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Towards a better framework for estimative intelligence – addressing quality through a systematic approach to uncertainty handling

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Towards a better framework for estimative intelligence – addressing quality through a systematic approach to uncertainty handling

The analytic standards governing the production of intelligence are outlined in a number of Intelligence Community Directives (ICDs). In this paper, we are concerned with ICDs 203, 206 and 208 and, in particular, how these relate to the handling of uncertainty in estimative intelligence. An inductive thematic analysis is employed which identifies several recurring themes. In addition, a conceptual map is developed which highlights relationships and the level of inter-connectedness between the standards. Requirements for improved operationalization of uncertainty handling are also discussed. The question of analytic feasibility is then examined in relation to the five themes extracted from the earlier analysis. The paper concludes that a new framework for uncertainty handling is required and suggests that such a framework should contain a process to assess analytic feasibility from the outset of a study.

Keywords: estimative intelligence; analytic standards; uncertainty; framework; analytic feasibility

The Analytic Tradecraft Standards and Uncertainty Handling

The evolution and substance of extant analytic standards

Common triggers for inquiries and transformational change are crises, scandals and intelligence failures, also referred to as "intelligence shocks".[1] However, few of the previous U.S. intelligence transformations and reforms have had the intended effects.[2] In this context, scrutinizing commission reports and a subsequent tightening of legislation around the U.S. IC followed in the wake of the 9/ 11 attacks in 2001, and the erroneous 2002 National Intelligence Estimate (NIE) on alleged Weapons of Mass Destruction in Iraq.[3]

To comply with requirements in the commission reports, and imposed legislation, the U.S. Director of National Intelligence (DNI) formalized a regime of

Intelligence Community Directives (ICD) in order to standardize intelligence guidelines, processes, and products across the ICs. One of the key ICDs specifically tailored to enhance the production and evaluation of intelligence, which quickly received significant scholarly attention, was the fielding of ICD- 203, Analytic Standards.[4] The first four Analytic Standards, mandated explicitly through the legislation, are generic and resemble what has existed for many years in e.g. the "Principles of Intelligence".[5] The fifth, and most interesting Analytic Standard, comprises nine Analytic Tradecraft Standards (ATS), all of which guide analytic processes in production and evaluation of intelligence.

The following extract from ICD- 203 in Table 01 summarizes the nine ATSs which will be considered in greater detail later:

-----Insert TABLE 01 about here-----

As an extension to the Analytic Standards, ICD- 208 (Maximizing the Utility of Analytic Products) was implemented shortly after the ICD- 203. This Directive contains five prioritized principles and highlights the importance of tailoring intelligence to consumer requirements.[6]

Reaction to the ICD- 203

Reactions to ICD- 203 have followed three main themes. The first theme is one of positive change. Claimed improvements include better training of analysts (the 'Analyst 101' course), increased transparency in intelligence products, and how such a "regime" of guidelines provides a good basis for evaluation of intelligence as well as having an instructive and disciplined effect on analysts.[7]

The second theme, however, concerns its lack of novelty, and the fact that current Analytic Standards are a matter of common sense and no more than a revitalization of what has existed for many years.[8] Besides lack of originality, Marchio convincingly shows an intermittent focus on the analytic tradecraft over several decades, and how the U.S. IC in the 1970s was critiqued for "…lack of rigor and transparency…" and handling of "analytic uncertainty" in intelligence analysis.[9] This critique coincides with how Borek and Mangio & Wilkinson characterize the current state of analytic tradecraft.[10] Moreover, in questioning the effect of implementing old standards in a new wrapping, Gentry clearly argues that ICD-203 has limited value and is only "…codifying what competent analysts have always known and done".[11] McEachin's monograph addressing "The Tradecraft of Analysis", and later on "A Compendium of Analytic Tradecraft Notes" by Davis , both corroborate the lack of novelty in ICD- 203 as well as in the interlinked ICD- 208.[12]

The third, and perhaps the most important theme, concerns the degree to which it is feasible to adhere to the ATSs. In an ideal analytic environment, the standards are difficult to contradict in terms of relevance and applicability. However, Marrin raises an important concern when arguing that the U.S. IC has "…established unattainable standards for its intelligence analysts", and that objectivity in particular is an analytic standard which cannot be pursued realistically due to the inherent subjective nature of applied intelligence analysis.[13] Gack and Marcoci et al. also address the importance of operationalizing the ATSs, to establish guidelines, and discuss the consequences of not addressing these paramount issues.[14]

One document which aims to operationalize the ICD- 203 is the ODNI "Rating Scale for Evaluating Analytic Tradecraft Standards".[15] This guidance document is intended to enhance consistency for evaluation of finished intelligence.

Each ATS is treated individually, however, the different rating narratives contain elements similar to the existing text in the ICD- 203 for each ATS. Thus, the notes to evaluators appear to add little value to the rating procedure apart from how to navigate the rating process. Another relevant example is found in the U.S. Air Force Handbook for Intelligence Analysis in which there are no further applied guidelines except for what is already provided in the ODNI Rating document.[16]

As part of governmental enacted oversight[17], the U.S. ODNI is required to submit reports to the Congress periodically in order to evaluate the degree to which the U.S. IC adheres to its own promulgated analytic standards.[18] So far, key findings in evaluation reports related to the degree of compliance to the ICD- 203 underpin the difficulties in improving the tradecraft of intelligence analysis.[19]
Consequently, we believe that the current operationalization of the ATSs is not sufficient for assessing feasibility or degree of compliance.

Aim and objectives

The aim of this paper is an attempt to better understand the nature of the ATSs, the relationships between them and the feasibility of achieving them. We have broken this down into the following three objectives:

1. To identify the main themes emerging from the ICDs. A thematic analysis is employed to achieve this.
2. To better understand the relationships between the various ATSs. A conceptual map is offered to help describe these and demonstrate their inter-connectedness.
3. To explore the nature of feasibility assessment in estimative intelligence. This is discussed in relation to the five themes identified from Objective 1.

Synthesizing the ICD- 203 with emphasis on uncertainty handling

Given the stated purpose and content of ICDs 203, 206, and 208, we argue that these intelligence directives are interconnected through both redundancy (ICD- 206) and in expanding the ATSs concerning consumers` requirements (ICD- 208). Moreover, the ICD- 203 is generic, and the majority of the ATSs address key analytic processes encompassing the derivation and communication of estimative products, i.e. subjective probabilities supported by statements of analytic confidence. As listed in ICD- 203, the nine ATSs can at first glance be viewed as separate standards. However, rather than viewing them in this way, we have treated the ATSs collectively to better identify the commonality and interrelated nature of their content.

We applied inductive thematic analysis to the ICDs 203, 206, and 208. The applied six-step method encompasses narrative analysis, identification and clustering of codes, and derivation of themes or patterns from the data.[20] The starting point of the thematic analysis was a verbatim extraction of the narratives in the three ICDs. The initial stage of analysis comprised an initial coding by inductively identifying key words, phrases and patterns within the qualitative data[21] in each of the ICD narratives. Next, by revising and collating the set of initial codes, five intertwined themes with clustered codes emerged from the data which in turn capture the essence of the ICDs. Table 02 represents a selected sample of the thematic analysis, and a full version is further detailed in Appendix 01 to this paper.

-----Insert TABLE 02 about here-----

The five themes are described in turn below.

 # 01- Uncertainty

First, in eight out of nine ATSs, different facets of uncertainty handling appear as a recurring theme and a common denominator, directly or indirectly. As noted by Gentry[22], ATS # 05 (demonstrate customer relevance) deviates from the rest of the standards. In addition, we argue that ATS # 09 (incorporation of visual information) is also of a different nature. However, the standard may be relevant in the context of uncertainty analysis and, when required, in communication of relevant aspects of uncertainties to consumers. A graphical depiction of, for example, types of uncertainties, and how uncertainties are intertwined and influence the problems being analysed, may enhance transparency and traceability in analysis, collaboration among analysts, as well as in communication of uncertainty.

