Understanding Uncertainty in Intelligence Analysis

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To quote Voltaire, “Uncertainty is an uncomfortable position, but certainty is an absurd one”. Intelligence analysts are tasked with managing uncertainty for decision makers, but they also face uncertainty of their own. Indeed, analysts struggle with different types of uncertainty, most of which are given little to no attention by researchers working in intelligence studies. Our focus remains firmly on the uncertainty inherent in intelligence products in general, and futures-oriented intelligence estimates in particular. This is unfortunate as the problem of uncertainty extends far beyond the subject the analyst is working on, and includes: the analyst’s goals; the outcomes they hope to achieve; their knowledge of their internal and external working environment, etc. This paper provides a first attempt to map the various types of uncertainty faced by intelligence analysts. It also discusses potential remedies and the implications for the training and development of intelligence professionals. The paper combines outputs of a broad, interdisciplinary literature review with the results of our work on two EU-funded projects, the FP7-funded VALCRI project (www.valcri.org), and the Global Crisis Response Support Program (www.gcrsp.eu), an extended capacity building project for analysts working in the Americas and the Caribbean.

All intelligence analysts have to contend with uncertainty. Understanding the many types of uncertainty that pervade the process of intelligence analysis is critical to improving the quality of intelligence outputs. Intelligence analysts face the sum of two types of uncertainty. One is the uncertainty inherent in the intelligence product (in other words, the uncertainty related to the issue they have been tasked to address). The second type of uncertainty extends beyond the subject of analysis and includes the process employed, the analyst’s objectives, and the internal and external environment the analyst works in.

While intelligence scholars have dedicated a significant amount of research to the first type of uncertainty, the second type – and the variables that inform it – rarely gets the attention it deserves. This is unfortunate as this second category can be hugely detrimental. Human knowledge is almost always incomplete, and our rationality is bounded. Yet, most humans are poor at dealing with uncertainty and find it cognitively and emotionally challenging.

This paper surveys the recent literature on uncertainty and identifies the twelve types of uncertainty intelligence analysts routinely confront. Inevitably, every typology simplifies a complex reality. Nevertheless, the one presented can be used to orient future research and identify suitable remedies.

On Uncertainty

Defining Uncertainty

To date, scholars have failed to converge on a single definition of uncertainty (Lipshitz & Strauss, 1997; Brugnach, Dewulf, Pahl-Wostl, & Taillieu, 2008; Grote, 2009). "There are almost as many definitions of uncertainty as there are treatments of the subject", observes Argote (1982, p. 420). The sheer number of definitions is not the only challenge researchers have to face. In the literature on decision making, risk and ambiguity are treated by some scholars as separate *concepts* (see, for example, Klinke and Renn (2002), who distinguish between uncertainty, complexity, and ambiguity while discussing their impact on risk management). Others (e.g. Anderson (1981)) see them both as *synonyms* of uncertainty. Others still see risk and ambiguity as *types* of uncertainty (see, for example, Brugnach, et al, 2008).

In light of the above, this paper uses the definition proposed by Lipshitz and Strauss (1997) who defined uncertainty "as a sense of doubt that blocks or delays action" (p. 150). Lipshitz and Strauss (1997) argue that uncertainty has three features (p. 151):

1. It is subjective (different individuals may experience different doubts in identical situations)
2. It is inclusive (no particular form of doubt, e.g., ignorance of future outcomes, is specified)
3. It conceptualizes uncertainty in terms of its effects on action.

We chose this definition exactly because of uncertainty's impact on action, as well as its consequences, such as indecisiveness and procrastination. Admittedly, however, this definition does have a drawback, which its authors readily acknowledge: it replaces "uncertainty" with the synonymous term "doubt". This would be fine were it not for the fact that these two terms are not entirely equivalent. Nevertheless, the definition is adequate for our purposes, and serves as a useful point of departure.

