represents the revised definition…which frames the concept of rigor as the composite of multiple process attributes." Zelik et al. (2007) p.3.

[33] "The Rigor Metric represents the revised definition…which frames the concept of rigor as the composite of multiple process attributes." Zelik et al. (2007) p.3.

We would add to this a concern about the generalizability of their account even *within* intelligence analysis. There are many types of intelligence analysis, and rigour will manifest somewhat differently in each type. The Zelik et al. attributes and indicators, as a set, fit some types better than others.

Second, the accounts mesh in the sense that (as mentioned above) the LOTSA definition *explains why* the indicators provided by Zelik et al. indicate what they do.

Overall, then, we regard the Zelik et al. account as being too *particular* to constitute an adequate definition of analytic rigour. However, their attributes and indicators as relatively detailed and insightful (though incomplete) descriptions of what analytic rigour can look like in practice.

4.7.2 Laboratory for Analytic Sciences

In recent years the most substantial research effort related directly to analytic rigour has been work undertaken at the Laboratory for Analytic Sciences (LAS).[34] They shared with the Hunt Lab their unpublished report Defining Analytic Rigor for Analysis in the Intelligence Community.[35]

The LAS report starts with a "candidate operational definition" of analytic rigor. The definition had been developed "through discussions with seasoned analysts, review of related professional policy, and subject matter experts' contributions." This development process is not further described in the document. The main part of the report discusses components of the definition in the light of literature from other disciplines (e.g., social sciences) as identified in the team's literature review.

The LAS candidate operational definition is:

> Rigor is an effort by an analyst or researcher to be as complete as possible in order to arrive at the most accurate assessment/results possible in conducting an analysis with integrity. This is achieved by employing methods and techniques meant to support a variety of indicators of sufficiency. Indicators of sufficiency include:
>
> - Objectivity
> - Thoroughness
> - Replicability, reliability, validity
> - Transparency (in analysis and analytic decision-making)
> - Credibility
> - Relevance.[36]

As would be expected, there is considerable overlap with our "LOTSA" definition, but there are also significant differences. These are summarised in Table 4-2:

[34] Laboratory for Analytic Sciences, North Carolina State University https://ncsu-las.org/

[35] Johnston, J. Defining Analytic Rigor for Analysis in the Intelligence Community [Unpublished report]. Laboratory for Analytic Sciences, North Carolina State University, (2020)

[36] Ibid. p.7. Underlining in the original, indicating "terms…intended to be operationalized through further study and research." (p.6)

Table 4-2: Comparison of the LOTSA dimensions with the Laboratory for Analytic Science's "indicators of sufficiency" or "characteristics"[37] of rigour.

Hunt "LOTSA" Dimensions	LAS – "Indicators or sufficiency" or characteristics	Comment
Logicality		Omission from LAS candidate definition
Objectivity	Objectivity	Alignment
Thoroughness	Thoroughness	Alignment
Stringency		Omission
Acuity		Omission
	Replicability, reliability, validity	Consequence of other dimensions/characteristics
	Transparency	Purpose (see s.4.4)
	Credibility	Purpose
	Relevance	Separate virtue of analytic work; or falls under other dimensions.

The two definitions agree that Objectivity and Thoroughness are important ingredients of rigour.

In our view the LAS candidate operational definition is missing Logicality, Stringency, and Acuity. To simplify our case for including these dimensions, ask: *what would you think of analytic work which lacked Logicality (i.e., had flawed reasoning)? Would you describe it as rigorous?* Similarly for Stringency and Acuity.

The LAS definition suggests four characteristics not appearing in LOTSA. All four are clearly important and related to analytic rigour. Whether they should be added to the LOTSA dimensions, or understood differently, is to some extent a matter of judgement, taking into account the various criteria on an explicative definition (s.4.1). In our view:

- Replicability and reliability[38] are natural consequences of work being rigorous in the LOTSA sense. These characteristics are important in the sciences, but less so in intelligence, where it is more unusual to repeat work to verify results.
- Transparency and Credibility are best regarded as purposes of analytic rigour, as described above (s.4.4). That is, analytic work should be, inter alia, transparent and credible. Rigour helps achieve those objectives.
- The LAS paper usefully distinguishes external and internal relevance. External relevance, or *customer* relevance in the language of ICD 203, is a virtue of analytic work alongside and distinct from rigor. Internal relevance is the situation "what is being performed in the course of conducting intelligence analysis is directly relevant to the question or problem that is

[37] On p.11 the authors say that "the indicators of sufficiency in our definition of rigor…could also be viewed as characteristics of rigor." In our view, *characteristics* is the better term, and means much the same as *dimensions* in our own account.

[38] "Validity" appears in the candidate operational definition, but in our view shouldn't be lumped together with replicability and reliability.

being addressed."[39] While this is important, it is also thoroughly intertwined with other dimensions such as Logicality, which requires relevance of premises to conclusions.

4.8 Measuring rigour

Ideally, there would be a sound (valid, reliable, and practical) method for evaluating analytic rigour. Such a method could be used in many ways, including:

- Assessing whether any given piece of analytic work is sufficiently rigorous;
- Evaluating the performance of individuals, teams, units, or organisations;
- Conducting research on the factors impacting rigour; and
- Guiding the development and adoption of interventions aimed at improving rigour.

However, developing and deploying a sound method is very challenging.

- Rigour, as we have defined it, is an aspect of analytic work. Measuring rigour would therefore require carefully observing that work. This is slow, expensive, difficult, and intrusive.
- As an alternative, a method could assess rigour in an output, such as a report. In other words, instead of measuring the primary form of rigour, process rigour, it would measure a derivative form, product rigour. The trouble is that product rigour is a poor window on process rigour, as briefly discussed above.
- For any such method, there is the deep problem of establishing validity. How do you know the method is actually measuring rigour, when there is no independent "gold standard" to calibrate against?

Given these kinds of difficulties, and the fact that there has not been (until now) an adequate general definition of rigour, there is no sound method for evaluating rigour. A major recommendation of this report is that research and development effort be applied in this area.

4.8.1 The Zelik et al. Rigor Metric

We previously (s.4.3.2, 4.7.1) described the approach to analytic rigour developed by Zelik et al.. Their Rigor Metric is to our knowledge the most advanced work to date on measuring rigour, though we are not aware of it having been adopted in any real (non-academic) intelligence context.

We regard their general approach to measuring rigour as broadly promising, but have a number of concerns about the Rigor Metric specifically.

- It does not appear to be based on an independent general definition of analytic rigour such as the one we propose;
- Partly as a result, the indicators are only partial guides to rigour – analysis could fail to be rigorous in ways not covered by the indicators;
- The Rigor Metric is based on a particular breakdown of analytic work into eight critical attributes, such as Hypothesis Exploration, and so depends on the adequacy of that breakdown; and
- The Rigor Metric does not appear to have been rigorously assessed for reliability and validity (beyond face validity).

[39] Ibid., p.22.

4.8.2 Using other measures as proxies

An alternative to developing a method for evaluating analytic rigour specifically is to rely on information gathered through the use of other measures. To the extent that the information correlates with analytic rigour, the other measure can function as a proxy for a rigour measure.

For example, the ODNI's IC Rating Scale is a rubric for scoring intelligence products in terms of the analytic tradecraft standards specified in ICD 203. Those standards are intended to promote "analytic rigor and excellence" and so the IC Rating Scale, or some combination of its sub-scales, might be treated as a measure of rigour. In research currently underway in collaboration with the Laboratory for Analytic Sciences at North Carolina State University, the Hunt Lab is investigating the extent to which IC Rating Scale scores are indicative of product rigour as separately assessed by experienced analysts.

5 Factors Impacting Analytic Rigour

In this section we present our findings with regard to the factors contributing to, or detracting from, analytic rigour. We discuss our method, the results emerging from our three processes, and our synthesized list.

5.1 Method – Factors

5.1.1 Identifying causal factors

Our concern is with *causal* factors – roughly, those things which, to the extent they are present or absent, change the level of rigour in analytic work.

Causal factors are a central preoccupation of science, and methodologists have given it considerable attention. Researchers can now access a vast and evolving body of theory, methods and tools. Unfortunately, most of that sophisticated machinery cannot be applied to the challenge we face here.

One major approach scientists take to identifying causal factors is to run experiments. Applied to analytic rigour, this would involve manipulating potential causal factors and observing the effect on the level of analytic rigour, while holding everything else as constant as possible. For example, to evaluate whether and how cognitive diversity in the analytic workforce impacts analytic rigour, researchers would ideally take one or more intelligence organisations, systematically change the level of diversity, keeping everything else fixed, and record the consequent changes in analytic rigour in actual work.

However, such research is not feasible. Experiments like these are exceedingly difficult to run in practice for any type of organisation, and intelligence organisations don't allow themselves to be studied in this way. To our knowledge, no such experiments have ever been conducted, and so insight cannot likely be gained by looking in that direction.

Another approach often used, particularly by social scientists, is to take data which has been gathered outside any experiment (often called observational or correlational data), and apply statistical techniques to reveal the signal of causal impacts within the noise of large datasets. For example, an organisation might have kept records of both the level of cognitive diversity, and the level of analytic rigour, over many years. By comparing the patterns of change in these datasets, researchers could gain insight into whether the one was affecting the other.

This kind of research is beset by challenges at the best of times, and our times are not the best. Intelligence organisations are generally unlikely to have gathered the data we would need for questions about analytic rigour. For example, while they would have data about demographic diversity in their workforces, they probably do not have data about cognitive diversity specifically; and they would not have data about levels of analytic rigour as (newly) defined in this report. In addition, outside researchers often have difficulty accessing any data that does exist for security reasons.

That said, this research project has demonstrated the possibility of collecting data through partnership engagement; as these partnerships develop, increased scope for greater engagement on available data may be possible.

A third strategy is to conduct research *outside* intelligence organisations, and make inferences to causal factors in real analytic work *within* organisations. For example, we could study the relationship between cognitive diversity and analytic rigour in groups of university students doing hypothetical

intelligence-type problems, and extrapolate the results from the laboratory to the workplace. There are some examples of this approach, at least for certain aspects of rigour as we define it. These studies can be conducted with internal methodological rigour, but they suffer another problem, that of *external validity.* Rigour in the study is bought at the expense of such great differences between the study setup and real intelligence work that extrapolating from one to the other is difficult.[1]

In short, traditional scientific study of causal factors impacting analytic rigour in intelligence work is hard. Fortunately, there is a reasonable alternative. In simple terms, we can ask experts what they think. Experts, for this purpose, are people who have spent lots of time – much, if not all of their careers – immersed in, or thinking about, intelligence or closely related topics. With long accumulated experience, they have become at least somewhat attuned to the causal structure of the domain. That attunement can be a solid point of departure for understanding the causes of analytic rigour, or its lack.[2]

The reliability of expert insight into causal factors has been considered in various contexts. In a landmark article, psychologist Robyn Dawes summarised a large body of research which collectively implies that experts can provide good insight into what variables matter, and the direction of their influence (do they increase or decrease the variable of primary interest – in our case, level of analytic rigour).[3] This has been supported by prior work by a member of our team in an area adjoining intelligence, the assessment of extreme risks.[4]

Of course, expert opinion might be the first word, but it can't be the last. Experts asked for their intuitive "takes" on the causal factors will almost certainly not think of all causal factors, and they might nominate factors with no genuine causal role. The factors they do correctly identify might be inaptly described. For example, an expert might nominate demographic diversity as relevant to analytic rigour, when the underlying, or "real," causal factor might instead be cognitive diversity.[5] Expert intuition cannot quantify causal strength, and experts will have limited ability to describe interactions and dependencies among causal factors.

We can mitigate these problems to some extent using the wisdom of crowds. One expert may have a very partial and eccentric perspective; another's is also partial and eccentric, but in a different way.

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1 Yarkoni, Tal. "The Generalizability Crisis." *Behavioral and Brain Sciences*, 2020, 1–37.

2 One version of the "ask the experts" strategy is ethnographic inquiry. Robert Johnston and Bridget Nolan have produced notable instances of ethnographic study of intelligence work. Neither was focused specifically on analytic rigour, but such studies, cautiously interpreted, can yield insight into factors impacting rigour. See Johnston, R. (2005). *Analytic culture in the US intelligence community: An ethnographic study*. Center for the Study of Intelligence, CIA.; and Nolan, B. R. (2013). *Information Sharing and Collaboration in the United States Intelligence Community: An Ethnographic Study of the National Counterterrorism Center*. PhD Dissertation, University of Pennsylvania. Due to both resource constraints and access challenges, we have not used ethnography as a source in this project, but Johnston's and Nolan's outputs are included in our literature review.

3 "The statistical model may integrate the information in an optimal manner, but it is always the individual (judge, clinician, subjects) who chooses variables. Moreover, it is the human judge who knows the directional relationship between the predictor variables and the criterion of interest, or who can code the variables in such a way that they have clear directional relationships." Dawes, R. M. (1979). The robust beauty of improper linear models in decision making. *American Psychologist*, 34(7), 571–582.

4 de Rozario, R., 2015. Scenario Analytics. Presentation at the Centre of Excellence for Biosecurity Risk Analysis, University of Melbourne.

5 What is the Relationship Between Demographic Diversity and Cognitive Diversity? Issue Paper #4, Military Leadership Diversity Commission, https://bit.ly/DemCog

Combined, their views are less partial, and the idiosyncracies cancel out, or are diluted. To exploit this effect we should draw on as large a group of experts as we can, and apply a suitable process to aggregate and refine their contributions.[6]

Our process, then, is to:

1. Obtain candidate factors from as diverse and representative a range of experts as we feasibly can, via our Literature Review, Expert Panel, and Survey. For each of these processes, our method is described in more detail in the relevant appendix.
2. Further synthesise and categorise the candidate factors, resulting in a refined set; and
3. Enrich our description of factors with reference to prior research, where available.

5.1.2 Categorising factors

Given the centrality of analytic rigour in intelligence work, it will be no surprise that our research has revealed many and diverse factors impacting rigour. A first step in making sense of this collection is sorting them into groups. The scope description for this project suggested that factors might come in four kinds – individual, social, organisational, and technological. However, in the Expert Panel process, we found that the range of candidate factors was better handled by an expanded set of categories:

1. **Analyst attributes**: Attributes of individuals involved directly in analytic work;
2. **Processes**: The processes, activities, methods, etc., used by analysts and managers, individually or collaboratively, to produce a particular analytic output;
3. **Resources**: The amount and nature of the resources (e.g., staff time) available when producing any given analytic output;
4. **Organisation**: Features of the organisation in which analytic work is conducted;
5. **Culture**. Aspects of the culture in which analytic work is enveloped;
6. **Technology**: The forms of technology supporting and shaping analytic production; and
7. **Ergonomics**: Features of the working environment.

These categories are not wholly distinct. It is difficult to draw sharp lines between processes and culture, or between culture and organisational features. Nevertheless, we think this set of categories is useful for, in Francis Bacon's terms, *catching the resemblances of things, and at the same time distinguishing their subtler differences*.[7]

5.2 Process results - Factors

Our three processes (Literature Review, Expert Panel, and Survey) generated literally scores of suggested factors impacting rigour. For comprehensive listings of these factors, see the relevant

[6] The classic explanation of crowd wisdom is Surowiecki, J.. *The wisdom of crowds: Why the many are smarter than the few*. Little, Brown & Co. (2004). Surowiecki identifies a set of conditions for crowds to be wise. Those conditions are not perfectly satisfied in the current situation, but there is not, to our knowledge, any better strategy available.

[7] The full passage from the great statesman and early philosopher of science Sir Francis Bacon is a classic in thinking about analytic rigour: "For myself, I found that I was fitted for nothing so well as for the study of Truth; as having a mind nimble and versatile enough to catch the resemblances of things… and at the same time steady enough to fix and distinguish their subtler differences; as being gifted by nature with desire to seek, patience to doubt, fondness to meditate, slowness to assert, readiness to consider, carefulness to dispose and set in order; and as being a man that neither affects what is new nor admires what is old, and that hates every kind of imposture.."

Appendices and supporting documents. **Table 5-1** summarizes the number of suggested causal factors identified by each process, after initial sorting and synthesis within each process.

Table 5-1: Number of candidate factors impacting analytic rigour, after initial sorting and synthesis. Columns show the number of factors suggested by a given process, for each category of factor. Note that many factors were identified by two or more processes; such a factor is counted in each column. The final column shows the number of factors in our final list, i.e. after further synthesis, winnowing and additions by our team.

	Literature Review	Expert Panel	Survey	Final list
Analyst attributes	3	7		7
Processes	6	15		7
Resources	1	3		3
Culture	2	6		5
Organisation	2	9		6
Technology	1	-		3
Ergonomics	-	-		2
Totals	15	40		33

Of course, there was considerable overlap in the factors identified by each process, so numbers shouldn't be added across rows.

To produce our final list, we pooled the factors from the three processes, taking three main steps:

- Combining factors that were essentially the same, even if worded somewhat differently (e.g., a factor might contribute to rigour, or the lack of it might detract from rigour);
- Winnowing out candidates we believed were of negligible significance or were best treated in other ways, such as opportunities;
- Adding some additional factors which came to our attention in other ways.

5.3 Factor list

5.3.1 Analyst attributes

Generic analytic skills

Generic analytic skills are those skills useful for analysis in all or most domains, not just intelligence. They include skills in logical reasoning, basic numerical and statistical thinking, and research methods. Exhibiting such skills is inherent to the LOTSA concept of analytic rigour, particularly Logicality. The *level of expertise* an analyst has in these skills is plausibly *causally* related to the level of analytic rigour in their work and outputs.

Intelligence-specific analytic skills

Analysts are also expected to possess a range of analytic skills which are more distinctively related to intelligence work. The full range of skills or competencies are delineated in documents like the PHIA Professional Development Framework. Intelligence-specific analytic skills listed in such contexts include:

- Understanding and addressing customer decision-making;

- Planning collection activities;
- Evaluating sources in accordance with the organisation's practices;
- Using structured analytic techniques (SATs); and
- Making probabilistic judgements, assessing analytic confidence, and communicating uncertainty in accordance with the organisation's practices.

Below we discuss the impact of using *processes* like SATs on analytic rigour. Here, our concern is with the impact of the *level of expertise* analysts have in intelligence-specific skills such as SAT use.

Broadly, expertise should enhance analytic rigour. After all, in many cases that is the *point* of these skills. If an analyst is poor at evaluating sources, for example, they will find it harder to produce adequately rigorous work. However, the net effect may not be particularly strong. A strong majority (71%) of the Expert Panel were lukewarm about the impact of expertise in intelligence-specific skills.[8] This may reflect doubts about the value of the intelligence-specific skills themselves. If SAT use, for example, does not clearly enhance rigour, expertise in SAT use will not be much help.

Domain knowledge

Domain knowledge, also known as subject matter knowledge, is general knowledge, understanding and expertise in areas such as history, politics, geography, culture, language, science and technology, as it relates to the domain in which intelligence activity is occurring.

Plausibly, having more domain knowledge can and often will lead to increased rigour. The more you know what you're talking about, the more rigorously you can think about it.[9] The Expert Panel supported this view.[10]

Domain knowledge can help improve rigour in various ways. For example, one aspect of the LOTSA dimension Thoroughness is thoroughly considering alternative hypotheses. This cannot mean exhaustively considering all alternative hypotheses, since there are always innumerable alternatives, most of which are wildly implausible. Thoroughness means duly considering a sufficient number of *reasonable* alternatives. Domain knowledge can help an analyst rapidly delineate the set of reasonable alternatives.

Domain knowledge does not, of course, *guarantee* high rigour. Even the most knowledgeable analyst might be deficient in other critical dispositions, such as objectivity. Worse, domain knowledge may impede rigorous thinking. Some evidence[11] suggests than when an analyst knows so much about a topic that they "know" the answer already, they are less inclined to thoroughly consider potential problems and alternatives.[12]

Thus, while domain knowledge is essential to intelligence work, the net effect of domain knowledge on analytic rigour specifically is unclear.

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[8] 71% thought that intelligence-specific skills 'somewhat' enhance rigour; only 23% thought they strongly enhances rigour. Nobody thought it harms rigour.

[9] Expert panelist: "The extent and quality of knowledge an analyst has is the single most important enabler of higher-level thinking and analytic rigour. You need quality bricks to build a sturdy wall."

[10] A strong majority claimed that domain knowledge somewhat enhances (40%) or strongly enhances (46%) analytic rigour.

[11] Educational psychologist Deanna Kuhn found evidence of this in a large study of peoples' ability to deploy generic argument skills. Kuhn, D. (1991). *The Skills of Argument*. Cambridge University Press.

[12] Expert panelist: "Hard to discern, but still influential is the cult of the expert. SMEs who use their personal authority to hinder objective, tradecraft-based analysis."

Reflective mindset

Rigour is improved to the extent that analysts have what we call a *reflective mindset*. It might also be called a disposition to *thoughtfulness*, and embraces intellectual curiosity, metacognitive awareness, conscientiousness, and comfort with ambiguity and uncertainty. This attribute recorded the strongest endorsement of any factor from the Expert Panel, with 100% agreement that it either enhances or strongly enhances analytic rigour.

Commitment

Rigour is improved when analysts possess what we call *commitment* – a mix of passion for their job, belief in the organisational mission, focus on excellence, and mental energy to "do what it takes." For example, one panellist decried lack of commitment: "Wrong people hired to do the job. In my organisation it is often the job conditions that draw people to the analyst role - or rather the avoidance of other jobs - rather than a passion for intel."

Cognitive biases and capacity limits

There was strong (though not universal) agreement across our three processes that rigour is harmed by innate human cognitive biases and capacity limits. Biases are where individuals systematically deviate from some rational standard due to innate features of human cognitive architecture. Capacity limits (e.g., working memory capacity) lead to general degradation in cognitive performance.

We support this view, with a number of caveats:

1. The evidence for some famous supposed biases has been undercut by the replication crisis in the social sciences;[13]
2. In other cases, there is much debate among academics over the best interpretation of the evidence – in particular, it has been argued that phenomena some view through the lens of problematic biases are better described as the operation of powerful heuristics with remarkable utility;[14] and
3. Cognitive biases at an individual level might be functional at a group level, enabling groups to be more rational collectively than individuals, and more rational than groups would be if made up of less biased individuals.[15]

More broadly, it appears to us that the intelligence community has absorbed a picture of cognitive biases, their impact on analysis, and what should be done about them, which can now be seen to be somewhat oversimplified and outdated.[16]

[13] Schimmack, U., Heene, M., and Kesavan, K. Reconstruction of a Train Wreck: How Priming Research Went off the Rails. *Replicability Index* (2017).

[14] Gigerenzer, G., Todd, P. M., & the ABC Research Group. *Simple heuristics that make us smart*. New York: Oxford University Press (1999).

[15] For example, some Hunt Lab research has found that teams of analysts with a mix of scores on the Actively Open Minded Thinking Scale tended to produce better work than teams with more uniformly good scores. In other words, it may help to have some more dogmatic people on teams.

[16] This picture is the one found in the influential work Heuer, R. J. *Psychology of Intelligence Analysis*. Langley VA: Central Intelligence Agency Center for the Study of Intelligence, 1999.

Experience

Common sense suggests that experience should enhance rigour. We would naturally expect more senior analysts, with greater experience, to be more rigorous than new analysts. This is consistent with the general relationship between experience in a domain and expertise in that domain, which appears to hold true for intelligence analysis.[17] However, this is a vexed issue. We have found no research bearing directly on the relation between analyst experience and rigour, and the issue was not raised by the Expert Panel. Anecdotes suggest that senior analysts are not always fully rigorous.[18] Reasons to be sceptical of a strong impact include:

- For experience to build expertise, it must generate timely, informative feedback.[19] Experience in intelligence work might not provide enough by way of quality feedback specifically related to rigour.
- The development of expertise with additional experience tends to plateau if practitioners are not actively engaged in skill development.[20] Analysts need to be working *on* their game, not just *in* the game.
- If more senior analysts are more rigorous than junior analysts, this may be largely a selection effect. That is, it may be that the more naturally rigorous junior analysts tend to be retained as analysts, thus gaining experience and seniority, without further improvement in rigour resulting from that experience.
- Very senior analysts may show cognitive decline due to aging.[21]

Overall, we do not find strong support for a causal link between experience in analysis and analytic rigour.

5.3.2 Processes

Use of Structured Analytic Techniques

The standard view in the intelligence community is that using SATs improves rigour; this view had wide (albeit lukewarm) support from the Expert Panel.[22] It is an intuitively appealing view, since often SATs have been designed in order to improve analysis, in part by counteracting cognitive biases, and they have at least superficial or "face" plausibility as methods.

However, there were many dissenting views expressed across our three processes. Key concerns are:

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17 Moore, David, and Robert Hoffman. "Cognition and Expert-Level Proficiency in Intelligence Analysis." In *The Oxford Handbook of Expertise*, edited by Paul Ward, Jan Maarten Schraagen, Julie Gore, and Emilie Roth, 977–1000. Oxford UK: Oxford University Press, 2020.

18 E.g., Monk, Paul. "Preface." In *Thunder from the Silent Zone: Rethinking China*, ix–xx. Scribe, 2005. This describes experience from the 1990s.

19 Kahneman, Daniel, and Gary Klein. "Conditions for Intuitive Expertise." *American Psychologist* 64, no. 6 (2009): 515–26.

20 Ericsson, Anders, and Robert Pool. *Peak: Secrets from the New Science of Expertise*. Houghton Mifflin Harcourt, 2016.

21 "The most important changes in cognition with normal aging are declines in performance on cognitive tasks that require one to quickly process or transform information to make a decision, including measures of speed of processing, working memory, and executive cognitive function." Murman, Daniel L. "The Impact of Age on Cognition." *Seminars in Hearing* 36 (2015): 111–21.

22 65% of the Expert Panel thought SAT use somewhat enhances rigour; only 17% thought it strongly enhances rigour.

- There is little, if any, good evidence (i.e., evidence going beyond informal impressions) that use of SATs actually improves rigour, accuracy, or the quality of intelligence more broadly;
- The studies that have been done – notably, on the Analysis of Competing Hypotheses – have generally failed to support their use. Note, however, that these studies are of mixed quality;
- There are valid theoretical concerns about SATs;[23] and
- SATs may be poorly used in practice.

Our position is that:

- The view that SAT use in its current form generally improves rigour is ill-founded.
- However, "good" SAT use is likely to improve rigour. That is, SAT use *would* improve rigour *if* the following conditions are met:
    - The SATs are well designed by people with relevant expertise;
    - Their utility has been confirmed with rigorous testing (not yet achieved);
    - Analysts are well trained in their use; and
    - Analysts have the time, resources and motivation to use them properly.

It is worth noting that SAT use may have benefits other than improving rigour, such as increasing transparency.

Adherence to analytic tradecraft standards

The relationship between analytic rigour and tradecraft standards is complicated, as discussed in Analytic standards (s.4.6.3). However, while they are different things, the activity involved in meeting, or striving to meet, analytic standards should causally contribute to analytic rigour.