 # 02- Use of assumptions and indicators to address uncertainty gaps

Second, ATSs # 02, 03 and 04 all describe the use of assumptions as a substitute for uncertainty gaps or an insufficient knowledge base, and the importance of identifying indicators. The latter enables a focused collection of information for subsequent revision and updating of key uncertainties in the light of new information. Such indicators are also relevant when explaining changes to analytic judgments which is the concern of ATS# 07 (change to or consistency of analytic judgements), although they are not explicitly mentioned within it. Addressing similar elements of uncertainty handling in several ATSs emphasizes the interconnectedness between the standards, and the importance of a formalized and systematic approach to uncertainty handling when handling assumptions which cannot be easily validated.

Marshall highlights the criticality of managing assumptions, as well as how unresolved assumptions influence assessments, and that these uncertainties must be understood by decision- makers.[23] Common methods include e.g. peer reviewing, key

assumptions check, devil's advocacy, with its primary function of critiquing analytic processes and products.[24] These have only been subject to intermittent scholarly attention.[25]

The use of "layering" in intelligence analysis is closely related to the use of assumptions and indicators. Layering represents a common and necessary mechanism in analytic processes which occurs when using existing knowledge about a topic or prior estimative assessments as facts or inputs without bringing forward "…the cumulative uncertainties…" in the production of new intelligence.[26] There are several justifiable reasons for using layering in analytic practices, e.g. time and analytic resources available, a poor knowledge base, and lack of tailored collection capabilities. This inevitable and important analytic process is implicitly contained within ATSs # 02, 06 and 07 , and encompasses the necessity of coherent and consistent reasoning in marshalling and aggregation of uncertainties across analytic processes. However, layering as an analytic process is also interconnected with several themes derived in the thematic analysis.[27]

Layering was explicitly highlighted as one of the main analytic flaws in the U.S. and UK commission reports on the pre- war intelligence assessment with regards to the Iraq War in 2003.[28] For this reason, and with a clear negative connotation, layering has been addressed by several scholars in the context of analytic deficiencies and pathologies.[29] However, there are to our knowledge no recommendations for mitigating potential analytic pitfalls concerning its dysfunctional effects.

 # 03- The consumers' uncertainty requirements

The third theme concerns the consumer dimension. Consumers are presented with two estimative products comprising measures of subjective likelihood underpinned by statements of analytic confidence.

Based on studies of analytic confidence[30], it is clear that steps have been taken to conceptualize this as a construct. However, as asserted by Irwin & Mandel, criteria for determining what to include in a confidence statement are not sufficiently operationalized.[31] Moreover, as pointed out by Wheaton, it may be challenging to decide what to include in a confidence narrative.[32] In addition, we argue that uncertainty is poorly operationalized in terms of formalizing determinants comprising key elements of uncertainty which in turn makes it challenging to derive and communicate a consistent justified degree of belief (i.e. subjective likelihood) to consumers. In essence, consumers' requirements for understanding uncertainties inherent in estimative assessments are neither sufficiently addressed in the tradecraft standards nor in ICD-208, which represents a noteworthy shortfall in the current framework for estimative intelligence.

 # 04- Analytic traceability and transparency

One overarching driving force represents governmental oversight and quality control of ICs, which both Müller-Wille and Moran argue will lead to increased demands for transparency (i.e. clarity) and public disclosure.[33] The current ODNI regime for quality control (periodic audits), and a legislated requirement for measurement of accuracy in finished intelligence (ATS # 08) require uncertainty handling to be subject to both transparency and analytic traceability. As well as being central to ATSs # 06 and 08, this theme is also apparent in ATSs # 02, 03, 07 and 09. The importance of these requirements can be described by a spiral. The necessity of maintaining transparency and traceability in judgmental estimative assessments will increase as a function of complexity in problems (NATO RTO, 2012a) [34], which in turn may be subject to likely corresponding scrutiny and subsequent accountability in case of analytic flaws and non-intended consequences of decision- making.

We believe that the required transparency and traceability in key estimative processes and products lack sufficient formalization in order to comply with extant requirements set forth in ICDs 203, 208, and 206 whereby the latter ICD corresponds to ATS # 01 (properly describe quality and credibility of sources) in the ICD- 203. Both Marrin and Adamski advocate the importance of establishing an analytic audit trail in assessments, and for maintaining transparency in communication.[35] In this context, Analysis of Competing Hypothesis (ACH), a well-known Structured Analytic Technique (SAT) mandated in ATS # 04 (analysis of alternatives), does provide transparency and an audit trail in consideration of its nine steps and evaluation matrix.[36] However, besides questioning the analytic effects of ACH[37], the technique does not incorporate a consistent and systematic method for uncertainty analysis. Furthermore, transparency is also embedded as the fifth principle in ICD- 208 (demonstrate transparency) in order to maximize the utility for consumers.[38] However, transparency in the context of what to include and how to communicate uncertainty in accordance with consumers' requirements in confidence statements is still a subject in need of further operationalization.

 # 05- Analytic rigour

Lastly, analytic rigour may be viewed as a facet of quality, and Cardillo states that both ICD- 206 and ICD- 203 (the 2007 version) "…injects rigor into our processes and products and holds analysts and managers accountable for results".[39] However, an appropriate definition of analytic rigour is missing in intelligence publications[40]. Moreover, Rojas goes further by stating that "…the expected level of rigor is not specifically defined, quantified, or communicated… nor have they provided the mechanism for analysts to communicate a measure of applied rigor".[41]

In a NATO research study outlining the "Code of Best Practice for 'Soft' Operational Analysis", a domain we argue is relevant to the tradecraft of intelligence analysis, the term rigour is succinctly defined as "quality achieved through strict enforcement of logical rules and doctrine".[42] This correlates with what Michealson presents as a definition of analytic rigour; "the application of precise and exacting standards... to better understand and draw conclusions...".[43] However, using rigour as a criterion for quality has limited value as long as it is open to numerous interpretations and connotations. Besides Mandel et al., who examine analytic rigour in context of endorsement and compliance to ICD- 203[44], a report by Barnett et al. define rigor through the "LOTSA" dimensions (Logical, Objective, Thorough. Stringent and Acute), further detailed by a comprehensive list of impacting factors[45]. We argue that these novel contributions provide an excellent basis for further operationalization of analytic rigor in an applied context.

The call for enhanced quality in intelligence has been traversing the intelligence literature for several years.[46] However, as noted by Marrin, there are still no clear criteria or metrics for measuring the quality of intelligence products or the utility of estimative assessments from the consumers' perspective, the two of which are interlinked.[47] Based on our analysis, we believe that achieving enhanced quality of intelligence by compliance with ICD- 203 depends on formalizing various intertwined aspects of uncertainty handling. In our view this points to the need for a framework that allows uncertainty to be characterized more systematically and thoroughly, particularly to satisfy ATS # 02 (properly caveat and express uncertainties or confidence), and to provide sufficient underpinning for all of the other ATSs, except for ATS # 05 (demonstrate customer relevance).

The Concept Map (CMap) in Figure 01 is intended to visually represent the interconnectedness of the five themes with the underpinning clustered codes (see Table 02), all of which can be explicitly or implicitly linked to different aspects of uncertainty handling.

The nodes in the ATS model, originating from the thematic analysis, are arranged in a logical sequence, following the convention for construction of CMaps[48]. The model is also intended to capture and highlight essential analytic areas and challenges within the tradecraft or profession of estimative intelligence analysis.

However, such maps leave room for subjectivity by the researcher, and consequently, there is no single "correct" map. Nonetheless, we believe they are a useful device for developing exploratory and descriptive models which in this case can aid communication and further operationalization of the ATSs.

