SOPHIE: Social, Open Pro-active Hub for Information Exchange to Support Intelligence Communities

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Abstract. Military intelligence communities need to collect, process and disseminate information as quickly and efficiently as possible, for example in answering requests for information by commanders. Currently, the flow of information between the field and intelligence communities is hampered by disparities in the integration of the various components of the information chain. We propose to create a hub for information exchange called SOPHIE, where information from heterogeneous sources comes together. This hub proactively notifies military users to relevant information based on their profile. In addition, users can search or browse available information products and consult experts to receive quick answers to their information requests.

Keywords: intelligence community, collaboration, context-awareness, military.

1 Introduction

The primary task of military intelligence communities is to collect, process and disseminate information to support missions of commanders on all levels. Commanders and staffs request specific information relevant to their mission. Intelligence analysts compile and send information products in response to these requests. However, currently information does not reach recipients timely and efficiently, thereby making military missions less effective. A number of problems can be identified. Due to time constraints, information requests go unanswered, or receive only a generic answer. Especially when information requests are not specific enough, the context of the mission is not considered and quality criteria for the product are lacking. On a general level, differences in goals, prioritization and mindset limit effective understanding and collaboration between intelligence and command and control communities.

Military organizations should strive towards a tight coupling between Command & Control (C2), Intelligence (I) en Surveillance & Reconnaissance (S&R) [1], [2]. These three processes are currently not synchronized into one chain of information: the C2ISR-chain. Due to the scarcity of resources (sensors, UAVs) and the

increasingly complex operational environment, an efficient integration of this chain is required to allow commanders to benefit from information obtained from ISR sensors [3]. In this chain, the Environment Cell is a pivotal point; analysts in this cell are responsible for gathering information and answering Requests for Information (RFIs) from commanders. As pointed out above, clear information requests, insight into available information and speedy information processing are vital requirements to allow information to flow efficiently through this whole chain. Catalysts for this process are improved technological means of information exchange, such as mobile devices and big data analysis.

This project builds on innovative technologies to strengthen the C2ISR chain. First, we provide insight into current functioning of the intelligence chain, focusing on the interaction between the Environment Cell (EC) and the commanders in the field. Then, we propose the concept of SOPHIE: a Social, Pro-active Hub for Information Exchange between the EC and commanders. We present the functionality illustrated by a use case and point out future directions. As this is work in progress, we plan to host a first evaluation session with end-users in April 2014.

2   Domain Analysis: Current Practices and Bottlenecks

This domain analysis is based on results from three research activities: 1) observations of the functioning of the Environment Cell during a military exercise (feb/march 2013), 2) interviews with three platoon commanders with expeditionary experience and 3) a workshop where military experts and human factors experts were brought together to identify current practices and bottlenecks.

In all these activities, the focus of research was on the processing of an 'request for information' (RFI) into a finished information product and the interactions between commanders and experts in the Environment Cell in this process. At a global level, the process is as follows; an information request from a commander is sent to the EC digitally (e-mail) or on paper using standard forms. Information requests originating from the field (near real-time) are done by radio via the mission manager in the operations room. Depending on the priority of the request and the available knowledge and expertise, a request can be answered directly by an analyst. Alternatively, information needs to be gathered by sensors to answer this request. When information becomes available to answer this request, depends again on the priority and the available resources. The analysts in the EC gather the available information into an information product, and make it available to the commander (either digitally or on paper).

What can be concluded is that at this moment, the intelligence gathered and processed in the EC is insufficiently contributing to Command & Control, mainly due to low quality and accessibility of information, insufficiently flexible technological resources and misunderstandings or cultural differences between the actors. To start with the first point; it is currently hard to keep track of available information and where this is stored. In the EC, a number of databases are used for the analysts, but commanders have no direct access to EC databases. They do have access to a large

number of generic information products, but these are stored in a very user-unfriendly way and are hard to search or browse even for analysts. Moreover, the standard information forms are not helping commanders to ask specific and context-dependent questions, resulting in insufficient or standard answers or no answer at all. In fact, very little feedback is provided as to the status of a request. In the case of radio requests, the mission manager in the operations room is not trained in handling intelligence information requests.

