Handling and communicating intelligence information: A conceptual, historical and information design analysis

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Abstract

Effective communication of information is essential to intelligence work. This paper identifies the main obstacles to good communication: policy-related challenges; cognitive impediments; resource limitations; cultural and structural issues within intelligence communities; and technical information. To illustrate, it examines four cases when poor communication contributed to intelligence shortcomings. Via questionnaire and document survey, the study identifies the current state of practice in UK intelligence communities. The survey of visualization documents currently in use revealed errors against established principles of Information Design. Thus, to ensure better handling and dissemination of intelligence, there is a distinct need to apply Information Design principles.

Keywords: intelligence information; intelligence cycle, information design, information visualization, visual communication, dissemination

1. Introduction

'The process of relaying intelligence can distort its meaning.' [1]

It seems self-evident to write that intelligence is about information. Nonetheless, it is important to emphasize that the latter is integral to every stage of the Intelligence Cycle. The process of national security intelligence is about knowing what information you need, how to collect it, how to analyse it, and finally how to communicate it to those who use it in support of decision-making. In the words of James S. Major, a forty-year veteran of intelligence, 'In intelligence work, information is our life's blood.' [2]

And yet, the quest to better exploit national security information is hindered by a number of factors. Some of the main impediments are: limited resources, time pressure, scale and complexity of threat, organizational structure and culture, cognitive impediments (including confirmation bias, groupthink, mirror imaging etc.), and decision-makers lack of engagement with intelligence. These myriad challenges call for various responses. One area were advances can be made is improving the communication of information, since poor communication can exacerbate difficulties in the collation, analysis and dissemination stages of the intelligence cycle.

In this way, communication is defined as 'the imparting or exchange of information', [3] operating on the 'sender, message, receiver' schema. [4] This includes how information is shared, but also the form of presentation used for the message. The form of presentation, especially in its 'visual communication' guise, is the focus of this paper. According to the IDA (Information Design Association), for information to have impact, it must be easy to find, simple to use, and instantly understandable. [5] That is, information needs to be designed. With this in mind, this study looks at how information is shared in intelligence communities, with a particular focus on the visual organization and display of information.

There is a small, but growing literature dedicated to the task of communicating national security intelligence. [6] This interdisciplinary study, which brings together researchers from Intelligence Studies and Information Design, makes an original contribution to this literature. It was tasked specifically to assess how visualization of intelligence information can enhance the effectiveness of communication. In this study, information visualization approaches in intelligence communication include: infographics, charts, graphs, tables, pictograms, etc.; where color, graphic and typographic features are of high relevance. Visualization contributes to good communication by making information clear, concise, persuasive, actionable, and able to be processed quickly and accurately. If done properly, good communication of information should help mitigate the effects of mind-set and information overload; can improve receptivity in policy makers, and help maximize the allocation of resources. The benefits of good communication to intelligence work are described in the main body of the paper.

A broader aim of this study is to pioneer research that brings together the fields of information design and intelligence studies, both in academia and the public sector. More specifically, this study aims to answer the following research questions:

- How important is the effective communication of information in intelligence work?
- What are the obstacles to effective communication of information in intelligence work?

- Which principles of information design relate to the handling and communication of intelligence information? (Principles are here interpreted as a set of guidelines/rules on how to best use and organize graphics, typography, color, contrast, hierarchy, etc. to make information clear and accessible. Further breakdown of some of these principles can be seen in Table 1 in Section 5.2).
- How effectively is intelligence and security information handled and communicated in departments within government that conduct intelligence analysis ('intelligence communities').

To answer these research questions, this paper begins by identifying the significance of good information communication in the work of intelligence. Then, on the basis of theoretical and historical analysis, it identifies the main obstacles to good communication: policy-related challenges; cognitive impediments; resource limitations (especially in relation to information overload and time pressure); cultural and structural issues within intelligence communities; and technical and specialist information. To provide an historical basis for the analysis, the paper discusses four cases in which poor communication of information contributed to intelligence shortcomings: Pearl Harbor, 9/11, the UK's 45 minute claim on the Iraqi WMD programme, and recent terror incidents in the UK. These represent cases in which information was not clearly communicated, and thereby the message was not clearly received and understood by the receiver. It is important to note that the objective of this paper is not to explain intelligence failure per se. Rather, the focus of the paper is on the role of information communication and its contribution to shortcomings and failures in intelligence. Moreover, because the literature on intelligence information communication is so scarce, the case studies cited include shortcomings in communication that relate to both sharing and forms of visual presentation. The cases also cover communication issues at various stages of the intelligence cycle.

The work then discusses current research that was conducted with departments within government that conduct intelligence analysis. Specifically, the researchers conducted a questionnaire of existing staff and a document survey of existing forms of visual communication within the UK intelligence communities. [7] Responses from the questionnaire reveal the challenges of handling and visually communicating masses of information. The document survey reveals significant room for improvement in the visualization of information. The work concludes with an analysis of the contribution information design and visualization can make to the communication of intelligence information.

2. Why Good Information Communication is Important

Despite the requirement for clear and effective visual communication of intelligence, there is often a considerable gap between the intelligence that is communicated and the needs of the user. [8] This is the case in relation to both current intelligence and long-range estimates. [9] This is problematic, because as United States Intelligence Community Directive (ICD) 208 states, analysts should provide consumers with intelligence in a form they can easily share and use. [10] The fact that this often does not happen is explained by Information-gap theory. This describes a situation in which there exists a severe and consequential disparity between what one knows and what one needs to know to make effective decisions. [11] Good visual communication can help close the information-gap. There is evidence that receptivity improves when decision makers are presented with information that is clear and actionable. [12] The obvious conclusion to draw is that much commendable intelligence work is being wasted due to poor communication. This is certainly one of the conclusions of the 9/11 Commission Report, which

identified communication problems within the intelligence community, but also acknowledged the difficulty of making decision makers aware of the nature of the threat prior to the attack. [13]

The answer to an information-gap is not simply more information. Indeed, an increase in raw quantity can exacerbate uncertainty through information overload. Rather, and bearing in mind resource and time constraints, information needs to be communicated in a clear, concise and understandable form to those who likely do not have extensive knowledge of intelligence matters. [14] If analysts wish to provide effective decision aid to policy makers, then clear communication is essential. [15] This is especially important in an increasingly complex security environment, when policy makers and/or analysts have to make sense of, and prioritize amongst, vast arrays of security challenges. [16] The history of the President's Daily Brief (PDB) is evidence of the importance of clear visual communication. From President Truman onwards, the occupants of the White House have requested a clear format for the PDB. For example, President Ford liked short sentences and President Carter requested clear visual hierarchy in text. [17] These, and other communication techniques that are well established in information design, should be applied to all intelligence products.

There is more, however, to good intelligence communication than simply making the information clear and understandable. To avoid costly mistakes, intelligence reports must include important information regarding the veracity of the intelligence. For example, products should include reference to the limits of intelligence and the levels of certainty contained within. This was a key recommendation of the Butler Review. [18] There are various methods to communicate uncertainty. These include numeric and linguistic probabilities, but could also take the form of visual cues, including the use of color, size, placement, etc. [19] Underlying assumptions must also be evident in any report. [20] The troubled intelligence surrounding Iraq's Weapons of Mass Destruction programme was built upon a shared assumption (shared by all major intelligence communities and United Nations weapons inspectors) that Iraq continued to hold WMD ambitions and was reconstituting its programmes. In the case of Iraq, this assumption was taken for granted and therefore not clearly identified and emphasized in the intelligence products. As a result, the reliability of certain sources, including the HUMINT source Curveball, was not questioned sufficiently.

The validity of sources is another area where effective visual communication is key. [21] Both analysts and decision makers need an indication of source validity. As one intelligence community report describes, intelligence agencies must apply the 'show your work' principle if they wish to enhance decision maker engagement with their outputs. [22] From the analyst's perspective, details on sources are also important. In the case of Iraqi WMD, working from IMINT sources, analysts assumed there was increased Iraqi activity around suspected WMD facilities. In fact, the perceived increase was merely reflecting the fact that the satellites had been reprogrammed to image the sites more regularly. This important source information was not communicated to analysts. [23]

When assessing how intelligence information is visually communicated, we are left with a quandary. On the one hand, information must be concise, clear and accurate. [24] At the same time, the information must contain a degree of background information, especially that relating to levels of certainty, source validity, and underlying assumptions. These various demands appear somewhat contradictory. How does one engage a busy decision maker or analyst, without overwhelming them with qualifying information? The answer to this problem, as detailed in this paper, is the use of effective information design, including a legible

typographic layout and strong visualization. The importance of this is evident when one considers the myriad obstacles to communicating national security information.