-----Insert FIGURE 01 about here-----

As illustrated by node 04 and its successor nodes 05, 09 and 11, all of which represent the content of ATS # 02, we observe that the other seven standards contain one or more facets of uncertainty which are intrinsically related to these nodes. By thinking of node 04 as a root node in the ATS model, we clearly see how the various facets of uncertainty handling are interconnected and thus address a basic requirement for a consistent and systematic approach to uncertainty handling across analytic processes. Consequently, the importance of not treating the standards in isolation or as mutually exclusive is reinforced. As noted by Marcoci et al.[49], we also observe that there is a level of redundancy within the ATSs as several standards address similar and overlapping

elements of uncertainty handling. Lastly, the importance and weight on the consumer dimension in the three ICDs, depicted by node 16 in Figure 02, are made clear by the number of arcs leading into this sink node.

Towards better Operationalization of Uncertainty Handling

Key aspects of uncertainty

As previously argued, there is a need for greater conceptualization and operationalization of uncertainty within the current framework from both the analyst and consumer perspectives.[50] The existing framework for estimative intelligence has an audit trail back to the mid-1960s[51], and has evolved little since then. Paradoxically, considering how the operating environment has changed, most of the analytic controversies and challenges as introduced by Rieber concerning uncertainty handling are still valid today.[52] In addition to Ben-Israel, who argued for the necessity of a conceptual framework for estimative intelligence, Cooke claimed that "…it is impossible to form a picture of the way in which the intelligence community deals with uncertainty".[53]

The domain of uncertainty is interdisciplinary in nature with a diversity of approaches tailored to different domains and their ranges of application. Consequently, there is no universally agreed approach to handling uncertainty or risk, and as emphasized by Refsgaard et al. and Samson et al., most definitions are discipline and context dependent as well as being related to the type of decision- making problems being addressed.[54]

Uncertainty is challenging to conceptualize and to frame analytically, and there is currently no comprehensive framework to deal with uncertainties. Ben-Israel

highlighted methodological challenges in addressing complex problems three decades ago[55], and these remain as valid today. Approaches including critical thinking and sensemaking are intended to be supported by the current toolbox of SATs, and by the adoption- and standardization of System of Systems Analysis in intelligence analysis.[56] However, lessons identified from previous conflicts in Iraq, Afghanistan, and the Balkan conflict in the 1990s reinforce both a methodological inadequacy and a missing conceptualization of uncertainty.[57]

A commonly used dichotomy for uncertainty is the distinction between aleatory and epistemic uncertainty. Aleatory uncertainty describes the inherent stochastic nature of some problems or phenomena, and is usually associated with representation of uncertainty by quantitative approaches.[58] Conversely, epistemic uncertainty represents incomplete or lack of knowledge. This type of uncertainty may be reducible by further data collection[59], and is often associated with a subjective approach[60] in which the use of subjective probabilities is commonly used to assess and communicate a degree of belief numerically or linguistically (or both) to consumers of intelligence. However, the separation between aleatory and epistemic uncertainty can be ambiguous due to the nature of problems, and many problems contain both aleatory and epistemic uncertainties.[61]

Epistemic uncertainty is intrinsically linked to intelligence. As part of a still ongoing quest for the definition and the purpose of intelligence, Herbert asserts that the purpose of intelligence analysis encompasses management of and "coping with epistemic complexity".[62] This is also supported by Johnston's study in which the importance of including epistemology as an inherent part of analytic tradecraft is emphasised.[63] A closely related question is whether it is the purpose of estimative intelligence to assess or reduce uncertainty.[64] Firstly, while aleatory uncertainty is not usually directly

reducible, its effects might be mitigated by changing plans, for example. Epistemic uncertainties, however, relate to our lack of knowledge. Typically, some of these are reducible, and some are not. Moreover, new intelligence does not guarantee a reduction - it might actually increase the level of uncertainty being faced as new possibilities emerge which had not previously been considered.[65] Such a change in understanding can yield just as valuable decision support to consumers as any notional reduction in uncertainty. Therefore, as also advocated by Friedman & Zeckhauser[66], it is not sensible to make reduction of uncertainty the goal of Estimative Intelligence. In many cases, of course, such a reduction may be both unachievable and inappropriate anyway in the face of complex problems.[67]

Analytic processes and outputs in estimative intelligence

Uncertainty analysis is pivotal and drives key analytic processes in estimative intelligence and in risk analysis. However, analytic processes are still scarcely addressed in the literature on intelligence analysis[68] which should not come as a surprise due to the nature and shortfalls in the extant framework for estimative intelligence. This gap is further reinforced by Borek who identifies clear conceptual shortfalls, lack of understanding, and notes that the analytic tradecraft is "…an understudied and poorly understood concept…".[69]

The majority of scholarly discourses related to analytic processes are often limited to reoccurring critiques of various aspects of whether the Intelligence Cycle is suitable as a model for intelligence processes.[70] Moreover, core analytic processes are simplistically framed in intelligence publications within the "processing" stage of the Intelligence Cycle.[71] This "black- box" taxonomy encompasses five generic steps (collation, evaluation, analysis, integration, and interpretation), whereby integration and

interpretation comprise inference with and aggregation of uncertainty, and consequently derivation of estimative products.

Another important analytic process which is explicitly linked to the Intelligence Cycle and uncertainty handling, is called the Intelligence Requirements Management and Collection Management Process (IRM & CM).[72] Along with risk assessment processes, this key process is scarcely addressed in the intelligence literature, and does not contain any concrete and standardized guidelines for identification, evaluation, analysis, and assessment of uncertainties throughout the respective iterative analytic processes.

Derivation and communication of subjective probabilities, underpinned by statements of analytic confidence constitute the core outputs in estimative intelligence. Collectively, these two estimative products comprise a measure of uncertainty or, conversely, they are indicative of a judgmental belief of "analytic certainty".[73] Estimative assessments are normally subject to scrutiny and quality assurance through different corroboration and collaboration mechanisms in different production stages. However, we argue that there is little emphasis on how estimative probabilities are analytically derived and justified in the intelligence literature. There are several proven methods for elicitation of subjective probabilities.[74] These techniques are often applied in the context of elicitation of expert judgments in order to "…inform decisions by characterizing uncertainty and filling data gaps…" and normally contain "…expert's beliefs about relationships, quantities, events, or parameters of interest".[75] Despite the existence of these techniques, we are not aware of their widespread adoption within the intelligence community as a formalized, systematic procedure. Undoubtedly, such elicitation techniques can require much time and analytic resources, but this may be justified for special intelligence requirements followed by important decisions with likely significant consequences.

As for the concept of analytic confidence[76], several studies have highlighted the confusion or conflation in applied use of the constructs probability and analytic confidence.[77] Moreover, there are shortfalls related to lack of standardized lexicons and identification of inclusion criteria for derivation of confidence levels. Both of these are prerequisite for deriving consistent and differentiated confidence statements tailored to the consumers' requirements. With Friedman & Zeckhauser's suggested framework for analytic confidence as a basis[78], Irwin & Mandel recommend a framework for "information accuracy" and to communicate confidence numerically by confidence intervals applicable for use in Bayesian analysis and validity studies (statistical audits).[79] However, due to lack of formalized elicitation techniques, tailored SATs for handling of complex problems, and ICs' reluctance to embrace Bayesian analysis[80], we argue that that the current framework has clear limitations in terms of handling uncertainty by use of confidence intervals in the way described.

Another important aspect of analytic confidence entails communication of responsiveness to new information, also termed the value of additional information.[81] In the context of both risk assessments and estimative intelligence, many consumers require an informed assessment of whether further collection or allocation of resources to obtain more information are likely to yield useful additional information before consequential decisions are made.[82] This is exactly the kind of responsiveness, which we might also describe as decision sensitivity. However, decision sensitivity is to our knowledge not currently sufficiently formalized in analytic processes. Another shortfall is evident with regards to source reliability and information credibility, the Admiralty System[83], in which there is a lack of tailored operationalized determinants for evaluation of uncertain premises across information types.