Information and source evaluation

Information and source evaluation are crucial to good intelligence analysis. Evaluating information and sources for relevance, quality, reliability, credibility and the possibility of deception are aspects of tradecraft that are identified in multiple practitioner documents.[24] Many organisations have methods or guidelines for information and source evaluation, such as the NATO Admiralty Code.[25]

Generally speaking, to be analytically rigorous in intelligence work, on our account, means being LOTSA in all aspects of intelligence work, including information and source evaluation (or, according to the breakdown of Zelik et. al., Information Validation). Therefore, the quality of information and source evaluation will impact the overall level of analytic rigour in a given piece of work. Quality can be poor in at least two ways. First, analysts may carry out the methods, or follow the guidelines, only poorly, due to factors such as time pressure or limited training. Second, methods or guidelines such as the Admiralty Code might themselves be inadequate. This has been persuasively argued by Irwin and Mandel, who propose an alternative approach.[26]

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[23] See e.g. Chang, W. et al. (2018) 'Restructuring structured analytic techniques in intelligence', *Intelligence and National Security*, 33(3) page 340

[24] See, for example Canadian Forces Intelligence Command. *Aide Memoire on Intelligence Analysis Tradecraft* (2015), 34.

[25] NATO Standardization Office. AJP-2.1, Edition B, Version 1: Allied Joint Doctrine for Intelligence Procedures. Brussels, Belgium (2016).

[26] Irwin, Daniel, and David R. Mandel. "Improving information evaluation for intelligence production." *Intelligence and National Security* 34, no. 4 (2019): 503-525.

Collaboration

Broadly, collaboration improves analytic rigour. The Expert Panel uniformly and strongly agreed on the positive impact of collaboration with others within an analytical unit, with others more widely in the organisation and the intelligence community, and with others outside the intelligence community. The mechanism underlying this benefit is obvious enough; collaboration brings more perspectives to an analytical challenge, increasing the chance of identifying deficiencies across the five LOTSA dimensions. Of course, the level and nature of collaboration matter. There can be too much collaboration ("too many cooks"), or the form of collaboration can be inefficient for unconstructive.[27]

Group-level biases

The opposite side of the collaboration coin is the emergence of biases at the group level. A range of such biases have been identified. Groupthink is the most familiar, although this concept is now used loosely to describe group failure rather than the specific problem originally intended.[28] Other group biases include error amplification, cascade effects, group polarisation or extremisation, and a focus on shared knowledge. Group-level biases can be mitigated by improvements to group deliberation processes.[29]

Coordination and review

Coordination and review processes are an essential part of the analytic workflow. There are many reasons for coordination and review, but enhancing analytic rigour is one of the most important. In practice, however, these processes can sometimes harm rigour, as when for example review by senior staff compromises objectivity.[30] It appears that the net effect of coordination and review processes is positive,[31] but the extent of this impact (and even whether it is a net positive) significantly depends on how well they are conducted in any given case.

Clear and effective communication

Communicating clearly and effectively is an important part of producing useful intelligence products. We view communication and analytic rigour as separate things, with communication being an important tradecraft standard, while analytic rigour helps ensure that judgements and assessments are clearly communicated. The relationship is complex and some disagreement exists, however.

[27] For illuminating discussion of this, see Nolan, Bridget Rose. "Information Sharing and Collaboration in the United States Intelligence Community: An Ethnographic Study of the National Counterterrorism Center." University of Pennsylvania, 2013.

[28] See Janis, Irving Lester. *Victims of Groupthink: A Psychological Study of Foreign-Policy Decisions and Fiascoes*. Boston: Houghton, Mifflin, 1972.

[29] Sunstein, Cass, and Reid Hastie. *Wiser: Getting Beyond Groupthink to Make Groups Smarter*. Boston M.A.: Harvard Business Review Press, 2014.

[30] Gentry, John. *Lost Promise: How CIA Analysis Misserves the Nation*. New York, NY: University Press of America, 1993. See also Nolan, ibid.

[31] The Expert Panel gave coordination and review processes moderate support as a factor: 40% thought it somewhat enhances rigour, and 33% thought they strongly enhance it.

5.3.3 Resources

Time pressure

Intelligence analysts often work under serious time constraints. Judgements and decisions often need to be made quickly, especially in investigatory, tactical and operational settings. However, analytic rigour is inherently time-consuming. Thus, we would expect time pressure to harm analytic rigour. The less time an analyst has, the less rigorous they can be. This was strongly supported by the Expert Panel[32]. That said, the relationship between rigour and time is complex. See Timeliness (s.4.6.8) for further discussion.

Information quality, quantity or availability

Information is a "raw input" to the analytic process. There was discussion in our processes of whether, or the extent to which, information (quality, quantity or availability) impacts rigour. The Expert Panel was divided on this.

Our view, broadly, is that rigour is a matter of what you do with what you've got, and that, in general, information quality, quantity or availability have no direct impact on rigour in analytic work, even if it can affect the value of the output. However, information quality, quantity of availability can impact rigour indirectly, by affecting the allocation of effort. For example, in a situation where good information is scarce, an analyst might need to spend more time and effort seeking more information, at the expense of other aspects of the analytic process.

Support from specialist staff

Rigour is enhanced when analysts can draw on support in tackling analytic challenges from sources such as dedicated methodologists or those senior analysts with extensive experience and strong expertise.

5.3.4 Culture

An organisation's culture is the totality of predominant beliefs, values and practices which help shape what is expected or appropriate within that organisation.[33] Cultural features of intelligence organisations relevant to rigour include:

Culture of constructive challenge

Rigour is improved to the extent that the culture fosters constructive challenges to analysis and conclusions.[34] This can be manifested in many ways, such as managers challenging analysts, analysts challenging managers and leaders, analytic work challenging prior analytical lines, and analysts within teams challenging each other. A culture of challenge embraces both a willingness to challenge, and an openness to being challenged.

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[32] 75% of panellists claimed short timeframes harm, or strongly harm, analytic rigour. Sample comment: "Time pressures, while unavoidable, can be harmful to analytic rigour. We must acknowledge these cases." Interestingly, another also noted: "too much time equals poor analysis as too much data is gathered and decision paralysis."

[33] This is our formulation, drawing upon standard references such as Schein, Edgar H. "Organizational Culture." *American Psychologist* 45 (1990): 109–19.

[34] Panellist: "An open and inclusive workplace which promotes vigorous discussion is crucial for honest and genuine interrogation of a thought process which in turn is crucial for high analytic rigour."

Intellectual or psychological safety

A close and necessary counterpart to a culture of challenge is a culture of intellectual or psychological safety. Staff must be able to question, challenge, express new or different ideas, and admit uncertainty or lack of knowledge, without fear of ridicule, censorship, career harm, or any other negative consequences. The importance of safety was very strongly endorsed by the Expert Panel, second only to having a reflective mindset.[35]

Supporting and valuing analysts

Another subtle but important cultural feature is the extent to which analysts feel supported and valued as professionals. "Support" here is not just the provision of resources, but the more intangible ways an organisation, particularly managers and leaders, will assist, endorse, recognise, and back up or stand behind analysts in their work. Strong support in this sense will improve rigour, and lack of support will harm it. [36]

Politicisation

Politicisation, whether from external or internal sources, harms analytic rigour, both by definition (it conflicts directly with Objectivity) and in practice. This is a cultural issue; whatever an organisations' official standards and policies may be, resistance to politicisation is ultimately a matter for the cultural "immune system." The danger of politicisation was emphasised across all our processes. The only questions are the extent to which it is occurring and how successfully any given organisation is avoiding it.

Epistemological misconceptions

Intelligence organisations, whose business is knowledge, are necessarily suffused with epistemological perspectives and assumptions, i.e., "theories" about what knowledge is and how to achieve it. Where these theories are outdated or mistaken, they can harm analytic rigour.[37] Since knowledge is complex terrain, and epistemology is an evolving discipline, this harm can arise in many ways, usually subtle and imperceptible. For example, David Mandel has argued that the lack of systematic and rigorous empirical evaluation of intelligence practices – resulting in adoption or continuation of practices which in some, perhaps many cases are ineffective or even counter-productive – is grounded in "a rather pre-scientific, if not fully anti-scientific, attitude," grounded in "widespread ignorance of scientific principles and values."[38]

5.3.5 Organisation

Cognitive diversity

We have noted that analytic rigour requires creativity and insight, and that it is enhanced when viewpoints are subject to challenge from differing perspectives. These factors are themselves affected by the level of diversity in analytic teams. Note that what is important here is *cognitive*

[35] 73% of panellists thought safety strongly enhances rigour. As one panellist said: "Workplace culture and power dynamics can affect the ability of staff to feel like they can either express divergent views (in a text) or pursue a divergent path and negatively affect analytic rigour."

[36] The Expert Panel strongly endorsed "Strong leadership actively promoting, supporting and rewarding analytic rigour" as a factor enhancing rigour.

[37] The Expert Panel strongly endorsed this: 56% said pervasive epistemological misconceptions strongly harm rigour, and 40% said they somewhat harm it.

[38] See Mandel, David R. "Intelligence, Science and the Ignorance Hypothesis." PsyArXiv. January 20, 2021.

diversity, i.e., people who *think* differently.[39] Cognitive diversity may be grounded in demographic or identity diversity, but it can also come from differences in experience (prior roles, education, training) or neurocognitive makeup.

Training

Rigour is enhanced to the extent that an organisation has a well-designed and well-implemented program of training related to analytic rigour.[40]

Incentives

Rigour is harmed to the extent that there is a lack of alignment between incentives and the objective of rigorous analysis. As one panellist put it, "Incentives to analysts for engaging in activities that promote rigour are needed. People will only do what they are going to get promoted for doing."

Secrecy and security

While necessary, secrecy and security requirements can harm analytic rigour in various ways,[41] including:

- By acting as a filter in recruitment for "safe" staff and thereby reducing cognitive diversity;[42]
- By allowing analysts or organisations to shield positions or reasoning from challenges by critics without access to the same information;
- By reducing the range of experts analysts can interact with and potentially be challenged by (e.g., uncleared academics with strong domain knowledge);[43] and
- By limiting external scrutiny of an organisation's practices, standards and performance.[44]

Lack of systematic evaluation of rigour in analytic work or products

Rigour would be enhanced by a systematic process for evaluating analytic quality; conversely, the lack of any such process harms rigour.[45]

'Systematic process' here does not mean the kind of evaluation which typically occurs in the ordinary course of business. For example, almost every piece of analytic work would be reviewed, with at least an informal assessment of quality, by managers before being sent on. In a systematic process, by contrast, a single sound (reliable, valid and practical) evaluation method is applied broadly across the organisation and over time. We have in mind something akin to the evaluation process applied

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[39] Page, Scott. *The Diversity Bonus: How Great Teams Pay Off in the Knowledge Economy*. Princeton NJ: Princeton University Press, 2017; Straus, Susan G., Andrew M. Parker, and James B. Bruce. "The Group Matters: A Review of Processes and Outcomes in Intelligence Analysis." *Group Dynamics: Theory, Research, and Practice* 15, 2011: 128–46.

[40] For discussion of the nature and impact of the US "Analysis 101" training, see Immerman, Richard H. "Transforming Intelligence Analysis" in *Rethinking Leadership and "Whole of Government" National Security Reform*. Strategic Studies Institute, US Army War College, 2010.

[41] The Expert Panel gave modest support to the view that secrecy and security requirements harm analytic rigour (60% Harms, or Strongly Harms).

[42] See Parrish, S. The Stormtrooper Problem: Why Thought Diversity Makes Us Better (2019) https://fs.blog/2019/03/stormtrooper-problem/

[43] Panellist: "Enhance analysts' opportunities for meeting, discussing issues with outside experts. Security too often is an unhelpful barrier to such activities."

[44] Panellist: "An exaggerated focus on secrecy re. methods can lead to a risk of overestimating the efficiency of these methods, and can easily lead to stagnation in terms of development of new/revised methods."

[45] The Expert Panel very strongly endorsed this: 56% "strongly harms," 42% "somewhat harms."

by ODNI's Analytic Integrity and Standards division to products from organisations across the U.S. national intelligence community, using the IC Rating Scale, though we recognize that there are valid concerns about the Scale and the manner of its deployment.[46]

We mentioned above that there is currently no adequate method for evaluating analytic rigour. This is a problem for any attempt or plan to systematically evaluate rigour across an organisation, and is one reason we recommend that a method be developed (see

Recommendations, s.3.2).

Lack of systematic evaluation of policies and practices

At a higher level, there is a general lack of systematic evaluation of policies and practices aimed at improving intelligence analysis generally and analytic rigour in particular. This results in the adoption, or continuation, or policies and practices which in some cases are ineffective and may even be harmful.[47] In making this point we are not suggesting that intelligence organisations are unusually deficient in this regard. Much the same could be said of most organisations. However the point is especially *pertinent* in regard to intelligence organisations, since knowledge generation is for them core business.

5.3.6 Technology

To understand the impact of technology on analytic rigour, we need to briefly consider the nature of analytic work.

A simple view is that analytic work is a kind of cognitive work done by analysts, who happen to use various tools. In a previous era, those tools were largely pen, or typewriter, and paper, telephones, and printed books and reports, whereas today they are mostly computer-based. Better tools help analysts work more efficiently, but the nature of the work is largely independent of those tools.

A better view is that analytic work is an emergent property of complex distributed socio-technical systems,[48] where technologies not only support analytic work but deeply shape it by "affording" some kinds of cognitive activity rather than others.[49] Current computer technologies are not just conveniences, but enablers and shapers of analytic work as it manifests now.[50]

From this perspective, the impact of technology on analytic rigour is also complex. The level of rigour present in the analytic work of any intelligence organisation today is made possible, in part, by the range of technologies forming the "technical" side of those organisations considered as sociotechnical systems. To take a simple example: the technical ability to "track changes" in a digital document facilitates a specific form of feedback on drafts, in which a colleague or manager suggests

[46] There are significant concerns about the Rating Scale, and the systematic evaluation process which relies upon it. See https://timvangelder.com/2019/05/19/the-odni-rating-scale-issues-abound/ for a discussion of some issues with the Scale.

[47] For detailed discussion of this point see Mandel, David R., and Philip E. Tetlock. "Correcting Judgment Correctives in National Security Intelligence." *Frontiers in Psychology* 9 (2018).

[48] Carayon, Pascale. "Human factors of complex sociotechnical systems." *Applied Ergonomics* 37 (2006).

[49] Naikar, Neelam, and Ashleigh Brady. "Cognitive Systems Engineering: Expertise in Sociotechnical Systems." *The Oxford Handbook of Expertise*, 2019. As one panellist said: "Achieving substantial improvements in analytic rigour will require a corporate and systemic approach that recognizes the ways that people, technology and organization interact to generate capability."

[50] See also work on the concept of the *joint cognitive system*, e.g., Woods, David D., and Erik Hollnagel. *Joint Cognitive Systems: Patterns in Cognitive Systems Engineering*. CRC Press, 2006.

the exact wording and placement of changes. Plausibly, this results in more, and more specific, input, generally resulting in a higher *net* level of rigour in the work.[51]

At the same time, the current nature and configuration of those technologies can detract from analytic rigour, or at least from potentially achievable levels of rigour. Here we briefly highlight three ways this can happen.

Inefficiencies in generic technologies

A considerable portion of analytic work is done with generic, off-the-shelf technologies, such as the Microsoft Office suite. Powerful as these are, they can have inefficiencies in the context of an analytic workflow.[52] These reduce the mental time and effort analysts can put into rigorous thinking.

Poorly designed analysis-specific technologies

There have been many attempts to improve analysis by introducing software tools designed specifically to support analytical activities. However, this approach does not have a good track record; the tools are often poorly designed for the realities of analytic work,[53] even if they have strong foundations in theory.

Poorly integrated technologies

Analysts work with many different tools. Often, these tools have no integration, or only poor integration. This again creates inefficiencies which detract from high-level thinking.

5.3.7 Ergonomics

Ergonomic factors are those features of the working environment affecting performance, health and comfort. Such factors were not raised in any of our processes, but are worth considering because their impact on cognitive performance – and hence on analytic rigour – can be quite direct and substantial. For example, high levels of CO_2, of the kind easily attained in office environments such as meeting rooms, have been found in some studies to reduce performance on cognitive tests.[54] Effects on cognitive performance have been noted for a range of other ergonomic factors such as ambient noise (particularly intelligible speech), and size and number of computer monitors.[55]

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[51] This is an empirical conjecture which might be rigorously tested. Providing feedback using tracked changes is a very common practice. Does it actually improve results on balance (as compared with what)? This is just one of the myriad of detailed aspects of analytic work we don't fully understand.

[52] Many analysts or ex-analysts have described to us how their workflow involves, or involved, drafting reports as Microsoft Word documents and circulating these for input or review as Outlook attachments – and their frustration at the delays and extra work this involved, particularly in reconciling different versions. We presume that most organisations are heading in the direction of real-time collaborative editing, similar to Google Docs.

[53] Hoffman, Robert, Simon Henderson, Brian Moon, David T. Moore, and Jordan A. Litman. "Reasoning Difficulty in Analytical Activity." *Theoretical Issues in Ergonomics Science* 12 (2011).

[54] See, e.g., Allen Joseph G. et. al. "Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers." *Environmental Health Perspectives* 124 (2016): 805–12 but see also Du, Bowen, Marlie C. Tandoc, Michael L. Mack, and Jeffrey A. Siegel. "Indoor CO2 Concentrations and Cognitive Function: A Critical Review." *Indoor Air* 30 (2020).

[55] See e.g. Ling, Chen, Alex Stegman, Chintan Barhbaya, and Randa Shehab. "Are Two Better Than One? A Comparison Between Single- and Dual-Monitor Work Stations in Productivity and User's Windows Management Style." *International Journal of Human–Computer Interaction* 33 (2017).

5.4 Limitations

To our knowledge, the catalogue of factors presented above represents the most comprehensive and well-grounded treatment of this topic produced to date. However it is important to keep in mind some major limitations of the analysis.

First, almost none of the factors has been the subject of rigorous scientific study in the context of real intelligence work. Their inclusion is based on aggregated expert opinion, general plausibility, and sometimes indirect empirical evidence.

Second, in no case do we have any real grasp of the *strength*[56] of the causal relationship between the factor and analytic rigour. Note that strong agreement among the experts that something *is* causally relevant is not the same as being a strong causal factor. For example, experts strongly agree that passive smoking is causally related to lung cancer, but the relationship is weak.

Third, for all factors the *shape* of the causal relationship with analytic rigour is unclear. Plausibly, for many factors this relationship will be strongly non-linear, such as threshold effects, where increasing the factor from low levels greatly increases analytic rigour, but increasing from high levels makes very little difference. Put differently, the factor may be functioning like a necessary condition.

Finally, our analysis has not considered the *interactions* between causal factors. We have written as if each of the 33 factors directly and independently affects analytic rigour. This is almost certainly not the case. It seems obvious that some factors will have their effect on analytic rigour only indirectly or contextually, by causally contributing to or operating in conjunction with other factors. For example, training would raise analytic rigour by raising some analyst attributes (e.g., intelligence-specific analytic skills).

In other words, analytic rigour is situated in a complex causal web.[57] Our account has focused on identifying the nodes in this web, but has been silent on its structure, beyond the claim that for any given node, there is a direct or indirect causal pathway to analytic rigour.

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[56] While we all have an intuitive understanding of causal strength, this is itself a complex and difficult topic. See e.g., Griffiths, Thomas L., and Joshua B. Tenenbaum. "Structure and Strength in Causal Induction." *Cognitive Psychology* 51 (2005).

[57] "One of the advantages of traditional cause–effect models is that they assume that causal factors can be conceptually and methodologically isolated and the magnitudes of their effects assessed. The problem is that what happens in groups usually is overdetermined. It is not any one factor or even any linear combination of factors that drive what transpires. It is, instead, that numerous features of the group structure, its context, its leadership, and even the behavior of its members tend over time to come into congruence—sometimes in ways that foster a group's viability but other times in ways that mitigate against teamwork...Influences on group behavior and performance do not come in separate, distinguishable packages. They come, instead, in complex tangles of redundant features and forces. To try to partial out and assess the causal effects of each component can be an exercise in frustration because each ingredient of what may be a spicy stew loses its zest when studied separately from the others.The fact that group behavior and performances are overdetermined—that is, that they are products of multiple, nonindependent factors whose influence depends in part on the fact that they are redundant—means that we will need to find new ways of construing and researching group phenomena." Hackman, J. Richard. "From Causes to Conditions in Group Research." *Journal of Organizational Behavior* 33 (2012).

6 Opportunities to Improve Analytic Rigour

In this section we describe opportunities for intelligence organisation to improve analytic rigour. We review our method for identifying opportunities, the results emerging from our three processes, and present our synthesized list with brief discussion of each opportunity.

6.1 Method – Opportunities

We define an opportunity as a potential *intervention* within, or directly related to, a particular intelligence organisation, which is intended to enhance analytic rigour, and is relatively *attractive*.

By *intelligence organisation*, we mean a medium to large government organisation whose sole or primary function is intelligence. To the extent that an organisation or unit differs from this model, our guidance may be less relevant.

An intervention is a change the organisation could bring about through targeted managerial action.

Attractiveness should be evaluated from four perspectives:

1. **Impact on analytic rigour**: the extent to which the intervention will improve analytic rigour in the organisation. The impact might be on analytic rigour as a whole, or focused on some aspect of it, such as Logicality.
2. **Cost**: the costs directly related to making the intervention, including both initial implementation and sustainment. These include staff time and other funding needs. Cost can be estimated, but must also be evaluated relative to the scale and resources of the organisation. A cost might be manageable for one organisation but not for another.
3. **Incidental effects**: the full gamut of other consequences, positive and negative, within and outside the organisation. Any significant intervention will have many and diverse consequences. This will be especially true for analytic rigour, given that it is so central to intelligence work. A rigour-focused intervention might, for example, affect staff recruitment and/or retention, productivity or efficiency, morale, workplace harmony, and organisational prestige. There are also the opportunity costs of undertaking the intervention as opposed to any number of other possible interventions.
4. **Timeframe**: the period over which the intervention, and its costs and incidental effects, unfold.

The challenge, then, is how to identify plausible interventions, and how to assess their attractiveness.

6.1.1 Identifying plausible interventions

Given the complexity of the concept of analytic rigour, the web of causal factors impacting rigour, and the size and complexity of intelligence organisations, the range of possible interventions aimed at enhancing analytic rigour is very large. Indeed, the range is practically unbounded, since interventions can be “sliced and diced” in many ways. Consequently, we aim not to exhaustively enumerate all potential interventions, but to identify a reasonably comprehensive list of relatively attractive interventions.

In the Factors section, we identified many and diverse factors impacting analytic rigour. Each of these *could* be regarded as providing an opportunity to improve analytic rigour. In simple terms, if it enhances analytic rigour, then dial it up; if it harms, dial it down. For example, politicisation harms rigour, so to improve analytic rigour, an organisation should reduce politicisation.

However, many causal factors cannot be directly manipulated. There is no dial for *level of politicisation* waiting to be turned. Politicisation can only be modified indirectly, via other more tangible actions, such as recruitment and promotion strategies. For this reason, we cannot simply crank out a list of interventions as direct counterparts of the causal factors impacting analytic rigour. Those factors can, however, provide clues as to plausible interventions.

6.1.2 Evaluating attractiveness

Evaluating the attractiveness of interventions is also difficult. Attractiveness depends on impact, cost, incidental effects, and timeframe, so for rigorous evaluation each of these must be estimated for any given intervention. However:

- Estimating **impact** of a particular intervention is difficult for three deep reasons:
  i. There is no measure of analytic rigour. We have defined analytic rigour as primarily a feature of analytic work within an organisation ("process rigour") and secondarily as a feature of outputs ("product rigour"). In neither case is there an accepted way to quantify level of rigour, even on a coarse scale.
  ii. Partly for the above reason, we[1] have little or no experience estimating levels of rigour,[2] let alone estimating the impact of interventions on levels of analytic rigour. All we have are informal impressions and anecdotes, which can be ill-founded or seriously misleading.
  iii. Analytic rigour is situated in a very complex causal web; factors impact each other, or have different impacts on rigour depending how other factors are operating.
- Estimating the direct **cost** of an intervention is generally more tractable, but (a) can still take quite a bit of effort, and (b) requires detailed organisation-specific information, so is not a practical option in this research project.
- If estimating impact is difficult, estimating **incidental effects** can be a nightmare.[3]

There is then the additional problem of combining these estimates into an overall assessment of attractiveness. How should the aspects be weighted? How are trade-offs managed?

6.1.3 Aggregating expert opinions

Given these challenges, our approach to identifying opportunities (attractive interventions) is, as with Factors, to gather and synthesise expert opinions. In outline, we:

1. Obtain potential interventions (i.e., candidate opportunities) from as diverse and representative a range of experts as we can. Our three primary sources, of course, are the Literature Review, Expert Panel, and Survey.
2. Synthesise the various candidate interventions into a unified and categorised set.

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[1] Here "we" is meant broadly to include not just the Hunt Lab team, but anyone working in a relevant field, including analysts and managers in intelligence organizations, and academics in intelligence studies or any other discipline.

[2] We do have some experience with measures bearing some relationship to rigour. For example, the ODNI's IC Rating Scale is based on ICD 203, which sets tradecraft standards aimed at "excellence, integrity and rigor." However, the extent to which a score on the Rating Scale is an indication of rigour is very unclear. This is the focus on a 2021 Hunt Lab research project in collaboration with the Laboratory for Analytic Sciences, NCSU.

[3] See Merton, R. (1936). The Unanticipated Consequences of Purposive Social Action. *American Sociological Review*, 1(6), 894–904; and Mansfield, J. (2010). *The Nature of Change or the Law of Unintended Consequences: An Introductory Text to Designing Complex Systems and Managing Change*. Imperial College Press.

3. Exclude those we deem insufficiently attractive. That is, we either reject or include a candidate opportunity based on a subjective assessment of attractiveness of an opportunity in the context of the entire set; we do not try to put opportunities on a scale or apply ranking. Note however that a ranking did emerge in the Expert Panel process; see Appendix B – Expert Panel (s.8.2.3).

6.1.4 Categorizing opportunities

As mentioned, opportunities generally do not correspond directly to individual causal factors. Similarly, opportunities do not naturally group in the same way as factors. We found that opportunities were best sorted under the following headings:

1. Recruitment
2. Staff development
3. Resources
4. Processes
5. Evaluation and feedback
6. Collaboration
7. Research
8. Technology

6.2 Process results – Opportunities

The Literature Review identified a rich assortment of candidate opportunities in many (not all) of the categories just listed; see Appendix A – Literature Review for details. In many cases, the literature explores particular opportunities in depth and makes compelling cases for adoption. Considered as a whole, however, the literature has some limitations. First, the contributions are made without the help of a clear, common conception of analytic rigour, and so the discussion is often only diffusely connected to rigour. Second, the contributions are mostly focused on improving particular aspects of intelligence activity, and are not attempting to achieve a synoptic view of how to improve rigour.