3. Obstacles to Effective Information Communication

Amongst the many obstacles impinging upon the efficacy of information communication, five are especially prominent in the discourse: policy-related challenges; cognitive impediments; resource limitations (especially in relation to information overload and time pressure); cultural and structural issues within intelligence communities; and technical and specialist information. The ultimate test of the intelligence process is whether it makes a positive contribution to national security decision-making. It is of significant concern, then, that engaging with policy makers is fraught with difficulties. Since the scale of modern governance has increased exponentially, policy makers are notoriously busy, with little time to dedicate to the many issues they face on a day-to-day basis. [25] The 1991 National Intelligence Estimate (NIE) on the collapse of the Former Yugoslavia evidences the challenge this poses to intelligence communities. The 1991 NIE is noted for presenting an accurate and detailed prediction of coming events in Yugoslavia. Nonetheless, policy makers at the time did not act upon the information, partly because they were distracted with other issues and agendas. [26] One can perhaps conclude that the intelligence contained in the NIE was not compelling enough in what was a complex and demanding policy environment.

Additionally, intelligence products are but one source of policy-relevant information. Policy makers have access to many sources of information beyond those provided by the intelligence services. [27] These include, but are not limited to: increasingly prevalent open source material (including social media), as well as information from diplomatic channels. It is, therefore, increasingly difficult for the intelligence services to have their voice heard sufficiently to aid decision making.

Even if policy makers take note of intelligence, there may be political reasons to ignore or minimize the impact of intelligence outputs. Taking policy action always comes with political costs, and may upset established agendas or political sensibilities. [28] In 1916, the British government had general and detailed intelligence on the forthcoming Irish Uprising, but failed to act upon it due to political concerns related to the implementation of Home Rule. [29] Likewise, in relation to Iraq's WMD programmes, the regime change agenda was so dominant in the White House and Pentagon that it was extremely difficult for contrary intelligence to get a hearing. As the Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction concludes, 'it is hard to deny the conclusion that intelligence analysts worked in an environment that did not encourage scepticism about the conventional wisdom.' [30] In the face of such stubborn political obstacles, intelligence reporting must be compelling (including visual impact) if it is to break through and enable a change in policy momentum.

Information is analyzed by, and communicated to, human beings. As a consequence of this truism, the processing of national security information is subject to various encumbering cognitive, emotional and social obstacles. [31] These include so-called 'mind-set' issues such as confirmation bias, mirror imaging, groupthink, etc. Although mind-set plays an important part in analysis, by alerting analysts to patterns of behaviour, it also has played a negative role in the history of intelligence receptivity. For example, the US failed to anticipate the 1958 Iraq revolution because it relied too heavily on Iraqi government HUMINT sources, was too focused

on the communist threat in the country, and thus was unreceptive to information that went against this narrative. [32] The fall of the Berlin Wall and the Yom Kippur War offer further examples of foreign and security policy not reacting to information that challenged established assumptions. [33] As veteran CIA analyst and writer on intelligence matters, Jack Davis, notes: 'confirmation bias represents the inherent human mental condition of analysts to see more vividly information that supports their mind-set.' [34] Effective visualization of information can help increase the vividness of divergent data, and thus can help reduce the effects of mind-set bias.

Perhaps the greatest challenge facing contemporary intelligence communities is that of limited resources in the face of growing and diverse security threats. When considered alongside the requirement to process vast amount of data, often under time pressure, the resource issue becomes a major obstacle to effective communication and effective analysis. Although the Intelligence and Security Committee of Parliament (ISC) Report on the killing of Fusilier Lee Rigby concludes that the attack could not have been reasonably prevented from an intelligence perspective, it does identify the impact resource issues have on the processing and communication of intelligence. Specifically, the report notes that important information concerning the relationship between Michael Adebowale and an Al Qaeda Subject of Interest (SoI) was not passed by GCHQ to MI5. This was a communication failure. In its response to the ISC, GCHQ noted that 'all three Agencies had been…working at very high tempo, long hours… So I think at the bottom of this, we have got something that felt very low profile and you have got an analyst who was unfamiliar with a lot of the targets and the detail of it that he was newly tasked on…' [35]

Faced with limited resources and copious information to process, intelligence services inevitably have to prioritize certain threats or SoIs. As evidenced by the GCHQ example above, the value of certain pieces of information may not be fully appreciated, and the scale of developing threats may be missed. In its comprehensive report, The 9/11 Commission also identified the severe challenges that result from this state of affairs; 'We sympathize with the working level officers, drowning in information and trying to decide what is important or what needs to be done.' [36] Of course, part of the answer to the resource obstacle is an increase in resources. However, working on the reasonable assumption that resources will never match needs, we can look to better communication and visualization of information. As will be discussed later, improved visual communication can help staff process information more effectively.

Intelligence communities and policy-making bureaucracies are social institutions. Consequently, they exhibit unique cultures that interact within complex institutional structures. This can affect the methodology behind how national security information is processed, communicated and used. For example, it is reported that the CIA favours collection over analysis, thereby producing volume of information rather than deep interpretation of data. [37] When interpretation is done, it tends to be deductive rather than inductive in nature. Richard Heuer, one of the CIA's foremost analytic methodologists, notes that 'analysts typically form a picture first and then select the pieces to fit.' [38] As a result, the information that is communicated within intelligence communities, as well as to decision makers, will often be large in volume but bereft of the subtleties that reflect complex security realities. Again, effective visualization can help manage volume of information and communicate complex realities in a digestible form.

Problems with information communication are also the result of structural issues within intelligence communities. [39] Information flow around communities was a significant problem prior to 9/11. This is evident between the agencies and even within them. This was especially problematic for the FBI, which had cultural problems with how it handled its intelligence responsibilities. [40] In particular, it is said that the FBI is more an amalgam of 56 field offices than it is a coherent, unified federal institution. [41] The attack on Pearl Harbor also highlights the impact of structure on information communication. On the morning of the attack, the US Army and Navy both spotted unusual Japanese military activity around the island. However, 'little communication between them meant that no one received both pieces of information together prior to the attack.' [42] Had these two pieces of information been considered together, it is possible that the island would have gone on a heightened state of alert. More effective communication of information, including visualization, can facilitate inter and intra-institutional coordination and awareness.

The technical and specialized nature of some information creates a further obstacle to the effective communication of intelligence. As noted by Brian Holmes and May Greenlee, 'Scientific and technical intelligence analysts thus face the great challenge of quickly, effectively, and clearly conveying information to policymakers.' [43] As with all information, technical intelligence must be communicated in a way that is accessible and actionable, but also maintains accuracy. [44] The dangers associated with this area are well illustrated by the example of aluminium tubes in the Iraqi WMD case. The UK intelligence community had information that the tubes Iraq was attempting to procure would require substantial re-engineering to make them suitable for a nuclear weapons programme. However, according to the Butler Review, in the publicly released Iraq Dossier, 'the JIC omitted the important information about the need for substantial re-engineering of the aluminium tubes to make them suitable for use as gas centrifuge rotors. This omission had the effect of materially strengthening the impression that they may have been intended for a gas centrifuge and hence for a nuclear programme.' [45] A recent study, conducted by the Center for Strategic and International Studies, found that when digesting technical information policy makers require simple explanations, limited jargon and obvious relevance to policy. [46] The significance of good communication and presentation is obvious. Specifically, well designed infographics can communicate detailed, copious, complex and specialist information in an accessible and compelling manner.

4. Examples of Communication Failure

The obstacles identified above, in conjunction with poor handling and communication of information, can produce dire consequences. Too often, decision makers or analysts do not have access to the information they require, or do not comprehend the significance of the information available to them.

Pearl Harbor is a textbook example of this problem, and reveals a number of obstacles to effective utilization of intelligence. Firstly, the senior American commanders in Hawaii – Admiral Kimmel and US Army General Walter Short – suffered from severe cognitive rigidity and mirror imaging. Their mind-set was such that they completely dismissed the possibility of an attack on Hawaii. Thus, any information suggesting Japanese intent to attack the naval base was dismissed under confirmation bias. This failing was exacerbated by the fact that decision makers (military and political) in Washington distrusted Communications Intelligence (COMINT), largely because it was a relatively new discipline and not properly understood. As a

consequence, indications of hostile Japanese intent, especially intercepted communications between Tokyo and its Washington embassy, were ignored. [47]

The intelligence agencies in Washington also had a role to play in the unfolding disaster about to engulf Pearl Harbor. In October and November 1941, US COMINT had intercepted Japanese communications requesting detailed knowledge on the placement of ships at Pearl Harbor. This intelligence was never passed to commanders on Hawaii. [48] As noted, the confirmation bias of Kimmel and Short suggests that such information may not have altered their perspective on the vulnerability of Pearl Harbor. Nonetheless, had the information been detailed, overwhelming, and presented clearly, it perhaps could have made a difference in terms of alert preparedness. As Dahl notes, 'receptivity is largely influenced by the level of precision of the intelligence provided.' [49] This brings us to the final problem with intelligence communication prior to Pearl Harbor, and underlines the interplay of the different obstacles discussed above. With limited resources available, US intelligence assets were focused on Japanese and German diplomatic intercepts, rather than on the more detailed Japanese naval codes that could have provided more detailed information on the attack plans.