Inadequate evaluation of uncertain information and analytic confidence are likely to result in poor or flawed communication to consumers.[84] This may in turn lead to reduced credibility towards analysts and thus lower receptiveness to estimative assessments. The latter is explicitly highlighted as a challenge by Marrin with regards to the influence of intelligence in informed decision- making.[85] From the perspective of a slow development of the analytic tradecraft[86], and the current distance between scholars and practitioners[87], we argue that one of the main reasons for this situation is a missing formalized and epistemologically justified analytic framework for uncertainty handling. Without adequate guidelines and evidence- based rigorous analytic practices for uncertainty analysis, it is challenging to improve intelligence analysis systematically, or to comply with quality requirements as directed in ICDs 203 and 208.

The need for consistent terminology

A formalized and consistent uncertainty terminology comprises an important element in conceptualization of uncertainty, in applied theory- building, and in developing an analytic framework for estimative intelligence. The U.S. IC has formalized an estimative language as a guidance for recipients of National Intelligence Estimates (NIE). However, both Marchio and Wheaton emphasize that the estimative terms are not agreed upon, and that the formalization is in its early stage.[88] The formal existence of a specific "estimative language", which is intended to consistently address estimative products, may thus be viewed as a paradox due to a missing theoretical basis or justification for use of such terminology.

Two main issues reflect the poor maturity related to current uncertainty terminology. First, several authors have addressed a conflation of terms in the use of estimative products in intelligence assessments.[89] The degree to which conflated

practices are rectified is questionable due to current analytic practices and existing shortfalls in the current framework. Second, examples of interchangeable use of key estimative terminology are widespread across discourses in the intelligence literature over several decades, and there is no clear audit trail in terms of justification and consistent use.

Terms like "estimation", "prediction", "forecasting", and "foresight" all signify an ambition in terms of assessing uncertainty, and the degree to which accuracy can be reasonably expected. These terms are commonly used interchangeably in intelligence publications and in the literature. As opposed to Lowenthal, who argued that an estimate is "…an analytical appraisal «and not a forecast or prediction[90], the intelligence literature mainly revolves around the use of the terms "prediction"[91] and "forecasting"[92] to address the core function of estimative intelligence.

The use of interchangeable terminology is also referred to as "de-objectification".[93] This adds to the analytic burden for analysts and inhibits applied theory building, scholarly discourses, framework development in the context of a systematic knowledge accumulation[94], and fostering "…conversations across disciplinary and domain boundaries…".[95] In addition, similar to challenges in Climate Sciences, extant practices are "subject to different interpretations and connotations" by consumers.[96]

In this context, ATS # 08 (accurate judgements and assessments) in ICD- 203 reflects a requirement to enhance quality by evaluating accuracy in estimative intelligence retrospectively. This has received considerable attention in recent years in terms of advocating the measurement of forecasting accuracy through quantitative validity studies.[97] However, in spite of a general critique related to the use of accuracy as a criterion for quality assurance of intelligence,[98] current IC efforts to measure

accuracy in forecasting represents a good example of de- objectification and thus conflation of essential terminology.

Formalizing an assessment of Analytic Feasibility

Assessing Analytic Feasibility

With the thematic analysis and the conceptual ATS model as a basis, and by addressing current shortfalls and challenges in the current framework for estimative analysis, we argue that current analytic practices need to be improved in order to better comply with the extant ATSs. The feasibility of conducting estimative analysis in compliance with ICDs 203 and 208 depends on many intertwined factors. These include domain specific constraints (e.g. available analytic resources, the knowledge base, and time available) and the nature of uncertainty present which in turn informs methodological choices, and consumers' requirements and expectations. Consequently, complying with the call for enhanced quality of intelligence requires that the ATSs should be subject to a wider understanding and conceptualization of uncertainty.

In the spirit of "learning from other disciplines"[99], our suggestions seek to draw on existing analytic frameworks and best practices for uncertainty handling from relevant interdisciplinary application domains. One such relevant practice is that of a flexible or differentiated approach to how uncertainty is handled.[100] An analytic framework which permits a differentiated and systematic approach to uncertainty handling within estimative intelligence seems desirable. To our knowledge such a framework for estimative intelligence does not openly exist.

As a first step towards the development of such a framework, we suggest that an assessment of analytic feasibility (AF) should be made throughout the relevant analytic stages. The assessment of AF should be a consistent, systematic, and iterative process which supports a differentiated approach to the management of uncertainty in support of the derivation of estimative products tailored to consumers' requirements. A traceable, transparent, and realistic assessment of AF would thus guide analytic processes and the intelligence dialogue, and should as a minimum consider domain specific constraints, types of problems, a systematic approach to uncertainty analysis, and elicitation of consumers' requirements and expectations of estimative products. When considering types of problems, the categorization described by Menkveld in relation to problem complexity offers an excellent starting point.[101] In the next section, we discuss the assessment of analytic feasibility, firstly with respect to problem framing and then in relation to the five themes that we identified earlier.

Effects and likely implications of assessing analytic feasibility

Framing the problem

The first effect is related to problem analysis, normally comprising the first iterative analytic process which serves the purpose of gaining a deeper understanding of the nature of the problem(s) inherent in consumers' intelligence requirements. This analytic phase also initiates an intelligence dialogue between analysts and consumer. An early understanding of AF would help analysts to better focus and prioritize limited resources, which is paramount to bring into the intelligence dialogue as early as possible.

Problem analysis is linked to ensuing analytic processes. However, if not addressed sufficiently at an early stage, there is a risk of ending up with a flawed or less relevant

assessment. The importance of this process is emphasized by Coulthart who advocates the importance of problem structuring. The author uses the term "Type III error" as a description of "solving the wrong problem", and consequently, the risk of "invalid analysis" is likely to increase as a function of problem complexity.[102] Accordingly, addressing uncertainty gaps consistently and systematically in this initial phase is likely to minimize analytic pitfalls and thus enhance the quality of problem analysis. An enhanced basis for subsequent iterative processes, prioritization of resources, and an efficient intelligence dialogue in which the consumer actively contributes are then reinforced.

In a review of SATs by Dhami et al., 70 analytic techniques were classified as a function of their intended purpose.[103] Of the 13 collated main categories, however, we find no tailored problem structuring methodology or technique comprising a sufficient and transparent approach for derivation of uncertainty gaps by a systematic and consistent identification, classification, and analysis of uncertainties and their influence on the associated intelligence requirements. We further argue that techniques encompassing e.g. idea generation, problem decomposition techniques and Social Network Analysis, as listed in the literature on SATs, do not sufficiently address uncertainty analysis required for framing complex problems inherent in intelligence requirements. The same applies to sensemaking which both Fishbein & Treverton and Moore argue is useful and applicable for understanding and analyzing complex problems.[104]

Uncertainty methods and structured analytic techniques

The lack of tailored methods and techniques encompassing uncertainty analysis reinforces the need for an analytic framework containing a differentiated approach to uncertainty handling which in turn ought to reflect assessment of AF in different

analytic processes.

A critical review of suitable and feasible methodological approaches for uncertainty analysis is outside the scope of this paper. However, to address current shortfalls we suggest looking at relevant interdisciplinary application domains.

In particular, we suggest that analytic frameworks in which there are formalized processes for a justified selection of suitable and feasible techniques informed by uncertainty analysis, domain specific constraints, and consumers' requirements are of particular relevance.

The European Food Standards Agency (EFSA) and the Netherlands Environmental Assessment Agency (PBL NL) are two application domains which both provide such guidance encompassing both quantitative and qualitative methodological approaches.[105] These recommendations deviate from disciplines typically addressed in the intelligence literature, e.g. medicine, policy analysis, history and social science.[106] However, we believe that these application domains are particularly relevant relative to applied uncertainty analysis in the context of handling complex problems, and for integrating consumers' uncertainty requirements throughout relevant analytic processes. Of course, as also noted by several researchers[107], any approaches borrowed from other disciplines would still have to be tested and considered fit for purpose in the domain of estimative analysis.