The Expert Panel process, by contrast, did aim to deliver comprehensive account. The process generated 2 distinct opportunities, ranked according to the overall level of support from the panellists. For example, *Implement or strengthen feedback mechanisms, including peer-review, that are immediate and clear, which encourage analysts to reflect on the accuracy of their assessments* was the top-ranked opportunity, selected by 62% of panellists as one of their top ten opportunities. The list is presented in Appendix B – Expert Panel.

6.3 Opportunity list

As discussed above, we took the outputs of the three processes and further synthesized and evaluated the opportunities to produce the following final list.

6.3.1 Recruitment

Strengthen recruitment for analyst attributes

Where possible, strengthen recruitment processes to select more effectively for those analyst attributes contributing to analytic rigour, particularly:

- Generic analytic skills;
- Intelligence-specific analytic skills;
- Reflective mindset;

- Commitment; and
- Relative lack of cognitive bias and capacity limits.

Regarding many of these we recommend the work of Stanovich and colleagues, particularly their rationality assessment tool, the Comprehensive Assessment of Rational Thinking.[4]

Strengthen recruitment for cognitive diversity

Strengthen recruitment programs to produce a more *cognitively* diverse workforce,[5] including neurodiversity.[6]

6.3.2 Staff development

Provide or improve rigour-related training for both novice and experienced analysts

Provide analysts with high-quality training in topics related to analytic rigour. Training should be evidence-based and up-to-date in both *content* and training *methods*.

Training should not be limited to entry-level analysts or to induction programs. "Refresher" and advanced training should be available to more experienced analysts.[7]

Provide rigour-related training for supervisors and managers

Provide supervisors and managers with high-quality training related to analytic rigour, including training in evaluation and feedback.[8]

6.3.3 Resources

Increase proportion or analyst time available for rigorous thinking

We noted above (s.4.6.8) that analytic rigour is inherently time-consuming, and that short time frames tend to compromise rigour. Therefore, anything an organisation can do to increase the time available to analysts for their work should generally help to increase analytic rigour. Some causes of time pressure are intrinsic to the job, such as the tempo of external events. Others, such as the size of the analyst workforce relative to the demands on the organisation, are difficult to change.

We suggest instead that organisations continually seek to increase the *proportion* of their time analysts can devote to rigorous thinking. This can be achieved in many different ways, such as minimising administrative chores, making meetings more efficient, and improving information technology to increase efficiency.

Strengthen staff support for analysts

Strengthen the in-person support available for analysts to draw on while performing analytic work. This support can come from:

- Dedicated methodologists, facilitators, editors, etc. in an analytic support unit; and

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[4] Stanovich, Keith E., R. F. West, and M. E. Toplak. *The Rationality Quotient (RQ): Toward a Test of Rational Thinking*. Cambridge MA: MIT Press, 2016.

[5] National Academies of Sciences, Engineering, and Medicine. *Workforce Development and Intelligence Analysis for National Security Purposes: Proceedings of a Workshop*. Washington D.C.: The National Academies Press, 2018.

[6] Austin, Robert, and Gary Pisano. "Neurodiversity as a Competitive Advantage." *Harvard Business Review*, May 1, 2017.

[7] This was one of the top recommendations of the Expert Panel.

[8] This opportunity was ranked highly by the Expert Panel.

- Advice or mentoring from senior analysts with strong expertise.

6.3.4 Processes

Strengthen the evidence base for rigour-related analytic processes

Increase the proportion of rigour-related analytic processes which have a solid evidence base for their effectiveness. This includes:

- Adopting new processes only where supported by good evidence; and
- Retiring those with no demonstrable impact, or negative impact, on rigour.

This is a general, long-term opportunity; some opportunities described below are special cases. Note also that this opportunity requires research, discussed separately below.

Introduce numerical expression of uncertainty

Agencies should introduce, increase or strengthen the practice of expressing uncertainty in numerical terms.

The case for numerical expressions is usually made on the basis of communicative fidelity. Here, however, we recommend using numerical expressions due to its positive impact on analytic rigour. We note that a majority of the Expert Panel regarded use of numerical expressions as enhancing or strongly enhancing rigour.[9]

We are aware that this is a longstanding and controversial issue in general, and it was controversial in our Expert Panel process, receiving considerable attention in the discussion forum. We include it as an opportunity based on our view that from a theoretical perspective the debate is increasingly settled in favour of numerical expression.[10] For a succinct, high-level review of the issues and arguments, see the Hunt Lab's report on this topic.[11]

Improve information and source evaluation methodology

As argued by Irwin and Mandel, [12] common approaches to information and source evaluation, such as use of the Admiralty Code, are problematic. Organisations may be able to improve rigour by a substantial redesign of their approach.

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[9] 29% Strongly enhances; 29% Enhances; 25% Neutral; 12% Somewhat harms; 5% Strongly harms.

[10] See particularly the work of David Mandel and colleagues, e.g. Ho, Emily H., David V. Budescu, Mandeep K. Dhami, and David R. Mandel. "Improving the Communication of Uncertainty in Climate Science and Intelligence Analysis." *Behavioral Science & Policy* 1 (2015): 43–55; and Friedman and colleagues, e.g. Friedman, Jeffrey A. *War and Chance: Assessing Uncertainty in International Politics*. Oxford, New York: Oxford University Press, 2019.

[11] van Gelder, Timothy. Expressing Uncertainty – Summary of Issues and Arguments. Hunt Laboratory for Intelligence Research, 2020. Available on request.

[12] Irwin, Daniel, and David R. Mandel. "Improving information evaluation for intelligence production." *Intelligence and National Security* 34, no. 4 (2019). They recommend: "First, information accuracy should be communicated as a subjective probability expressed in numeric form, and clarified (when warranted) by a confidence interval. Second, collaboration and revaluation should be formalized during information evaluation. Third, considerations of information redundancy, completeness and diagnosticity should be considered later in the intelligence production stage as part of the assessment process…Rather than imposing these methods on evaluators in every circumstance, we favour a pragmatic, contingent approach in which the level of evaluative detail corresponds to the relative importance of the information under scrutiny."

Strengthen record keeping and source connection

While record keeping is crucial for defensibility and accountability, thorough record keeping will also help analysts find key pieces of information, prior judgements, information etc. that are necessary for good analysis. Organisations may be able to increase rigour by improving record keeping and the ability to find connections between these records and new sources of information.

Use multiple methods or approaches in handling analytic challenges

To the extent feasible given time and staffing constraints, initially tackle analytic tasks with multiple analytic methods or approaches, then adopt and develop the one (or combination) which works best.[13]

6.3.5 Evaluation and feedback

Strengthen feedback processes, including peer review

Improve the quantity, quality and timeliness of feedback analysts receive in the course of analytic work, whether from supervisors or managers, peers, analytic support staff, or from outside the organisation.[14]

Good feedback improves analytic rigour in at least two ways: by identifying, and prompting correction of, problems in a piece of work, and by helping analysts develop expertise.

Implement systematic evaluation for rigour

Develop and implement a systematic organisation-wide process for systematic evaluation of analytic work for rigour.[15] Among other things, this would provide essential information for rigorously assessing the organisation's performance and the impact of current practices and new initiatives. This requires the development of a good evaluation method, which is raised below as a separate opportunity.

Refine incentives to drive rigour

Refine KPIs and incentives to better reward analytic rigour in comparison with other kinds of performance. For example, rewarding productivity, measured in simple terms like number of products generated, can conflict with rigour.[16] In doing this, care must be taken to avoid the problem where *extrinsic* incentives such as career or financial rewards "crowd out" *intrinsic* incentives grounded in analyst personalities and values, or analytic culture.[17]

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[13] Use of multiple methods or approaches was strongly endorsed by the Expert Panel, with 98% agreeing that it enhances or strongly enhances rigour. It is also one of the lessons of the IARPA-funded research by the SWARM Project. See van Gelder, Timothy, and Richard de Rozario. "Contending Analyses: A New Model of Collaboration for Intelligence Analysis." *Journal of the Australian Institute of Professional Intelligence Officers* 26 (2019); and van Gelder, et al. "Improving Analytic Reasoning via Crowdsourcing and Structured Analytic Techniques." *Journal of Cognitive Engineering and Decision Making* 14 (2020).

[14] This opportunity was the most strongly supported by the Expert Panel, with 62% including it in their top ten.

[15] This was one of the top opportunities selected by the Expert Panel (44%).

[16] On rewarding productivity, see Nolan, Bridget Rose. "Information Sharing and Collaboration in the United States Intelligence Community: An Ethnographic Study of the National Counterterrorism Center." University of Pennsylvania, 2013.

[17] Deci, Edward L., and Richard Flaste. *Why We Do What We Do: Understanding Self-Motivation*. Reprint edition. London: Penguin Books, 1996.

Strengthen visible leadership support for analytic rigour

Analysts are sensitive to overt indications that their organisation, its leaders, and its customers, genuinely value analytic rigour. Leaders' actions need to go beyond bland pronouncements ("motherhood statements"), and demonstrate through identifiable commitments that rigour ranks highly among the organisation's many priorities.[18]

6.3.6 Collaboration

Improve team-level collaboration

There is a good empirical case that improving team level collaboration improves analytic rigour and intelligence analysis generally.[19] Team level collaboration, done well, can help improve rigour by, for example, providing a diversity of opinion and helping analysts to challenge assumptions, improving objectivity, thoroughness and potentially acuity.

Improve collaboration between organisations

There have been many calls[20] for increased collaboration between organisations to improve analytic rigour, and some evidence that increased cooperation does improve intelligence analysis. To the extent that cooperation and collaboration lead to increased means for analysts to show LOTSA, for example by thoroughly exploring all sources of intelligence, this is an opportunity to improve rigour.

Improve collaboration with outside experts

Collaboration with outside experts is another area frequently highlighted as an opportunity to improve analytic rigour, and we agree. Zelik et al.[21] include collaboration with experts as part of their Rigor Metric, where *consulting independent experts and going beyond a 'core group of contacts' to do so* is an indicator of high rigour. Consulting experts increases rigour by helping ensuring that analysts are both thorough and objective in their analysis, and outside experts may also provide, or help analysts achieve acuity.

6.3.7 Research

Impact of current methods and practices

Broadly, there is a major opportunity for organisations, or the intelligence community, to increase rigour in the long term by conducting or supporting research into the impact of current methods and practices on analytic rigour, objective measurement of performance, and quality of intelligence generally. Most methods and practices in intelligence organisations – as with all organisations[22] – have not been subjected to rigorous scrutiny. Conducting such scrutiny is challenging, and time- and

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[18] The Expert Panel rated "Leadership should more strongly demonstrate commitments and ownership of responsibility to improve analytic rigour" as one of the top three opportunities.

[19] See for example, Schwarz, Monika, Tim Dwyer, Kim Marriott, Tim van Gelder, Ariel Kruger, and Richard de Rozario. "What makes a team successful?" Hunt Laboratory for Intelligence Research 2020.

[20] E.g., by the WMD Commission. The Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction. Report to the President of the United States (Washington, D.C.: 2005), 274.

[21] Zelik, Daniel J., Emily S. Patterson, and David D. Woods. "Measuring attributes of rigor in information analysis." *Macrocognition metrics and scenarios: Design and evaluation for real-world teams* (2010): 65-83.

[22] Even including research organisations, ironically.

resource-intensive. However, it is essential for the long-term transition to demonstrably higher performance.[23]

Method for evaluating rigour

We have already highlighted the need for, and absence of, a good method for evaluating rigour. Developing such a method requires a substantial research effort. Investing such effort is one of the main recommendations of this report.[24]

Expression of uncertainty

Above, we listed the adoption of numeric expressions of uncertainty as one opportunity to improve rigour. While we regard this as warranted by the existing research base, there is opportunity to further enhance rigour by developing greater understanding of a range of issues, including:

- The optimal form of numerical expression;
- The range of situations in which numeric expressions can or should be provided;
- How visualisation might be used to improve understanding of numerical representations;
- The amount and nature of training required for analysts to be proficient in numerical expressions; and
- Strategies for communicating the benefits of, and dispelling misconceptions about, numerical expression.

6.3.8 Technology

There are many opportunities to directly or indirectly improve rigour.

Better support for collaboration

Adopt or improve technologies for more efficient and effective collaboration between analysts and managers working on analytic tasks, and between organisations.[25]

Supporting use of SATs

Adopt well-designed technologies supporting use of well-supported SATs, i.e. those SATs for which there is good evidence that their use increases rigour.

Automate low-level tasks

Continue to increase the automation of low-level tasks that analysts often have to do "manually." For example, it should be easy to search and sort information from all databases simultaneously rather than searching each one individually.

Building AI into the analytic workflow

Develop and incorporate new technologies applying AI and machine learning to aspects of intelligence work. We see this unfolding in three broad directions:

- Intelligent **inputs**, where AI takes over increasingly sophisticated information processing tasks, delivering inputs on request to higher-level analytic work by human analysts;

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[23] The medical profession has been a leader here. See Claridge, Jeffrey A., and Timothy C. Fabian. "History and Development of Evidence-Based Medicine." *World Journal of Surgery* 29 (2005): 547–53.

[24] This was also very highly rated as an opportunity by the Expert Panel.

[25] This was the most highly rated technology-related opportunity in the Expert Panel, with 42% selecting it as one of their top opportunities.

- Intelligent **agents**, which undertake analytic sub-tasks on their own initiative; and
- Intelligent **environments**, which shape the activity of teams of analysts (human or artificial agents) to enhance performance.[26]

While we see this trend as both inevitable and desirable with regard to increasing rigour, we acknowledge and indeed underscore the many challenges around this, including *validation* of AI contributions (are they in fact as intelligent as presumed or advertised?); building *trust* among various stakeholders (analysts, managers, customers) in outputs based in whole or part on AI; ensuring that AI systems do not build in systemic *biases*; and ensuring that AI contributions are adequately *explainable*.

Internal 'Crowdsourcing'

Adopt technologies to support widely distributed contribution to particular analytic tasks or components. The term 'crowdsourcing' may be misleading here since it implies engaging public crowds. Rather, the opportunity here is to incorporate technologies (and corresponding practices) to support relatively large numbers of people within one organisation, or the larger community, contributing to certain kinds of tasks. Crowdsourcing approaches can increase rigour through aggregation of diverse inputs. Some examples of such technology are the platform supporting the US IC Prediction Market,[27] or prediction polling of the kind done by the Good Judgement project.[28]

6.4 Limitations

To our knowledge, the catalogue of opportunities presented above represents the most comprehensive and well-grounded treatment of this topic to date. However it is important to keep in mind some major limitations of the analysis.

First, the attractive opportunities have been listed but not scaled or ranked. We have not ventured any assessment of the *relative* attractiveness of the listed opportunities. Note however that the Expert Panel process did generate a ranking of the opportunities considered by the Panel. See Appendix 2, s.8.2.3, for this ranking.

Second, the evidence base for each of these opportunities is generally modest at best. As described in the Methodology section above, they are included primarily on the basis of aggregated expert opinion, sometimes augmented by additional indirect evidence of various kinds. There has been very little by way of rigorous evaluation of these opportunities in practice.

[26] Expert panellist: "Technological tools (software) can help analysts in maintaining a high level of rigour, either by offering explicit help, or by implicit nudging and a smart 'design' of the analytical process." For a more comprehensive overview of the role of AI in intelligence, see Katz, Brian. *The Analytic Edge: Leveraging Emerging Technologies to Transform Intelligence Analysis*. Center for Strategic and International Studies, 2020.

[27] Treverton, Gregory F. "New Tools for Collaboration: The Experience of the U.S. Intelligence Community" Washington DC: Center for Strategic and International Studies, 2016.

[28] Mellers, B., L. Ungar, J. Baron, J. Ramos, B. Gurcay, K. Fincher, S. Scott, et al. "Psychological Strategies for Winning a Geopolitical Forecasting Tournament." *Psychological Science* 25 (2014): 1106–15.

7 Appendix A – Literature Review

We conducted a systematic literature review in order to understand and assess the current and prior thinking regarding analytic rigour within the intelligence community and within related academic disciplines. Another objective was to provide the Expert Panel members, and the community, with an up-to-date list of key documents - including academic journal articles, government publications, and relevant standards, definitions and metrics from relevant policy and legislation within Five-Eyes countries.

The initial review surfaced 839 works, of which 281 were deemed relevant after application of inclusion/exclusion criteria, as described below. From the 281, we identified 49 works as being highly relevant to questions concerning analytic rigour. These were entered into a database made available to participants in the Expert Panel.

In this appendix, we describe our methodology and detailed findings.

7.1 Methodology

We chose to conduct a *systematic* literature review as a means of casting as wide a net as possible and to ensure that we obtained a comprehensive view of the state of thinking regarding analytic rigour in the area of intelligence analysis.

Systematic literature reviews emerged as a means of conducting an unbiased survey of empirical studies and a refined methodology has been developed for conducting them, especially in the fields of medicine and epidemiology, but also in the social sciences. The method is less often used in other disciplines, where traditional 'narrative ' literature reviews tend to be used.

In traditional narrative literature reviews, a scholar generally reads as much literature as possible on a given topic, often within a given discipline, then constructs a careful narrative synthesising the current status of research, identifying themes, debates, and gaps.[1] One problem with traditional reviews is that they can be highly subjective, and potentially biased, especially in the identification of literature; for example, they may miss or exclude relevant research from disciplines outside the scholar's normal disciplinary purview.[2] Further, because the search methodology, and reasons for inclusion or exclusion, are generally not recorded, and are often ad hoc, it is difficult for someone reading the review to judge how comprehensive and unbiased the search process and subsequent review was.

Systematic reviews, by contrast, are designed to be comprehensive, transparent, and reproducible. The process involves consulting with expert librarians, who aid in the design of the search, identifying search terms, and selecting databases and search engines. In this way a systematic literature review reduces bias or partiality in the selection of literature to review. Additionally, because systematic reviews are designed to be as comprehensive as possible, they are particularly suited for analysing the range and diversity of research on a given topic, and for identifying potential gaps in the research.

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1 Green, Rosemary. American and Australian doctoral literature reviewing practices and pedagogies. PhD Thesis, Deakin University, 2009.

2 Pickering, Catherine, and Jason Byrne. "The benefits of publishing systematic quantitative literature reviews for PhD candidates and other early-career researchers." *Higher Education Research & Development* 33 (2014): 534-548.

There is thus a growing appreciation of the advantages of systematic literature reviews in interdisciplinary fields such as bioethics.[3]

The method we used for the literature review was adapted from the *Preferred Reporting Items for Systematic reviews and Meta-Analyses* (PRISMA) guidelines, and informed by other best practice guidelines.[4]

Note the methods and results discussed here refer to the literature review as it was conducted prior to the Expert Panel process. During that process, some additional relevant works were brought to our attention and figured into our thinking for the larger report.

7.1.1 Initial search

In the first phase of the systematic review our goal was to find as many works as possible relating to analytic rigour. Additionally, because works might contain substantive insight related to analytic rigour, but not mention the term rigour explicitly, we developed a list of terms that we found were often used synonymously or in close association with analytic rigour.

- analytic standards
- analytic tradecraft standards
- analytic performance
- analytic accuracy
- failures of intelligence (analysis)

Librarians at the University of Melbourne advised us on search term design, data-bases and search engines and overall search methodology. The search terms we used are listed in Table 7-1.

Table 7-1: Search terms used in our systematic literature review.

analytic* rigo*r AND intelligence community intelligence org* intelligence agenc* intelligence service	intelligence failure* AND intelligence community intelligence org* intelligence agenc* intelligence service	intelligence cycle* cycle* of intelligence AND intelligence community intelligence org* intelligence agenc* intelligence service	tradecraft AND analy* AND rigo* AND intelligence community intelligence org* intelligence agenc* intelligence service

Because of the vast nature of the literature on these four topics, we limited our initial search to the year 2000 onwards.

The initial literature search surfaced some 839 works. We found 43 works through other means, and added these to the pool. These included works that had previously been assessed to be relevant to the project by members of the Hunt Lab research group, as well as practitioner and government

[3] Strech, Daniel, and Neema Sofaer. "How to write a systematic review of reasons." *Journal of Medical Ethics* 38, no. 2 (2012): 121-126.

[4] Petticrew, Mark, and Helen Roberts. *Systematic reviews in the social sciences: A practical guide*. John Wiley & Sons, 2008; and Moher, David, Larissa Shamseer, Mike Clarke, Davina Ghersi, Alessandro Liberati, Mark Petticrew, Paul Shekelle, and Lesley A. Stewart. "Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement." *Systematic Reviews* 4 (2015).

documents identified through other specific searches, and documents recommended by contacts in the expert community.

Inclusion and exclusion criteria were then developed and applied. Inclusion and exclusion criteria were collaboratively drafted by a team of five researchers. Works were excluded if:

- They were not explicitly relevant to the intelligence sector.
- They did not contain or purport to contain substantive insight on the nature of, factors impacting on, or opportunities for enhancing analytic rigour. Articles with passing reference to rigour but deemed not to have substantive discussion were thus excluded.
- The focus of the article was on the consequences of intelligence failures, rather than causes.

After raters had worked through 10% of their assigned works to review, the exclusion criteria were collaboratively revised. Raters then worked through remaining works.

All works were assessed by two raters working independently. For works on which the two raters disagreed on their inclusion/exclusion, a third rater independently applied the exclusion criteria in a deciding 'vote'.

This process reduced the number of included works to some 281 items. Figure 7-1 records the search and exclusion process in accordance with current best practice for systematic literature reviews.

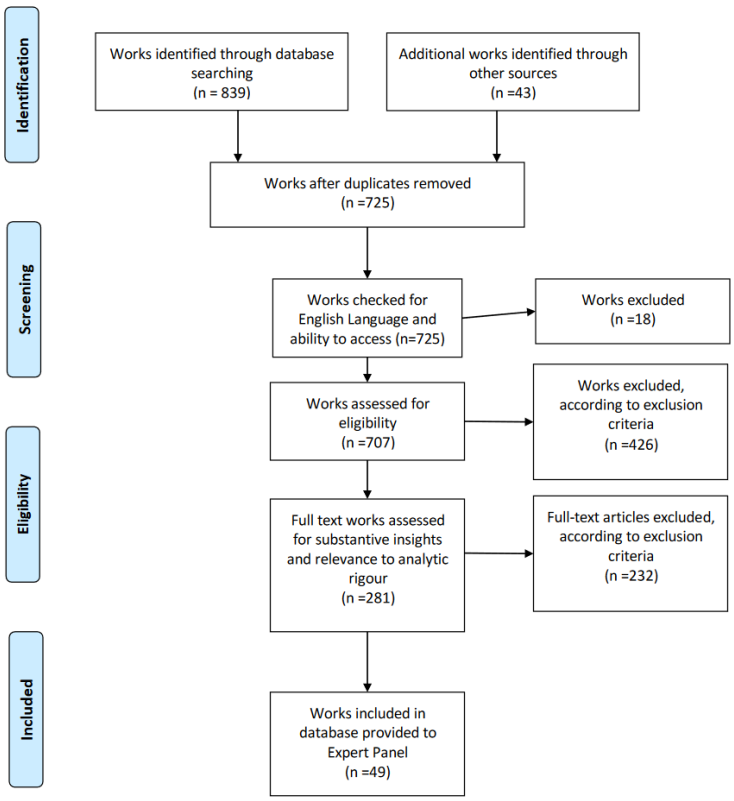

Figure 7-1: PRISMA Diagram for analytic rigour systematic literature review.[5]

We then read the remaining works more closely, aiming to identify works of particular relevance and with substantial insights. During this phase, we excluded additional works if a close reading revealed

[5] Adapted from- Moher, David, Alessandro Liberati, Jennifer Tetzlaff, and Douglas G. Altman. "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement." *International Journal of Surgery* 8 (2010).

no substantive insight about the three elements of analytic rigour which are the focus of the project (i.e. nature, factors, and opportunities). This winnowing was aided by our own background knowledge and familiarity with the literature built up before and during the systematic review.

Initially, this phase also included manual extraction of the following attributes of each work:

a. Bibliographic information
b. Author institution
c. Geographic focus
d. Recurring themes
e. Author disciplines
f. Methods (if study)
g. Participants (if study)
h. Structured abstracts (if study)
i. Relevant questions (1 = nature, 2 = contributing factors, 3 = opportunities for improvement)
j. Whether it is of sufficient quality/relevance to include in online repository
k. Brief description of why it is important/relevant (if it is).

However, after about 35 works, we ceased extracting most of these attributes, as we had lost confidence that this would produce worthwhile insight, due to the the sparsity and heterogeneity of the literature.

The purpose of this additional winnowing was to identify a much smaller number of journal articles, reports, or other documents of particular depth and relevance with regard to analytic rigour. This resulted in a subset of 49 works which were used to seed the online literature repository established to aid the Expert Panel. This repository included bibliographic information, a work's thematic importance to analytic rigour, and a brief description of a work's general relevance. The 49 works are listed in Table 7-2.

Table 7-2: Shortlist of 49 works of most relevance to analytic rigour emerging from our systematic literature review.

Author and Year	Title	Theme	Relevance
Antonik, 2015	How Do Professional Analysts Judge Rigor: The Effect of Indicators of Analytic Rigor on Critiques of Analytic Product and Process	Defining AR, Evaluating AR	Master's thesis describing a study in which 19 intelligence analysts were tasked with twice evaluating the rigour in a sample analytic product using the 'Rigor Metric': once using only the product, and a second time having access to analytics about the analysis process that lead to the product. Certain process analytics were found to influence evaluations more than others. Also contains a reasonably thorough literature review into visualisations of the analysis process.
Bar-Joseph & McDermott, 2008	Change the Analyst and Not the System: A Different Approach to Intelligence Reform	Improving AR	Argues that changing recruitment would be a more effective approach than other reforms designed to improve intelligence analysis.
Barnes, 2016	Making Intelligence Analysis More Intelligent: Using Numeric Probabilities	Improving AR	Good discussion of the benefits and challenges of using numerical probabilities when stating uncertainty levels in intelligence.
Borek, 2019	Developing a Conceptual Model of Intelligence Analysis	Cognitive Science of Analysis	Interesting discussion of how to think about what intelligence analysis is. Might help clarify the domain or tasks AR is supposed to apply to or be exhibited in.
Chang & Tetlock, 2016	Rethinking the training of intelligence analysts	Improving AR	Explains how trying to eliminate one type of biases may encourage a different one.
Chang, 2012	Getting It Right: Assessing the Intelligence Community's Analytic Performance	Evaluating AR	Advocates for the establishment of groups responsible for comprehensive evaluation of the accuracy of judgements and forecasts in analytic products produced by intelligence organisations.
Chang, Berdini, Mandel & Tetlock, 2018	Restructuring structured analytic techniques in intelligence	Contributing Factors, Improving AR	Argues that SATs may be based on incorrect beliefs about psychology and thus counterproductive and recommends ways to improve their use.