9/11 provides another sobering example of how reasonably convincing intelligence information was not able to adequately inform decision making, or indeed elements within the intelligence community, of the developing Al Qaeda threat. This is best summed-up by the 9/11 Commission Report, when it describes how counterterrorism coordinator, Richard Clarke, spent 12 years unsuccessfully trying to persuade Washington of the direct and growing danger posed by Al Qaeda. [50] A number of examples relating to 9/11 illustrate the challenge of communicating the Al Qaeda threat in the years prior to the attack. On Friday, December 4th, 1998, the President's Daily Brief contained a reasonably lengthy piece detailing Al Qaeda plans to highjack US airliners. Despite appearing in what is regarded as the most important intelligence product of the US intelligence community, this intelligence warning had little impact on President Clinton or Vice-President Gore. Less than a year later, Clinton stated: 'I am not aware of any specific threats against American airlines.' Similarly, Vice-President Gore does not recall any such warning being made. [51]

The Bush administration, likewise, failed to recognize or act upon intelligence regarding the threat posed by Al Qaeda. Most famously, the PDB of 6th August 2001 contained a section titled 'Bin Ladin Determined to Strike in the US'. Although the intention of the piece was to highlight the current threat from Al Qaeda, President Bush regarded it as more historical in nature. [52] Finally, in July 2001, the FBI and Counterterrorism Security Group (CSG) issued warnings to federal agencies (including the Federal Aviation Authority) concerning the growing risk of terrorist attack against US interests. Unfortunately, the warnings were not well communicated. There was confusion over whether the threats were directed against targets in the US, and also how much information could be disseminated and to whom. [53] Taken together, these instances reveal that although there was ample intelligence regarding the growing Al Qaeda threat, and indeed, the 'system was blinking red' in the summer of 2001, the intelligence community had little impact on US counterterrorism policy. The intelligence was there, it just was not having the desired effect on decision makers. Whilst there are various reasons why decision makers may not register or act upon intelligence products, insufficiently compelling or actionable communication of information is one of them.

Turning our attention to intelligence matters in the UK, we find similar problems. One of the more infamous cases of poor intelligence communication is the 45 minute claim relating to Iraq's WMD. This piece of information, which concerns the time it would take Iraq to deploy

chemical and biological weapons to military units, appeared in a 9 September 2002 Joint Intelligence Committee (JIC) Assessment and the 24 September publicly released government dossier on Iraq. The importance of the 45 minute claim is that it strengthened the case for action against Iraq, by giving the impression of an imminent threat to the UK from Iraq's WMD programme. Simply put, it strengthened the case for war. Moreover, in retrospect it damaged the reputation of the intelligence services. As the author of the Iraq Dossier, the JIC became embroiled in accusations of 'sexing-up' intelligence to support government policy on Iraq.

On closer inspection, the problem stems from poor communication of national security information. The Assessments Staff of the JIC, who wrote the 9 September Assessment, based their report on intelligence from MI6 and the Defense Intelligence Service (DIS). Crucially, although this intelligence noted a time of 20-45 minutes for deployment of WMD, it did not indicate the means of delivery this referred to. In giving evidence to the ISC, the Assessments Staff admitted that in their judgement the deployment time most likely referred to battlefield weapons, rather than Iraq's longer-range ballistic missile programme. [54] This uncertainty on delivery means, and the Assessment Staff's subsequent judgement, were not reported in the 9 September Assessment, and subsequently failed to appear in the Iraq Dossier. Had this limitation to the intelligence been made clear, the 45 minute claim may not have been so prominent, and would not have caused the intelligence community such a post-war headache. In its report on the matter, the ISC concludes: 'Whilst the 9 September JIC Assessment was a balanced assessment of scenarios, it did not highlight in the key judgements the uncertainties and gaps in the UK's knowledge about the Iraqi biological and chemical weapons.' [55] Moreover, the Butler Review notes that post-war investigations by MI6 have raised doubts concerning the validity of the sources upon which the 45 minute claim was based. [56]

The recent terror attacks in London and Manchester provide further examples of important information not being effectively handled or communicated, with the result that its significance was not fully appreciated. Referring to Salman Abedi, who perpetrated the Manchester Arena attack, the Anderson Report concludes that 'On two separate occasions in the months prior to the attack, intelligence was received by MI5 whose significance was not fully appreciated at the time … In retrospect, the intelligence can be seen to have been highly relevant to the planned attack.' [57] Although the report concludes that disruption of the attack would have been unlikely, a better appreciation of the counterterrorism relevance of the information would have opened a new investigation on Abedi, and perhaps subjected him to questioning upon his return from Libya prior to the attack. [58]

The Anderson Report also addresses the case of Youssef Zaghba, one of the three men who perpetrated the attack on London Bridge. In this case, two information handling/communication issues stand out. The Italian authorities had information that Zaghba wanted to travel to Syria to join ISIS. In response, they placed Zaghba on the Schengen Information System, an EU-wide system designed to share and coordinate information relating to law enforcement and border control matters. Unfortunately, Zaghba was incorrectly given a marker relating to serious crime, rather than one indicating a terrorist threat. In this sense, information concerning the subject was incorrectly handled and communicated. Furthermore, MI5 received a communication from Italian authorities requesting terror-related information on Zaghba. Anderson reports that there is no evidence that MI5 responded to the information request, nor that the Italian authorities followed-up the unanswered request. Again, we are left with the impression that the significance of information relating to national security was not fully appreciated, and was not well handled. Although the Anderson report acknowledges that 'even if the intelligence had been actioned, it would have resulted in a nil return'. [59]

Finally, we return to the killing of Fusilier Lee Rigby. As background, we have already noted the significant resource constraints that impacted on this case. In relation to handling and communicating national security information, a number of issues are raised by this case. Prior to the attack, one of the perpetrators, Michael Adebolajo, had appeared in five different intelligence operations. Although he was never identified as a key individual engaged in planning an attack, the ISC raised concerns about how the intelligence services handle information on recurring Subjects of Interest. [60] The ISC report also raises concerns about how information was handled and recorded, especially surrounding Adebolajo's trip to Kenya, where he was arrested on the suspicion of attempting to travel to Somalia to engage in terrorist activity. The same report identifies a 'missed opportunity' concerning important information regarding the online activities of the second attacker, Michael Adebowale. Specifically, analysts did not see information about online contacts between Adebowale and another SoI. [61] Finally, the ISC report identifies that the way MI5 handled information did not adequately reflect the developing narrative of a case. [62] Various measures have already been instituted to address these concerns. Nonetheless, in this particular situation, effective visualization of information could have been used to further improve how such information is handled, presented, understood and utilized. As Adrian Wolfberg notes, complicated and/or ambiguous intelligence information is more likely to be rejected or ignored. [63]

5. Current Practice in the UK Intelligence Community

Building from this theoretical and historical basis, the researchers conducted a questionnaire of staff and a visual survey of documents in the UK intelligence communities. A visual survey is a research method that involves a comprehensive and systematic analysis of the graphic and typographic features of a document on the basis of well-established guidelines, in this case from the field of Information Design. This visual survey was concerned specifically with documents communicating the allocation of resource decisions in intelligence communities. The findings from both methodologies support the narrative that intelligence communities deal with masses of information on complex security threats, experience information overload and that current practices are not aligned with Information Design guidelines, meaning documents do not always communicate intelligence information in the optimum way.

5.1. Findings of the Questionnaire

The questionnaire was initially devised online via Google Forms. However, due to internal security, it was then printed and distributed internally to 30 people within intelligence communities who deal with management-level resource allocation tasks. It contained 23 questions, as mentioned further below. Ten responses were received. [64] The respondents' details were as follows. Gender: female 60%, male 40%; Age: 30-39 - 30%, 40-49 – 40%, 50-59, 30%; Education: undergraduate 60%, postgraduate (Masters) 10%, A-Level 10%, other 20%.

The objective of the survey was to ascertain how much information the respondents deal with, how it is presented to them, whether or not it is presented in a clear and effective manner, and how easy is it to make use of the information. The questionnaire is divided into four sections: 'About You', 'Receiving Information Documents', 'Use of Information Documents', and 'Perceiving Information Documents'. In total, the respondents were asked 23 questions.

The responses to the survey clearly indicate that the respondents deal with large amounts of information on a regular basis. Indeed, 100% of the respondents receive and process more than 20 information documents per week. All 100% of the survey population 'Always' (30%) or 'Often' (70%) process information under time pressure. This results in 40% of the respondents indicating that they feel 'Always' or 'Often' overwhelmed by the amount of information they receive (Figure 1). This fits with the findings from the literature and reports on intelligence communities. As previously noted, there is a general consensus that intelligence communities have to handle vast amounts of data, with limited resources. At times, this leads to staff being overworked and potentially making errors in the handling of information.