Understanding the Different Types of Uncertainty

One's understanding of uncertainty can be furthered if one acknowledges its different *types*. Alas, there is some debate here too. Lipshitz and Strauss (1997) classify uncertainty by issue and source. Classification by issue focuses on what the person can be uncertain about. According to Lipshitz and Strauss (1997), uncertainty can concern the character of a situation, available alternatives, and possible outcomes. Meanwhile, classification by source considers what causes the uncertainty, specifically incomplete information, inadequate understanding, and undifferentiated (equally unattractive or attractive) alternatives. Lipshitz and Strauss' (1997) distinction, however useful, simplifies a phenomenon that is both nuance and complex. As this paper surveys the different types of uncertainty experienced by intelligence analysts, it is necessary to examine alternative typologies to see how other researchers approach the different dimensions of uncertainty.

To begin, there are two main issue-based typologies: general and domain specific. With regard to the first category, the typology offered by Berkeley & Humphreys (1982) is a good example for it expands upon the framework proposed by Lipshitz & Strauss (1997) describing no less than seven categories of uncertainty. Quoting these authors, "[t]hese seven types are:

1. Uncertainty about the probabilities of outcomes of subsequent events, conditional on what has preceded them in the act-event sequence between immediate acts and consequences.
2. Uncertainty about the probabilities of subsequent events, conditional on the occurrence of other events extraneous to the sequences in (i).
3. Uncertainty about how to incorporate prior information (e.g. results of prior sampling, base rate in a reference population) in determining the probability of a subsequent event.
4. Uncertainty about how to conceptualise the worth of consequences: assessing a consequence's utility requires the generation of a single number describing its wholistic (and entire) "moral worth". When more than one criterion of "worth" is involved (as in the "job" example above) uncertainty can arise about how to combine these criteria.
5. Procedural uncertainty, which Hogarth et al. (1980) describe as "uncertainty concerning means to handle or process the decision", e.g., specifying relevant uncertainties, what information to seek, and where, how to invent alternatives and assess consequences, etc.
6. Uncertainty about how the decision maker will feel, and wish to act having arrived at a subsequent act (choice point) after intervening events have unfolded "for real".
7. Uncertainty about the extent one possesses agency for inducing changes in the probabilities of subsequent events (conditional on acts yet to be taken, as in (i), above)

through being able to alter relations between states of the world (Savage 1954)" (p. 206).

The typology suggested by Milliken (1987) is also general. Milliken (1987) describes three types of perceived uncertainty about the environment. The first type is a state uncertainty which individuals experience "when they perceive the organizational environment, or a particular component of that environment, to be unpredictable" (Milliken, 1987, p. 136). The second one is an effect uncertainty which "is defined as an inability to predict what the nature of the impact of a future state of the environment or environmental change will be on the organization" (Milliken, 1987, p. 137). Finally, the third type is a response uncertainty "defined as a lack of knowledge of response options and / or an inability to predict the likely consequences of a response choice" (Ibid.). Bradley & Drechsler (2013) supplement Milliken's classification with three additional categories that include: ethical uncertainty which "arises if the agent cannot assign precise utilities to consequences", option uncertainty which "arises when the agent does not know what precise consequence an act has at every state", and state space uncertainty which exists "when the agent is unsure how to construct an exhaustive state space" (p. 1225).

Further, numerous researchers have developed issue-based typologies of uncertainty specific to particular domains. For example, Abbot (2005) identifies five types of uncertainty that affect planning: causal uncertainty (uncertainty about the causal relationships), human and organisational uncertainty (uncertainty about the intentions and present and future actions of individuals and organisations), external uncertainty (uncertainty about the character and influence of the social environment), value uncertainty (uncertainty about people's views and values), and chance uncertainty (uncertainty about unforeseeable one-chance events). In a similar vein, Chapman and Ward (2011), discuss the different types of uncertainty that affect project management. Among others, they mention:

- Uncertainty associated with project parties
- Uncertainty about objectives and priorities
- Uncertainty about design, operation, and resources for operation
- Uncertainty about design, execution, delivery and termination logistics

Many researchers also study manifestations of uncertainty in the context of organizational change. Two issue-based typologies developed in this regard include those by Bordia et al. (2004), and by Allen et al. (2008). According to Bordia, at al. (2004), the three principal types of uncertainty experienced by employees during organizational change include (1) uncertainty about direction, proceeding, and other features of change; (2) uncertainty about the chain of command, policies, practices, division of work, etc., and (3) uncertainty about job security, career opportunities, changing roles and responsibilities, etc. Allen, et al. (2008) offers a corresponding typology distinguishing between strategic uncertainty (uncertainty about the impact of organizational change on the organization),

implementation uncertainty (uncertainty about the implementation of organizational change), and job-related uncertainty (uncertainty about the impact of organizational change on one's employment, career prospects, etc.).