Commission on the Intelligence Capabilities of the United States Regarding WMDS, 2005	Report to the President of the United States	Contributing Factors, Defining AR	Claims that a lack of rigour was a contributing factor to misjudgements made about WMDs in Iraq and discusses some of the components of AR.
Corkill, 2008	Evaluation a critical point on the path to intelligence	Evaluating AR	Argues that better evaluation is needed for quality intelligence. Explains why the Admiralty Scale is not used correctly.
Dhami & Careless, 2019	Intelligence analysts' strategies for solving analytic tasks	Cognitive Science of Analysis, Improving AR	Survey investigating intelligence analysts' use of deliberative and intuitive strategies at different stages of the analytic workflow. Found that deliberative strategies are favoured at the beginning and end but not when planning a response or obtaining data. Little discernible difference between analysts who had received analytic thinking training and those who had not.
Folker & Fudemberg, 2020	Empowering the Information Warrior: Unlocking the Latent Value of this Strategic Asset	Improving AR	Higher-order and critical thinking are fundamental to incorporating analytic rigor into the intelligence process. This paper describes a specific approach, which uses a web-based platform to guide the analyst through the higher-order thinking process, develop those skills, and assess these skills.
Folker, 2000	Intelligence Analysis in Theater Joint Intelligence Centers	Improving AR	This thesis sets forth the key opposing arguments in the long-standing controversy over the role of structuring in intelligence analysis for without structure, ensuring rigor within the analytic process is near impossible. Rigor also demands that the Intelligence Community design and conduct reliable tests to demonstrate which analytic approach is superior: structured or intuitive. Given the wide range of available structuring techniques, each one should be tested in competition with intuition.
Gentry, 1993	Lost Promise: How CIA Analysis Misserves the Nation	Contributing Factors	Illuminating historical account of the challenges of producing high-quality intelligence in a large organisation such as the CIA. Includes discussion of bureaucratic and political obstacles.
Gentry, 2015	Has the ODNI Improved U.S. Intelligence Analysis?	Contributing Factors, Improving AR	Overview of the impact of the Intelligence Reform and Terrorism Prevention Act (IRTPA) on the US intelligence community. Includes detailed discussion of the limitations of analytic standards (ICD 203 in particular), SATs, and the rapid expansion of intelligence organisations following 9/11.
Gentry, 2016	The "Professionalization" of Intelligence Analysis: A Skeptical Perspective	Improving AR, Nature of Intelligence	Sceptical discussion of standard views on how to improve the skills of intelligence analysts.
George, 2010	Beyond Analytic Tradecraft	Contributing Factors	Concise summary of biases that may affect rigour. Has a useful taxonomy of sources of bias.
Harrison, Walsh, Lysons-Smith, Truong, Horan and Jabbour, 2020	Tradecraft to Standards—Moving Criminal Intelligence Practice to a Profession through the Development of a Criminal Intelligence Training and Development Continuum	Improving AR	The article explores the development of the Australian criminal intelligence training and development continuum used by intelligence analysts in the AFP and Australian Criminal Intelligence Commission. The article shows how the continuum developed standards and competencies and how it articulates with the MA (Intelligence Analysis) program at Charles Sturt University.
Hedley, 2005	Learning from Intelligence Failures	Improving AR	Explains past attempts by the IC to learn from intelligence failures.
Hendriks & Mandel, 2019	Intelligence Professionals' Views on Analytic Standards and Organizational Compliance	Analytic Standards, Defining AR, Evaluating AR	Introduces psychometric instruments for measuring personal support for and perceived organisational compliance with each of the analytic standards specified in ICD 203. Finds that dimensions cluster into 3 factors corresponding to unbiasedness, rigour, and relevance. Conscientiousness and actively open-minded thinking correlate with personal endorsement of the analytic standards.
Hoffman et al., 2011	Reasoning difficulty in analytical activity	Contributing Factors	Discussion of the factors contributing to analytical difficulty (organisational factors, as well as the inherent difficulty of the task). Criticises existing attempts at SATs, new tools as being cases of 'designer-centred design', that don't address the real challenges faced by intelligence analysts.
Irwin & Mandel, 2019	Improving information evaluation for intelligence production	Improving AR	Discusses problems with the Admiralty Code and recommends replacement based on numerical probabilities and increased collaboration.
Jackson, 2014	How Do We Know What Information Sharing Is Really Worth?: Exploring Methodologies to Measure the	Evaluating AR, Improving AR	Comprehensive discussion on information sharing interventions in the US intelligence community, the difficulty of assessing their value and the limitations of previous attempts to do so.

	Value of Information Sharing and Fusion Efforts		
Kampman, Mangio & Marsh, 2013	Advanced Analysis Cognition: Improving the Cognition of Intelligence Analysis:	Cognitive Science of Analysis, Improving AR	Set of recommendations for improving analysts' cognition based on comprehensive literature review of over 5,800 documents. Includes concise summary of the literature on critical thinking, thinking dispositions, practice based learning and epistemological beliefs as they relate to intelligence analysis. Note: it's a 400-page document, but all but the first 40 pages are references.
Klein, 2011	Critical thoughts about critical thinking	Improving AR	Proposes that performance in intelligence analysis involves both increasing insights and reducing mistakes. Argues that interventions to promote critical thinking may reduce mistakes but also reduce insights.
Landon-Murray & Coulthart, 2016	Academic Intelligence Programs in the United States: Exploring the Training and Tradecraft Debate	Improving AR	Discusses which aspects of analytic tradecraft can be taught in academic programs and how this might benefit the training of intelligence analysts.
Lowenthal, 2008	Towards a Reasonable Standard for Analysis: How Right, How Often on Which Issues?	Analytic Standards, Contributing Factors, Improving AR	Argues that analytic standards (particularly the IC Rating Scale) are neither sufficient to produce the type of analysis sought by intelligence customers, nor achievable in practice. Pokes holes in the "lessons learned" from recent high-profile intelligence "failures".
Lowenthal, 2013	A Disputation on Intelligence Reform and Analysis: My 18 Theses	Improving AR	18 concise points on the state of US intelligence analysis. Not explicitly related to rigour but does a good job of summarising recent literature and thinking on intelligence reform. Sums up the content of at least a dozen other papers in this repository.
MacEachin, 1994	The Tradecraft Of Analysis Challenge And Change In CIA's Directorate Of Intelligence	Analytic Standards, Defining AR	Interesting historical document presenting an insider take on elements of AR that were lacking and recommendations on how to improve products by focusing on facts, findings, and linchpins.
Mandel, 2015	Accuracy of Intelligence Forecasts from the Intelligence Consumer's Perspective	Evaluating AR	Long-term study of strategic intelligence shows accurate forecasting (Brier scores ~ 0.075) and evidence of effective communication of uncertainties to policymakers.
Mandel, 2020	The occasional maverick of analytic tradecraft	Improving AR	Discussion of the lack of evidence supporting the use of structured analytic techniques, as well as broader issues around the slow pace of improvement in the intelligence profession.
Mandel, Karvetski & Dhami, 2018	Boosting intelligence analysts' judgment accuracy: What works, what fails?	Improving AR	Between-subject study evaluating the effect of using the Analysis of Competing Hypotheses (ACH) structured analytic technique on judgement accuracy in intelligence analysts. Found that ACH failed to improve analysts' probabilistic judgement accuracy.
Marchio, 2014	Analytic Tradecraft and the Intelligence Community: Enduring Value, Intermittent Emphasis	Contributing Factors, Improving AR	Historical overview of the intermittent focus on analytic standards in the US intelligence community, and the very mixed success of attempts to improve analytic quality.
Marcoci, Vercammen & Burgman, 2019	ODNI as an analytic ombudsman: is Intelligence Community Directive 203 up to the task?	Evaluating AR	Studies indicating that the ODNI's IC Rating Scale, based on ICD 203, has moderate reliability and validity.
Marrin, 2017	Understanding and improving intelligence analysis by learning from other disciplines	Improving AR	Introduction to a special issue on what intelligence analysis can learn from other discipline. Summarises many interesting ideas that may help improve AR.
Michaelson, 2006	Bringing Analytical Rigor to Joint Warfighting Experimentation: Bringing Analytical Rigor to Joint Warfighting Experimentation	Defining AR	Description of a workshop which discussed the meaning and promotion of AR in joint warfighting experimentation.
Monk, 2005	Preface to Thunder from the Silent Zone	Contributing Factors	Anecdotal description from an intelligence analyst of the struggle to achieve analytic rigour in an Australian intelligence organisation in the 1990s. Illustrates how social and cultural factors can impede rigour.
Moskal, Sudit & Sambhoos, 2011	The role of information fusion in providing analytical rigor for intelligence analysis	Improving AR	Discussion of the role of information fusion in improving AR in intelligence analysis. Concludes with 8 strategic guidelines to promote this outcome.
Nolan, 2013	Information Sharing and Collaboration in the United States Intelligence Community	Contributing Factors	Illuminating view into the realities of analysis production in a large organisational, and some of the cultural and organisational factors affecting output.

ODNI, 2015	ICD 203	Analytic Standards	Key analytic standards document. Important part of ODNI initiatives to improve AR.
Rojas, 2019	Masters of Analytical Tradecraft: Certifying the Standards and Analytic Rigor of Intelligence Products	Defining AR, Evaluating AR	Proposes a process for evaluating the AR of products.
Treverton & Gabbard, 2008	Assessing the Tradecraft of Intelligence Analysis	Improving AR	Quality, high-level analysis of the state of intelligence analysis in the US, concerns of analysts, needed innovations, future directions for intelligence analysis and recommended reforms.
Walsh, 2011	Intelligence and Intelligence Analysis	Nature of Intelligence	The book is relevant to how we conceptualise intelligence analysis and improve it from an institutional perspective.
Walsh, 2017	Improving Strategic Analytical Practice Through Qualitative Social Research	Improving AR	This article underscores the need for more empirical and exploratory evidence that various social science approaches can improve analytical outputs and rigour. It looks at qualitative social scientific methods and how they can be applied to strengthen strategic intelligence products.
Walsh, 2017	Teaching Intelligence in the Twenty First Century Towards and Evidence Based Approach for Curriculum Design	Improving AR	This article addresses a fundamental issue in current intelligence analytical research and in practice that we need more evidence based frameworks about what education/training works and how to design this into future curriculums. The article argues a holistic understanding of intelligence education and what works is required to improve intelligence education and analysis in the workplace.
Walsh, 2020	Intelligence Leadership and Governance Building Effective Intelligence Communities in the 21st Century	Improving AR	This book is available in late 2020 and focuses on how we improve the next generation of IC leaders. One key focus in the book is that analytic rigour and innovation is not just the responsibility of analysts or educators but leaders too need to become more literate in technology, cultural, psychological and other factors that will improve rigour.
Zelik, Patterson & Woods, 2007	Understanding Rigor in Information Analysis	Defining AR, Evaluating AR	Proposes a re-understanding of AR as a measure of degree of context-dependent sufficiency, rather than as a degree of deviation from standard processes. Proposes the 'Rigor Metric' as an instrument for measuring AR, and the Participatory Exchange Model (a more conversational framework for intelligence briefings) as an intervention to promote accurate assessments of rigour.
Zelik, Patterson & Woods, 2007	Judging Sufficiency: How Professional Intelligence Analysts Assess Analytical Rigor	Defining AR, Evaluating AR	Study that used Elicitation by Critique (of two intelligence-style products) to investigate how intelligence analysts assess AR. Rigour was assessed both before and after access was given to documentation of the analysis process. Found that access to process information often changed forced-choice rigour evaluations, though respondents were split on which of the two products was more rigorous.
Zelik, Patterson & Woods, 2010	Measuring Attributes of Rigor in Analysis	Defining AR, Evaluating AR	Overview of the authors' previously developed sufficiency conception of AR, and their 'Rigor Metric' rubric used to measure it.
Zelik, Woods & Patterson, 2009	The Supervisor's Dilemma: Judging When Analysis is Sufficiently Rigorous	Defining AR, Evaluating AR	Elaboration of the authors' previously-introduced notion of The Supervisor's Dilemma: "a generic situation wherein a supervisor must decide if the output product of an analysis is acceptably rigorous or if more analytical resources must be invested in that analysis process before sending it forward."

7.2 Results

7.2.1 Nature of analytic rigour

With regard to the nature of analytic rigour, we wanted answers to the following questions:

1. What has been said about analytic rigour?
2. How has analytic rigour been defined, either in academic or practitioner literature?
3. To what extent has there been clarity or consensus about the nature of analytic rigour?
4. Has analytic rigour been sufficiently studied?

Overall we found that although the term "analytic rigour," or just "rigour," is widely used, there has been little clarity or agreement on its meaning, either in academic literature, or within the Intelligence Community (IC). It is often used more or less synonomously with quality of intelligence

analysis or adherence to tradecraft standards. With few exceptions, little attempt has been made to elaborate the concept of analytic rigour as a distinct topic.

For example, the ODNI Intelligence Community Directive 203 (ICD 203), in establishing a number of tradecraft standards for the U.S. intelligence community, states its purpose to be, in part, "to promote a common ethic for achieving analytic rigor and excellence,"[6] but it does not define analytic rigour. The Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction *Report to the President*[7] (hereafter WMD Commission) highlights a "decline" and a "lack" of analytic rigour, but the term is not clearly defined. Rather, when the term is used, it is immediately followed by discussion regarding tradecraft standards and quality of analysis, and no clear distinction is made between these concepts.

There have been two notable attempts to characterise analytic rigour in the academic literature. Zelik and colleagues offered a conception of rigour in intelligence work embodied in their "Rigor Metric."[9] Recently, the Laboratory of Analytic Sciences has produced a report providing a "candidate operational definition."[10] In our view, while both these efforts reflect valuable insights, neither is fully adequate. We describe the Zelik et al. and LAS definitions, and our criticisms of them, in s.4.7.

Since there is no explicit, clear and widely accepted definition of analytic rigour, either in the academic or the IC practitioner literature, the relationships between analytic rigour and other notions, such as quality of analysis, integrity and analytic tradecraft standards, are unclear and hard to disentangle.

This problem has not gone unnoticed within the intelligence community itself. According to the *Aide Memoire on Intelligence Analysis Tradecraft,* a Canadian Forces Intelligence Command (CFINTCOM) training document, one of the rare works we found that attempts an explicit definition of rigour, the term analytic rigour "is widely used, but few analysts or managers can actually describe what it entails – not very helpful!"[11]

7.2.1.1 Prior characterisations of analytic rigour

Canadian Forces Intelligence Command Conception of Analytic Rigour

According to an *Aide Memoire* for intelligence analysts produced by the Canadian Forces Intelligence Command (CFINTCOM):[12]

> To exhibit **analytic rigour**, intelligence analysts should:
>
> - Make accurate judgements;
> - Be clear;

[6] Office of the Director of National Intelligence. Intelligence Community Directive 203 (Washington D.C. 2015).

[7] The Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction. *Report to the President of the United States* (Washington, D.C.: 2005), 12 and 26.

[8]

[9] See, for example, works by Zelik, Patterson and Woods, as discussed in Appendix A – Literature Review. E.g. Zelik, Daniel J., Emily S. Patterson, and David D. Woods, "Judging sufficiency: How professional intelligence analysts assess analytical rigor," *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, vol. 51, no. 4 (2007): 318-322.

[10] Johnston, J., "Defining Analytic Rigor for Analysis in the Intelligence Community" [Unpublished report], Laboratory for Analytic Sciences: North Carolina State University (2020), p.4.

[11] Canadian Forces Intelligence Command. *Aide Memoire on Intelligence Analysis Tradecraft* (2015), 13.

[12] Ibid., 26.

- Be insightful, timely and relevant; and
- Highlight trends over time.

This should be demonstrated through:

- Identifying confidence in analytic judgements;
- Identifying assumptions;
- Considering alternate hypotheses,
- Identifying indicators; and
- Applying structured analytic techniques.

Finally, analytic rigour depends on the quality and reliability of the evidence as examined through the lens of the provider, the information itself, its relevance, and the potential for denial and deception.

The *Aide Memoire* also includes a detailed concept map of analytic rigour and the surrounding territory:

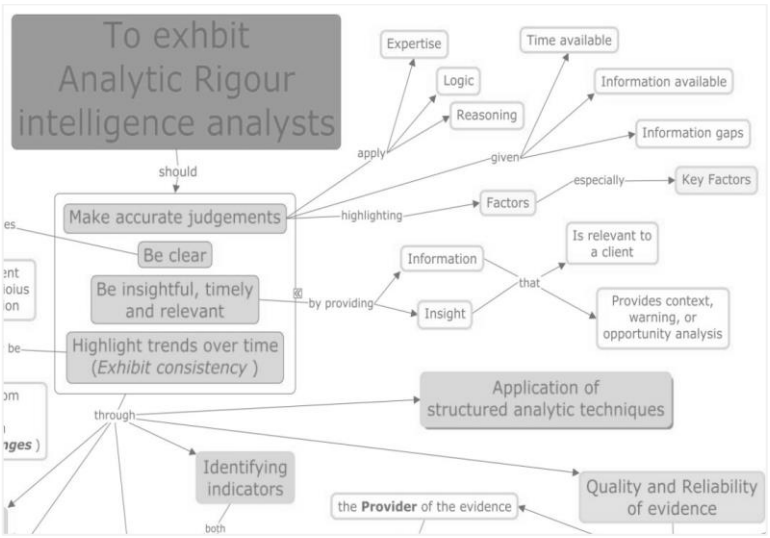

Figure 7-2: A portion of the Analytic Rigour concept map in the Canadian *Aide Memoire.*[13]

In our view the CFINTCOM account is a sweeping gesture in the general direction of analytic rigour, but not itself a rigorous definition. It is too broad, being tantamount to an attempted account of good analysis generally, rather than an articulation of analytic rigour as one aspect of good analysis. At the same time, it is incomplete; it misses some critical aspects of either good analysis generally, or analytic rigour more specifically – such as objectivity.

The U.K. Professional Head of Intelligence Assessment (PHIA)

The U.K.'s Professional Head of Intelligence Assessment established a set of analytic standards to "ensure a consistent standard of rigour, integrity, language and best practice across the UK intelligence assessment community."[14]

[13] Ibid., 113

[14] "Professional Development Framework for All-Source Intelligence Assessment." Professional Head of Intelligence Assessment (PHIA), UK, 2019. p.26.

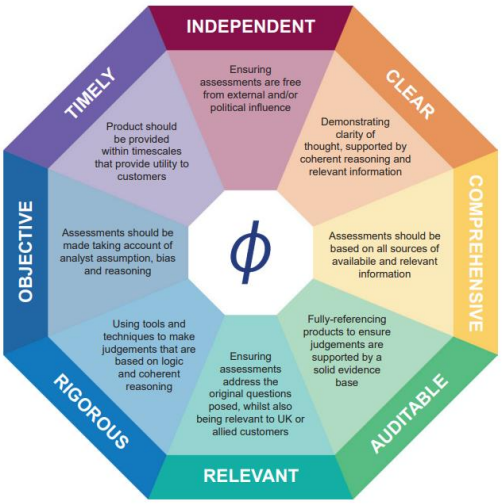

Figure 7-3: The PHIA Common Analytic Standards. *In Professional Development Framework for All Source Intelligence Assessment*. PHIA, 2019, 26.

As shown in **Figure 7-3**, these standards include being rigorous, which they characterize as follows:

> Analysts should use processes, methods, tools and techniques appropriate to the intelligence requirement in order to be able to show logical and coherent reasoning upon which the resulting judgements are based. Analysts should identify and systematically evaluate differing hypotheses, especially when judgements contain significant levels of uncertainty or complexity (such as forecasting future trends), or when low probability outcomes would have high impact results. This activity should be recorded in a discoverable format for the audit trail. (p.28).

There is ambiguity in the way rigour is used in the PHIA standards. On the one hand, Rigorous is a standard alongside other qualities such as being relevant, independent, timely, and so on. In that context, rigour is focused narrowly on "making judgements based on logic and coherent reasoning." On the other hand, these standards (including Rigorous) are meant, in turn, to ensure "a consistent standard of rigour, integrity, language and best practice." It seems likely that what is meant by rigour here is something more general than the standard.

The WMD Commission

The WMD Commission provides a negative sketch of analytic rigour under the heading of "Lack of rigorous analysis":

> The scope and quality of analysis has eroded badly in the Intelligence Community and it must be restored. In part, this is a matter of tradecraft and training; in part, too, it is a matter of expertise.
>
> Analytic "tradecraft"—the way analysts think, research, evaluate evidence, write, and communicate—must be strengthened. In many instances, we found finished intelligence that was loosely reasoned, ill-supported, and poorly communicated. Perhaps most worrisome, we found too many analytic products that obscured how little the Intelligence Community actually knew about an issue and how much their conclusions rested on inference and assumptions. We believe these tendencies must be reversed if decision makers are to have confidence in the intelligence they receive.

> And equally important, analysts must be willing to admit what they don't know in order to focus future collection efforts.[15]

However, as mentioned previously, the WMD Commission does not clearly define analytic rigour in a positive sense, and the term is deeply entangled with other concepts, such as tradecraft, and quality of analysis.

Analytic rigour in the work of Zelik, Patterson and Woods

The Rigor Metric was developed by by Zelik, Patterson and Woods[16] based on a small study involving professional analysts. They express dissatisfaction with definitions they perceive as emphasising rigid adherence to process, and thus seemingly at odds with the need for analysis to be flexible and adaptable. Zelik, Patterson and Woods suggest an emphasis on rigid adherence to processes "mischaracterises the understanding of analytical rigor" and assert that "rigor is more meaningfully viewed as an assessment of degree of sufficiency, rather than degree of adherence to an established analytic procedure." Zelik, Patterson and Woods then define rigor as a "… composite of multiple process attributes (p. 3)." Thus, rigor is defined as sufficient performance according to criteria or cues, as judged by an analyst's supervisor[17] and operationalised in terms of eight attributes of the analytical process. The eight attributes used in the rigor metric are:

1. Hypothesis Exploration;
2. Information Search;
3. Information Validation;
4. Stance Analysis;
5. Sensitivity Analysis;
6. Specialist Collaboration;
7. Information Synthesis; and
8. Explanation Critique.

See Figure 7-4 for a more complete description of the Rigor Metric attributes.[18]

[15] The Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction. Report to the President of the United States (Washington, D.C.: 2005), 12.

[16] Zelik, Daniel, Emily S. Patterson, and David D. Woods. "Understanding rigor in information analysis." In *8th International Conference on Naturalistic Decision Making*, Pacific Grove, CA (2007), 1.

[17] Zelik, Daniel, David D. Woods, and Emily S. Patterson. "The supervisor's dilemma: Judging when analysis is sufficiently rigorous." In *CHI 2009 Sensemaking Workshop*, Boston, MA. (2009).

[18] As found in Zelik, Daniel J., Emily S. Patterson, and David D. Woods. "Measuring attributes of rigor in information analysis." Macrocognition metrics and scenarios: Design and evaluation for real-world teams (2010): 65-83.

Attribute Description	Indicators of... LOW Rigor	MODERATE Rigor	HIGH Rigor
Hypothesis Exploration The construction and evaluation of potential explanations for collected data.	– Little or no consideration of alternatives to primary or initial hypotheses. – Interpretation of ambiguous or conflicting data such that they are compatible with existing beliefs. – Fixation or knowledge shielding behaviors.	– Some consideration of how data could support alternative hypotheses. – An unbalanced focus on a probable hypothesis or a lack of commitment to any particular hypothesis.	– Significant generation and consideration of alternative explanations via the direct evaluation of specific hypotheses. – Incorporation of "outside" perspectives in generating hypotheses. – Evolution and broadening of hypothesis set beyond an initial framing. – Ongoing revision of hypotheses as new data are collected.
Information Search The focused collection of data bearing upon the analysis problem.	– Failure to go beyond routine and readily available data sources. – Reliance on a single source type or on data that are far removed from original sources. – Dependence upon "pushed" information, rather than on actively collected information. – Use of stale or dated source data.	– Collection from multiple data types or reliance on proximal sources to support key findings. – Some active information seeking.	– Collection of data from multiple source types in addition to the use of proximal sources for all critical inferences. – Exhaustive and detailed exploration of data in the relevant sample space. – Active approach to information collection.
Information Validation The critical evaluation of data with respect to the degree of agreement among sources.	– General acceptance of information at face value, with little or no clear establishment of underlying veracity. – Lack of convergent evidence. – Poor tracking and citation of original sources of collected data.	– Use of heuristics to support judgements of source integrity, e.g. relying on sources that have previously proven to be consistently accurate. – A few "key" high-quality documents are relied on heavily. – Recognizes and highlights inconsistencies between sources.	– Systematic and explicit processes employed to verify information and to distinguish facts from judgements. – Seeks out multiple, independent sources of converging evidence. – Concerned both with consistency between sources and with validity and credibility within a given source.
Stance Analysis The evaluation of collected data to identify the relative positions of sources with respect to the broader contextual setting.	– Little consideration of the views and motivations of source data authors. – Recognition of only clearly biased sources or sources that reflect a well-defined position on an issue.	– Perspectives and motivations of authors are considered and assessed to some extent. – Incorporates basic strategies to compare perspectives of different sources, e.g. by dividing issues into "for" or "against" positions.	– Involves significant research into, or leverages a preexisting knowledge of, the backgrounds and views of key players and thought leaders. – May involve more formal assessments of data sources, e.g. via factions analysis, social network analysis, or deception analysis.
Sensitivity Analysis The evaluation of the strength of an analytical assessment given possible variations in source reliability and uncertainty.	– Explanations are appropriate and valid at a surface level. – Little consideration of critical "what if" questions, e.g., "What if a given data source turns out to be unreliable?" or "What if a key prediction does not transpire as anticipated?"	– Considers whether being wrong about some inferences would influence the overall best explanation for the data. – Identifies the boundaries of applicability for an analysis.	– Goes beyond simple identification to specify the strength of explanations and assessments in the event that individual supporting evidence or hypotheses were to prove invalid or unreliable. – Specifies limitations of the analysis, noting the most vulnerable explanations or predictions on which the analysis is at risk of erring.
Information Synthesis The extent to which an analyst goes beyond simply collecting and listing data in "putting things together" into a cohesive assessment.	– Little insight with regard to how the analysis relates to the broader analytical context or to more long-term concerns. – Lack of selectivity, with the inclusion of data or figures that are disconnected from the key arguments or central issues. – Extensive use of lists or the restatement of material copied directly from other sources with little reinterpretation.	– Explicit, though perhaps not systematic, efforts to develop the analysis within a broader framework of understanding. – Depiction of events in context and framing of key issues in terms of tradeoff dimensions and interactions. – Provides insight beyond what is available in the collected data.	– Extracted and integrated information in terms of relationships rather than components and with a thorough consideration of diverse interpretations of relevant data. – Re-conceptualization of the original task, employing cross-checks on abstractions. – Performed by individuals who are "reflexive" in that they are attentive to the ways in which their cognitive processes may have hindered effective synthesis.
Specialist Collaboration The extent to which substantive expertise is integrated into an analysis.	– Minimal direct collaboration with experts. – Little if any on-topic, "outside" expertise is accessed or sought out directly.	– Involves some direct interaction with experts, though usually via readily available specialists. – Expertise is drawn from within preexisting personal or organizational networks.	– Independent experts in key content areas are identified and consulted. – Efforts to go beyond a "core network" of contacts to seek out domain-relevant experts, with additional resources and "political capital" potentially expended to gain access to such specialist expertise.
Explanation Critiquing The critical evaluation of the analytical reasoning process as a whole, rather than in the specific details.	– Few if any instances of alternative or "outside" criticisms being considered. – Reliance on preexisting channels of critiquing, primarily those supervisory.	– Brings alternative perspectives to bear in critiquing the overall analytical process. – Leverages personal or organizational contacts to examine analytical reasoning, e.g. by way of peer analysts, proxy decision makers, etc.	– Familiar as well as independent perspectives have examined the chain of analytical reasoning, explicitly identifying which inferences are stronger and weaker. – Use of formal methods such as "red teams" or "devil's advocacy" to challenge and vet hypotheses and explanations. – Expenditure of capital, political or otherwise, in critiquing the analytical process.