Concerning the technological resources, a lot of the interaction is done by phone or in face-to-face contacts, which are not recorded and cannot be reproduced. E-mail is also increasingly used, but this is only efficient from one person to another, not to groups. Products are stored in a secured data folder, in a standard, pre-determined folder structure which cannot be changed ad-hoc. Over periods of months, these folders can become very extensive and hard to search. Finally, the differences between actors are hampering efficient communication and understanding between the EC and commanders in the field. This has mainly to do with different opinions on what information should be made available and for what reasons, resulting in discussions on the priority of a request. But also insufficient insight into each other's work practices, differences in rank and differences in security focus are not contributing.

3   Technological Innovations

Based on our domain analysis and relevant literature on military information exchange, we identified three global directions for solutions.

1. Make information products better available through intelligent access and better documentation. For example using smart technologies such as reasoning based on user-defined document tags, ontologies or information fusion technologies [4]. Also increase accessibility of information where and when it is needed, using innovative hardware such as mobile or head-mounted devices and augmented reality. Support of the RFI process should provide feedback on the status of a request.
2. During initiation of a request, the context, boundary definitions and possible impacts ("what happens when you do not receive this information") of the request should be made much more explicit, instead of filling out a standardized, generic form. This should be partly done by a digital e-partner ("Intelbuddy"), who keeps a profile of your information needs and wishes [5]. Also, by strengthening the informal human-human communication, for example by bringing commanders into direct contact with the necessary experts or analysts based on their profiles [6].
3. The amount of available information and the speed of availability should be increased. Primarily by quick documentation in the field of mission-relevant observations and findings, using categorized annotations and tags. Smart algorithms should facilitate the matching between information elements and user profiles [4].

4   SOPHIE Concept

Following the directions outlined above to improve the interaction and collaboration between intelligence communities and commanders, we propose the concept of SOPHIE: a Social, Open Pro-active Hub for Information Exchange. Using SOPHIE, commanders can access existing information products and initiate new information requests, even in the field. SOPHIE builds up a user profile (including interests, role and context factors) by monitoring mission planning, execution and mission reports. Based on the profile, SOPHIE helps to make information requests more specific, with
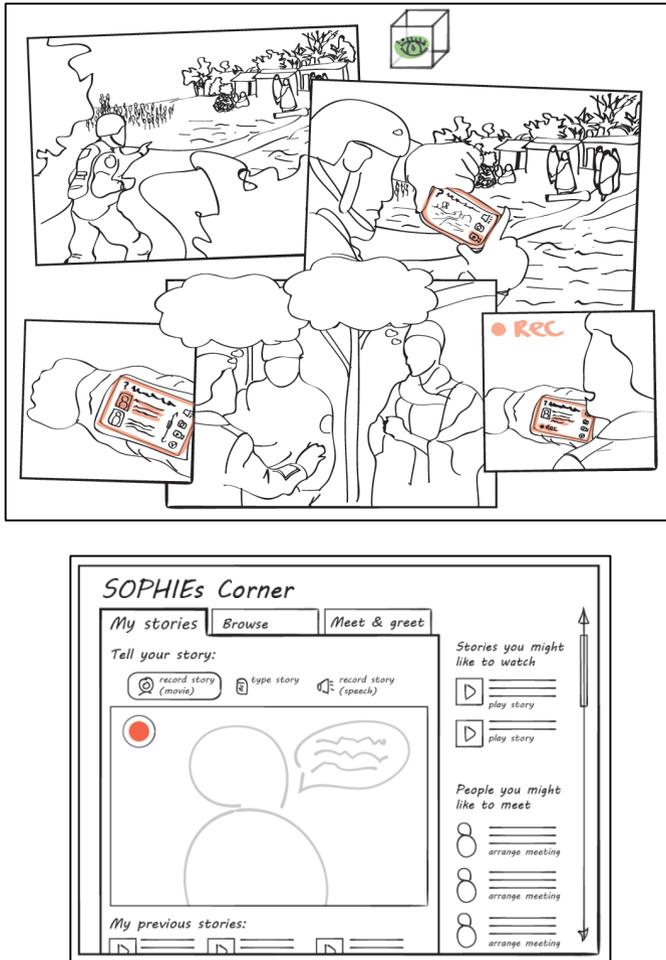

Fig. 1. Illustrations showing SOPHIE monitoring mission execution in real time (top) and an impression of SOPHIEs corner where the informal knowledge network is maintained (bottom)

emphasis on quality criteria: what do users need to do with the information? In addition, SOPHIE notifies users to relevant new information and makes suggestions to consult other experts or documentation. All personnel including intelligence analysts connect and maintain an informal knowledge network using SOPHIE [6].