Source-based classifications are as important as issue-based classifications. Understanding the sources of uncertainty is crucial as it informs response strategies. One interesting source-based typology distinguishes between epistemic uncertainty or lack of knowledge (also known as informational or cognitive uncertainty), ontological uncertainty or unpredictability (also known as variable or ontic uncertainty) and ambiguity (also known as indeterminate uncertainty), which occurs when there are multiple alternative interpretations of the system with no unique understanding being possible (Raadgever, et al., 2011). While epistemic uncertainty is easy to understand, a difference between unpredictability and ambiguity may be confusing. In simplest terms, unpredictability occurs when we know what possible scenarios are, but we do not know which one will occur. Ambiguity, in turn, occurs when a set of likely scenarios cannot be identified.

The "lack of knowledge" mentioned by Raadgever, et al. (2011) – and included in the aforementioned typology by Lipshitz & Strauss (1997) – is probably the most frequently mentioned source of uncertainty. However, the relationship between uncertainty and knowledge is not as simple as it may seem. In fact, uncertainty can prevail regardless of the amount of knowledge and information available (Van der Sluis, 1997; Grote, 2009). To this end, rather than talking about incomplete information or knowledge, Funtowicz and Ravetz (1990) talk about inadequate information. Information and knowledge can be inadequate not only because they are lacking, but also because they are inexact, or unreliable. The "Four Quadrants" model, which many intelligence scholars are likely to be familiar with, is also a result of knowledge-focused studies of uncertainty. According to this model, uncertainty can be divided into fathomable uncertainty consisting of "known knowns" and "known unknowns", and unfathomable uncertainty consisting of "unknown knowns" and "unknown unknowns" (Cleden, 2009, p. 13). D'Souza and Renner (2016) combine the "Four Quadrants" model with the Cynefin framework developed by David Snowden which turns the latter into yet another tool for understanding the different types of uncertainty and its sources.

Knowledge is also at the center of another typology worthy of mention. Kahneman and Tversky (1982b) distinguish between internal uncertainty (or ignorance) caused by the lack of knowledge, and external uncertainty, or the uncertainty resulting because "causal systems [in the external world] have dispositions to produce different events" (p. 13). Kahneman and Tversky (1982b) argue that internal uncertainty can be controlled. What cannot be controlled is external uncertainty. Thus, uncertainty about the past is a form of ignorance that can be controlled through study or enquiry. Uncertainty about the future, however, cannot be controlled as we can only project what we think might happen going forward.

Kahneman and Tverky's classification adds another dimension to the classification mentioned by Raadgever, et al. (2011). Here, epistemic uncertainty is a form of internal uncertainty while ontological uncertainty and ambiguity are both forms of external uncertainty. It is also similar to what Walker, et al. (2003) present as the classification of

uncertainty by its nature. Here, Walker, et al. (2003) distinguish between epistemic uncertainty, which corresponds to the internal uncertainty conceptualized by Kahneman & Tversky (1982b), and variability uncertainty, which is an equivalent of external uncertainty.

Walker, et al. (2003) do not stop there, adding more nuance to their analysis. In addition to a classification "by nature", their three-level framework proposes classification "by location" and classification "by level" (p. 9-13). Walker, et al. (2003) stress that, when dealing with uncertainty, it is important to accurately evaluate its "level", or its extent. In other words, we must determine how uncertain we are. An accurate evaluation of level is significant as it conditions our ability to reduce uncertainty.