Figure 7-4: The Rigour Metric scoring rubric, from Zelik, Patterson and Woods (2010).

Zelik, Patterson and Woods also draw a useful distinction between analytic rigour as it undertaken in the process of intelligence analysis, which they term *effective rigour* and analytic rigour as manifest in intelligence products, which they term *perceived rigour.*[19]

The Laboratory for Analytic Sciences

More recently the Laboratory for Analytic Sciences the University of North Carolina has also been working on defining analytic rigour. According to an unpublished report[20] emerging from that work:

> Rigor is an effort by an analyst or researcher to be as complete as possible in order to arrive at the most accurate assessment/results possible in conducting an analysis with integrity. This is achieved by employing methods and techniques meant to support a variety of indicators of sufficiency. Indicators of sufficiency include:
>
> - Objectivity
> - Thoroughness
> - Replicability, reliability, validity
> - Transparency (in analysis and analytic decision-making)
> - Credibility
> - Relevance.[21]

7.2.2 Factors

Our literature review revealed a rich body of literature, academic and practitioner, as well as policy documents that discuss factors that may impact on intelligence analysis. Some of the commonly identified factors impacting on intelligence analysis in general are:

- Structured analytic techniques;[22]
- Source evaluation;[23]
- Evaluation (lack thereof);[24]
- Tradecraft standards;[25]
- Training;[26]
- Technological factors;[27]
- Politicisation;[28] and

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19 This is an important distinction, though we prefer the terms 'process rigour' and 'product rigour.' This distinction, and our terms, were well received in the Expert Panel forum.

20 Johnston, J. Defining Analytic Rigor for Analysis in the Intelligence Community [Unpublished report]. Laboratory for Analytic Sciences, North Carolina State University, (2020).

21 Ibid. p.7. Underlining in the original.

22 E.g., Rojas, J. T. "Masters of Analytical Tradecraft: Certifying the Standards and Analytic Rigor of Intelligence Products" Thesis, Air Command and Staff College, Air University Maxwell AFB United States, (2016), 7.

23 E.g., Irwin, Daniel, and David R. Mandel. "Improving information evaluation for intelligence production." *Intelligence and National Security* 34, no. 4 (2019): 503-525.

24 E.g., Chang, Welton. "Getting It Right: Assessing the Intelligence Community's Analytic Performance." *American Intelligence Journal* 30, no. 2 (2012): 99-108.

25 E.g., Marchio, Jim. "Analytic tradecraft and the intelligence community: enduring value, intermittent emphasis." *Intelligence and National Security* 29, (2014): 159-183.

26 E.g., Dhami, Mandeep K., and Kathryn Careless. "Intelligence analysts' strategies for solving analytic tasks." *Military Psychology* 31 (2019): 117-127.

27 E.g., Hoffman, Robert, Simon Henderson, Brian Moon, David T. Moore, and Jordan A. Litman. "Reasoning difficulty in analytical activity." *Theoretical Issues in Ergonomics Science* 12, no. 3 (2011): 225-240.

28 E.g., Pillar, Paul R. "Intelligence, policy, and the war in Iraq." *Foreign Affairs* 85 (2006): 15.

- Cognitive biases.[29]

However, as with the nature of analytic rigour, little attention has been paid to factors impacting on analytic rigour specifically.

7.2.2.1 Analyst attributes

The literature frequently mentions how important reasoning and critical thinking skills and avoiding biases are to analytic rigour.[30] The literature also discusses how the nature of the job places cognitive stressors on analysts that hinder analytic rigour. Analytic thinking about complex matters is inherently difficult especially under the pressure of high stakes, stressful workloads, and little time.[31] Increasingly analysts are facing a deluge of data that encourages shallow analysis.[32]

7.2.2.2 Processes

Structured Analytic Techniques

One of the most important processes discussed in the literature is use of Structured Analytic Techniques. The impact of SATs on rigour is contentious. The standard view is that SATs are helpful or even necessary for achieving rigour.[33]

However, Chang et al. challenge the view that SATs install rigour, claiming that there is insufficient research on their effectiveness and that there are plausible reasons to think they are poorly designed. They argue that 1) SATs fail to address that cognitive biases are bipolar and that attempts, for example, to reduce over-confidence, might increase under-confidence, and 2) that the way SATs break down judgements into many stages that feed into another, may compound error, as the noise from each stage feeds into the next.[34]

Without a thorough review of all SATs and how they are used in practice it is hard to know how generalisable these criticisms are. Perhaps, the most important reminder for future work is their claim that "Current training is anchored in a mid-twentieth century understanding of psychology that focuses on checking over-confidence and rigidity but ignores the problems of under-confidence and excessive volatility."[35]

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[29] E.g., Heuer, Richards J. *Psychology of intelligence analysis* (Center for the Study of Intelligence, 1999), and Marrin, Stephen, and Efren Torres. "Improving how to think in intelligence analysis and medicine." *Intelligence and National Security* 32 (2017): 649-662.

[30] Hendrickson, Noel. 2018. *Reasoning for Intelligence Analysts*. Security and Professional Intelligence Education Series. Lanham: Rowman & Littlefield; Moore, David T. 2007. *Critical Thinking and Intelligence Analysis*. Washington, DC: National Defense Intelligence College.

[31] Hoffman, Robert, Simon Henderson, Brian Moon, David T. Moore, and Jordan A. Litman. "Reasoning Difficulty in Analytical Activity." *Theoretical Issues in Ergonomics Science* 12, no. 3 (2011).

[32] Zelik, Daniel J., Emily S. Patterson, and David D. Woods, 'Understanding Rigor in Information Analysis', in. *Proceedings of the Eighth International NDM Conference*. (2007).

[33] Rojas, J Tucker. "Masters of Analytical Tradecraft: Certifying the Standards and Analytic Rigor of Intelligence Products," 2019.

[34] Chang, Welton, Elissabeth Berdini, David R. Mandel, and Philip E. Tetlock. "Restructuring Structured Analytic Techniques in Intelligence." *Intelligence and National Security* 33, (2018).

[35] Chang, Welton, and Philip E. Tetlock. "Rethinking the Training of Intelligence Analysts." *Intelligence and National Security* 31, (2016): 903

Evaluating sources

Similarly, it has been argued that the standard methods of evaluating sources is inadequate. Corkill claims that "Generally speaking there appears to be very little intellectual rigour applied to the evaluation of information in particular where the information appears to confirm what is already known."[36] Irwin and Mandel explain some of the conceptual confusion inherent to Admiralty Code typically used to assess sources, pointing out that it asks raters to make assessments without providing guidence on how to make them. For example, the Admiralty Code say that independent corroboration is required, but provides no guidance on how much corroboration is required to warrant a particular rating.[37]

7.2.2.3 Organisational factors

Pressures from organisations can impact negatively on analytic rigour.[38] Well-intended reforms can be misguided and backfire. For example, Lowenthal asserts that "A misguided emphasis is placed on efficiency. Intelligence analysis is an intellectual activity. It cannot be made efficient. The IC should strive for effective intelligence analysis."[39]

Evaluation

One of the most apparent factors from the literature is the lack of evaluation of analytic rigour, with previous efforts in the US IC not being sustained for long enough to have a lasting impact.[40]

Chang writes, "… how often does the United States Intelligence Community (IC) "get it right"? We simply do not know. Why cannot an enterprise with a roughly $75 billion budget answer this question? Despite reform and oversight efforts since 9/11 and myriad commissions examining intelligence failures, the IC has not developed a way to determine when, how often, and why it makes the right or wrong assessments."[41]

Gentry describes current evaluation attempts in the US IC as insufficiently informative, writing that the community "makes no judgment about what scores are acceptable or not, leaving doubts as to whether the IC is doing well or not. Annotated ratings of specific products appear to go to analyst authors and their reviewer/managers only episodically, limiting opportunities for them to help improve analysis."[42]

Tradecraft standards

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[36] Corkill, Jeffrey. "Evaluation a Critical Point on the Path to Intelligence." *Journal of the Australian Institute of Professional Intelligence Officers.* 16 (2008): 8

[37] Irwin, Daniel, and David R. Mandel. "Improving information evaluation for intelligence production." *Intelligence and National Security* 34, no. 4 (2019): 503-525.

[38] Hoffman, Robert, Simon Henderson, Brian Moon, David T. Moore, and Jordan A. Litman. "Reasoning Difficulty in Analytical Activity." *Theoretical Issues in Ergonomics Science* 12, (2011): 228

[39] Lowenthal, Mark M. "A Disputation on Intelligence Reform and Analysis: My 18 Theses." *International Journal of Intelligence and CounterIntelligence* 26, (2013):35

[40] Marchio, Jim. "Analytic Tradecraft and the Intelligence Community: Enduring Value, Intermittent Emphasis." *Intelligence and National Security* 29, (2014):173; Hedley, John Hollister. "Learning from Intelligence Failures." *International Journal of Intelligence and CounterIntelligence* 18, (2005): 441

[41] Chang, Welton. "Getting It Right: Assessing the Intelligence Community's Analytic Performance." *American Intelligence Journal* 30, (2012): 99

[42] Gentry, John A. "Has the ODNI Improved U.S. Intelligence Analysis?" *International Journal of Intelligence and CounterIntelligence* 28, (2015): 644

The role of tradecraft standards in ensuring analytic rigour is debated in the literature. Marchio explains how Robert Gates was one of the most important advocates of analytic standards in the US. "Gates … argued that the best defense against Politicisation and ensuring objectivity was strong tradecraft. Gates went on to make the case for many of today's IC's Analytic Standards. He observed that 'distortion of analysis is much less likely, and much easier to spot, if there is a concerted effort at all levels to observe basic standards".[43] However, some argue that adherence to standards can be taken too far and can become an "intellectual straitjacket."[44] And, the extent to which adherence to standards are counterproductive could be due to how the standards are selected or codified.[45]

Training

The literature often mentions the importance of well-designed training. However one review of empirical studies found little evidence of impact of standard analytic training.[46] While we shouldn't make sweeping generalisations from such studies, it is a reminder that rigorous evaluation of training courses is required to ensure they actually improve the quality of analysis.

Shared understanding of analytic rigour

There are anecdotal indications of a lack of a shared understanding of what analytic rigour involves. The WMD Commission wrote that "Long after the Community's assessment of Iraq had begun to fall apart, one of the main drafters of the NIE told us that, if he had to grade it, he would still give the NIE an "A." By that, he presumably meant that the NIE fully met the standards for analysis that the Community had set for itself. That is the problem."[47] According to Borek "Douglas MacEachin, a career analyst at the CIA who served as Deputy Director for Intelligence from 1993 – 1995, reportedly told a colleague in 1994 that after reading a number of published intelligence assessments designed to support policymakers "roughly a third of the papers…had no discernible argumentation to bolster the credibility of intelligence judgments and another third suffered from flawed argumentation."[48]

Relatedly, Marchio suggests that the emphasis on how explicit analytic products need to be about the their tradecraft has varied over time. "… the emphasis and visibility afforded tradecraft in the IC's analytic production has fluctuated significantly throughout the community's existence. Early on many products included source reference citations, explicitly addressed intelligence gaps and analytic assumptions, and prominently highlighted alternative views. Later, however, many of these same tradecraft elements appeared less frequently in finished intelligence products …"[49]

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[43] Marchio, Jim. "Analytic Tradecraft and the Intelligence Community: Enduring Value, Intermittent Emphasis." *Intelligence and National Security* 29, (2014): 177

[44] Lowenthal, Mark M. "Towards a Reasonable Standard for Analysis: How Right, How Often on Which Issues?" *Intelligence and National Security* 23, (2008):36

[45] Gentry, John A. "Has the ODNI Improved U.S. Intelligence Analysis?" *International Journal of Intelligence and CounterIntelligence* 28, (2015)

[46] Dhami, Mandeep K., and Kathryn Careless. "Intelligence Analysts' Strategies for Solving Analytic Tasks." *Military Psychology* 31, (2019): 124

[47] "Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction." Report to the President, 2005, 12.

[48] Borek, John J. "Developing a Conceptual Model of Intelligence Analysis." *International Journal of Intelligence and CounterIntelligence* 32, (2019): 5

[49] Marchio, Jim. "Analytic Tradecraft and the Intelligence Community: Enduring Value, Intermittent Emphasis." *Intelligence and National Security* 29, (2014): 160

7.2.2.4 Technological factors

Hoffman et al argue that inadequate software hinders the quality of analysis primarily because they do not sufficient meet the word requirements of analysts."[50]

7.2.2.5 Conclusion

The literature relevant to factors contains many important points and explores crucial research questions, but even taken collectively the literature does not provide a systematic account of the causal factors bearing on analytic rigour. The piecemeal discussion of the factors impacting on analytic rigour and related concepts underscores the need for more systematic research of the kind undertaken in the current project.

7.2.3 Opportunities

Our systematic literature review into analytic rigour helped us answer the following questions:

- What opportunities for enhancing analytic rigour have been previously identified?
- What studies have been done with regard to opportunities for enhancing analytic rigour?
- Have opportunities for enhancing analytic rigour been suitably explored and studied?

The literature proposes many opportunities for improving rigour and its components. One of the first attempts to list the main areas of improvement explicitly is the WMD Commision report.[51] Under the heading of "Improve the rigor and 'tradecraft' of analysis" it reports:

> Our studies, and many observers, point to a decline in analytic rigor within the Intelligence Community. Analysts have suffered from weak leadership, insufficient training, and budget cutbacks that led to the loss of our best, most senior analysts. There is no quick fix for tradecraft problems. However, we recommend several steps: increasing analyst training; ensuring that managers and budget-writers allot time and resources for analysts to actually get trained; standardising good tradecraft practices through the use of a National Intelligence University; creating structures and practices that increase competitive analysis; increasing managerial training for Intelligence Community supervisors; enabling joint and rotational assignment opportunities; ensuring that finished intelligence products are sufficiently transparent so that an analyst's reasoning is visible to intelligence customers; and implementing other changes in human resource policies—such as merit-based-pay—so that the best analysts are encouraged to stay in government service.[52]

In addition to these recommendations, the main opportunities for improving analytic reasoning we found in the literature were:

Better evaluation of analytic rigour

While there are rubrics for evaluating analytic standards, and these standards overlap with elements of analytic rigour, rigour itself is not generally measured or evaluated specifically. Having trained evaluators rate the analytic rigour in products using an established feedback mechanism may help improve rigour and could be used to certify products in a way that would allow customers to make

[50] Hoffman, Robert, Simon Henderson, Brian Moon, David T. Moore, and Jordan A. Litman. "Reasoning Difficulty in Analytical Activity." *Theoretical Issues in Ergonomics Science* 12, (2011):229

[51] "Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction." Report to the President, 2005.

[52] Ibid., p.26

more informed judgements.[53] Metrics for rating analytic rigour should make analysts more reflective and avoid the all too easy trap of thinking that shallow analysis is rigorous.[54] Also, a scientifically sound method of evaluating the accuracy of judgements would, if used widely, help analysts and organisation learn from past mistakes and successes.[55] For example, such data could help explore the link between ability to construct narratives and make forecasts.[56]

Express uncertainties numerically

Many papers discuss the idea using numeric probabilities to describe uncertainty would improve the clarity of assessment and encourage a higher level of analytic rigour. In a study by Barnes, use of numeric probabilities was trialed at by an Canadian government's strategic intelligence analysis unit where it was postively received and "allowed for a more effective discussion of the key factors and chain of logic that underpinned the analyst's conclusion."[57] For a summary of issues and arguments, see the brief report on this topic prepared by the Hunt Lab.[58]

Better source evaluation

The evaluation of sources could be improved with the use of explicit rules to weight and categories sources, and keeping record of the role played by different types of sources to improve future evaluations.[59] Irwin and Mandel argue that, instead of making separate judgements about the reliability and credibility of sources, analyts should use a unitary measure of information accuracy that combines all relevant factors and is expressed as a probability estimate.[60]

Making analytic reasoning more explicit

For a long time there have been calls to improve the quality and communication of reasoning in intelligence products to make it easier to view and critique analytic reasoning. The CIA's Deputy Director for Intelligence from 1993 – 1995, Douglas MacEachin, wrote in a memo on improving the quality of analysis that "Consumers present and past have consistently told us that for them, the value added -- and the credibility --- of the intelligence product is directly dependent on the information conveyed, its reliability, and their understanding of the analytic logic that supports the conclusions. If these are not made explicit and clear, the intelligence product becomes simply an opinion that may be agreed with or swept aside … Conclusions are to be presented as the result of

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53 Rojas, J Tucker. "Masters of Analytical Tradecraft: Certifying the Standards and Analytic Rigor of Intelligence Products," 2019: 13

54 Zelik, Daniel J., Emily S. Patterson, and David D. Woods. "Measuring Attributes of Rigor in Analysis." In *Macrocognition Metrics and Scenarios: Design and Evaluation for Real-World Teams*. Farnham, Taylor & Francis Group, 2010. 81

55 Chang, Welton. "Getting It Right: Assessing the Intelligence Community's Analytic Performance." *American Intelligence Journal* 30, (2012): 99

56 Chang, Welton, and Philip E. Tetlock. "Rethinking the Training of Intelligence Analysts." *Intelligence and National Security* 31, (2016): 915

57 Barnes, Alan. "Making Intelligence Analysis More Intelligent: Using Numeric Probabilities." *Intelligence and National Security* 31, (2016):333

58 van Gelder, T. Expressing Uncertainty – Summary of Issues and Arguments. Hunt Laboratory for Intelligence Research, 2020. Available on request.

59 Chang, Welton, Elissabeth Berdini, David R. Mandel, and Philip E. Tetlock. "Restructuring Structured Analytic Techniques in Intelligence." *Intelligence and National Security* 33, (2018):346

60 Irwin, Daniel, and David R. Mandel. "Improving Information Evaluation for Intelligence Production." *Intelligence and National Security* 34, (2019): 513

evidence and analysis, not simply as "views." Disagreements must be focused on the evidence and logic, not the judgment that proceeds from them."[61]

Training

Training on analysis, especially that which focuses on cognitive biases, is often based on outdated psychological research and could be improved with an updated understanding of the cognitive psychology behind the design of standard analytic thinking courses.[62]

Evaluate SATs

As mentioned in the previous section on the literature on factors the effectiveness of SATs is controversial. Further research could warrant substantial changes to how SATs are used.[63]

7.2.3.1 Conclusion

The literature proposes many possible opportunities to improve the quality of intelligence analysis, or tradecraft generally. The argument for each of them is generally substantial enough to warrant serious consideration. However, as with the other areas, the discussion is not very comprehensive, and does not provide guidance on how these opportunities should be prioritised. Moreover, the lack of a commonly accepted and well-grounded definition and account of of the nature of analytic rigour makes it difficult or impossible to identify which opportunities will enhance analytic rigour specifically. Identifying and implementing the means to evaluate the effectiveness of interventions aimed at enhancing analytic rigour also needs further research.

[61] MacEachin, Douglas J. "The Tradecraft Of Analysis Challenge And Change In Cia's Directorate Of Intelligence," 1994. 10

[62] Chang, Welton, and Philip E. Tetlock. "Rethinking the Training of Intelligence Analysts." *Intelligence and National Security* 31, (2016): 911

[63] Ibid. p.915

8 Appendix B – Expert Panel

8.1 Methodology

The purpose the Expert Panel was to articulate what the international community of relevant experts collectively thinks about analytic rigour in intelligence. The relevant experts include academics, intelligence practitioners (analysts or managers, current or retired), and some other government officials, drawn primarily, but not exclusively, from Five Eyes countries.

8.1.1 The modified Delphi Method

In seeking to ascertain the Collective View of a group of experts, we wanted to go beyond a simple survey, as we did not want responses to be limited by the perspectives and imaginations of those drafting the survey. Instead, we sought a process in which the panel itself would generate the views to which the panel could, in turn, react. To achieve this we adapted the widely-used Delphi method.[1] This method was originally designed as a way to obtain the collective view of an expert group on numerical estimation problems. The method proceeds in a series of rounds: in each round, the experts privately make their best estimates, which are then shared with the group for discussion. At the end of each round, the experts can revise their estimates, and the revised estimates can be aggregated to form a single group estimate.

The challenge in our case was not to make numerical estimates, but to articulate shared views on analytic rigour. These views are qualitative and so cannot be aggregated in any simple statistical manner. Instead, we looked to identify the views which find wide agreement among the experts, and quantify this agreement.

Hence, we developed a process by which the more widely held views are identified, debated and assessed by the group as a whole. The design was further constrained by the need to conduct this process in a purely online mode.

8.1.2 Phases of the adapted Delphi Method

Our version of the Delphi process had three primary stages: **Generate**, **Discuss,** and **Assess,** followed by an **Output Phase** in which the Collective View is presented. The Collective View consists of the statements which emerge with support from a clear majority, along with the levels of support and comments associated with each statement. The phases are depicted in Figure 8-1 and described in more detail below.

[1] Linstone, Harold A., and Murray Turoff. *The Delphi Method: Techniques and Applications*. Reading MA: Addison-Wesley, 1975.

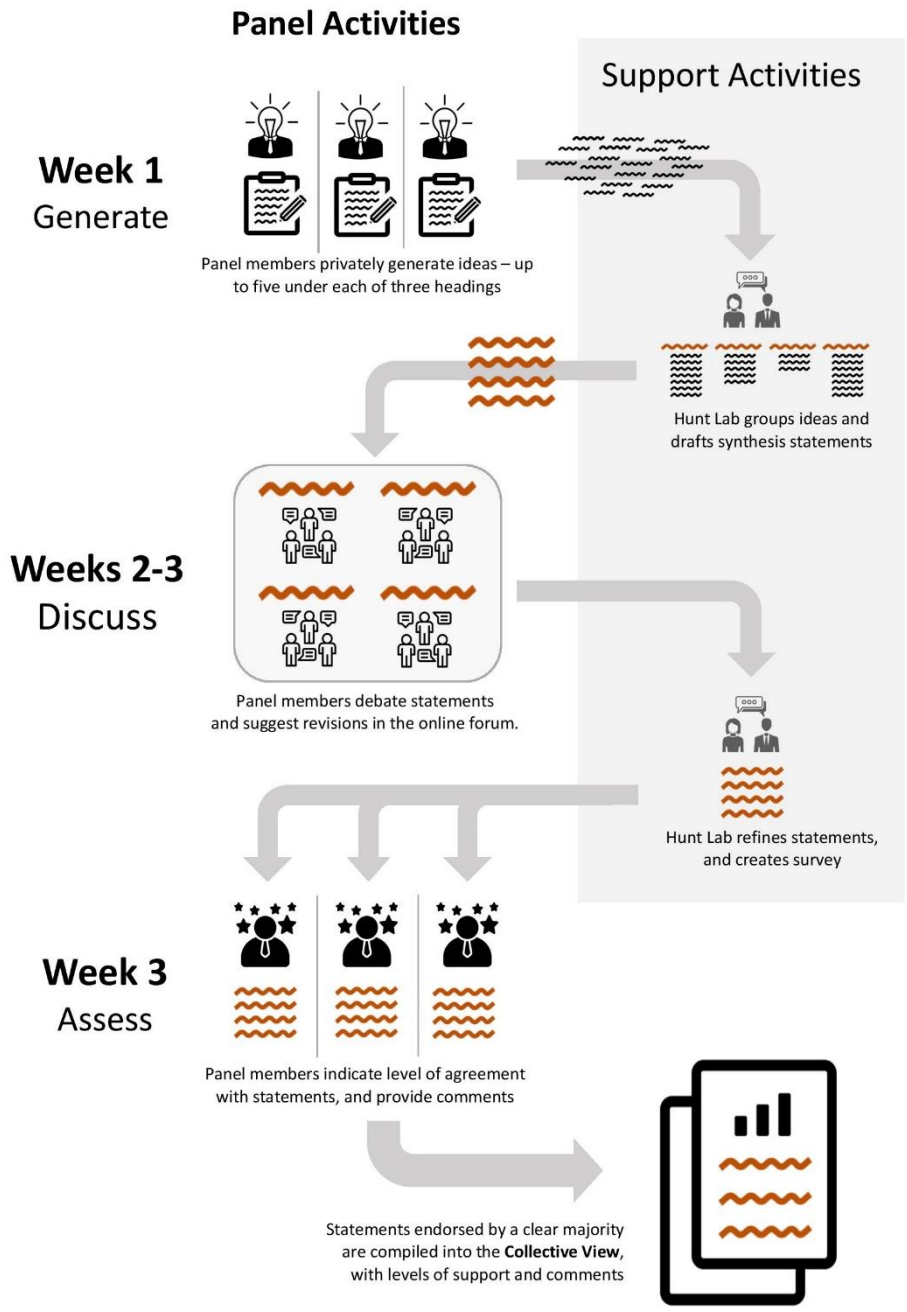


Figure 8-1: The Expert Panel process – an adaptation of the Delphi method.

8.1.2.1 Preparation

Prior to convening the Expert Panel we carried out a number of preparatory activities. These included identifying and inviting participants, producing resources to be made available to the Expert Panel to guide and assist in the process, and pilot-testing the modified Delphi method.

We identified potential participants in the Expert Panel by various means. First, many international experts in areas related to intelligence analysis and analytic rigour were already known to us through past research projects and our interactions with organisations and professional associations. To add to these, we identified additional academic experts and practitioners through our systematic literature review. We then sent out invitations and asked these experts and practitioners to

nominate other potential participants. Lastly, we advertised the project on our website and included an “expression of interest” form for interested people to apply.