In consideration of developing an analytic framework tailored to estimative intelligence, an important issue subject to further research encompasses the degree to which a modelling approach to uncertainty analysis is required. We argue that this issue is of particular interest with regards to being able to consistently assess the relative impact of uncertainties in complex problems, and consequently, to assess and

communicate decision- sensitivity. A commonly used technique associated with uncertainty modelling is Sensitivity Analysis, which in turn is a prerequisite for assessing decision- sensitivity. Except for Bayesian analysis, there are no proven methods within the SAT inventory which handles uncertainty consistently and coherently in accordance with the axioms of probability.

Lastly, formalizing an analytic framework may incur resistance in analytic communities. This may be conceived as another imposed processual layer of which inhibits production in an already constrained analytic environment. As such, an analytic framework for uncertainty analysis will likely be more suitable for analysts working on less time critical analysis projects, i.e. for production of basic intelligence. However, production of current and time critical intelligence relies on the quality of such basic intelligence. Therefore, as emphasized by several authors[108], there is a need for acquiring a balance between current- and basic intelligence in order for ICs to remain relevant and credible.

Assumptions and indicators

The effects of assessing AF are intertwined, and we believe that a more systematic approach to uncertainty analysis is likely to improve several core analytic processes. First, we argue that some of the challenges and dysfunctional effects related to layered inference can be mitigated by assessment of AF throughout the analytic stages. This is due to enhanced consistency and analytic traceability in identification and evaluation of uncertainties inherent in prior intelligence and in new information as directed in ATS # 07 (change to or consistency of analytic judgements). Moreover, uncertainties in prior intelligence are consistently and jointly assessed with uncertainties inherent in new premises. This may in turn enable a better cumulative assessment of uncertainties and hence an enhanced consistency in judgmental revisions of posterior uncertainty

estimates.

Second, closely related to layering is management of assumptions which is a key underlying process for assessing and communicating decision- sensitivity to consumers. We argue that addressing assumptions as part of a systematic approach to uncertainty analysis may complement relevant SATs and provide an enhanced basis for management of assumptions, and thus, a better ability to inform consumers how, for example, allocation of more analytic resources is likely to impact uncertainty.

Third, ATS # 08 calls for precision in the context of accuracy which in principle conflicts with the use of non- standardized lexicons for communication of uncertainty. A systematic approach to uncertainty analysis supports a better justified foundation for derivation of estimative products. Hence, aiding analysts with regards to a more consistent and coherent use of dual numeric- verbal lexicons and in derivation of confidence statements.

Consumers' uncertainty requirements

The third effect concerns the consumer dimension which guides analytic efforts in terms of meeting requirements and expectations of estimative assessments.

Besides decades of ongoing discussions addressing the relationship between policymakers and analysts[109], several authors have intermittently addressed shortfalls, challenges, and the importance of communicating uncertainties to consumers.[110] Henceforth, in extension of Marrin's argument of consumer utility being one of three criteria for evaluating quality of intelligence[111], we argue that this core dimension is poorly operationalized in ICD- 208, and is still an under- researched topic in terms of understanding consumers' requirements for managing uncertainty. Moreover, by comparing the current ICD- 208 with the first version implemented almost 10 years earlier, we see no clear development in terms of any added fidelity to the guidelines.

The challenges of understanding, balancing and meeting consumers' requirements are not unique to intelligence, and several other application domains face the same challenges.[112] A prerequisite for achieving consumer utility throughout analytic processes is to better understand how consumers cope with and handle uncertainties. Besides Wolfberg, the study by Lipshitz & Strauss, later expanded on by van den Heuvel et al.[113], provide a good starting point for a better understanding of this dimension. Another example which may provide interesting insight to analysts concerns the development of a taxonomy of uncertainty management strategies.[114] Lastly, Gabbert et al. provide another relevant perspective by investigating users' "uncertainty information needs" in the context of a user driven approach to uncertainty analysis.[115] This sample of recommendations provides a relevant basis to build upon in order to develop a better understanding of consumer utility.

Analytic traceability and transparency

The fourth effect of implementing an iterative assessment of AF concerns increased traceability and transparency (i.e. clarity) in estimative processes and assessments, both of which address parts of the reason for implementing ICDs 203 and 208 with regards to enhanced quality in production of intelligence.[116] These two important constructs represent general scientific principles which can be associated with reliability and validity, and in context of estimative intelligence, aspects influencing rigour, analytic integrity, as well as credibility and transparency towards justification of epistemic judgmental knowledge claims[117] and consumer receptiveness.

Marchio highlights missing rigour and transparency in uncertainty handling as being a key issue raised in the U.S. ICs as early as in the 1970s.[118] Similarly, in order to enhance receptiveness and influence on consumers, Marrin advocate the importance of transparency.[119] In the context of this paper, this may include communication of

relevant underlying inferential analytic processes and key elements underpinning aggregation of uncertainty and thus derived judgmental probabilities. Consequently, given the judgmental nature of estimative intelligence, traceability and transparency are intrinsically linked to assessment and communication of uncertainty, and should therefore be embedded in statements of analytic confidence as required. An iterative assessment of AF is therefore likely to enhance transparency and traceability in analytic processes which in turn provide a better basis for maintaining an effective intelligence dialogue, to conduct focused intelligence collection, to better prioritize scarce analytic resources, and for deriving estimative products. Moreover, if AF is limited due to e.g. the nature of the problem and available analytic resources, a trade-off related to reduced transparency and traceability can be more easily justified and thus maintain consumers' receptiveness and credibility towards analysts.

Moreover, an analytic audit trail will likely provide a better foundation for inter- and intra IC collaboration, which was again brought to the IC agenda after the Iraq War in 2003.[120] In addition, both Bacheș-Torres & Torres-Bacheș and Vogel & Tyler highlight the importance of interdisciplinary cross- domain collaboration as a prerequisite for evolving intelligence analysis[121] which is reinforced in the face of complex multi-domain problems. This dimension also includes engaging outside experts as directed in ICD- 205- "analytic outreach".[122] Another interlinked process concerns quality assurance of analytic processes and products. We believe that the use of methods such as peer reviewing, key assumptions checking, and devil's advocacy[123] will enhance transparency and traceability in estimative processes through a systematic approach to uncertainty analysis.

Another measure which is likely to improve transparency and traceability concerns visualization of uncertainty which Thomson et al. argue may mitigate biases

and improve the effectiveness of analytic techniques.[124] Currently there are no formalized evidence- based techniques for visualizing uncertainties in extant tradecraft practices. However, to further address ATS # 09 (incorporation of visual information), we recommend drawing on practices from relevant application domains. For example, the ”uncertainty matrix” developed by Walker et al. aims to provide a basis “...for the systematic treatment of uncertainty in decision support in order to improve the management of uncertainty in decisionmaking processes…”.[125] The main idea is to identify all relevant aspects of uncertainty as early as possible in analytic processes. Key uncertainties are then analyzed along three intertwined dimensions: the nature, level, and location of uncertainty. This commonly used framework, which seek to identify and manage uncertainties from both the analyst and decision maker perspectives, may provide a useful starting point in order to strengthen and evolve clarity in analytic processes, facilitate collaboration, and improve communication of uncertainty. Furthermore, Boschetti's representation of uncertainty by a “3D Level-Awareness-Perception Plot”[126], tailored to complex decision making, may also serve as a basis for developing a visualization technique for obtaining an analytic audit trail in long-term analysis projects and for transparency in the intelligence dialogue. We intend to explore these possibilities further in a future paper.

Applied analytic rigour

Lastly, there is a growing body of published research which contests the effect and utility of the application of SATs.[127] Moreover, there are currently no evidence-based methodological approaches which address the complex end of the problem spectrum, or how SATs can increase rigour and enhanced compliance with the ATSs.