Finally, there are researchers who combine issue- and source-based classifications. A typology by Cleden (2009) is a good example. Cleden (2009) attempts to look beyond the lack of knowledge as the first-order source of uncertainty. He offers a simple categorisation of uncertainty, depending on the source that generates the lack of knowledge: "uncertain information", "uncertain understanding", "uncertain complexity", and "uncertain tempo" (Cleden, 2009, p. 10-12). "Uncertain information" implies the lack of complete or perfect knowledge. "Uncertain understanding" occurs when one cannot construct a model of the system that effectively explains its functioning. "Uncertain complexity" is driven by an issue's complexity and refers to imperfect information on critical system dependencies. "Uncertain tempo" is caused by temporal uncertainty, including a situation when we know "what" but we do not know "when". One could supplement this typology with event uncertainty described by Ward and Chapman (2012) which presents a situation when the analyst has doubts about both the "what" and the "when". Ward and Chapman (2012) describe event uncertainty as the lack of knowledge associated with events, conditions, circumstances or scenarios that may or may not happen.

Summing up, there is a lack of agreement among scholars on both a definition and a universal typology of uncertainty. When thinking about uncertainty, it is important to remember that it can vary depending on the issue at hand, how it arises, its source, its nature, whether it is external or internal, and its level (or rather how uncertain we are).

The Impact of Uncertainty

A lack of understanding and effective response to uncertainty can be costly for both organizations and individuals. Uncertainty can cause psychological, emotional, and even physical distress. It can also lead to unforeseen consequences, lost opportunities, policy blunders, poor decisions and faulty actions.

Not surprisingly, our brains far prefer the alternative. Rock (2009a) compares the brain's craving for certainty to addiction (p. 121-122):

> *Like an addiction to anything, when the craving for certainty is met, there is a sensation of reward. … It's part of the reason that games such as solitaire, Sudoku, and crossword puzzles are enjoyable. They give you a little rush from creating*

> *more certainty in the world, in a safe way. Entire industries are devoted to resolving larger uncertainties: from shop-front palm readers, to the mythical "black boxes" that can supposedly predict stock trends and make investors millions. Some parts of accounting and consulting make their money by helping executives experience a perception of increasing certainty, through strategic planning and "forecasting." While the financial markets of 2008 showed once again that the future is inherently uncertain, the one thing that's certain is that people will always pay lots of money at least to feel less uncertain. That's because uncertainty feels, to the brain, like a threat to your life.*

Elsewhere, Rock (2009b) argues that uncertainty results in an error message in the brain. Instead of relying on familiar processes, the brain has to use additional neural energy to cope with unfamiliarity. This affects our reasoning, memory, and overall performance. Life is uncertain by default. However, when the level of uncertainty increases beyond the usual, it challenges our brains leading to bad decisions and actions, emotional discomfort and even panic.

Our preference for certainty, and our discomfort with uncertainty, are manifest throughout the day. Many of us dread saying "I don't know". Admitting uncertainty makes us uncomfortable and feels disempowering (D'Souza & Renner, 2016). Further, while certainty is typically associated with power, uncertainty is seen as a weakness. We often expect certainty from people with authority, such as politicians and domain experts (Ibid.). Our trust in them is likely to dwindle if they admit their ignorance. Moreover, when faced with conditions of uncertainty, we attempt to regain control. As D'Souza and Renner (2016) explain, "When things are changing and becoming more unpredictable, stress levels rise and we fear more at the mercy of our circumstances. Control appears as a defense, an antidote to Not Knowing; a grasp for certainty. We can experience ourselves tightening or closing down. Or we can apply more power and become more directive and authoritarian" (p. 120).

Although every human brain craves certainty, people differ in the degree to which they are willing to accept uncertainty. There are those who thrive under uncertainty and those who are paralysed by it. An individual's attitude toward uncertainty can be measured via the Intolerance of Uncertainty scale developed by a group of Canadian researchers in 1994 (Freeston, Rhéaume, Letarte, Dugas & Ladouceur, 1994). Those with a high level of intolerance are prone to worry (Buhr & Dugas, 2002; Laugesen, Dugas & Bukowski, 2003), anxiety and depression, among other psychological conditions (see Brown, Antony, & Barlow, 1992; Greco & Roger, 2001, 2003; Dugas, Gagnon, Ladouceur, & Freeston, 1998; Dugas, Gosselin, & Ladouceur, 2001; Tolin, Abramowitz, Brigidi, & Foa, 2003).