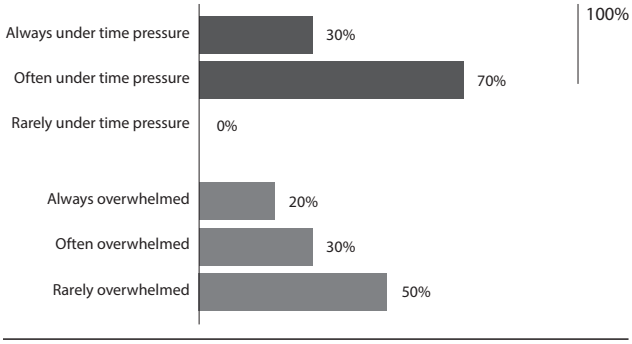

Figure 1. Responses for (per 3 rows from top to bottom): 1) Do you read the information documents under some time pressure? | 2) Do you ever feel overwhelmed by the amount of information in the documents you receive?

Of particular interest to this study, is the fact that 90% of respondents wanted the information to contain some form of visualization. More specifically, 80% of respondents prefer the information to be communicated in a combination of text and visuals (Figure 2). The information design literature confirms that such a combined approach reduces cognitive load, thereby maximising the potential for understanding, retention and recall. [65] As visualization is becoming more prevalent and required within intelligence communities, it is essential that infographics (a combination of text with visuals/graphics) play a major role, and that they are constructed according to design principles.

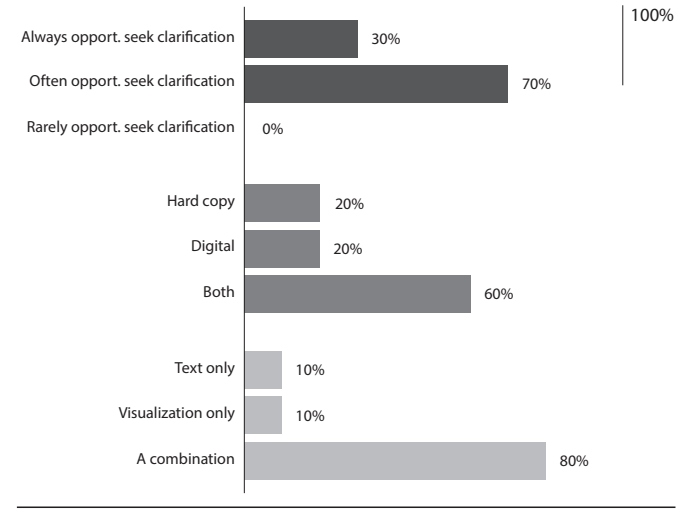

Figure 2. Responses for: 1) Do you have the opportunity to ask questions and/or seek clarification on the information documents you receive? | 2) Do you prefer a hard copy of the document, a digital version or both? | 3) Would you prefer the information to be presented as text only, visualization only, or a combination of both?

The information received by the respondents is used in a number of ways. As many as 90% of the survey population specified that the information they receive both directly supports decision-making and/or provides background data. In terms of what information they need, 60% require both detailed analysis and raw data; with 30% stipulating a more pressing need for detailed analysis. All respondents specified that they 'Often' need to recall the information at a later date. Finally, 60% of the population make notes on the documents they receive (Figure 3).

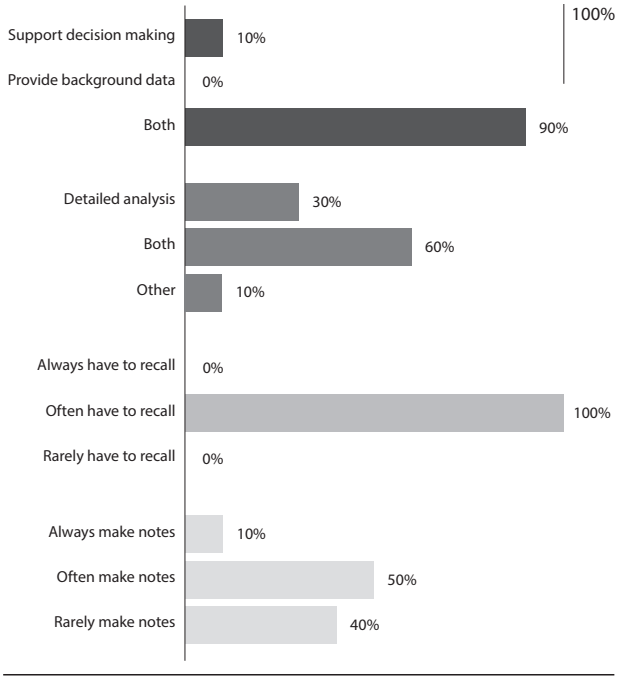

Figure 3. Responses for: 1) Do the information documents you receive support decision making, provide background data, or both? | 2) In your role, do you need raw data, detailed analysis, or both? | 3) Do you need to recall the information in the documents at a later date? | 4) Do you make notes on the document?

These responses speak to different forms of information communication, and provide important cues for creating appropriate infographics. For example, information used directly in support of decision-making needs to be presented in a form that is appropriate for iconic memory and working memory. Information usually remains in the iconic memory for less than a second before being forwarded to the working memory. Therefore, this reinforces the importance of grabbing the user's attention at a glance with well designed information. Working memory is maintained for about 5 to 15 seconds; a very limited time during which the user is making sense of the information and either keeps the information or decides it is irrelevant and ignores it. Therefore, well designed information that takes less time to make sense of is also more likely to be kept and forwarded to long-term memory. [66] All in all, amongst other things, this requires accessible, clear and legible information that can help the user make sense of the information quickly.

Furthermore, the fact that the respondents make notes on the documents suggests a need for generous margins and ample white space for printed information, and an appropriate note-making facility in digital media. Historically, wide margins and ample white space have been notable features of the President's Daily Brief [67] and strongly supported by the Information Design and Typography literature. [68]

The questionnaire also sought the respondents' perception of the information documents they receive and use. For the most part, the survey population has a positive perception of the documents. 80% consider the documents to be 'Rarely' confusing and unclear; 100% consider them 'Often' to be clearly organized; 90% thought the relative importance of the information was 'Often' clear; 80% that the relationships amongst the information was 'Often' clear; 80% that the information was 'Often' presented in a consistent manner; and 80% thought the documents had the right amount of information (Figure 4 and 5). These results appear to contradict the findings of the visual survey of sample documents conducted for the study. As is detailed below, nine documents used by the questionnaire population were surveyed, and all were found to significantly breach a number of information design guidelines. That being the case, the perception of the users should have been more negative.

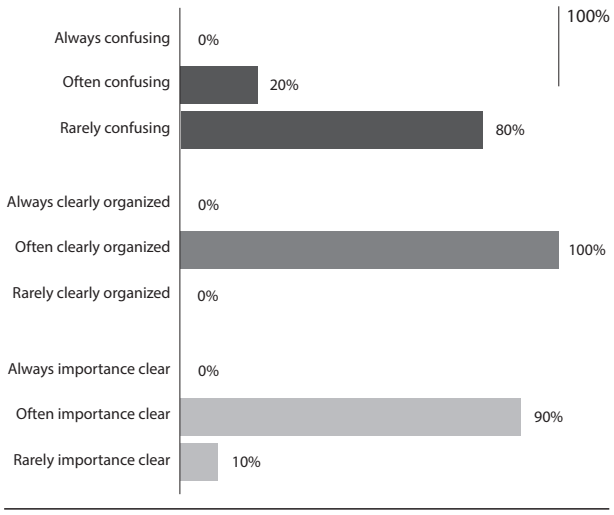

Figure 4. Responses for: 1) Overall, do you ever find the way information is presented in the documents confusing or unclear? | 2) Overall, is the information organized clearly on the document page?

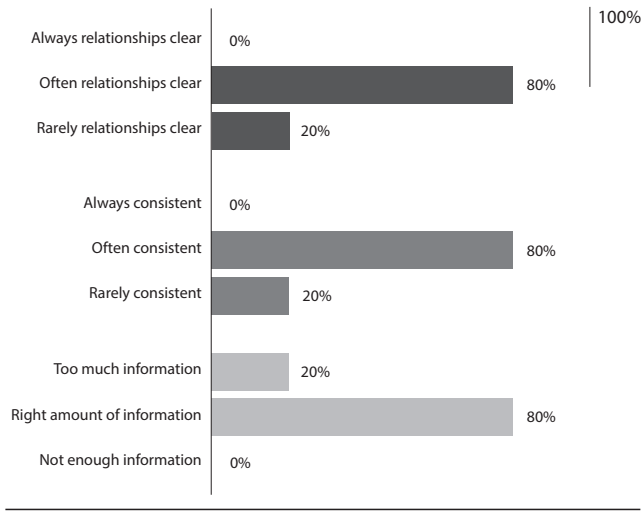

Figure 5. Responses for: 1) Overall, are the relationships amongst the information in the documents clear? | 2) Overall, is similar information presented in a consistent manner in the documents? | 3) Overall, would you say documents have too much information, the right amount, or not enough information?