There have, however, been intermittent attempts intended to improve quality through analytic rigour. Several studies have been published in order to illustrate the applicability and utility of Bayesian analysis to intelligence analysis.[128] Analytic inference by evidence marshalling and evaluation of source credibility[129], to better represent uncertainty in Analysis of Competing Hypothesis[130], and a study encouraging ICs to use Bayesian analysis as a vehicle for evaluation of premises[131] also serve as illustrative examples. However, recommendations in these studies have to our knowledge not been openly pursued in Western ICs.

Hall & Citrenbaum advocate the use of critical thinking in order to establish "rigor of advanced analysis" and to prevail in a complex analytic environment.[132] This concept has also been formally adopted in the U.S. IC as a required basic analytic skill and as an "…intellectually disciplined process…".[133] Moreover, systems thinking and critical thinking are also included in the core competencies for training and evaluation of intelligence analysts in ICD- 610.[134] However, Gentry critically compares this concept to the commercialism of SATs, and that the "worth" or effect has not been satisfyingly proved.[135]

Assessing analytic feasibility will not fully remedy current shortfalls and challenges in current analytic appraoches to uncertainty handling for, in particular, the complex end of the problem spectrum. However, in the light of problem framing and the above described five interrelated effetcs, we argue that quality through analytic rigour is likely to be enhanced by implementing an asessment of analytic feasibility. Thus, a differentiated and systematic appraoch to uncertainty analysis throughout key analytic processes, and in communication of estimative intelligence to consumers, will likely contribute to evolve current framework and applied practices in respect to analytic rigour. Barnett et al. also emphasize the importance of rigor through a

"…systematic process for evaluating analytic quality".[136] We believe that we can draw on the Barnett et al. study in terms of two of the LOTSA dimensions, "logical" and "thorough", in which analytic feasibility and a systematic approach to uncertainty handling may contribute to substantiate.

Even though this aspect of quality of intelligence does not contain concrete metrics or criteria, as highlighted by Marrin[137], or precise standards[138] , which in turn may not be suitable in estimative analysis, we believe that rigour in intelligence analysis is likely to improve. Thus, in partricular, an increased compliance to the intertwined facets of uncertainty handling in ATS # 02 (properly caveat and express uncertainties or confidence).

Conclusions, Policy Implications and Recommendations

This paper aims to contribute to development of the current framework and analytic practices for uncertainty handling in estimative intelligence. We used thematic analysis to examine the analytic tradecraft standards from ICD- 203, alongside ICDs 206 and 208. We have drawn four intertwined conclusions from this study.

First, by conducting an inductive thematic analysis of ICDs 203, while simultaneously developing a conceptual model of the Analytic Tradecraft Standards (ATS), we identified five main themes which involve recurring, overlapping and intertwined aspects of uncertainty handling. Common denominators across the themes comprise a basic requirement for conceptualization of uncertainty and a consistent, coherent, and systematic approach to uncertainty handling.

Second, we argue that lack of conceptualization and operationalization of uncertainty from both the analyst and consumer perspectives inhibit applied theory-building and development of an analytic framework.

Third, the extant framework is static and analytic practices lack sufficient epistemological justification and formalization. In addition, except for Bayesian analysis, there are currently no evidence-based methodological approaches which provide sufficient rigour and a consistent, coherent, and systematic approach to uncertainty analysis.

Lastly, we advocate that formalizing an assessment of analytic feasibility as an integral part of an analytic framework, is likely to enhance estimative processes with regards to problem analysis, traceability and transparency, derivation of estimative products, and to better meet consumers' uncertainty requirements.

To further advance analytic practices in the context of compliance with ICDs 203 and 208, we recommend development of an analytic framework with a differentiated and systematic approach to uncertainty handling. Such a framework should as a minimum incorporate an assessment of analytic feasibility including domain specific constraints and elicitation of consumers' uncertainty requirements, a problem typology, and a systematic and differentiated approach to uncertainty analysis.

Contemporary and future problems cannot be handled by single disciplines alone. In order to evolve, an analytic framework for estimative intelligence ought to draw on relevant interdisciplinary research. This requires the identification and evaluation of relevant application domains in which applied uncertainty handling and the intertwined analyst and consumer dimensions are embedded. Such tailored interdisciplinary studies have so far received little scholarly attention in the intelligence studies literature and should therefore be subject to further research.

Additional sources:

Appendix 01: Inductive Thematic Analysis of ICDs 203, 206, and 208

Disclosure statement

The authors report there are no competing or conflicting interests to declare.

Notes

[1] Johnson, "Intelligence shocks".
[2] Warner and McDonald, US Intelligence Community Reform Studies.
[3] U.S. Congress, Intelligence reform and terrorism…; U.S. WMD Commission, Commission on the Intelligence Capabilities; US H. Rept., 107-792- Joint Inquiry.
[4] ODNI, ICD- 203 (2007 and 2015).
[5] NATO, AJP-2; NATO, AJP-2.1; US JCoS, Joint Pub. 2-0.
[6] ODNI, ICD- 208 (2008 and 2017).
[7] Pigg, "Common Analytic Standards"; Immerman, "Transforming Analysis".
[8] Gentry, "Has the ODNI Improved…"; Marchio, "If the Weatherman Can…"; Marchio, "Analytic Tradecraft"; Marchio, "Review of National Intelligence"; Marcoci et al., "ODNI as an analytic ombudsman".
[9] Marchio, "Analytic Tradecraft"; Marchio, "If the Weatherman Can…" -32.
[10] Borek, "Developing an Understanding"; Borek, "Analytic Tradecraft in the U.S."; Mangio & Wilkinson, "Intelligence Analysis".
[11] Gentry, "Has the ODNI Improved" -651.
[12] McEachin, "The tradecraft of Analysis"; Davis, "CIA- A Compendium…".
[13] Marrin, "Analytic objectivity and science" -1.
[14] Gack, "Analytic Standards"; Marcoci et al., "ODNI as an analytic ombudsman".
[15] ODNI, ODNI Rating Scale.
[16] US Air Force, Air Force Handbook 14-133.
[17] U.S. Congress, Intelligence reform and terrorism.
[18] CIGIE, Quality Standards for Inspection; Gentry, "Has the ODNI Improved".
[19] U.S. DoD, Unclassified Report; U.S. DoD, Evaluation of Combatant Command; U.S. Senate, Report of the U.S. Senate.
[20] Braun & Clarke, "Using thematic analysis"; Vaismoradi et al., "Content analysis and thematic analysis".
[21] Ibid.
[22] Gentry, "Has the ODNI Improved…".
[23] Marshall, "The Joker is Wild".
[24] Heuer & Pherson, Structured Analytic Techniques; US Government, A Tradecraft Primer.
[25] Canton, "The Active Management of Uncertainty"; Muller, "Intelligence analysis".
[26] Bruce, Making analysis more reliable…- 181.
[27] See Appendix 01, themes 01- 04
[28] Butler et al., Review of Intelligence; U.S. Senate, Report on the U.S. Intelligence Community.
[29] Cooper, Curing Analytic Pathologies; Phythian, "The Perfect Intelligence Failure?"; Wirtz, "The Art of the Intelligence Autopsy".
[30] E.g. by Peterson, Appropriate factors to consider; Wozny, Optimizing Communication.
[31] Irwin & Mandel, Chapter 18.
[32] Wheaton, "Evaluating Intelligence" and "The Revolution Begins".
[33] Müller-Wille, "Intelligence and Democratic Accountability"; Moran, "The Pursuit of Intelligence History".
[34] NATO RTO, NATO Guide (Client-oriented Volume).
[35] Marrin, "Intelligence Analysis"; Adamski, "Enhancing the ODNI Analytic Standards".