Further, those with low tolerance of uncertainty struggle when faced with ambiguous tasks (Buhr & Dugas, 2002) or ambiguous information (Heydayati, Dugas, Buhr, & Francis, 2003). This, in turn, affects their problem-solving ability. Decision making and action taking can be delayed as they have a tendency to excessively search for information (Tallis, Eysenck, & Mathews, 1991; Kramer, 1999; Berger & Calabrese, 1975). The stress caused by uncertainty

can also have physical effects, such as high blood pressure and an elevated heart rate (Greco & Roger, 2001, 2003).

In addition to being emotionally challenging, uncertainty is also cognitively demanding. It impedes decision making, choice behavior, and action taking. For the most part, people are poor at making judgments under uncertainty. As Kahneman & Tversky (1982a) showed, our brains developed a number of simplified approaches that are used to deal with this kind of decision making. Three examples of similar heuristics include: representativeness (an assessment of the problem based on how closely its representation matches a typical case); availability (an assessment of the problem based on how easily that problem is recalled, which is often skewed by recent and memorable cases); and anchoring (which involves clinging to an initial, diagnostic hypotheses even as contradictory evidence accumulates). Heuristics tend to lead to biases and other distortions to judgment. Decision making is about choosing between alternative options. Yet, our poor ability to cope with uncertainty can disrupt this process. For example, we avoid options for which probability is unknown due to missing information (Baron, 2007). Baron (2007) also notices that uncertainty can hinder action taking (p. 285):

> *Uncertainty can affect our reasons for acting. We may be reluctant to act without some clear reasons, and reasons may be unclear if we do not know the outcome. If we are uncertain about the reasons, we may prefer to defer the decision.*

On the organizational level, uncertainty can diminish effects, or even lead to the complete paralysis of strategic planning (Milliken, 1987). It can disrupt group decision making, reduce individual and organisational performance, and affect motivation and job satisfaction (Mitchell, 1979). It can also lead to the tendency to making the work environment overly structured (Ibid.). The latter is likely to deprive the organization of agility, which is critical when operating in a rapidly changing environment. Further, uncertainty can lead to faulty decisions with long-term debilitating consequences for the organization. For example, if, as a result of temporal uncertainty, events occur faster than expected, the affected organization will be forced to make hasty or ill-informed decisions. Errors in decision-making will also occur when the situation develops slower than expected. In general, if events do not occur as planned, the affected organisation tends to consume more resources than estimated and is more likely to face other problems, such as the accumulation of incomplete tasks (Cleden, 2009). As Mack (1971) summed up, “Uncertainty deteriorates the results of most purposive procedures relative to what they would be if all the relevant information were readily available”.

Uncertainty and Intelligence Studies

Intelligence scholars pay limited attention to the challenge of uncertainty. There is limited acknowledgement of the different types of uncertainty affecting intelligence

professionals. Most research focuses on the uncertainty generated when drafting intelligence products or when engaging in estimative intelligence. Until now, and to the best of our knowledge, no attempt has been made to develop an intelligence-specific typology of uncertainties. Moreover, any research on this topic has originated in the United States and focuses on the experience of the US Intelligence Community.

Uncertainty is implicit in intelligence products. Intelligence helps decision makers deal with issues that are complex and ambiguous, and, as Canton observes (2008), "As complexity and ambiguity increase, uncertainty rises" (p. 489). There is some debate over how "realistic" the objectives of analysis can be when dealing with the uncertainty inherent in those issues analysts are tasked to address.