How do we explain this discrepancy? Since the information design guidelines are so well established, based on both research and practice, we can reject the notion that the guidelines are in error. It is possible, therefore, that the survey population has low expectations of information design, and is unaware of how much more effective information communication can be when it follows well established information design principles. It is also worth noting that 20% of the survey population have negative responses to the documents they receive. In this sense, these users think the documents lack clarity, consistency and effective organization of information. Moreover, the positive responses, which are 'Often' rather than 'Always', still leave room for improvement. Methodologically, it is also possible that had a 'Sometimes' response been available, the frequency of the 'Often' response may have been reduced. This would have reduced the positive nature of the responses.

Finally, the users were asked if the presentation of the information they received had ever radically changed their perception of an issue. This speaks to the 'impact' of intelligence information. The responses to this question were less positive than the other questions in the Perception section. 40% indicated that the presentation of information 'Often' changed their perception, whereas 60% responded 'Rarely' (Figure 6). This suggests that improved visualization could increase the impact of information communication.

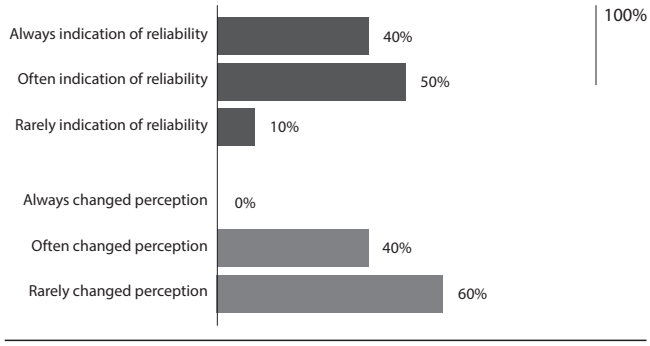

Figure 6. Responses for: 1) Does the information in the documents include an indication of its reliability? 2) Overall, has the way information is presented in a document ever radically changed your perception of an issue?

In terms of population groups (age, gender, and level of education), a few notable outcomes stand out, and are supported by research findings from the literature and from practice. Perhaps the most striking result concerns level of education. All of the respondents who felt overwhelmed (at times) by the information they receive, have a qualification below university undergraduate. This group was also more likely to perceive the information as less clear and poorly organized. This somewhat reflects research findings that non-professionals rate clarity of presentation more highly than professionals. The former also prefer standard visualizations over abstract visualization. [69] One possible explanation for these results is that those with a university education have had more exposure to many different forms of data. This speaks to the need to communicate information in a manner tailored to the user. Although half of the women felt overwhelmed (at times) with the information, as a group they were completely happy with the clarity and organization of the information documents. This contrasts somewhat with men, who were much less happy with the clarity and consistency of the information. This again supports research findings, which specify that women are more comfortable with many different forms of information presentation, including non-graphic data. [70]

Finally, some differences were notable in age groups. Respondents in their 30s seemed most at ease with the information they receive. None of this age group felt overwhelmed with the information, and almost unanimously perceived the documents to be clear and well organized. In contrast, all of those in the 40s age group felt overwhelmed by the information (at times). 50% of the 40s age group also had issues with the clarity and presentation of the information. One third of the 50s age group felt overwhelmed by the information, and perceived the documents to be unclear at times. The two thirds of the over 50s who were not overwhelmed have a university level of education, either at undergraduate or postgraduate level.

5.2. Visual Survey of Documents

A total of nine documents were collected from intelligence communities, seven of which can be considered an infographic (i.e. they combine text and visuals/graphics), and two a written document as only text is used. All these documents are used for decision making and resource allocation. The frequency with which they are sent to management staff in intelligence communities varies between “as needed”, “every two weeks” and “every month”. One document is produced around ten times a week. For security reasons, and since the focus was only on visual features, the original classified content was changed to “Lorem Ipsum” text. [71]

Due to the lack of research and literature on this subject matter (information design for security material), the authors referred to research in the area of infographics (including text legibility, color, visual elements, layout and structure), data visualization (as for infographics, plus the different chart types) and risk information (including visualization of risk information and intelligence reports). Five databases were used: Science Direct, EBSCO, Google Scholar, Sage Journals, Taylor and Francis Online; and three design journals: Information Design Journal, Visible Language, Infodesign. The selection of the databases and journals was based on their relevancy for research focusing on information visualization. The search used specific keywords such as: "infographics", "data visualization", "information visualization" "graphic risk information", and only focused on articles that were written in English and Portuguese (the latter because Brazil is very strong in information design research). The articles gathered went through two stages of examination and filtering process. In the first stage, the articles were checked and filtered based on the titles and abstracts, and then organized in individual folders according to sub-areas. In the second stage, the selected articles were reviewed in their entirety through detailed reading and highlighting of relevant information (as well as making notes). Approximately 230 papers were reviewed in stage 2. Due to the little research available in the area of information design and visualization, approximately 40 books were reviewed, which mainly offered practice-based tacit knowledge and recommendations.

From this survey of the literature, the researchers identified 486 information design guidelines. These guidelines were then reduced to 75, i.e. to those guidelines that were applicable to the nine documents surveyed. These guidelines therefore serve as a framework to conduct the survey on the visual features of the nine documents currently used in intelligence communities– see Table 1. The nine documents were selected to be representative of those currently in use in the intelligence communities. For security reasons, the great majority of the text was converted to 'dummy text', i.e. *Lorem Ipsum* text.

VISUAL FEATURES SURVEYED

General	Text	Graphics	Color
• Uncluttered • Simple and easily accessible • Consistency across infographics • Clear contrast between elements • Information clearly organized • Clear visual hierarchy • Generous margins • Aesthetically pleasant • Design principles applied • Target users considered • Tested with target users	• Maximum 2 clearly different typefaces • Bold used sparingly for emphasis • No underlining used for emphasis • No Italic used for descriptive text • Title is dominant and clear • Clear contrast between text elements • Good interword space (and no rivers) • Left aligned text (not right, nor centered) • All-capitals only for short headings • 9-12pt font size • 60-70 characters per text line • 1-4 extra points interlinear space • Sanserif bold type on color background • Sans serif for digital and small size type • Effective direct labelling • Text not inclined on labels • Concise labels	• Graphics used effectively • Graphics adequately arranged • Arrows provide direction effectively • Icons used to make data clearer	• 3 colors for infographics • 3-5 colors for coding w/ equal strength • 2-3 colors for charts • Contrast between text and background • Color groups pieces of information • Color helps to scan information • Color signals relationships • Color used sparingly for emphasis • Color used harmoniously • No highly saturated (primary) colors • Only colors that can be named are used • Color used consistently • Color contrast used for coding • Soft colors used for charts

Layout	Tables	Pie/donut charts	Bubble charts
• Layout in zigzag form • Grid used to organize information • Information well organized • Clear hierarchy • Good spread of white space overall • Good space around graphic elements • Good space around headings and text • Few and effective alignment of elements • Headings aligned in the same axes	• Tables fade to background • White space used instead of borders • Light rules (and borders if used) • Light filling colors used • Background does not alternate per row • Grid lines not used for every entry	• Chart accompanied by text • Effective direct labelling • Multiple donut charts avoided • Sum of parts equals 100% • No more than five segments • No further segmenting within a slice • Segments displayed clockwise • Donut chart used to show total value	• Effective at giving general sense • Effective at comparing different values • Visualization proportional to real data • Labels inside bubbles are effective • Outside labels clear and close to bubble • Colors for each category clearly distinct • Semi-transparent overlapped bubbles

Table 1. Framework with 75 information design guidelines used for the survey on the visual features of nine documents currently used in intelligence communities.

The results of the survey can be seen next in the form of a heat map where: dark grey is used for those features/guidelines that are not present in the respective document; medium grey for when those features/guidelines are present; and light grey for when some features are partially present, i.e. they might be in parts of the document but not in other parts. In simple terms, dark grey is bad and medium grey is good. A section of the heat map (surveying general guidelines only) is given as an example in Figure 7.