The resulting panel was comprised of 65 participants with approximate composition 20% women and 80% men; 50% located in the US, 37% in Australia, 8% in continental Europe, and the remainder in Canada and the UK; and 67% academics (including academics with prior experience working in intelligence), 22% practitioners, and 11% others working in government.

We produced a number of resources and made these available to members of the Expert Panel. These resources were accessible through the Expert Panel portal page on the Hunt Lab website. They included a detailed outline, schedule and visual representation of the process, further detailed description of the process, a “How-To” guide for accessing and using the online forum used during the second phase of the process, and information regarding attendance of Zoom virtual conference meetings held throughout the process. This page was updated regularly.

One of our goals was to provide participants with resources that could improve their contribution to the project, but that would also be of value to the community beyond the confines of the project itself. These included:

- A “live” (regularly updated and evolving) document of excerpts from relevant texts identified in our Literature Review;
- Access to an online database of key literature on analytic rigour;
- A table summarising and comparing a range of tradecraft standards documents and rating systems.

8.1.2.2 Generate phase

In the first stage, panellists were surveyed for ideas or views. Prior to sending the survey, three videoconference sessions were held (one each for Australia, North America, and the UK/Europe). This Zoom session was an opportunity for us to present the process and address participants’ questions, and for the panel to discuss topics of interest more generally.

The survey was sent to each panellist via email. It asked participants, working individually and privately, to make a number of statements expressing their views under each of three headings:

1. The nature of analytic rigour in intelligence
2. Factors impacting on analytic rigour in intelligence
3. Opportunities for enhancing analytic rigour in intelligence

Participants could make up to five 200-character statements under each heading. They were asked to express those views which they took to have particular importance and validity on the topic.

The survey questions were as follows.

Part One: The nature of analytic rigour

What are up to five important ideas about the nature of analytic rigour in intelligence?

Imagine you had been asked to brief a senior executive in a major intelligence organisation who has been charged with improving analytic rigour. What points would be most critical for that person to understand? Some angles you might consider include:

- What is analytic rigour? What is it *not*?
- What are the elements of analytic rigour?
- What are some misconceptions about analytic rigour?
- How does analytic rigour relate to other concepts such as standards?

Statement 1 (up to 200 characters):

[…]

Statement 5 (up to 200 characters)

Part Two: Factors affecting analytic rigour

What are up to five important factors affecting (improving or harming) analytic rigour in intelligence work? We hope you can help us build a comprehensive picture of these factors. Angles you might consider include:

- What factors most reliably or powerfully increase analytic rigour?
- Conversely, what factors are most detrimental?
- What are some of the external (vs. internal) or indirect factors?
- What factors might be hard to discern, but are still very influential?

Statement 1 (up to 200 characters):

[…]

Statement 5 (up to 200 characters):

Part Three: Opportunities for enhancing analytic rigour

What are up to five of the most important opportunities for an intelligence organisation to enhance analytic rigour?

Again, imagine you are advising a senior executive, who must proceed to implement changes to enhance analytic rigour.

Please consider both the level of impact and the feasibility of implementation. Angles you might consider include:

- What **gaps** in current practices in intelligence would, if filled, have most impact?
- What are some **non-obvious** ways that analytic rigour could be enhanced?
- What are the most **cost-effective** ways that analytic rigour in intelligence could be enhanced? ("Low hanging fruit")
- What might dramatically improve analytic rigour **in particular respects**, or in **particular types** of intelligence work?

Statement 1 (up to 200 characters):

[…]

Statement 5 (up to 200 characters):

We then reviewed and synthesised all responses received as part of the first survey. There were over 50 responses to the survey, generating approximately 700 individual points. The entire set of views expressed by all panellists under a given heading were sorted into groups based on content similarity or “affinity.” The larger groups were the ideas expressed more frequently by the experts. For each of these, a single statement expressing the essence or central tendency was drafted.

We used the Trello cloud platform[2] for this process. We created three Trello "boards," one corresponding to each section of the survey: Nature, Factors and Opportunities. We posted each statement formulated by a participant as a "card" to the relevant board. We then worked in teams of two to assign these cards into affinity stacks. These stacks and their thematic labels emerged as the teams read each statement card and searched for affinities with other statement cards. Some items were copied into multiple piles.

Once all cards were assigned into stacks, the teams reviewed these stacks and removed any overlap and repetition. They then sought to reduce the number of stacks and topics to the smallest number that adequately represents the ideas contained in the constitutive statements. Once the final set of stacks was arrived at, each team formulated a statement for each stack representing the general view shared by its constitutive cards. These statements are the 'synthesis statements' which emerged from the first survey. The teams then switched boards, reviewing the synthesis statements formulated by another team, such that each board was reviewed by a minimum of two teams. Modifications and amendments were made accordingly.

During this process, we held several meetings to compare notes, and to discuss any issues arising. We also communicated throughout the process using Slack.

8.1.2.3 Discuss phase

In the second stage, panellists had the opportunity to debate the statements, propose refinements, and generally discuss these topics. This stage allowed panellists to engage with one another.

Prior to launching the online discussion forum, we held videoconference meetings for participants to clarify the process, address questions and discuss the themes emerging from the survey.

The online discussion was held on the Loomio[3] online platform, which provides a ready-made solution for hosting discussion forums meeting a number of our criteria, including a robust email notification system to help keep participants engaged.

We seeded the forum with a subset of the synthesis statements representing the more popular, pertinent and controversial themes which emerged from the survey responses. We did this only as a starting point, aiming to spark discussion on these and other topics; panellists were free to discuss any statements or topics they wished and to post new topics. We provided panellists with the full set of synthesis statements, showing the statements which gave rise to each synthesis statement, arranged hierarchically by theme; as well as a document including all survey responses arranged by participant.

The discussion phase lasted ten days. At the conclusion of this phase, we began building the second and final survey, incorporating and refining statements from the first survey and from the forum.

8.1.2.4 Assess phase

In the third stage, we asked panellists to complete a survey indicating their level of agreement with a set of revised statements about the nature of and factors impacting on analytic rigour. The survey also invited them to select up to ten "opportunities" for enhancing analytic rigour from a list of 28. This survey was hosted on Qualtrics and notification was sent to all panellists via email.

The survey questions were as follows:

[2] www.trello.com

[3] www.loomio.com

Topic 1: The Nature of Analytic Rigour

This topic has the following sections:

- Purpose (4 statements)
- Locus (4 statements)
- Elements (13 statements)
- General issues (6 statements)
- The nature of analytic rigour: What is its purpose?

An important purpose of analytic rigour is to: [strongly disagree/disagree/neither/somewhat agree/strongly agree]

- produce analysis that is defensible
- produce analysis that is transparent and accountable
- achieve good outcomes, such as good decisions by customers, or securing of policy objectives

Comments

The nature of analytic rigour: Where is it located?

Analytic rigour is located: [strongly disagree/disagree/neither/somewhat agree/strongly agree]

- in the mind of the analyst
- in the process of analytic work ("process rigour")
- in the products or outputs of analytic work ("product rigour" or "perceived rigour")
- in the system comprised of people, technology and culture in a particular intelligence context (holistic/emergent)

Comments

The nature of analytic rigour: What are its elements?

Please indicate how you think each of the following concepts is related to analytic rigour.
The options are: [Major part/minor part/related to but not part of/independent of]

> **Major part:** The concept is a major element or aspect of what analytic rigour means or consists in.
> **Minor part:** The concept is a minor element or aspect of what analytic rigour means or consists in.
> **Related to:** The concept is related to analytic rigour in some other way. For example, it could be a factor impacting rigour, or a consequence of rigour.
> **Independent of:** The concept is independent of analytic rigour.

- **Thoroughness or completeness** in analytic work, including information considered, and possibilities explored
- **Objectivity:** Avoiding or mitigating harmful impacts of biases, prejudices, ideologies, conflicts of interest, and political
- **Logicality:** Making inferences in accordance with general principles of good reasoning; avoiding logical and mathematical errors and inconsistencies
- **Acuity:** Using concepts and language clearly, correctly, precisely and consistently; avoiding vagueness, ambiguity, equivocation, obfuscation, and idiosyncratic usages
- **Stringency:** Being strict or exacting in observing requirements, standards, procedures, or methods
- **Metacognition:** Being actively aware of one's own thinking, particularly how factors such as biases, assumptions, values, and stress and fatigue can affect analytic work and the resulting judgements
- **Defensibility:** Ensuring that a process or product can withstand legitimate questioning or critique
- **Transparency:** Clearly and informatively communicating the information base, methods or processes used, and limitations and uncertainties
- **Collaboration and peer review:** Exchange of expertise, perspectives, feedback, and good faith critique
- **Meeting customer needs** and actively clarifying and articulating these needs when they are unclear
- **Timeliness:** Adapting the analytic process to achieve the highest feasible level of quality consistent with delivering outputs to the customer in a timely fashion
- **Deception:** Taking into account the possibility of deception and adversarial intent

Comments

The nature of analytic rigour: Some general issues

This section covers a number of general issues about the nature of analytic rigour.

To what extent do you agree with the following statements? [strongly disagree/disagree/neither/somewhat agree/strongly agree]

- **Analytic tradecraft standards** and analytic rigour are different things, but meeting standards helps analysts achieve rigour.
- Analytic rigour is a component of **analytic confidence**; i.e., the level of analytic confidence one should have in a judgement depends on the level of rigour in the formation of that judgement.
- The nature of analytic rigour **depends on context** (e.g., different types of intelligence work).
- The nature of analytic rigour **evolves over time** due to large-scale shifts such as the changing nature and context of intelligence work, developments in technology, and advances in cognitive science and epistemology.
- Analytic rigour is a **matter of degree** – analysis is always more or less rigorous.
- Analytic rigour or its elements can be **measured** (i.e. evaluated or assessed on a scale).

Comments

Topic 2: Factors impacting Analytic Rigour

For each of the factors potentially impacting analytic rigour, we seek your view as to whether it harms or enhances rigour, and to what degree.

This topic includes these sections:

- Analyst attributes (7 factors)
- Resources (3 factors)
- Processes (12 factors)
- Culture (6 factors)
- Organisation (10 factors)

Factors affecting analytic rigour: Attributes of analysts

How do the following analyst attribute factors impact analytic rigour? [strongly harms/somewhat harms/no impact/somewhat enhances/strongly enhances]

- Innate cognitive biases and capacity limits
- Expertise in generic skills such as logic, statistics and research methods
- Expertise in intelligence-specific skills such as use of Structured Analytic Techniques
- Domain knowledge (e.g. historical, geographical, political and cultural)
- Reflective mindset, including curiosity, conscientiousness, self-awareness, and mental flexibility
- Commitment (morale, passion, dedication)
- Communication skills

Comments

Factors affecting analytic rigour: Available resources

How do the following resource factors impact analytic rigour? [strongly harms/somewhat harms/no impact/somewhat enhances/strongly enhances]

- Short timeframes for analytic work
- Quality of data or information available to the analyst(s)
- Quantity of information available to the analyst(s) (too much or too little)

Comments

Factors affecting analytic rigour: Processes

How do the following process factors impact analytic rigour? [strongly harms/somewhat harms/no impact/somewhat enhances/strongly enhances]

- Use of Structured Analytic Techniques
- Adherence to analytic tradecraft standards
- Articulating and displaying the structure of reasoning
- Transparently presenting the information base and methods used
- Expressing judgements in a clear, precise and falsifiable manner
- Using multiple methods or approaches on an analytic problem
- Communicating uncertainty using verbal expressions (including "words of estimative probability")
- Communicating uncertainty using numerical expressions
- Collaborating with others within the analytical unit
- Collaborating with others more widely in the organisation and intelligence community
- Collaborating with others outside the intelligence community
- Getting feedback on analytic work

Comments

Factors affecting analytic rigour: Culture

How do the following cultural factors impact analytic rigour? [strongly harms/somewhat harms/no impact/somewhat enhances/strongly enhances]

- Intellectual safety, i.e. the extent to which analysts feel they can question, challenge, express new ideas, admit uncertainty or lack of knowledge, without negative consequences
- Politicisation of analytical work and outputs
- Analysts feeling unsupported or undervalued
- The presence of pervasive epistemological misconceptions
- Using multiple methods or approaches on an analytic problem
- Lack of customer concern with analytic rigour

Comments

Factors affecting analytic rigour: The organisation

How do the following organisational factors impact analytic rigour? [strongly harms/somewhat harms/no impact/somewhat enhances/strongly enhances]

- Lack of systematic, rigorous evaluation of the quality of analytic work across the organisation
- Adoption or continued use of work practices, methods or standards without evidence for their effectiveness
- Restricted information flows within the organisation or between organisations
- Cognitive diversity in analyst workforce
- Training focused on analytic rigour
- Lack of alignment between incentive structures and the objective of rigorous analysis
- Organisation-wide manner and extent of implementation of analytic tradecraft standards
- Secrecy and security requirements and practices
- Senior leadership actively promoting, supporting and rewarding analytic rigour
- Product coordination and review procedures

Comments

Topic 3: Opportunities to Enhance Analytic Rigour

Here we are interested in the best opportunities for an intelligence organisation to improve analytic rigour.
A good opportunity has an attractive combination of **impact** and **feasibility**.
On the next page, you will find 28 opportunities which have emerged from the first survey and subsequent discussion.
Instead of rating each one, we ask you to select up to 10 opportunities you think are most attractive.

Select up to 10 of the following.

Analyst Attributes

- ☐ Strengthen recruitment for cognitive diversity
- ☐ Mandate and enable continuous learning related to analytic rigour for analysts

☐ Prioritise analytic rigour as a demonstrated and assessable analyst capability

Processes

☐ Strengthen use of existing methods (such as correct application of structured analytic techniques) to improve rigour
☐ Require, where appropriate, that uncertainties be expressed numerically
☐ Implement or strengthen feedback mechanisms, including peer-review, that are immediate and clear, which encourage analysts to reflect on the accuracy of their assessments
☐ Increase outcome-oriented collaboration between analysts within the organisation
☐ Increase outcome-oriented collaboration between organisations in the IC
☐ Increase dialogue opportunities between analysts and customers

Organisation

☐ Leadership should more strongly demonstrate commitment and ownership of responsibility to improve analytic rigour
☐ Implement and maintain systematic and rigorous organisation-wide processes for evaluating analytic rigour
☐ Distinguish clearly between product standards and process standards and implement assessment processes accordingly
☐ Better align incentives and KPIs with the objective of achieving analytic rigour
☐ Widen the training program to include analytic rigour specific training for managers
☐ Build trusted partnerships with academia to facilitate analyst cooperation with outside experts
☐ Build trusted partnerships with academia to develop tailored, quality training in analytic rigour
☐ Build trusted partnerships with academia to conduct research into key topics related to analytic rigour (see Research, below)

Technology

☐ Adopt technologies supporting the correct use of SATs
☐ Adopt accountability and audit technologies to better support data and process review capabilities
☐ Adopt technologies automating aspects of analytic work, particularly those leveraging artificial intelligence and machine learning
☐ Adopt technologies improving collaboration between analysts, and between analysts and others
☐ Adopt technologies to support crowdsourcing (e.g. prediction markets/polling)

Research

☐ Develop demonstrably reliable and valid methods for measuring analytic rigour
☐ Conduct further research on assessing and expressing uncertainty and probabilities
☐ Develop or refine analytic standards which reflect best international practice, and are designed with the analyst in mind
☐ Develop demonstrably better methods to assess the reliability of sources, including types of intelligence sources, to more rigorously integrate these into intelligence products
☐ Rigorously test and evaluate effectiveness of existing SATs and other tools or practices intended to improve analytic rigour
☐ Develop demonstrably effective new SATs and/or other analytic methods

Comments (possibly including attractive options not listed above)

We created the final survey with the goal of eliciting the final Collective View on analytic rigour from participants. We designed the survey in a process informed by discussion on the forum and by the initial round of synthesis of statement from the first survey. The statements on the forum, including new statements created by participants, served as the material from which survey questions were created. However, these were refined and modified to the requirements of a survey: that it generate, as far as possible, unambiguous responses, and that it be possible to complete the survey in under thirty minutes in accordance with best survey practice.

8.1.2.5 Output phase (The Collective View)

The Collective View, presented below, consists of sets of statements under the three headings previously discussed. For Nature and Factors, each statement has been endorsed by a clear majority of panellists. For Opportunities, we have provided a complete list ordered by the number of "votes" received from panellists.

8.1.3 Limitations

Our adapted Delphi process aimed to identify the Collective View of the expert community under some challenging constraints: a short time frame, experts distributed across many time zones, and face-to-face collaboration precluded by both cost and COVID-19 conditions. The process thus inevitably has some limitations, and the Collective View is only an approximation to the true position of the international community.

Representation of a rich field of views

The Expert Panel process was not designed to bring out diversity of detail and rich nuance across views, but rather to identify shared or commonly held notions among a group. This means that the Collective View does not reflect some of the richness and detail of the views expressed by panellists.

Scope of representation of views

Due to the necessity to keep the surveys and the Collective View document at manageable length, the final Collective View does not represent all the views and suggestions made throughout the Expert Panel process. Rather, the process focused on highlighting and developing shared ideas and testing controversial ones.

Synthesis and interpretation

Though the process sought to privilege the development and self-direction of the panel, in particular during the discussion phase, such that the views expressed and explored are not limited by the perspectives of Hunt Lab researchers, the parts of the process involving synthesis and representation of the panel's views nonetheless required a certain level of interpretation on the part of the researchers, as well as prioritisation of the themes we took to be emerging from the panel's responses and discussion. This means that a different group of researchers may have represented these views differently.

Privileging uncontroversial views

The process privileges less controversial views, as these are commonly shared by panellists; whereas controversial yet interesting and possibly insightful points may not receive majority support from the panel, and therefore have not made it into the final Collective View. This led to most statements in the final survey finding high agreement among panellists, with most generating over 80% agreement among respondents.

Short timeframe

Though there was a discussion and deliberation phase as part of the process which served to facilitate exchange of ideas and further in depth examination of views, the Expert Panel process was nonetheless not designed as a comprehensive deliberative one in which panellists explore, revise and engage deeply with the various questions. This could have been facilitated through a longer-term, iterative process.

Representativeness

Despite our efforts to secure a large and diverse membership, the Expert Panel was not fully representative of the international expert community.

8.2 Results

The process revealed that the Panel agreed strongly on many points. On the nature of analytic rigour, these points covered its purpose, location, elements, and other general issues. Regarding factors affecting rigour, the process identified a range of important analyst attributes, analytic processes, and cultural and organisational factors. Finally, the process surfaced 28 opportunities for organisations to improve analytic rigour, ranked from most to least attractive when considering both the potential impact and the feasibility of the intervention.

Overall, these results indicate that the international community of experts has a surprisingly strong shared perspective on analytic rigour. However this shared perspective was *implicit collective* knowledge. Prior to the Expert Panel process, this shared perspective had not been made explicit, and it was not known to exist. In other words the community of experts had a collective view, but it did not know what that view was, or even that it had a collective view.

8.2.1 Nature

8.2.1.1 Summary

The Panel was not tasked with formulating a precise or complete definition of analytic rigour in intelligence analysis, but agreed about a number of elements they take to be inherent to the nature of analytic rigour. In summary, these are:

- Thoroughness and completeness in analytic work;
- Mitigation of the effects of bias and external pressures;
- Adherence to good reasoning;
- Clear and accurate language;
- Observation of relevant procedures;
- Awareness of one's own thinking and of possible deception by others; and
- Robustness to questioning and transparency of process.

The Panel also indicated that analytic rigour is to be found not just in the final analytic product, but also in the mindset of the analyst and the process that leads to the final analysis, as well as in the overall system of technology, culture and people comprising the environment in which the analyst undertakes their work.

Finally, the Panel maintained that while tradecraft standards help analysts achieve rigour, meeting analytic tradecraft standards is not itself the meaning of being analytically rigorous. It also indicated that analytic rigour may vary in different contexts and may evolve with changes in technology, science and epistemology.

Of particular interest are the statements on which the Panel did not agree. They did not reach a clear majority (two thirds or more) agreement on:

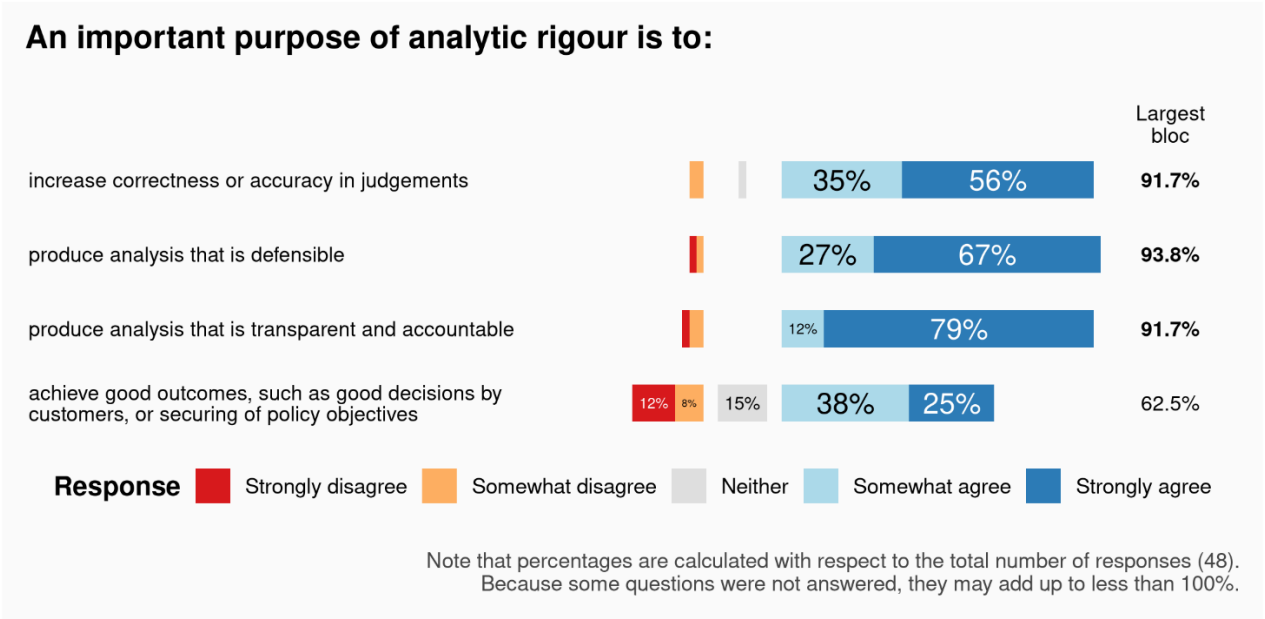
- whether the purpose of analytic rigour is to achieve good outcomes;
- whether clarifying and meeting customer needs constitutes part of what it means for analysis to be analytically rigorous;

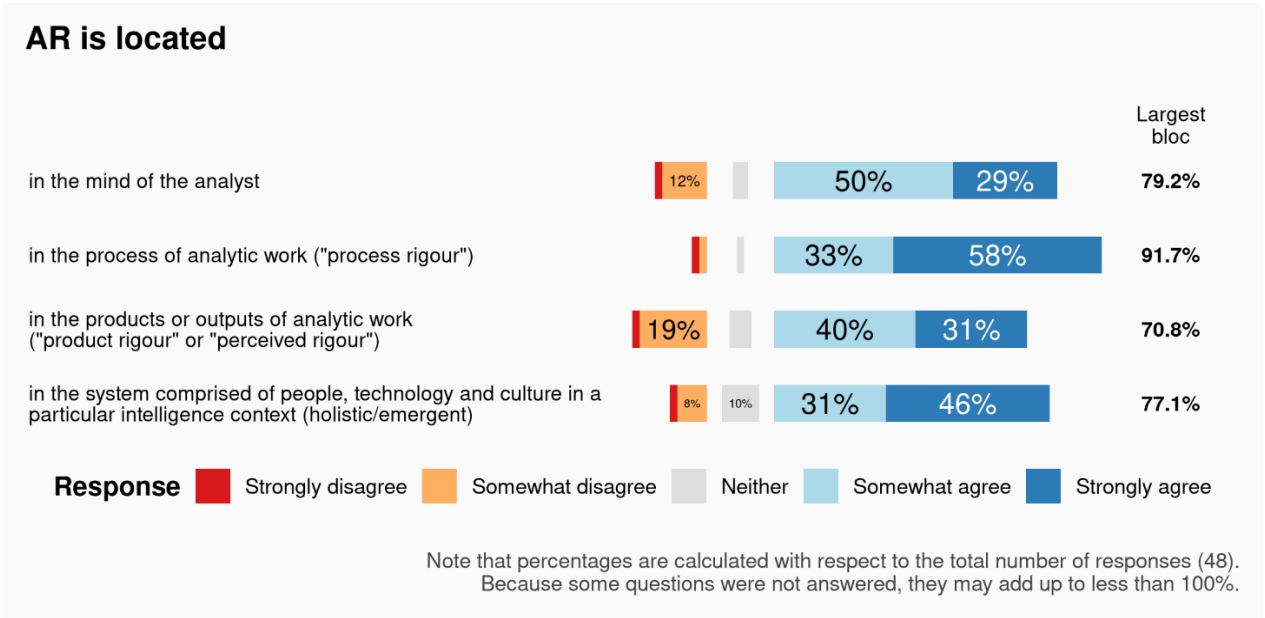
- whether adapting the process to deliver outputs in a timely manner should be seen as part of analytic rigour; and
- whether analytic rigour is something which can be measured or assessed on a scale.

These disagreements indicate matters may benefit from further debate, clarification, thought and research.