Many researchers consider the reduction of uncertainty for the decisionmaker the primary goal of intelligence (Wheaton & Beerbower, 2006; Fingar 2011; Harris & Spiker, 2012; Prunckun, 2015). Others observe that sometimes the opposite is the case and intelligence unavoidably increases uncertainty as it reveals new unknowns (Jervis, 2010; Handel, 1987; Friedman & Zeckhauser, 2012; Marrin, 2017). In light of this, Friedman and Zeckhauser (2012) conclude that the goal of intelligence should not be to eliminate uncertainty but rather to assess it. These authors also observe that many methods traditionally used to eliminate uncertainty affect the quality of intelligence products. They further offer recommendations on how these methods could be amended so that they produce better results. Approaches to dealing with uncertainty are also discussed by Canton (2008) and Borg (2017). Canton (2008) advocates for the active management of uncertainty using four processes: "drilling", "counterstrategies", "calibration", and "transparent communication" (p. 491). The last category, in particular, receives a special attention in the intelligence domain.

Communicating uncertainty to decision makers has been the focus of a long research tradition among intelligence scholars. Intelligence analysts wishing to communicate intelligence as accurately as possible have to find a way of conveying uncertainty so that it is acknowledged and understood. Doing so, however, isn't easy.

Interest in this topic stretches back to the writings of Sherman Kent, the father of modern intelligence analysis. Kent (1964) noted that the way uncertainty is conveyed in intelligence products can lead to misinterpretation. He also proposed a standard set of verbal expressions, or words of estimative probability (WEPs), that an analyst can use to express uncertainty in a more uniform and unambiguous way. The same volume of *Studies in Intelligence* that published Kent's article also included a piece by Wark (1964) who attempted to assign numerical values to various WEPs. Since then, the debate has been over whether quantitative or qualitative metrics are best for communicating uncertainty.

This debate continued in earnest following the intelligence reporting on Iraq's weapons of mass destruction. The need to improve how uncertainty is communicated was stressed by the WMD Commission Report and the 2004 Intelligence Reform and Terrorism Prevention Act (Rieber, 2006). This prompted a new wave of research on the topic. For example, in 2006, Rieber critically reviewed various methods that can be used to communicate uncertainty and offered additional recommendations on their implementation

within the US Intelligence Community. In 2008, Weiss shed new light on the challenges associated with evaluating and communicating uncertainty within the intelligence domain by looking at the related experience of other professions. Shortly thereafter, Dieckmann, Mauro, and Slovic (2010) described the results of using numerical ranges to convey uncertainty, and Marchio (2014) described experiments with the use of numeric probabilities conducted within the US Defense Intelligence Agency (DIA) in the 1970s focusing on lessons learned that could inform more recent attempts at improving the way in which uncertainty is communicated to decision makers.

Undoubtedly, the research conducted so far has increased our understanding of how uncertainty should be assessed and conveyed. We better understand the challenge we face and the options we have when it comes to addressing it. Alas, most of the publicly available research on the subject is US-centric. Moreover, it is largely focused on the uncertainty inherent in intelligence products and ignores the other types of uncertainty prevalent in intelligence analysis and the intelligence profession in general.

This paper addresses the latter gap. The starting point for our research were two EU-funded projects, the FP7-funded Visual Analytics for Sense-making in Criminal Intelligence Analysis (VALCRI) project[1], and the Global Crisis Response Support Program (GCRSP)[2]. Over the last five years, these projects have given us considerable access to analysts working in intelligence and security entities in Europe and beyond. The VALCRI project alone let us interact with more than 120 analysts from over 30 different law enforcement and security agencies from 12 countries. These interactions, together with experience gained as consultants to intelligence organisations across the globe, has helped us develop a typology of the 12 types of uncertainty faced by intelligence analysts. We describe these below.

The Twelve Types of Uncertainty Encountered by Analysts

We outline below the twelve types of uncertainty faced by intelligence analysts. This typology reveals that the analyst's uncertainty landscape is far larger and more varied than we typically acknowledge. The analyst should be cognizant of all types and will often be expected to manage two or more at the same time.