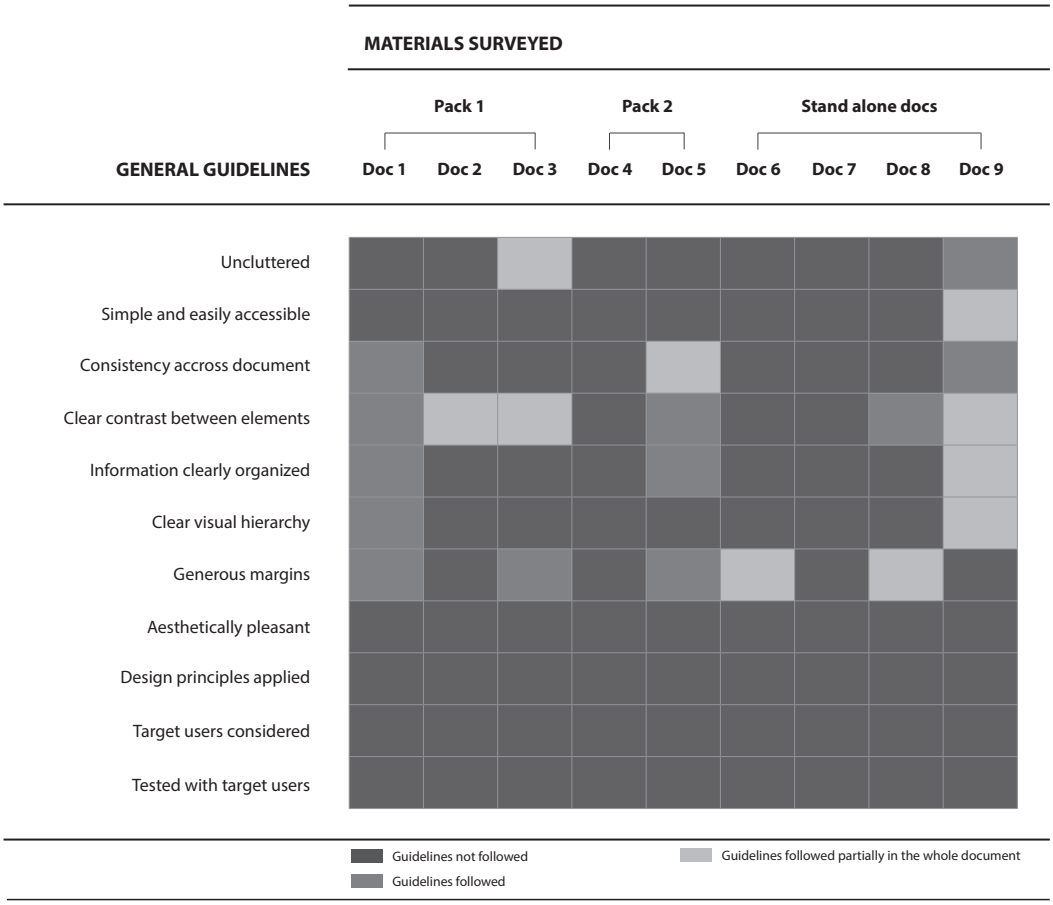

Figure 7. Heat map showing the general guidelines disregarded, followed and partially followed in the 9 documents surveyed.

The results show that overall the documents fail to communicate and visualize information in an effective manner. As shown in Figure 2, only 26% of document features were in agreement with the guidelines from Information Design. As many as 64% were not in agreement, and a further 10% were only partially in agreement.

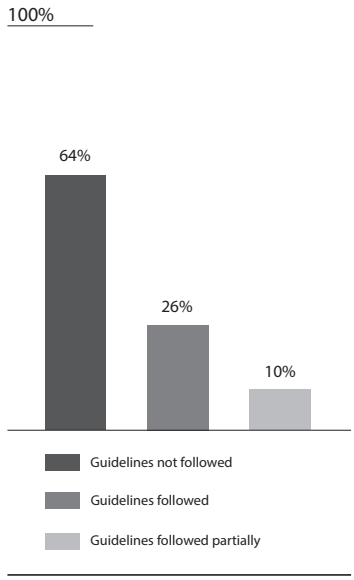

Figure 8. Overall document analysis

A detailed analysis was then conducted in order to identify the extent to which each document fails to follow good principles of information communication and visualization. The findings are very straightforward: the higher the amount of visualized information, the more problems there are in terms of good principles of visualization. The same is true for those documents containing mainly text, but where attempts were made to display the text in a table or inside boxes (Figure 9.1, 9.2 and 9.3). Strikingly, some documents were as high as 98% in breach of information design guidelines (Figure 9.2).

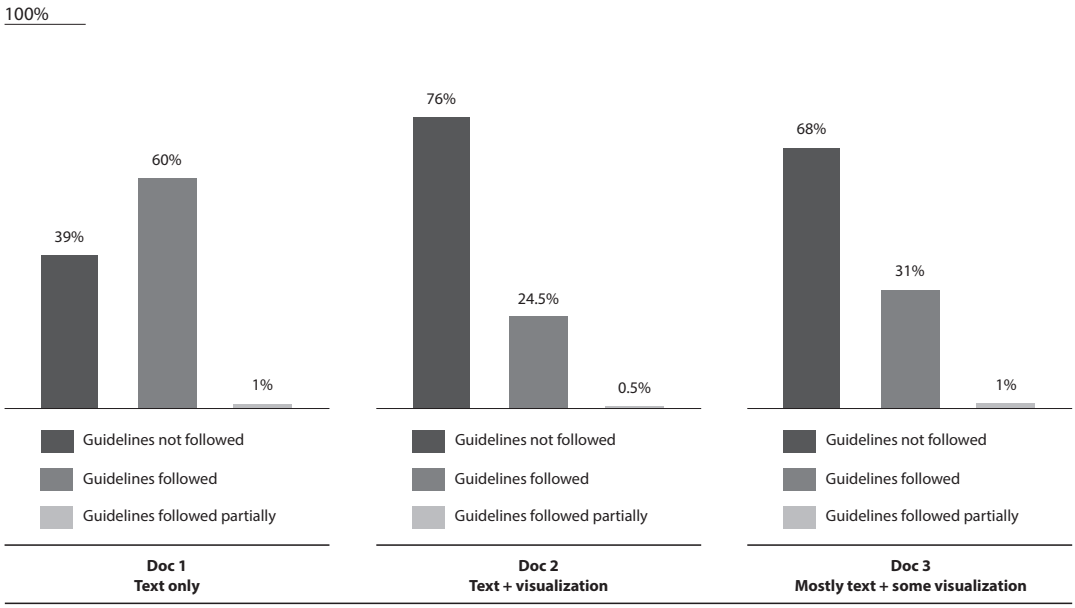

Figure 9.1. Individual document analysis (information pack 1 containing 3 documents)

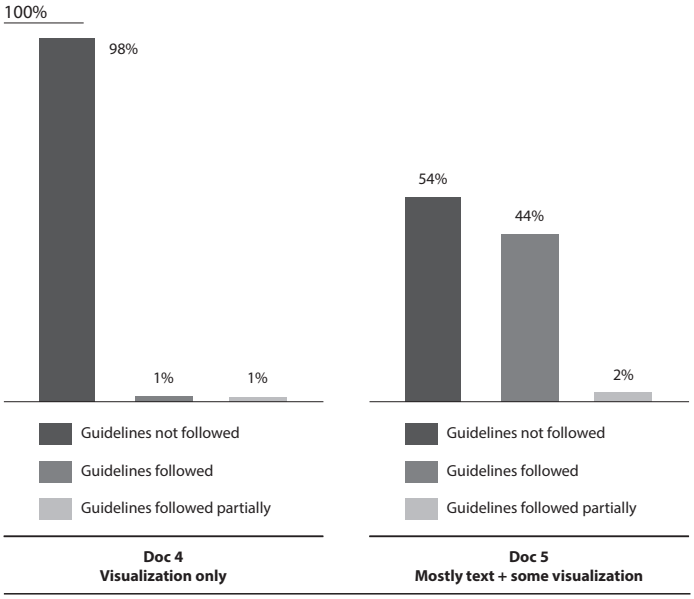

Figure 9.2. Individual document analysis (information pack 2)

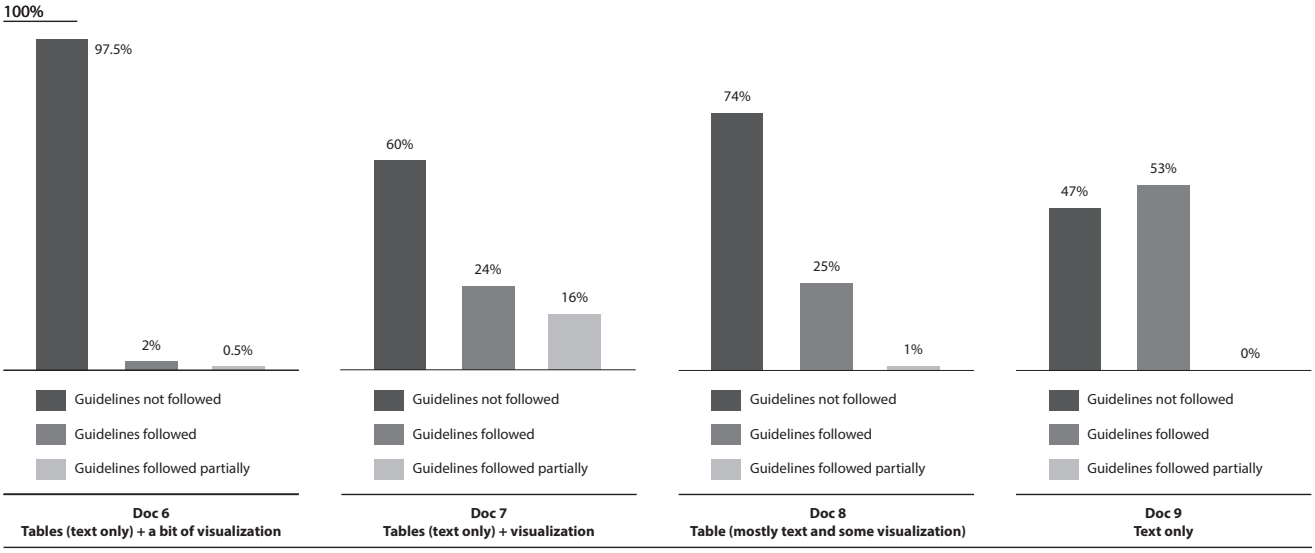

Figure 9.3. Individual document analysis (stand-alone documents)