[36] Heuer & Pherson, Structured Analytic Techniques.
[37] Dhami et al., «The analysis of competing hypothesis"; Chang et al., "Restructuring structured analytic techniques…".
[38] ODNI, ICD- 208.
[39] Cardillo, "A Cultural Evolution" 2.
[40] E.g. NATO, AJP-2.1; UK MOD, JDP 2-00; US DOD, Joint Publication 2-01.
[41] Rojas, Masters of Analytical tradecraft- 11.
[42] NATO RTO, NATO Guide (Analyst-oriented Volume)- xii.
[43] Michealson, MORS Workshop- 7.
[44] Mandel et al., "Policy for promoting analytic rigor…".
[45] Barnett et al., "Analytic rigour in intelligence".
[46] Marchio, "If the Weatherman Can…"; Marchio, "Analytic Tradecraft…"; Marrin, "Evaluating the Quality…"; Wheaton, "Evaluating Intelligence…".
[47] Marrin, "Evaluating the Quality…".
[48] Novak & Cañas, The theory underlying Concept Maps.
[49] Marcoci et al, "Better together: Reliable application of the Post-9/11 and Post-Iraq…".
[50] Isaksen & McNaught, "Uncertainty handling in estimative intelligence".
[51] Kent, "Words of Estimative Probability"; Wark, "The Definitions of Some Estimative Expressions".
[52] Rieber, "Communicating Uncertainty…".
[53] Ben-Israel, "Philosophy and methodology of intelligence"; Cooke, Experts in Uncertainty -23.
[54] Refsgaard et al., "Uncertainty in the environmental modelling process"; Samson et al., "A review of different perspectives on uncertainty".
[55] Ben-Israel, "Philosophy and methodology…".
[56] NATO, AJP-2; US DOD, Joint Publication 2-0.
[57] Connable, Military Intelligence Fusion; Flynn et al., Fixing Intel; Wentz, Lessons from Kosovo.
[58] Rotmans & van Asselt, "Uncertainty in Integrated Assessment".
[59] NRC, Review of Recommendations.
[60] Schultz et al., Decision making under uncertainty; Stewart, Uncertainty, Judgment, and Error.
[61] NRC, Review of Recommendations; Stewart, Uncertainty, Judgment, and Error.
[62] Herbert, "The Intelligence Analyst as Epistemologist" 667.
[63] Johnston, "Analytic Culture".
[64] Betts, "Analysis, War, and Decision"; Duvenage, Intelligence Analysis-Knowledge Age; Fingar, Reducing Uncertainty; Friedman & Zeckhauser, "Assessing Uncertainty" and "Why Assessing Estimative Accuracy"; Lowenthal, "Towards a Reasonable Standard".
[65] Boschetti, "A Graphical Representation of Uncertainty"; Skinner et al., "A review of uncertainty"; van der Keur et al., "Identification of major sources of uncertainty…".
[66] Friedman & Zeckhauser, "Assessing Uncertainty…".
[67] Sigel et al., "Conceptualizing uncertainty…"; Winkler, "Embracing Complexity and Uncertainty…".
[68] Mangio & Wilkinson, "Intelligence Analysis…".
[69] Borek, "Developing an Understanding…"- 1; "Analytic Tradecraft"; "Developing a conceptual model…".
[70] Breakspear, "A New Definition"; Clark, Intelligence Analysis; Hulnick, "What`s wrong with the Intelligence Cycle".
[71] NATO, AJP-2.1; UK MOD, JDP 2-00.
[72] NATO, CCIRM; NATO, AJP-2.
[73] DIA, Analytic Tradecraft Guidance.
[74] Comprehensively described by e.g. O`Hagan et al., Uncertain Judgments; Cook, Experts in Uncertainty.
[75] U.S. EPA, Expert Elicitation- 24.
[76] Friedman & Zeckhauser, "Analytic Confidence…"; Peterson, Appropriate Factors.

[77] Friedman & Zeckhauser, "Analytic Confidence…"; Irwin & Mandel, "Communicating uncertainty in national…".
[78] Friedman & Zeckhauser, "Analytic Confidence…".
[79] Irwin & Mandel, "Improving information evaluation"; Chapter 19.
[80] Dhami et al., "The analysis of competing hypotheses…".
[81] Friedman & Zeckhauser, "Handling and Mishandling…"; "Analytic Confidence…".
[82] Isaksen & McNaught, "Uncertainty handling…".
[83] Hanson, "The Admiralty Code"; Irwin & Mandel, Chapter 19; Samet, Subjective Interpretation of Reliability.
[84] Irwin & Mandel, Chapter 19.
[85] Marrin, "Understanding and improving intelligence analysis…".
[86] Borek, Analytic tradecraft…; Knorr, Foreign Intelligence and the Social Sciences
[87] Bacheș-Torres & Torres-Bacheș, "Cross-domain approaches…"; Marrin, "Understanding and improving…".
[88] Marchio, "If the Weatherman Can…"; Wheaton, "Evaluating Intelligence…" and "The Revolution Begins…".
[89] Friedman & Zeckhauser, "Handling and Mishandling…"; Javorsek II & Schwitz, «Probing Uncertainty…".
[90] Lowenthal, "Towards a Reasonable Standard…"-314.
[91] E.g. Ben-Israel, "Philosophy and methodology…"; Knorr, Foreign Intelligence…; NATO, AJP-2.
[92] E.g. Dhami et al., "Improving Intelligence Analysis…"; Mandel, "Accuracy of Intelligence…"; ODNI, National Intelligence Strategy.
[93] Hill et al., "Building understanding…"-188.
[94] Lynham, "The General Method…"; Marrin, "Improving Intelligence Studies…".
[95] Hill et al., "Building understanding…"-187.
[96] Bray & Storch, "Prediction or Projection?"-535.
[97] Dhami et al., "Improving Intelligence Analysis…"; Friedman & Zeckhauser, "Why Assessing Estimative Accuracy…"; Mandel, "Can Decision Science Improve…".
[98] Marchio, "How good is your batting average?"; Marrin, "Evaluating the Quality…".
[99] Gentry, "The Professionalization of Intelligence Analysis"; Marrin, "Understanding and Improving…".
[100] E.g. Benford et al., "Guidance on Uncertainty Analysis…"; IPCS, Uncertainty and Data Quality.
[101] Menkveld, "Understanding the complexity of intelligence problems"-4.
[102] Coulthart, "What's the problem?"-636-638.
[103] Dhami et al., "Critical Review of Analytic Techniques…".
[104] Fishbein & Treverton, Making Sense of Transnational Threats; Moore, Sensemaking.
[105] Benford et al., "The principles and methods behind EFSA's Guidance on Uncertainty"; van der Sluijs, "RIVM/ MNP Guidance for Uncertainty Assessment and Communication".
[106] Marrin, "Understanding and improving intelligence analysis...".
[107] Dhami et al., "The analysis of competing hypotheses…"; Mandel, "The occasional maverick…"; Irwin & Mandel, "Communicating uncertainty in national…".
[108] E.g. Marrin, "Evaluating CIA's Analytic Performance"; Phythian, "Intelligence analysis today and tomorrow".
[109] Betts, "Analysis, War, and Decision"; Davis, "The Kent-Kendall debate of 1949"; Gomez, "Intelligence reform commissions…"; Marrin, "Rethinking Analytic Politicization"; Scott & Jackson, "The Study of Intelligence…".
[110] Davis, "The Challenge of Managing Uncertainty"; Marchio, "If the Weatherman can…"; Phythian, "Intelligence analysis today and tomorrow"; Wheaton, "Evaluating Intelligence…"; Wolfberg, "When generals consume intelligence…".
[111] Marrin, "Evaluating the Quality of Intelligence…".
[112] E.g. Doyle et al., "Communicating model uncertainty…"; Etienne et al., Final report: Clear Communications and Uncertainty.