- **Personal uncertainty** - uncertainty arising from the analyst's assumptions, capabilities, biases, and emotional states and traits
- **Task / Project uncertainty** - uncertainty related to the work to be done, the order in which the tasks are to be completed, etc.
- **Outcome uncertainty** - uncertainty related to the desired outcome(s) the analyst should pursue or contribute to

[1] Please see the project's website for more details: https://www.valcri.org
[2] Please see the project's website for more details: https://www.gcrsp.eu

- **Organisational uncertainty** - uncertainty pertaining to the analyst's immediate operating environment and what effect this will have on one's work (and vice versa)
- **Issue uncertainty** - uncertainty pertaining to the issue, topic, or region the analyst is working on
- **Policy uncertainty** - uncertainty related to the internal or external policies or processes the analyst's work should support
- **Course-of-action uncertainty** - uncertainty pertaining to the optimal course of action the analyst or organisation should pursue to achieve a desired end
- **Decision uncertainty** - uncertainty related to the competing options and decisions that need to be taken on strategic and operational factors
- **Environmental uncertainty** - uncertainty on one's external operating environment and the drivers that shape the analyst's work
- **Stakeholder uncertainty** - uncertainty vis-a-vis the stakeholders that inform or are affected by the analysts work
- **Informational uncertainty** - uncertainty related to the quality of data and sources the analyst has to work with
- **Futures uncertainty** - uncertainty related to future scenarios and over-the-horizon issues and trends

There are two important observations that should be made in relation to this typology. First, the existence of multiple types of uncertainty is further complicated by the fact that they are highly interdependent. For example, decision uncertainty is closely related to personal uncertainty, as each decision is informed by one's assumptions and can be influenced by one's biases. Decision uncertainty is also related to course-of-action uncertainty as decisions are typically made after consideration of alternative options. Put differently, every category of uncertainty is related to the others. This is illustrated in Figure 1 below. Second, our research suggests that uncertainty is not confined to the process of analysis alone. Rather, the twelve types of uncertainty influence every stage of the intelligence cycle: requirements planning, information collection, processing, analysis and dissemination.