Although all pages are cluttered with information and visual elements, which in itself can result in a disengaged user, there are more serious concerns than that. These documents are of compulsory use, and staff read them under a certain amount of time pressure as shown in the results of the questionnaire. Therefore, reading strategies such as scanning and skimming are likely to be used as a starting point to have a general sense and then identify relevant information. However, as shown by Lonsdale, lack of legibility in a document impairs speed and accuracy of finding information in such circumstances. [72]

Moreover, because these documents are used for decision making, the information not only needs to be accessed and understood, but also recalled. Yet, humans can only store three or four chunks of information at a time in our working memory, which is then forwarded into the long-term memory. [73] However, if the cognitive load is high, as it will be with most documents here surveyed, then recall is very likely to be impaired.

In conclusion, and based on the guidelines from Information Design, the questionnaire and detailed visual survey strongly identifies the need to redesign the documents currently used in intelligence communities. Failing to do so will mean continuing with a form of communication that is clearly unsuitable within the context of intelligence information. This could lead to poor allocation of resources and decision making, which history suggests can have serious consequences.

6. The Contribution of Information Design and Visualization

This study has established that effective visual communication of information is important; that there are many obstacles that stand in the way; that serious consequences can result from poor communication; and that current practice in UK intelligence communities seems to breach well established information design guidelines. The paper will now identify the many ways in which good visualization can substantially enhance the communication and use of national security intelligence. Specifically, it will be shown that visualization can highlight important information; improve decision maker engagement with intelligence; provide more compelling evidence; identify and clarify complex relationships amongst data; improve the accuracy of intelligence communication; improve risk indicators in complex security threats; and facilitate better understanding of complex technical information.

The Operational Improvement Review (OIR) was commissioned by the Commissioner of the Metropolitan Police Service and the Director General of MI5 after the Westminster and Manchester attacks. Its purpose was to identify and take forward improvements to processes and capabilities for managing terrorism investigations. [74] It identified the need for better handling and exploitation of data. As noted in the Anderson Report, due to a combination of limited resources and information overload, staff in intelligence communities are constantly having to make tough choices regarding what threats to prioritize. In these difficult circumstances, 'even marginal improvements are capable of paying dividends.' [75] Strong and effective visualization of data would facilitate better information management and exploitation. Information, however compelling, does not speak convincingly for itself. As Richard Betts notes, warnings are evidence filtered through perception. [76] Alongside the cognitive impediments discussed above, perception is shaped, at least in part, by culture. The latter speaks to us through stories and symbolism. [77] Visualization helps to limit the negative effects of mind-set and culture, whilst at the same time making use of cultural symbolism to engage the user of intelligence through familiar visual references. Arguably, the need for

visualization is increasing. As consumers of intelligence become more digital-savvy, they have an expectation of enhanced visualization. [78] For example, a recent survey found that generals serving in Iraq and Afghanistan wanted visuals that communicated complex and meaningful information on the enemy in a digestible form. Simple wire-diagrams of enemy command and control are no longer sufficient. [79]

As noted in relation to the break-up of Yugoslavia, even accurate and detailed estimates may not engage decision makers distracted by a range of other priorities. Moreover, and to reiterate, Stephen Marrin reports that policy-makers often ignore intelligence that contradicts their established policy agendas or assumptions. [80] In such challenging circumstances, visualization provides possibilities for a more compelling and effective relationship between decision makers and intelligence communities. [81] Visualization can more readily engage with busy policy makers, and emphasize the importance of key information that might otherwise be lost in a sea of data. In this sense, it can provide better decision aid. The history of the President's Daily Brief reveals how the visual presentation of information can improve executive engagement with intelligence products. In his ground-breaking study, David Priess notes how improvements in layout and visualization substantially increased the utility of the PDB for Presidents Johnson and Carter. Indeed, the latter insisted on the inclusion of visualization to improve his understanding of complex security matters. [82]

The Second World War provides a compelling example of this argument. Following the attack on Pearl Harbor, the US needed to know the location of the next major Japanese assault. With limited resources, especially after the losses taken on Hawaii, the US fleet could not defend every vulnerable point. The codebreakers in Naval Intelligence were convinced that Midway was the next target. However, with cryptanalysis being such a new discipline, it was difficult to persuade Nimitz, commander of US forces in the Pacific, and Washington of the veracity of the intelligence emanating from Japanese decrypts. Exasperated by the lack of headway, Lieutenant Commander Edwin Layton, an intelligence officer in the Naval Intelligence Unit (Hypo), persuaded Nimitz to send his war plans officer, Captain McCormick, for a briefing. There, in what we might call an early form of visualization, Layton laid out on a table all of the key intelligence from decrypts in a manner that displayed the developing picture of Japanese war plans. The effect on McCormick was overwhelming: 'McCormick was fascinated. In the end, he spent not two but three and a half hours poking around, flipping the material, asking a thousand tough, show-me questions. Ultimately: McCormick came away completely convinced, and to sell McCormick was to sell Nimitz.' [83] As a result of this compelling intelligence visual presentation, the US fleet was deployed to Midway. And, on 4-5 June 1942, the US fleet inflicted a crushing defeat on the Japanese, including the loss of four precious aircraft carriers.

Recent terror attacks in the UK have underlined the nature of the increasingly complex threat environment. For much of their existence, the intelligence agencies dealt with state-based threats, or reasonably well-defined and structured terror and insurgent threats (such as the IRA, Al Qaeda and communist insurgencies in the colonies). In the contemporary setting, UK national security is most immediately threatened by lone-wolf terrorists or very small groupings of individuals. As is evident from the ISC and Anderson reports, this creates a massive intelligence challenge, in which any one of thousands of Subjects of Interest (SoI) could move rapidly to attack planning. In the face of this challenge, intelligence communities need more effective risk indicators and means to better identify the relationships amongst data on recurring SoI. [84] Part of the answer is more responsive databases. Visualization can also help by more clearly communicating complex relationships and thresholds for deeper investigation.

Visualization can also help to improve the accuracy and level of detail of an intelligence product. Various typographic and design techniques can be used to include background information on sources, differentiate facts from opinions, and make the limits and uncertainties of intelligence known to consumers. Some examples of these techniques are: color coding (to help the user connect and rank information sets), hierarchy (ordering of graphic and typographic information sets to help the user understand their relative importance), contrast (small versus large, light versus bold/dark), legibility (clear, clutter free and well organized graphics and typography), etc. [85] All of these factors are crucial when trying to build user trust in intelligence. At the same time, busy and time-pressured decision makers should not be overwhelmed by masses of background information and qualifying statements. Visualization offers an effective shortcut to communicate such detail without masses of extra text.

Finally, visualization can help in those instances when technical information must be communicated to non-specialists. Most executive consumers of intelligence fall into this category, and intelligence must be produced with the end-user in mind. As Brian Nussbaum notes in relation to the heavily specialized realm of cyber security, there is 'a broader problem of tailoring the products and deliveries to the customer's level of technical understanding. To overstate the importance of this tailoring and translation process is difficult.' [86] One telling example of when visualization made an important contribution is when Director of National Intelligence, Mike McConnell, was looking to induce policy makers to support an amendment to FISA to enable the NSA to intercept foreign communications passing through the US. In doing so, McConnell used Verisign's map of the world showing patterns and densities of network bandwidth, 80% of which ran through the US. As Fred Kaplan notes, everyone who heard and saw McConnell's pitch supported the idea: 'President Bush found a rationale for action in the Verisign map'. [87] The result was the Protect America Act, which gave McConnell exactly what he needed.

7. Conclusion

The challenges to more effective intelligence are many, and require several possible remedies: Structured Analytic Techniques (SAT), more resources, restructured communities, more oversight, etc. All of these initiatives, and more, have a role to play in improving the efficacy of intelligence aid to decision makers. Additionally, as evidenced in this paper and in the OIR commissioned by the Metropolitan Police Service and MI5, effective handling and exploitation of information is an increasingly essential component of modern intelligence work. Since the intelligence cycle is concerned with the flow and use of information, effective visual communication is essential. However, this paper identified five primary obstacles to effective information communication: policy-related challenges; cognitive impediments; resource limitations (especially in relation to information overload and time pressure); cultural and structural issues within the intelligence communities; and technical and specialist information. The possible consequences of these difficulties are evidenced in examples of intelligence shortcomings, including Pearl Harbor, 9/11, Iraq's WMD programme, and recent terror attacks in the UK. These examples all highlight the consequences of mishandling the communication of information and the need to communicate information in an effective manner.