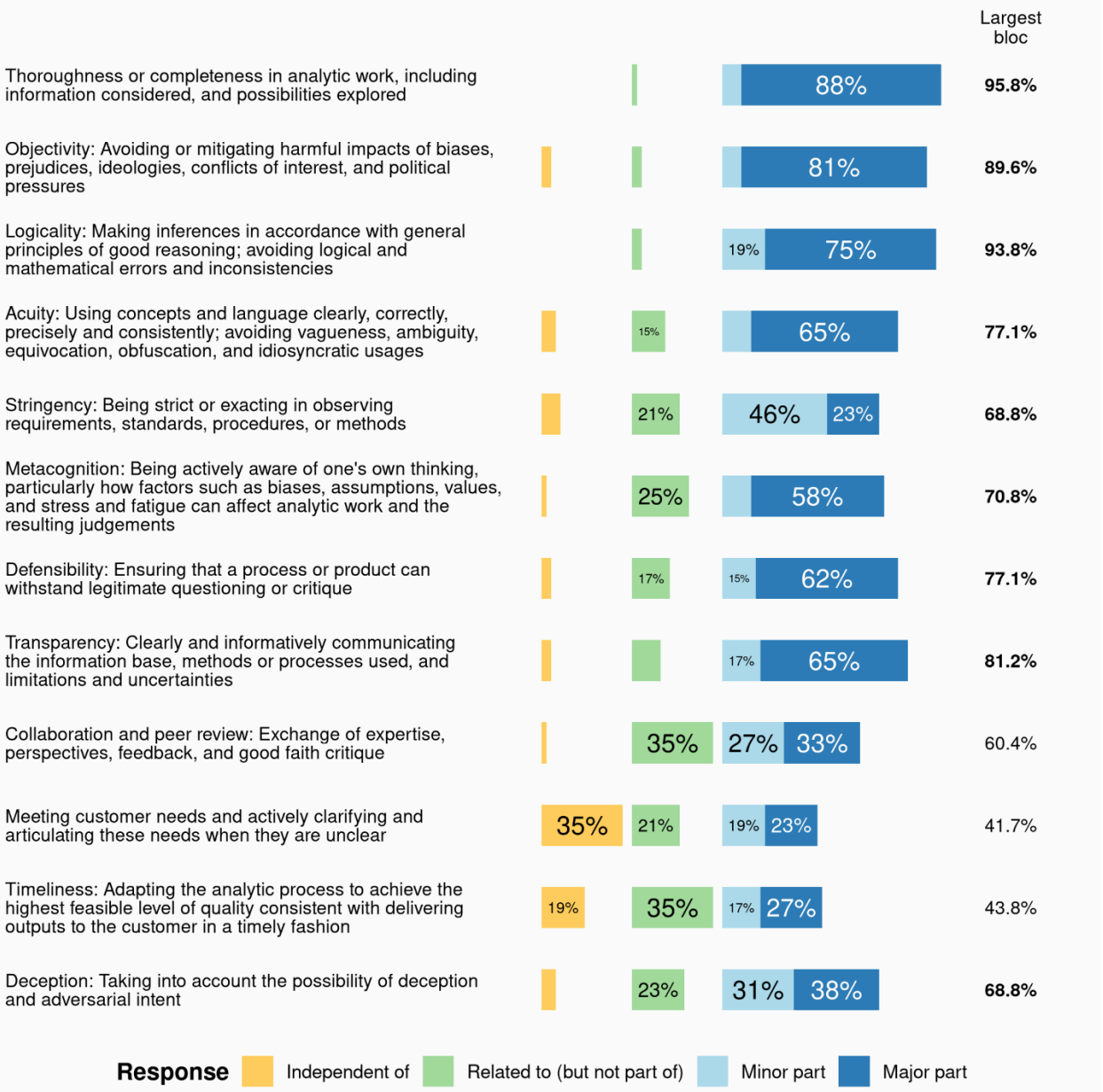
8.2.1.2 Detailed Results

In the following charts, "Largest bloc" is the larger of (i) the sum of Strongly agree and Somewhat agree, or (ii) the sum of Strongly disagree and Somewhat disagree. In other words, it indicates strength of agreement, one way or the other.

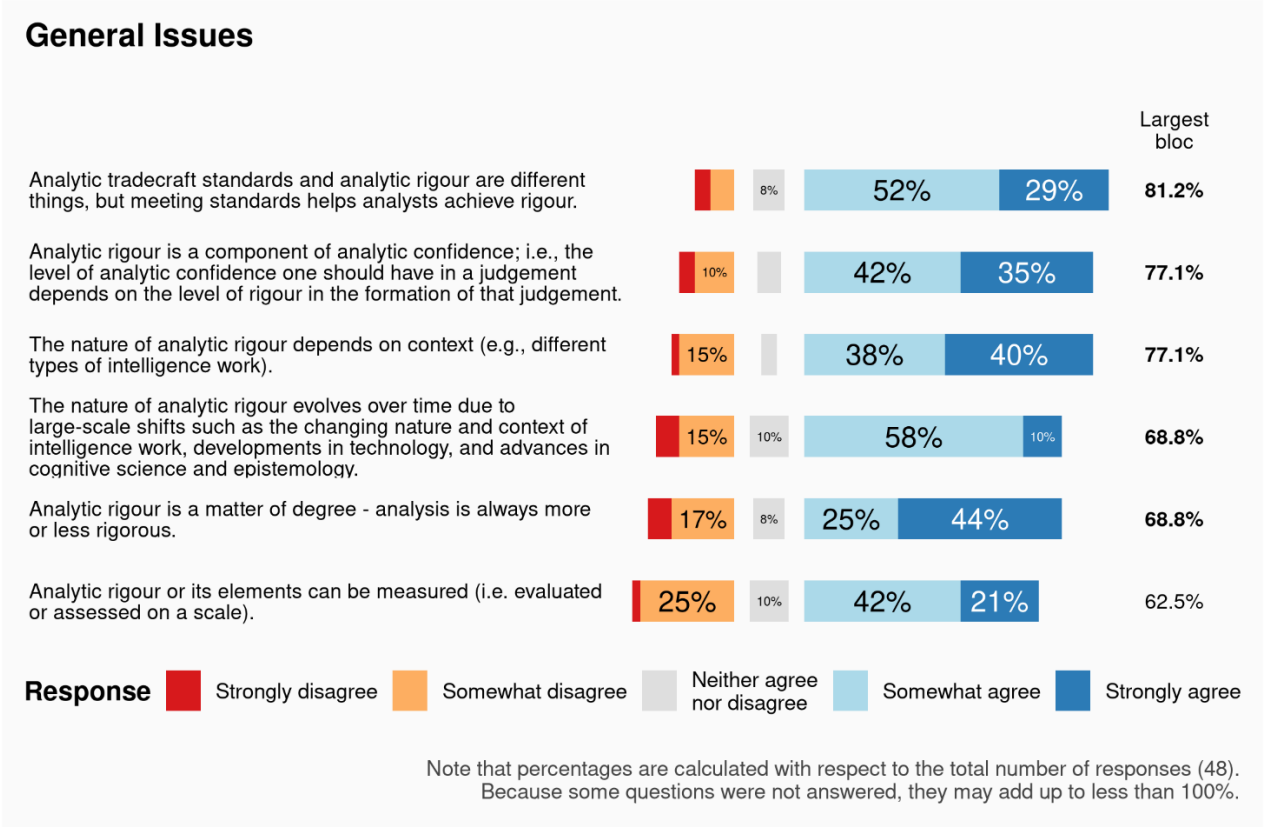




What are its elements?



Note that percentages are calculated with respect to the total number of responses (48).
Because some questions were not answered, they may add up to less than 100%.



8.2.2 Factors

8.2.2.1 Summary

Overall, collectively, the Expert Panel identified many and diverse factors impacting analytic rigour, and strongly agreed on whether a suggested factor did or did not affect analytic rigour, at least "Somewhat." The Collective View is summarised in Table 8-1:

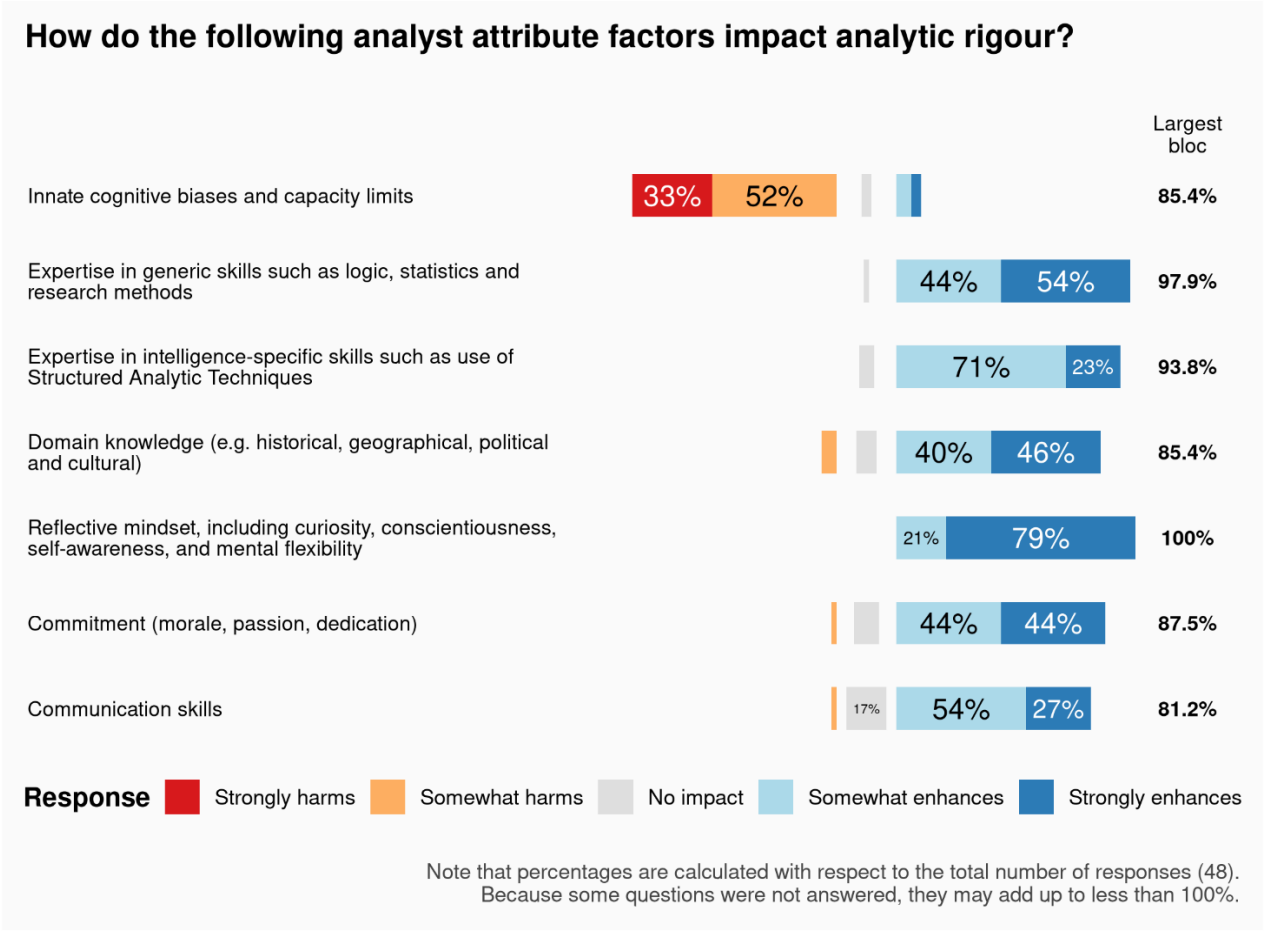
Table 8-1: Factors impacting analytic rigour emerging from the Expert Panel process.

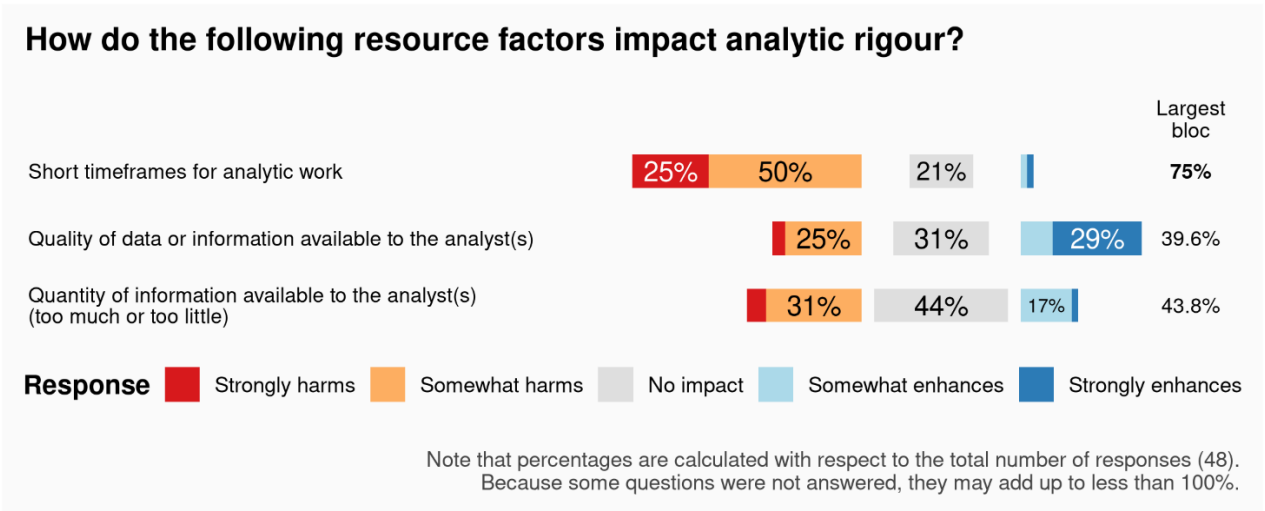
	Enhances	Harms
Analyst attributes	Expertise in both generic and specific skills, and communication	Cognitive biases and capacity limits
	Domain knowledge	
	Reflective mindset and commitment	
Processes	SATs and adherence to analytic tradecraft standards	
	Articulation of reasoning structure and transparent presentation of information and methods used	
	Clear and precise expression of judgements	
	Use of multiple methods/approaches	
	Collaboration on diverse levels and seeking feedback	
Culture	Intellectual safety	Politicisation of work and outputs
		Feeling by analysts that they are unsupported/undervalued
		Epistemological misconceptions
		Lack of customer concern with analytic rigour
Organisation	Cognitively diverse workforce	Lack of good evaluation of products
	AR training, support, promotion, reward of analytic rigour	Practices or methods unsupported by evidence of effectiveness
	Implementation of analytic tradecraft standards	Restricted information flows
	Product coordination and review procedures	

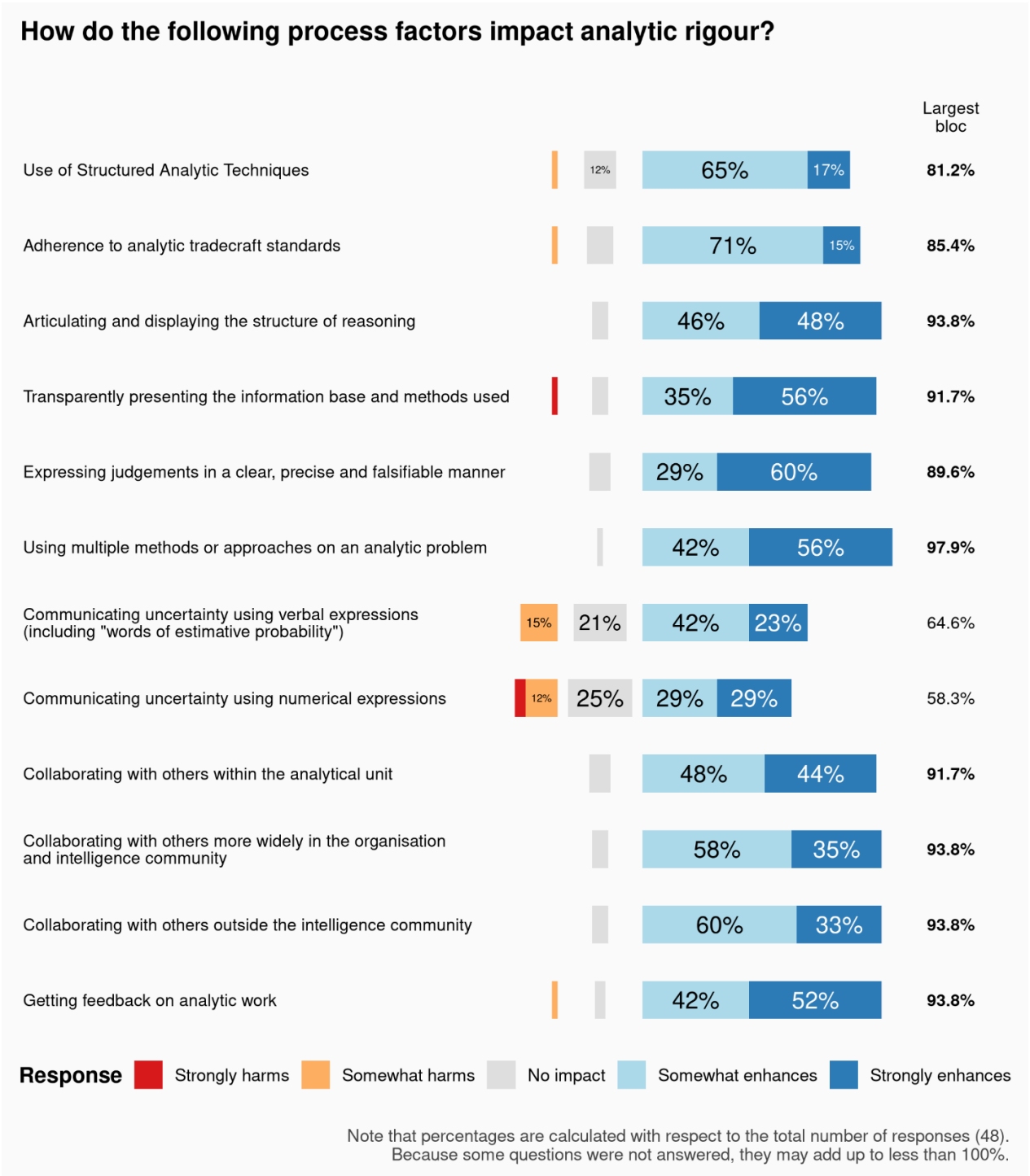
The panellists tended to have very strong agreement in one overall direction, with broad agreement (i.e., panellists choosing either “strongly enhances” and “enhances” or “strongly harms” and “harms”) in the majority of cases exceeding 90% of panellists. They expressed full, 100% agreement that a *reflective mindset, including curiosity, conscientiousness, self-awareness, and mental flexibility* enhances analytic rigour (strongly or not).

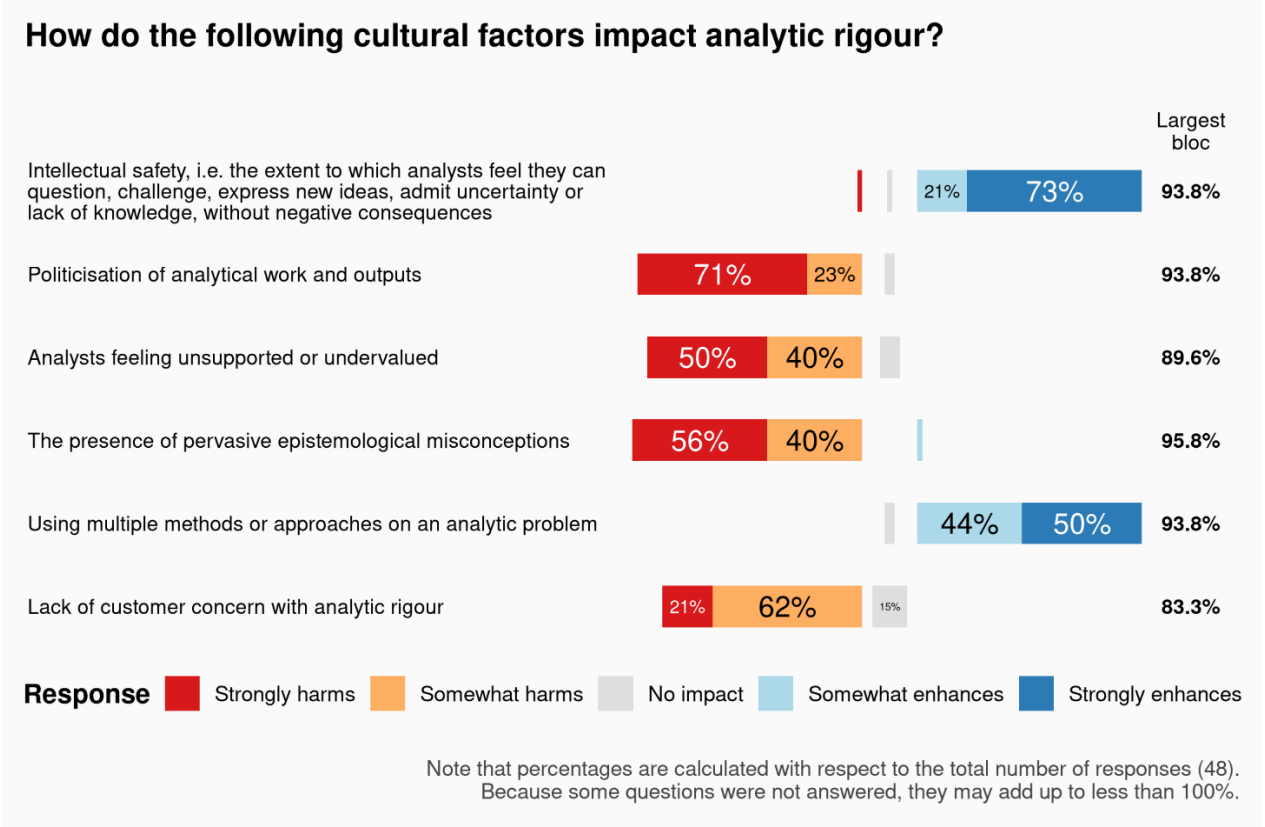
The Panel gave moderate endorsement of the positive impact of two factors *Communicating uncertainty using verbal expressions (including “words of estimative probability”)* and *Communicating uncertainty using numerical expressions.* One interpretation of this is that, according to the Panel, using words of estimative probability (“WEPs”) improves rigour, and using numerical expressions improves rigour, both relative to a baseline of unconstrained informal verbal expression. Use of WEPs is an increasingly common requirement; for example, it has been required for all organisations in the U.S. national intelligence community since the mid-2000s by ICD 203.

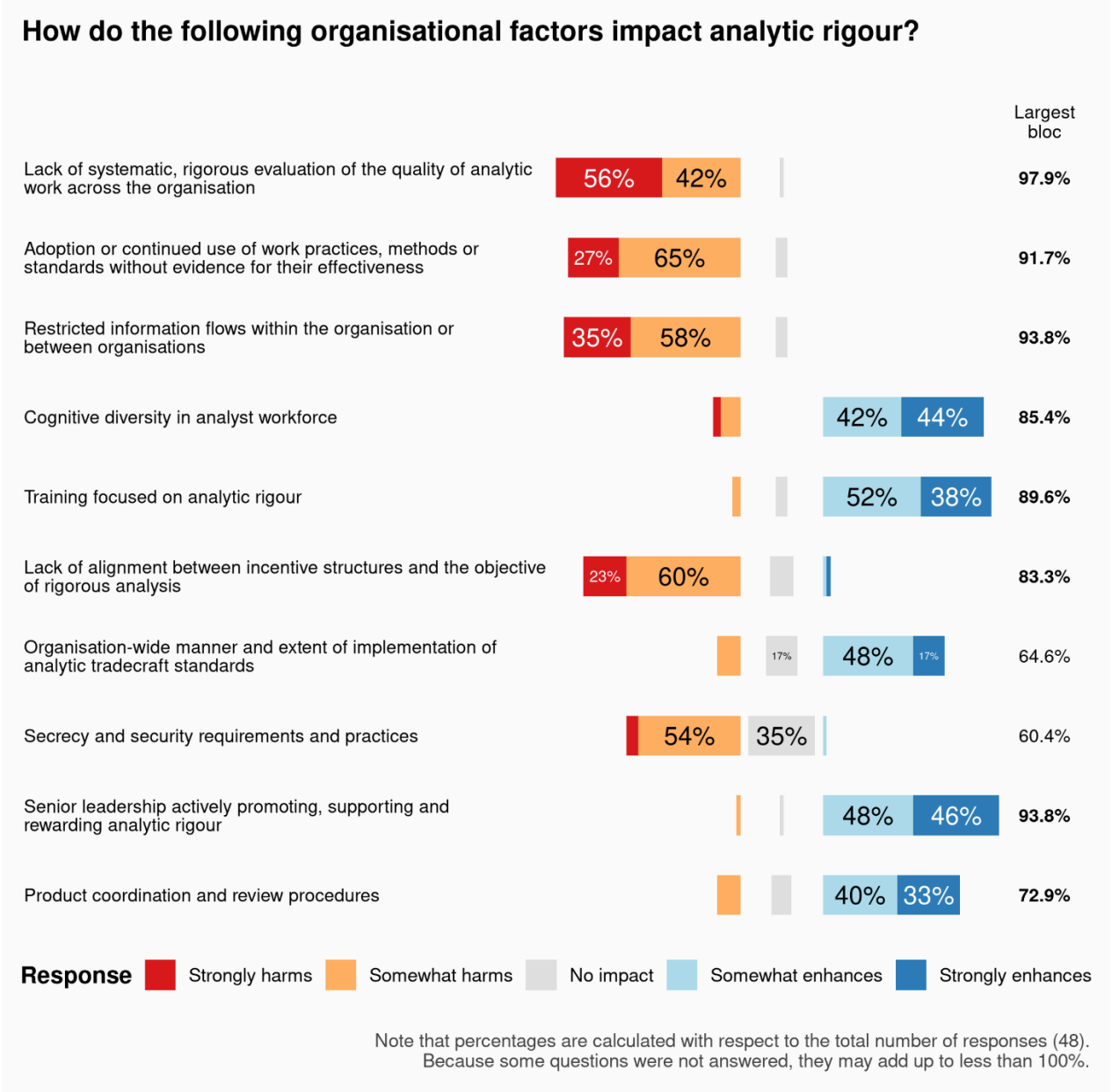
8.2.2.2 Detailed Results






How do the following process factors impact analytic rigour?
Largest bloc
Use of Structured Analytic Techniques
12%
65%
17%
81.2%
Adherence to analytic tradecraft standards
71%
15%
85.4%
Articulating and displaying the structure of reasoning
46%
48%
93.8%
Transparently presenting the information base and methods used
35%
56%
91.7%
Expressing judgements in a clear, precise and falsifiable manner
29%
60%
89.6%
Using multiple methods or approaches on an analytic problem
42%
56%
97.9%
Communicating uncertainty using verbal expressions (including "words of estimative probability")
15%
21%
42%
23%
64.6%
Communicating uncertainty using numerical expressions
12%
25%
29%
29%
58.3%
Collaborating with others within the analytical unit
48%
44%
91.7%
Collaborating with others more widely in the organisation and intelligence community
58%
35%
93.8%
Collaborating with others outside the intelligence community
60%
33%
93.8%
Getting feedback on analytic work
42%
52%
93.8%
Response
Strongly harms
Somewhat harms
No impact
Somewhat enhances
Strongly enhances
Note that percentages are calculated with respect to the total number of responses (48).
Because some questions were not answered, they may add up to less than 100%.


How do the following cultural factors impact analytic rigour?
Largest bloc
Intellectual safety, i.e. the extent to which analysts feel they can question, challenge, express new ideas, admit uncertainty or lack of knowledge, without negative consequences
21%
73%
93.8%
Politicisation of analytical work and outputs
71%
23%
93.8%
Analysts feeling unsupported or undervalued
50%
40%
89.6%
The presence of pervasive epistemological misconceptions
56%
40%
95.8%
Using multiple methods or approaches on an analytic problem
44%
50%
93.8%
Lack of customer concern with analytic rigour
21%
62%
15%
83.3%
Response
Strongly harms
Somewhat harms
No impact
Somewhat enhances
Strongly enhances
Note that percentages are calculated with respect to the total number of responses (48).
Because some questions were not answered, they may add up to less than 100%.