As Fig. 1 illustrates, SOPHIE takes many forms, from an e-partner that monitors mission execution to a virtual kiosk where users can record implicit knowledge, share experiences and consult other experts. Specifically, we define eight functionalities that should be included in SOPHIE to address the current bottlenecks in the process and provide added benefit to end-users.

1. SOPHIE should support user searches in existing information, for example in existing databases with information products. Search results are sorted and orderd based on time, source, role, mission so that relevant results can be obtained.
2. SOPHIE helps to specify the questions and context of a request. Because SOPHIE supports the user to elaborate the context, demands, boundaries and impact, the analysts in the EC can better interpret the request and find more relevant results.
3. SOPHIE constructs tailor-made information products, both on demand and proactively. For example, a sort of 'welcoming packet' when a new mission planning is initiated, outlining the available information based on user profile and mission details. Existing products are indexed and tagged, so that they can be found easily.
4. SOPHIE offers information products from the intelligence community to commanders (dissemination). This dissemination is specific for the request and context. Also, SOPHIE provides feedback on the status of a request, while it is underway.
5. SOPHIE identifies known-unknowns, by keeping an index of requests and answers and providing suggestions for research. Analysts in the EC want to know on what subjects many requests come in, but on which no information is available.
6. SOPHIE receives information from users via a virtual kiosk, either manually or autonomously. This way, not only the information is stored in a retrievable place, but this also helps to construct user profiles. SOPHIE can be 'fed' with information either explicitly (commander who enters a patrol report) or implicitly (SOPHIE monitors the activities and progress of the mission).
7. SOPHIE guides the user proactively in information searches. Based on the user profile constructed over time, SOPHIE provides users with suggestions for 'further reading' or notifications to incoming relevant information.
8. SOPHIE supports and utilizes the informal network that exists in military operations. In a 'coffee corner', SOPHIE matches users to each other based on profile similarities and interests. Informally, these people can exchange information (depending on their security clearance) which are logged easily for later retrieval.

5   Future Directions

This poster presents the concept of SOPHIE, a social, open pro-active hub for information exchange to support interactions between intelligence communities and

military commanders. In our domain analysis, we found evidence to suggest the process of initiating and answering an information request can be improved in military operations. Specifically, low availability of information, inflexible technological resources and misunderstanding of work activities between the user groups hamper efficient use of intelligence in the C2 chain [3]. This is not merely a technological challenge, but requires an integrated approach [1]. Our hub employs innovative technologies to address current bottlenecks, not only on a technological level (improved dissemination, better retrieval and tagging, matching of information relevance to user profiles) but also on an interpersonal level (increasing and maintaining an informal network, fostering collaboration). In our workshop, the validity of this integrated approach was confirmed by both the military and the human factors experts. In fact, in ongoing research, our team strives towards a technical demonstrator within a relevant military scenario by the end of 2014. In addition, the main functionalities and underlying assumptions are further checked with military end-users in a workshop evaluation.

Importantly, SOPHIE does not improve the *quality* of information itself. Investment in smarter and better sensor capability is a sine qua non to provide the commanders in the field with better information. In addition, if SOPHIE is to succeed, organizational and security aspects of military intelligence need to be reconsidered: who has the responsibility for following up on notifications? Who can control what is stored in the user profiles and which matches are made? Who has access to information and to what level? For technical implementation, challenges on reasoning structures, matching algorithms and information fusion tools must be overcome.

In the future, we see SOPHIE positioned not as the next best analysts' tool, nor as a Battlefield Management System for platoon commanders. We see SOPHIE as the pivotal point in making information better available, through helping those who need the information to ask for it in the right way. Only stronger integration of the various components of the C2ISR chain can truly contribute to an information-guided approach to military operations.

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