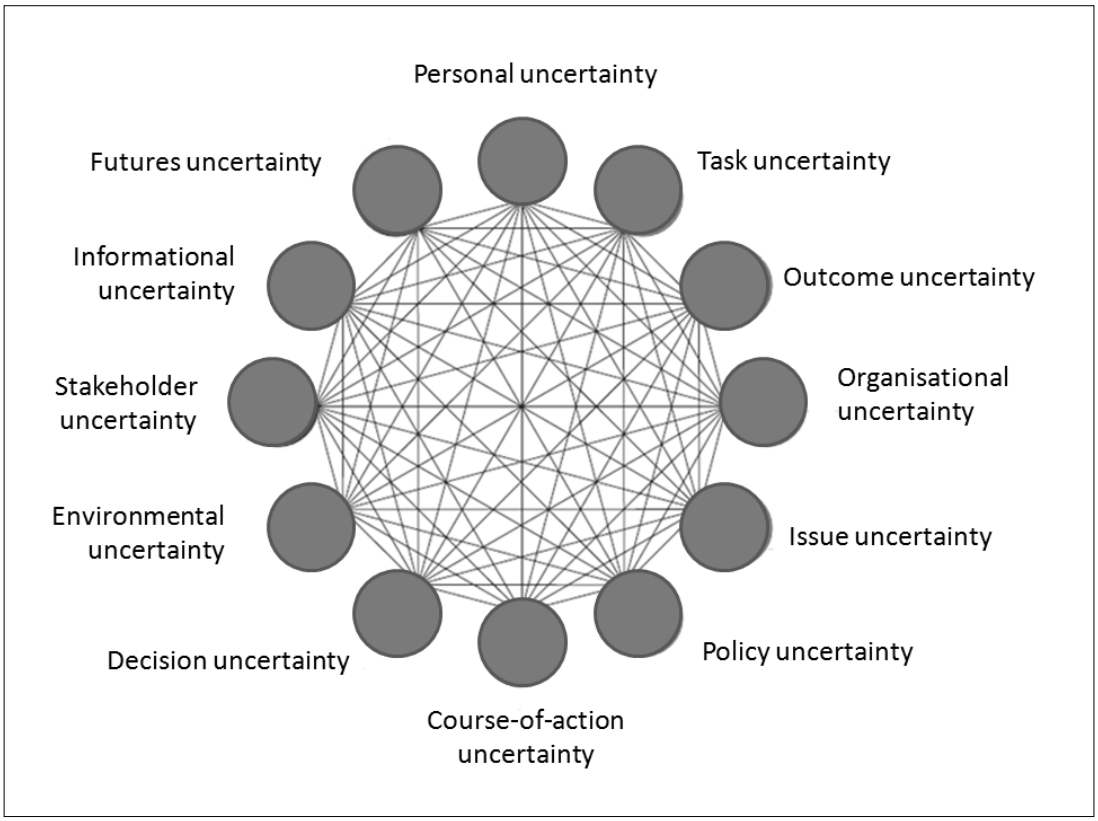

Fig. 5. Interdependencies between uncertainties in intelligence.

Responding to Uncertainty

The question remains: "How do we address the different types of uncertainty we have identified?" Uncertainty is ever present and eliminating it is an unattainable objective. Instead, our focus should be on its effective management. Analysts tend to ignore some categories of uncertainty, particularly those they are less familiar with, or those that make them uncomfortable. Other categories are dealt with informally. They rely on experience-based reasoning, intuition, and, often, luck. Informal approaches based on the use of experience and intuition certainly have value. However, it is difficult to see how they can produce fully refined and reliable outputs.

The twelve types of uncertainty listed above pose four unique challenges. First, analysts and their superiors have to identify the uncertainties they are facing or are likely to face in the future. Second, these uncertainties have to be understood in relation to:

- The specific issue that causes them (what are we uncertain about),
- The sources of uncertainty (why are we uncertain)
- The nature of uncertainty (whether it is internal or external)
- The level of uncertainty (how uncertain we are)

Third, the analyst has to decide which uncertainties to address and how. And fourth, they have to use the appropriate tools to manage the uncertainty.

The latter process requires uncertainty management skills that are rarely if never taught to analysts. Uncertainties can be approached using a variety of uncertainty management frameworks and structured methodologies (Brugnach, et al, 2008; Reymen, Dewulf, & Blokpoel, 2008; Cleden, 2009; Raadgever, et al., 2011). Alas, as the existence of these uncertainties has yet to be acknowledged in the intelligence domain, little is done to introduce these tools and techniques to the analytic process.

This is unfortunate as while managing uncertainty can be costly (Cleden, 2009), ignoring or mismanaging it can be costlier still. We do not know how the different types of uncertainty contribute to intelligence failure as no research has been done on this topic. That said, we can speculate on their impact as the effects of uncertainty on the effectiveness of organisations and individuals alike is well known. We posit, therefore, that turning analysts and their superiors into better uncertainty managers is essential to the improvement of outputs and outcomes of the analytic process. This can be done by amending existing curricula to better address the different types of uncertainty. It is essential we teach analysts how to decompose and address the uncertainties they confront, regardless of whether they are internal or external to the organisation. It is also important that they are equipped with the knowledge needed to mitigate or resolve such challenges. Failing to do so will impact the quality of intelligence outputs as well as any subsequent decisions taken.

Conclusions and Next Steps

Uncertainty abounds in the process of intelligence analysis. The approach presented in this paper stands in contrast to existing paradigms in the area of intelligence studies. The framework presented is intended to help analysts and their managers understand and manage the many types of uncertainty they confront. Much remains to be done to better understand the phenomenon of uncertainty and how it affects intelligence in general, and the process of intelligence analysis in particular.

We conclude this paper by suggesting four directions for further research. First, research is needed to better understand the challenge of communicating uncertainty in countries other than the US. Second, research is needed to understand the impact of uncertainty on the outputs of the analytic process and on intelligence failure in general. Third, research is needed on the tools and coping strategies analysts can use to manage the different types of uncertainty. Finally, we invite scholars and practitioners alike to critique, extend or amend the framework presented in this paper, and to explore how the different types of uncertainty manifest themselves at different stages of the intelligence cycle. We hope the typology presented here serves as a valuable point of departure, and we look forward to contributing further to any debates.

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