8.2.3 Opportunities

8.2.3.1 Summary

Unlike the other two topics, Expert Panel members were not asked in the final survey to express their level of agreement with specific statements representing opportunities for enhancing analytic rigour in intelligence organisations. Rather, opportunities were identified from the process to that point (the initial survey and online deliberation phase which followed), and panellists were asked to select up to 10 of these 28 opportunities that they consider most attractive.

Of these, three were selected by over 50% of the panel:

- Implement or strengthen feedback mechanisms, including peer-review, that are immediate and clear, which encourage analysts to reflect on the accuracy of their assessments (62%)

- Leadership should more strongly demonstrate commitments and ownership of responsibility to improve analytic rigour (60%)
- Mandate and enable continuous learning related to analytic rigour for analysts (56%).

However, lack of majority support in this case, by contrast to the other topic, does not point to disagreement; experts chose up to 10 opportunities they considered to be most important of the list, but this did not imply rejection of any opportunities not selected.

The opportunities identified related to a few main areas:

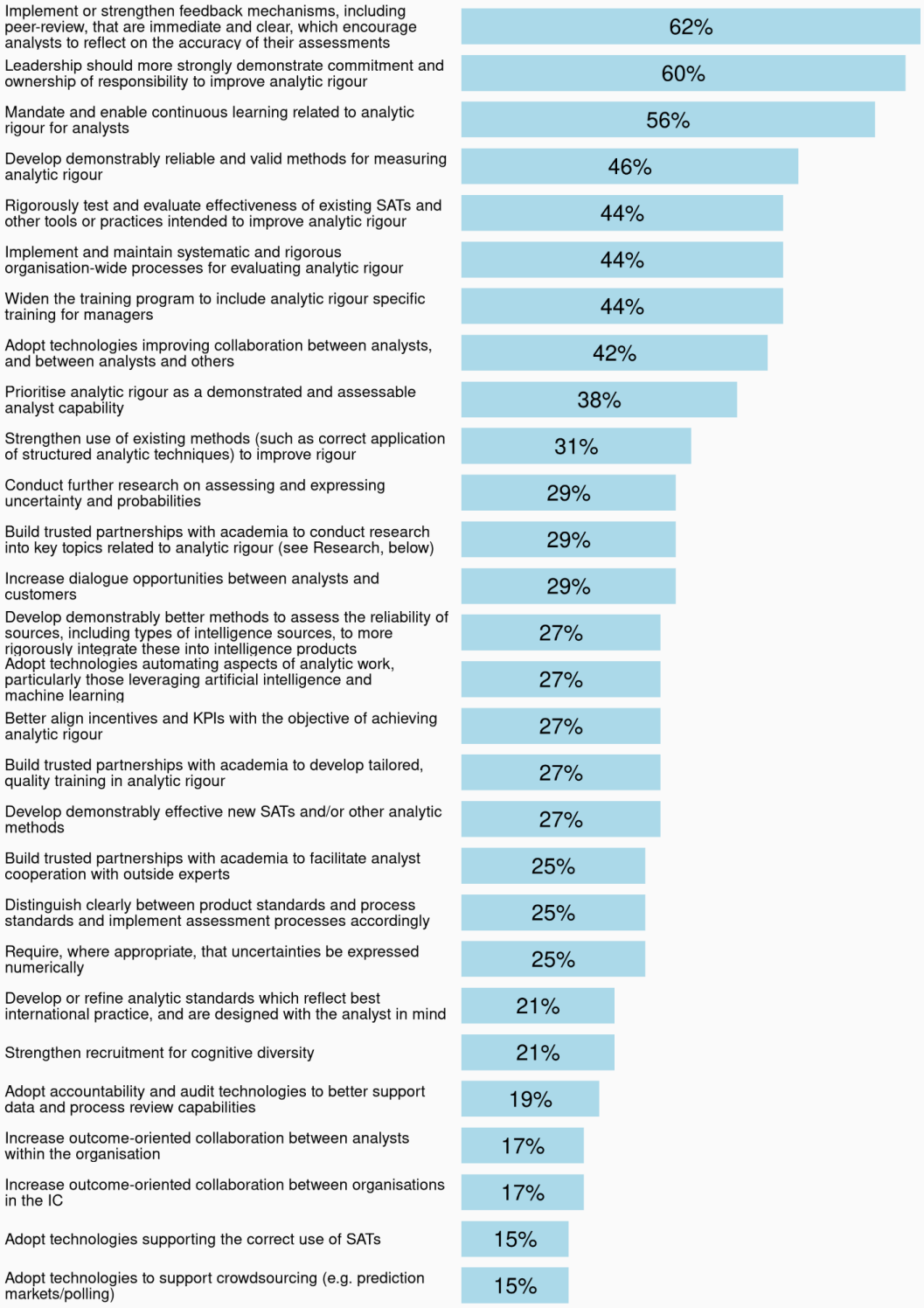
- Improved analysis processes within intelligence organisations
- Improved training, learning and leadership in intelligence organisations
- Improved evaluation methods for analytic rigour in analysis
- Improved technology
- Increased collaboration within organisations and outside them, including with research partners
- Support for further research on analytic rigour and development of effective new SATs or analytic methods
- Improved language and communication expectations within analytic products
- Improved technologies used in intelligence analysis.

The two opportunities which garnered the smallest number of selections were still selected by 7 of 48 Expert panelists (or 15%) as belonging to the 10 most important opportunities for enhancing analytic rigour in intelligence, and as such may still be considered well-supported ideas regarding opportunities for enhancing analytic rigour in intelligence organisations. These were:

- Adopt technologies supporting the correct use of SATs
- Adopt technologies to support crowdsourcing (e.g. prediction markets/polling).

8.2.3.2 Detailed Results

Panelists were presented with a list of options for enhancing analytic rigour and prompted to select up to 10 that they thought were the most promising. The options are presented below, in order from most commonly selected to least commonly selected. The bar chart indicates the percentage of respondents who selected each option.



Percentages are calculated with respect to the total number of responses (48).

8.3 Panellists

This list shows those who elected to be recognised as contributors by providing their details in the final survey of the Expert Panel process. It represents 46 of the 65 participants.

Note that inclusion on this list does not indicate endorsement of positions taken in this report.

Alan Barnes
Centre for Security Intelligence and Defence Studies Carleton University

Aleksandra Bielska
i-intelligence GMBH

Arnaud Chevallier
IMD Business School

Ashley Barnett
The University of Melbourne

Barry A. Zulauf
International Association for Intelligence Education

Brett Peppler
Intelligent Futures Pty Ltd

Brian Pierce
ARLIS

C Clancy

Charles Twardy
Jacobs / Mason

Chris Pallaris
i-intelligence GmbH

Christina Clarke

Christine Brugh
Laboratory for Analytic Sciences North Carolina State University

Daniel Irwin
Department of National Defence

David Kernot
DST

Doug Lorch

Elissa Wright
ONI

Emily S. Patterson
The Ohio State University

Jackie Cameron

Jacky Visser
University of Dundee

James Doty III
U.S. Army (Retired)

James Marchio
National Intelligence University

Jay Fudemberg
findingQED Inc.

Jeffrey A. Friedman
Dartmouth College

John A. Gentry
Georgetown University

Jorhena Thomas
Georgetown University

Judith Johnston
LAS/NCSU

Justin Fidock
Defence Science and Technology Group

Kent Prior

Lars Borg
Norwegian Defence Intelligence School

Lisa Jane Young

Luke Thorburn
The University of Melbourne

Marilyn B. Peterson
International Assn. Law Enforcement Intelligence Analysts

Mark Harrison
Australian Criminal Intelligence Commission

Morgan Saletta

The University of Melbourne

Owen Cooper
Australian National University

Richard Lempert
University of Michigan

Robert E. Horn
Stanford University

Robert Folker
PatchPlus Consulting

Ruthanna Gordon
University of Maryland Applied Research Laboratory for Intelligence and Security (ARLIS)

Simon Dunk
HMRC

Stephen Marrin
James Madison University

Tamar Primoratz
The University of Melbourne

Tim van Gelder
The University of Melbourne

Todd Sears
State of Vermont

Tony Ingesson
Lund University

W. C. Elm
Resilient Cognitive Solutions LLC

Zachery Tyson Brown

9 Appendix C – Survey

We conducted a Survey in partnership with an Australian government agency with intelligence functions to better understand how analysts and managers 'at the coal face' of intelligence work conceive analytic rigour.

9.1 Methodology

The Survey was built around the same three questions that we asked our Expert Panel in the first stage of our modified Delphi method. These questions asked participants to list up to five true and important things about the nature of analytic rigour, factors impacting on analytic rigour, and opportunities to improve analytic rigour.

The process we used to analyse the responses to the question was essentially the same as with the Expert Panel. A team of two researchers sorted the statements made into lists in Trello. To aid in the process, the researchers consulted the list heading previously developed for the Expert Panel results, and where appropriate, used or adapted these. Where statements did not fit an existing list category, a new one was created. After all cards were organised into lists by the first two researchers, they also created a statement that synthesised the statements on the cards as best as possible. Where conflicting views were held on a topic, this was indicated in the statement. Three additional researchers then reviewed the Trello boards, suggested or made changes, and the lists and synthesis statements were updated reflect this additional analysis.

Importantly, this Survey had a small number of participants (n=29), and they were self-selected and therefore not a fully representative sample. Moreover, because of time contraints related to ethics approvals, we were not able to include the second round of survey questions similar to those that which were given to the Expert Panel as a follow up to the first survey. Nevertheless, the Survey gives an interesting sketch of analysts and managers views on analytic rigour and good intelligence analysis.

9.1.1 Survey questions

Enhancing Analytic Rigour Project – Organisation Survey
Survey Introduction Thank you for taking part in the Hunt Lab's Analytic Rigour Survey. The Hunt Laboratory for Intelligence Research at the University of Melbourne is a research partner for Australian and Five-Eyes organisations seeking to improve performance in intelligence analysis. The Hunt Laboratory for Intelligence Research is conducting this research in partnership with the National Intelligence Community. This survey will inform our Analytic Rigour research project, which is funded by the Department of Defence Science and Technology. In addition to questions about analytic rigour, you will be asked some basic demographic questions, as well as some questions about the length of your professional experience, and your current role in the Intelligence Community. This survey anonymous, and the demographic and professional data will provide additional data that may help us to interpret and contextualise our findings. Please keep in mind that this survey is intended for an unclassified environment, and all answers should contain only unclassified material.
Before Proceeding, please indicate with a "Yes", that you have read the Plain Language Statement the Informed Consent Statement, and give your informed consent. If you have not read these, or do not give your informed Consent, indicate "No" and do not proceed.
Part One: In this section we will ask you some basic demographic and professional experience questions. All data is anonymous, and this may help us better interpret understand our data.
1. How many years have you worked in the IC?

- less than 1 year
- 1-2 years
- 2-3 years
- 3-4 Years
- 4-5 years
- 5-6 years
- 6-7 years
- 7-8 years
- 8-9 years
- 9-10 years
- over 10 years

2. How many years have you worked in your current organisation?

- less than 1 year
- 1-2 years
- 2-3 years
- 3-4 Years
- 4-5 years
- 5-6 years
- 6-7 years
- 7-8 years
- 8-9 years
- 9-10 years
- over 10 years

3. What is your current role in the IC?

4. Do you identify as: Male/Female/Non-binary/Prefer not to say

5. What is your age group:

- 18-24
- 25-29
- 30-34
- 35-39
- 40-44
- 45-49
- 50-54
- 55-59
- 60-64
- 65-69
- 70-74

Part Two: In this section, you will be asked about for your views on [] topics:

- The nature of analytic rigour
- Factors impacting on analytic rigour
- Opportunities for enhancing analytic rigour.

Answers are restricted to 200 characters each. If you have any additional comments, there is space to add that in a separate question at the end of this section. We are seeking your "Top 5" ideas, statements or views on the topics above. These need not be exhaustive or definitive. You can provide fewer than five points if you wish.

We are concerned with analytic rigour as it pertains to intelligence work, rather than analytic rigour in general.

We are seeking views that are diverse, insightful and non-obvious. Try to think how your unique situation gives you special insights.

For example, on the nature of analytic rigour, you could describe a common but important misconception about analytic rigour. You might also find it useful to think about analytic rigour in terms of individuals, as well in terms of an organisation or culture.

The nature of analytic rigour

Imagine you had been asked to brief a senior executive who has been charged with improving analytic rigour. What points would be most critical for that person to understand?

Some angles you might consider include:

- What is analytic rigour? What is it not?
- What are the elements of analytic rigour?
- What are some misconceptions about analytic rigour?
- How does analytic rigour relate to other concepts such as standards?

6. What are up to 5 important points that you think someone in your intelligence organisation should understand about the nature of analytic rigour?

Factors affecting analytic rigour

We hope you can help us build a comprehensive picture of these factors. Angles you might consider include:

- What factors most reliably or powerfully increase analytic rigour?
- Conversely, what factors are most detrimental?
- What are some of the external (vs. internal) or indirect factors?
- What factors might be hard to discern, but are still very influential?

7. What are up to 5 important factors that affect (improve or harm) analytic rigour in your intelligence organisation?

Opportunities for enhancing analytic rigour.

Again, imagine you are advising a senior executive, who must proceed to implement changes to enhance analytic rigour.

Please consider both the level of impact and the feasibility of implementation. Angles you might consider include:

- What gaps in current practices in intelligence would, if filled, have most impact?
- What are some non-obvious ways that analytic rigour could be enhanced?
- What are the most cost-effective ways that analytic rigour in intelligence could be enhanced? ("Low hanging fruit")
- What might dramatically improve analytic rigour in particular respects, or in particular types of intelligence work?

8. What are up to 5 of the most important opportunities for enhancing analytic rigour in your intelligence organisation?

Part Three: In this section we ask you to rate your organisation's capability on analytic standards, training in analytic rigour, and evaluation of analytic rigour, and to provide any additional comments.

On a scale of 1-10, how would you rate your organisation's capabilities regarding:

- Analytic Rigour Standards
- Training in Analytic Rigour
- Evaluation of Analytic Rigour

For the purposes of this question, a rating of one would represent a maturity of capabilities where Analytic Rigour standards have not been developed, training is not available, and evaluation is not carried out. A ranking of ten would represent a level where analytic rigour is perceived as a core competence and standards are highly developed and formalised, training in analytic rigour is excellent, and formal evaluation methods ensure analytic rigour standards are met or exceeded.

9. Do you have any additional comments about the nature of analytic rigour, factors affecting it, opportunities to enhance it, or things that someone in your organisation should know about analytic rigour?

This Survey and its specific questions were approved by the University of Melbourne Faculty of Science Human Ethics Advisory Board. The Survey itself was administered internally by the Australian government agency using a internal IT system. Participants were given a plain language statement explaining the purpose of our research and gave informed consent. We provided the questions and instructions in an Excel sheet, and were returned the data from the Survey in the same format. We did not receive any identifying information about participants other than the anonymous demographic data obtained via the Survey questions.

9.2 Results

Not included in public version of report

10 Appendix D – Table of Analytic Standards

In this appendix we present a table systematically comparing the analytic standards found in government analytic standards documents we were able to obtain, and in Zelik et al's Rigor Metric.

There are a number of government documents from Five Eyes countries containing analytic standards. Some are unclassified and publicly available, while others have a variety of handling procedures and cannot be shared publicly. Some of the latter have been made available to the Hunt Lab for use in this project only. Publicly available documents include U.S. Intelligence Community Directives, including the well-known U.S Intelligence Community Directive 203 (ICD 203), various handbooks and guides for intelligence analysis, professional standards documents, etc. from the U.K., Canada, and the U.S..

Some of these documents also include rubrics or assessment systems. For example, the U.K.'s Professional Head of Intelligence Assessment (PHIA) Common Analytic Standards, contained in the PHIA *Professional Development Framework,*[1] is not a not a rating system in itself, but explicitly outlines the standards by which organisations should develop assessment systems and by which intelligence products should be assessed.

Documents included

The table compares the following standards and/or documents (in the order listed in table):

- The Rigor Metric of Zelik, Patterson and Woods[2]
- U.S. Intelligence Community Directive 203 (two versions, one from 2007, the other from 2015 and superseding the previous)
- Australian government agency tradecraft document
- UK Professional Head of Intelligence Assessment's Common Analytic Standards[3]
- Canadian Forces Intelligence Command's Aide Memoire on Intelligence Analysis Tradecraft[4]
- U.S. Air Force Handbook 14-133 *Intelligence Analysis*[5]
- U.S. Department of Justice. *Common Competencies for State, Local and Tribal Law Enforcement Agencies*[6]

It should be noted that both the U.S. standards contained in the U.S. Air Force *Handbook 14-133 Intelligence Analysis* and the CFINTCOM *Aide Memoire on Intelligence Analysis Tradecraft* are largely

1 "Professional Development Framework for All-Source Intelligence Assessment." Professional Head of Intelligence Assessment, UK, (2019).

2 Zelik, Daniel J., Emily S. Patterson, and David D. Woods. "Measuring attributes of rigor in information analysis." Macrocognition metrics and scenarios: Design and evaluation for real-world teams (2010): 65-83.

3 PHIA, Professional Development Framework for All Source Intelligence Assessment (2019), 26-28.

4 Canadian Forces Intelligence Command. *Aide Memoire on Intelligence Analysis Tradecraft* (2015), 99-100.

5 Secretary of the Air Force. U.S. Air Force Handbook 14-133, *Intelligence Analysis* (2017), 22-24. .

6 United States Department of Justice. Common Competencies for State, Local and Tribal Law Enforcement Agencies (2010).

based (with some minor modifications[7]) on the standards outlined in ICD 203 and further developed in ODNI Rating Scale for Evaluating Analytic Tradecraft Standards.[8]

Observations

The table helps bring out a number of points about analytic standards in the intelligence community spanning the Five Eyes countries:

- A great many points have been designated as standards in one document or another, whether as a top-level standard or as an elaboration of a top-level standard.
- The various documents differ substantially in what they include or leave out.
- The number and diversity of points designated as standards suggests a lack of shared clarity about what a standard actually is. In particular, there appears to be confusion about the difference between a standard and a practice recommended because it should help analysts achieve standards.
- Nevertheless, focusing on the points most commonly listed as standards reveals an emergent position as to what the core standards are. In other words, there is a kind of collective view in the community, only partially captured by any one document.

[7] Canadian Forces Intelligence Command. *Aide Memoire on Intelligence Analysis Tradecraft* (2015). Notably, both the U.S. Air Force Handbook evaluation criteria and the Canadian Analytic Product Standards introduce additional criteria to the ODNI's to their rubrics. The Canadian system introduces two additional criteria, one relating to consistency of analysis over time and another criterion requiring the use of Structured Analytic Techniques (CFINTCOM Aide Memoire, 2015). The Air Force system, on the other hand, introduces a criterion on timeliness, and another regarding customer engagement (Air Force Handbook, 2017, p. 24-25 and 65-68).

[8] Office of the Director of National Intelligence. Rating Scale for Evaluating Analytic Tradecraft Standards, (2015).

Rigor Metric	# Occurrences	ICD 203 (2007)	ICD 203 (2015)	Australia Gov. Agency	UK PHIA	CFINTCOM	US Air Force	US DoJ
Objectivity	III 3			■	●		■	
Metacognition (critique own thinking)	IIII 4	❍		❑	❍			❍
Critical thinking	I 1							●
Not distorted by: politics or command	IIII 4		■	■	●		❑	
Not distorted by: emotion or bias	III 3		❑		❍		❑	
Employ strategies to reveal and mitigate bias	IIII 4			❑	❍		❍	❍
Use SATs (or consider their use)	IIII 4		❍		❍	●		❍
Use relevant IT tools	I 1						❑	
Ensure judgments are falsifiable	I 1				❍			
Professionalism								
Integrity	I 1						■	
Honesty / truthfulness	II 2				❍		❑	
Professional ethics	II 2						❑	❍
Anticipation	I 1						■	
Anticipate threats to mitigate surprise / risk	IIIII 6		❍	❍	❍	❍	❑	❍
Anticipate prospects / opportunities	III 3		❍	❍		❍		
Expertise	I 1					❍		
Understand backgrounds / views of key players	I 1	❍						
Be aware of events of intelligence interest	II 2			❑	❍			
Collaboration (internal, IC, allies, academia)	II 2						■	●
Establish networks	I 1							❍
Timeliness (so analysis is actionable)	IIIII 5		■	■	●	●	●	
Customer Engagement	I 1						●	
Engage continuously (to comprehend dynamic needs)	I 1						❑	
Hold working groups / technical exchanges	I 1						❑	
Be aware of customer activities / operations / schedules	IIII 4		❑	❑	❍		❑	
Anticipate and listen to questions	I 1						❑	
Follow up on product / be responsive to feedback	II 2						❍	❍
Balance competing obligations (customer familiarity, interpreted needs, collaboration, analytical judgment)	II 2						❑	❍
Create / maintain secure, organised archives	II 2		❍					❍

Squares (■,❑) denote 'analytic standards' or 'tenets'. Circles (●,❍) denote 'analytic tradecraft standards' or equivalent, which override the former. Solid shapes (■,●) denote headline, top-level standards. Empty shapes (❍,❑) denote standards listed subsidiarily.

Rigor Metric	# Occurrences	ICD 203 (2007)	ICD 203 (2015)	Australia Gov. Agency	UK PHIA	CFINTCOM	US Air Force	US DoJ	
Relevance	5		●	●		●	●	●	
Be insightful	3		❍	❍			●		
Address documented need statements and derivative data needs	4		❑	❑		❍		❍	
Explicitly reference customer requirement to which analysis responds	1					❍			
Address implications of analysis	2		❍	●					
Sources	2	●						●	
Use all information that is relevant / available	5	❍	■	■		❍		❍	
Use most recent information	1							❑	
Corroborate / validate sources	1	❍							
Use multiple source types	1	❍							
Exploit open sources	1								❍
Cite & describe source quality (accuracy, completeness, denial/deception, age, continued currency, technical elements of collection, source access, validation, motivation, possible bias, expertise)	7	❍	●	●		❍	●	●	❍
Stance analysis	1	●							
Be alert to possible deception	1	❍							
Take on perspective of adversary	1							❑	
Analyse factions / networks	1	❍							
Information Gaps									
Identify information gaps	6		❍	❍		❍	❍	❑	❍
Actively address information gaps	3		❍	❑					❍
Work with collection activities and data providers to develop access and collection strategies	5	❍	❍	❑				❑	❍
Sound / Logical Argumentation	6		●	●		●	❍	●	❍

Squares (■,❑) denote 'analytic standards' or 'tenets'. Circles (●,❍) denote 'analytic tradecraft standards' or equivalent, which override the former. Solid shapes (■,●) denote headline, top-level standards. Empty shapes (❍,❑) denote standards listed subsidiarily.

Rigor Metric	# Occurrences	ICD 203 (2007)	ICD 203 (2015)	Australia Gov. Agency	UK PHIA	CFINTCOM	US Air Force	US DoJ	
Alternatives	2			●				●	
Consider alternative explanations, hypotheses, futures	6	●		❍		❍	●	❍	❍
Evaluate / revise / broaden hypothesis set, as new data collected	1	❍							
Evaluate systematically	2					❍			❍
Assess likelihood of each alternative	3	❍		❍			❍		
Consider contending analyses, viewpoints	5	❍	●	❑			❍	❍	
Consultation	1	●							
Consult other analysts	1							❑	
Consult independent experts	1	❍							
Expend resources / capital to consult widely	1	❍							
Critique	1	●							
Seek independent vetting (other analysts, red teams, advocatus diabolii)	2	❍						❍	
Expend resources / capital in critiquing efforts	1	❍							
Uncertainties	1							●	
Express (explicitly) uncertainties / degrees of confidence	5		●	●		❍	●	❍	
Explain (causes of) uncertainties / degrees of confidence	3		❍	●			❍		
Use consistent terminology to convey probabilities	2			❍		❍			
Acknowledge contrary information	6		❍	❍		❍	❍	❑	❍
Sensitivity Analysis	1	●							
Explain implications if data/assumptions are wrong	5	❍	❍	❍		❍	❍		
Identify (and characterise) linchpin / load-bearing information	5	❍	❍	❍		❍	❍		
Identify (and characterise) indicators (that, if detected, would alter judgments, enhance or reduce confidence, signal whether assumptions are more or less likely, clarify which alternatives are more or less likely)	4		❍	❍		❍	●		

Squares (■,❑) denote 'analytic standards' or 'tenets'. Circles (●,❍) denote 'analytic tradecraft standards' or equivalent, which override the former. Solid shapes (■,●) denote headline, top-level standards. Empty shapes (❍,❑) denote standards listed subsidiarily.

Rigor Metric	# Occurrences	ICD 203 (2007)	ICD 203 (2015)	Australia Gov. Agency	UK PHIA	CFINTCOM	US Air Force	US DoJ
Consistency								
Exhibit internal consistency	5		❍	❍		❍	●	❍	
Exhibit consistency across time	1		●						
Be alert to the influence of existing judgments	1			❑					
Avoid being unduly constrained by previous jugdments	2			❑				❑	
Identify and justify any changes in analytic judgments	5		●	●		❍	●	❑	
Highlight differences between analytic elements	3			❍		❍		❑	
Deconflict analytic positions (where possible)	2					❍			❍
Synthesis	2	●						■	
Integrate data in terms of relationships / trends / patterns, not components	2	❍							❍
Re-conceptualise original task	1	❍							
Framing critical issues / questions	1								❍
Communication									
Structure									
Put the key judgments or "Bottom Line Up Front"	3			❍		❍	❍		
Distinguish raw information, assumptions and judgments	5		●	●		❍	●	●	
Provide relevant context	3		❍	❍			❍		
Be clear (fidelitous and/or unambiguous)	4		❍	❍		●	●		
Use best format(s) (written, verbal, visual) for understanding	3			●				●	❍
Data / visuals should embody standards too	3		❍	❍			❍		
Disseminate as widely as possible w/o undermining utility	2							❍	❍
Create versions at different classification levels, if needed	1		❍						
Accuracy									
Be accurate	4		●	●			●	●	
(given constraints and available information)	4		❍	❍			❍	❍	
Facilitate retrospective evaluation (be auditable)	2			❍		●			
Perform retrospective evaluation	2							❍	❍
Do not avoid difficult judgements to minimise risk of error	1			❍					

Squares (■,❑) denote 'analytic standards' or 'tenets'. Circles (●,❍) denote 'analytic tradecraft standards' or equivalent, which override the former. Solid shapes (■,●) denote headline, top-level standards. Empty shapes (❍,❑) denote standards listed subsidiarily.