This study identified the challenges faced by staff in contemporary intelligence communities. In particular, there is evidence of staff feeling overwhelmed by the amount of complex information they need to process, and a desire for increased use of visualization to act as an aid.

As a result, it is evident that Information Design, and increasingly, effective visualization, are indispensable to help manage large amounts of complex information. As noted, visualization can highlight important information; improve decision maker engagement with intelligence; provide more compelling evidence; identify and clarify complex relationships amongst data; improve the accuracy of intelligence communication; improve risk indicators in complex security threats; and facilitate better understanding of complex technical information

Yet, visualization can be done poorly. Indeed, as evidenced in the document survey, poorly executed visualization is counterproductive. The survey of extant visualization documents revealed errors against well-established principles of Information Design. In some cases, 98% of document features breached Information Design guidelines. Thus, in the quest for better handling and dissemination of intelligence, there is a distinct need to apply effective Information Design principles to the world of intelligence. A second stage of this research will go on to do exactly that, creating and testing new infographics and forms of visualization for use within intelligence communities. In this way, by bringing together the disciplines of Intelligence Studies and Information Design, the challenges to effective communication of information can be met.

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[1] Betts, 'Surprise despite warning', 555.

[2] Major, *Communicating with intelligence,* xvii.

[3] Oxford Living Dictionaries.

[4] Sless, *Learning and Visual Communication*, 24.

[5] Infodesign.org.uk

[6] Major, *Communicating with intelligence*, 1-14.

[7] The document survey and questionnaire were conducted within intelligence communities, but with no access to any information that is not in the public domain.

[8] Marrin, 'Adding value', 199.

[9] Analyst-IC Associate Teams Program, 'Probing the implications', 2.

[10] ibid, 3.

[11] Ben-Haim, 'Policy neutrality and uncertainty', 982.

[12] Dahl, 'Why won't they listen?', 68-90; Cline, 'Policy without intelligence', 121-135; Ben-Haim, 'Policy neutrality'; Marrin, 'Rethinking analytic politicization', 32-54; Friedman and Zeckhauser, 'Handling and mishandling', 77-99.

[13] National Commission on Terrorist Attacks Upon the United States, *Final report, xvi.*

[14] Wilder, 'An educated consumer', 25; Hollister Hedley, 'Analysis for strategic intelligence', 216.

[15] Marrin, 'Rethinking analytic politicization', p.4.

[16] Meador & Cerf, 'Rethinking the President's Daily', 5.

[17] Priess, *The President's book.*.

[18] Butler, *Review of intelligence,* 145.

[19] Dhami, 'Towards an evidence-based approach', 257-272; Barnes, 'Making Intelligence Analysis', 327-344; Dhami, et al. 'Improving Intelligence Analysis', 753-757; Lupton, *Thinking with Type;* Stones and Gent, *7 G.R.A.P.H.I.C. Principles.*

[20] Jervis, 'Reports, politics, and intelligence', 24.

[21] Friedman and Zeckhauser, 'Assessing uncertainty', 824-847.

[22] Analyst-IC, 'Probing the implications', 5.

[23] Jervis, 'Reports, politics, and intelligence'.

[24] Nussbaum, 'Communicating cyber intelligence', 751.

[25] Petersen, 'What I learned'.

[26] Treverton and Miles, *Unheeded warning*.

[27] Priess, *The President's book.*

[28] Betts, 'Surprise despite warning', p.91.

[29] Sloan, 'The British state', 453-494.

[30] Silberman and Robb, *The commission,* 11.

[31] Wolfberg, 'When generals consume intelligence', 461-462.

[32] Karam, 'Missing revolution', 693-709.

[33] Davis, 'Why bad things happen', 16-17.

[34] ibid, p.16.

[35] Intelligence and Security Committee of Parliament, *Report,* 121-122.

[36] National Commission on Terrorist Attacks Upon the United States, *Final report*, 355.

[37] Davis, 'Why bad things happen', Bar-Joesph and McDermott, 'The intelligence analysis crisis', 363; Nolte, 'Intelligence analysis', 413.

[38] Marrin, 'Rethinking analytic politicization', p.729.

[39] Jackson, 'On Uncertainty', 463.

[40] Zegart, '9/11 and the FBI'.

[41] Tromblay, 'Information Technology (IT) woes', 819.

[42] McDermott and Bar-Joseph, 'Pearl Harbor and Midway', 954.

[43] Nussbaum, 'Communicating cyber intelligence', p.746.

[44] ibid, 750-751.

[45] Butler, *Review of intelligence, pp.133-134.*

[46] Nussbaum, 'Communicating cyber intelligence', 749.

[47] Dahl, *Intelligence and surprise attack.*

[48] Wohlstetter, *Pearl Harbor;* Dahl, *Intelligence and surprise attack,* McDermott & Bar-Joseph, 'Pearl Harbor and Midway'.

[49] Dahl, *Intelligence and surprise attack, 70.*

[50] National Commission on Terrorist Attacks Upon the United States, *Final report*, 213.

[51] Priess, *The President's book, 219.*

[52] National Commission on Terrorist Attacks Upon the United States, *Final report*, 260.

[53] ibid, p.258.

[54] Butler, *Review of intelligence, p.126.*

[55] Intelligence and Security Committee. *Iraqi weapons of mass destruction,* 22.

[56] Butler, *Review of intelligence, p.127.*

[57] Anderson, *Attacks in London and Manchester,* 16.

[58] ibid, 27.

[59] ibid, 20-21.

[60] Intelligence and Security Committee of Parliament. *Report,* 52.

[61] ibid, p.95.

[62] ibid, pp.66-67.

[63] Wolfberg, 'When generals consume intelligence', 461.

[64] The results of only ten respondents are used to present these findings. Although the responses cannot be construed as a complete representative sample of all staff within intelligence communities, it gives a good indication of those areas where information design can be used to enhance the communication of intelligence information.

[65] Spiegelhalter, Pearson, and Short, 'Visualizing uncertainty', 1393-1400; Le, et al., 'Health providers' perceptions', 250-258; Lazard and Atkinson, 'Putting environmental infographics', 6-33; Niebaum, Cunningham-Sabo, and Carroll, 'Infographics: An innovative', 1-6; Lyra, et al., 'Infographics or graphics+text'; Murray et al., 'Maximising the impact', 619–620.

[66] Few, 'Common mistakes'; Few, *Show me the numbers*; Le et al., 'Health providers' perceptions'; Patterson, et al., 'A human cognition framework'; Lyra et al., 'Infographics or graphics+text'; Tetlan and Marschalek, 'How humans process'; Coyle, et al., 'Data can be beautiful'; Majooni, Masood, and Akhavan, 'An eye-tracking study'.

[67] Priess, *The President's book.*

[68] Simon, *Introduction to typography;* Spencer, *The visible word*; Tschichold, *Asymmetric typography*; McLean, *The Thames and Hudson manual;* Bringhurst, *The elements;* Hartley, 'Designing instructional'; Lonsdale, 'Typographic features of text'; Arslan and Toy, 'The visual problems'; Dikson, '7 mistakes to avoid'; Carter, et al., *Typographic design*.

[69] Quispel and Maes, 'Would you prefer pie'.

[70] Peterson, 'Tables and Graphs'.

[71] Because context can be important in understanding the relationship between text and visuals, the general nature of the documents was explained to the researchers, and hence the relationship between the text and visuals was understood for the purposes of the study.

[72] Lonsdale, 'Does typographic design'; Lonsdale, 'Typographic features of text: outcomes'; Lonsdale, 'Typographic features of text'.

[73] Cowan, 'The magical mystery four'; Patterson et al., 'A human cognition framework'; Tetlan and Marschalek, 'How humans process'; Coyle et al., 'Data can be beautiful'; Majooni et al., 'An eye-tracking study'; Pissierssens, 'Revealing the scientific basis'.

[74] Anderson, 'Attacks in London', 30.

[75] ibid, pp.46-48.

[76] Betts, 'Surprise despite warning'.

[77] Aldrich, 'Strategic culture', 631.

[78] Meador & Cerf, 'Rethinking the President's Daily', 3.

[79] Wolfberg, 'When Generals consume intelligence', 467.

[80] Marrin, 'Rethinking analytic politicization', 3.

[81] Meador & Cerf, 'Rethinking the President's Daily', 1.

[82] Priess, *The President's Book*, 47 & 127.

[83] Dahl, 'Why won't they listen?', 84.

[84] Intelligence and Security Committee of Parliament, *Report,* 81.

[85] Priess, *The President's Book*; Butler, *Review of Intelligence*.

[86] Nussbaum, 'Communicating Cyber Intelligence', p.746.

[87] Kaplan, *Dark territory,* 193.