[113] Wolfberg, "When generals consume intelligence…"; Lipshitz & Strauss, "Coping with Uncertainty…"; van den Heuvel et al., "Coping with uncertainty; Police strategies…".
[114] Raadgever et al., "Uncertainty management strategies…".
[115] Gabbert et al., "Uncertainty analysis in integrated assessment…"-131.
[116] Canton, "The Active Management…"; Immerman, "Transforming Analysis…".
[117] Bruce, Making Analysis…; Herbert, "The Intelligence Analyst…"; Marrin, "Analytic objectivity…"; Vrist Rønn & Høffding, "The Epistemic Status of Intelligence…".
[118] Marchio, "If the Weatherman Can…".
[119] Marrin, "Why strategic intelligence analysis…".
[120] Wirtz, "The Art of the Intelligence Autopsy".
[121] Bacheș-Torres & Torres-Bacheș, "Cross-domain approaches"; Vogel & Tyler, "Interdisciplinary, cross-sector Collaboration…".
[122] ODNI, ICD- 205.
[123] Heuer & Pherson, Structured Analytic Techniques.
[124] Thomson et al., A Typology for Visualizing Uncertainty.
[125] Walker et al., "Defining Uncertainty: A Conceptual Basis"-6.
[126] Boschetti, "A Graphical Representation of Uncertainty"-152.
[127] Artner et al., Assessing the Value, Chang, "Restructuring structured analytic techniques…", Coulthart, "An evidence-based evaluation…".
[128] Fisk, The Sino-Soviet Border Dispute; Schweitzer, "Bayesian analysis"; Zlotnick, "Bayes' Theorem".
[129] McNaught & Sutovsky, "Representing Variable Source Credibility…" and "Evidence Marshalling…".
[130] Karvetski et al., "Structuring and analyzing…".
[131] Irwin & Mandel, Chapter 7.
[132] Hall & Citrenbaum, Intelligence Analysis -33.
[133] US Air Force, Air Force Handbook -29.
[134] ODNI, ICD-610- Competency Directories for the Intelligence Community Workforce.
[135] Gentry, "Has the ODNI Improved…" -650.
[136] Barnett et al., "Analytic rigour in intelligence"- 39.
[137] Marrin, "Evaluating the Quality…".
[138] Michealson, MORS Workshop- 7.

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Tables and figures

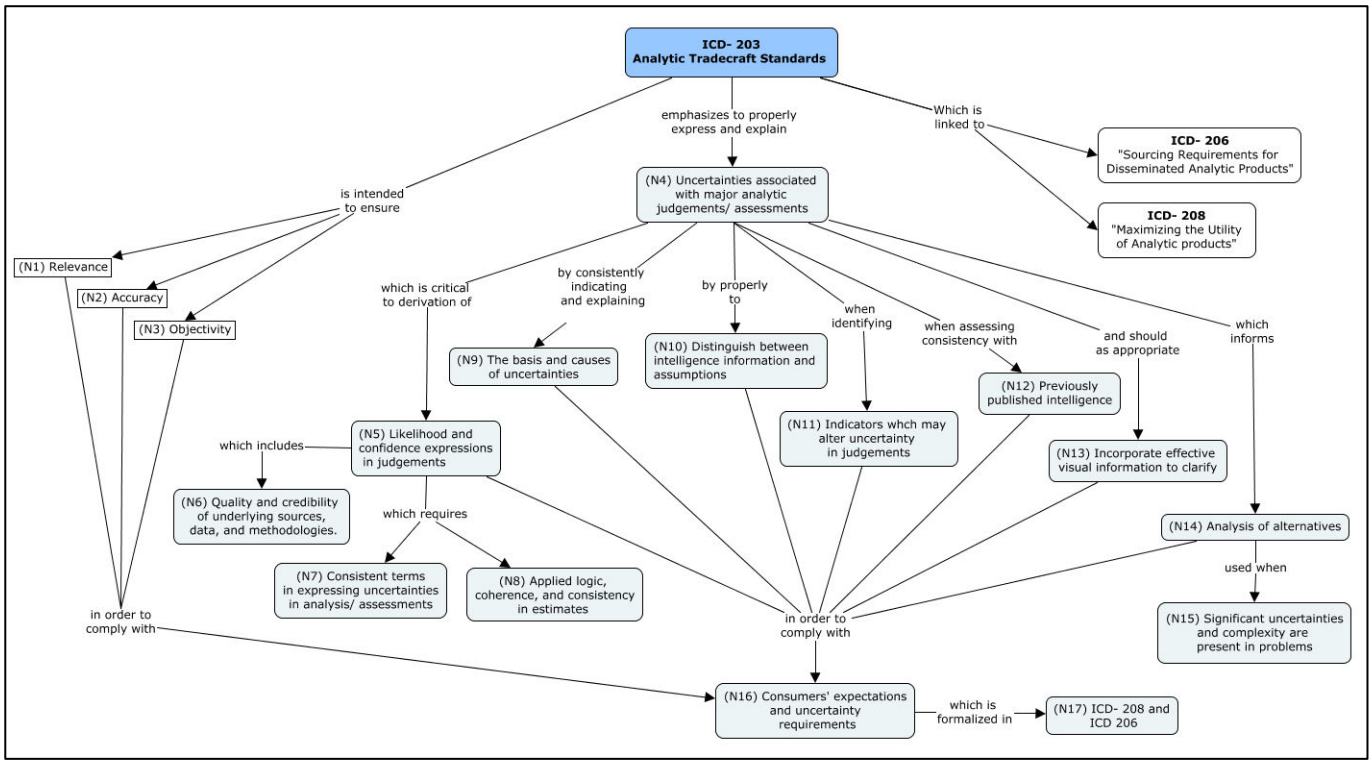
Table 01: The Analytic Tradecraft Standards- ICD-203 (verbatim)

#	Analytic Tradecraft Standards (ICD- 203)
1	Properly describes quality and credibility of underlying sources, data, and methodologies.
2	Properly caveat and express uncertainties or confidence in analytic judgments.
3	Properly distinguish between underlying intelligence and analyst's assumptions and judgments.
4	Incorporate analysis of alternatives.
5	Demonstrate customer relevance and addresses implications.
6	Use clear and logical argumentation.
7	Explains change to or consistency of analytic judgments.
8	Make accurate judgments and assessments.
9	Incorporate effective visual information where appropriate.

Table 02: Extracted elements from inductive thematic analysis of ICDs 203, 206 and 208

Verbatim extractions from ICDs 203, 206, and 208	Initial coding	Themes w/ clustered codes
ICD- 203 (Analytic Standards)		
ATS # 02- Properly *expresses* and *explains uncertainties* associated with major analytic judgments 1. Indicate and *explain* the *basis for the uncertainties* associated with major analytic judgments. 2. Analytic products should note *causes of uncertainty* (e.g. *type, currency*, and amount of information, *knowledge gaps*, and *the nature of the issue*) and explain how *uncertainties affect analysis* (e.g., to what degree and *how a judgment depends on assumptions*).	*T 2: Explain basis for uncertainties* *T 2: Causes of uncertainty* *T 1: Address knowledge gaps* *T 2: Influence by uncertainty* *T 1: Handling assumptions* *T 4: Consistent terminology*	**T # 01: Assumptions and indicators** - Address knowledge gaps - State influence - Altering judgements **T # 02: Uncertainty** - Identify and explain causes - Systematic uncertainty analysis - Influence by key uncertainties - Assessment of uncertainty - Warranted accuracy
ATS # 07- Explains *change* to or *consistency* of analytic judgments 1. …should state how their *major judgments* on a topic are *consistent with* or represent a change from those in *previously published analysis*… 2. …*make clear* how *new information or different reasoning led to the judgments* expressed in them.	*T 4: Consistency in analytic products* *T 4: Clear and coherent reasoning* *T 2: Adding new information* *T 3: Explaining change*	**T # 04: Analytic rigour** - Inference with uncertainty - Logic and coherence in reasoning - Analytic consistency

Figure 01: Intertwined aspects of uncertainty handling embedded in ICD- 203 (ATS)





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Towards a better framework for estimative intelligence – addressing quality through a systematic approach to uncertainty handling

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