Report of Break-Out Group 4

Situation Awareness

Christopher A. Horeczy
Land Force Doctrine and Training System Headquarters
Canada

Marcus Lem
Health Canada
Canada

Sonya McMullen
Tech Reach, Inc.
USA

Thomas Porathe
Mälardalen University
Sweden

Joachim Stamm
PLATH GmbH
Germany

Margaret Varga
QinetiQ
UK

1 LEVEL OF ABSTRACTION

A critical aspect of situation awareness is the **level of abstraction** of the objects and contents, which are displayed and analysed with a visualisation tool. To get a clear picture of the situation around you do not have to see everything that has been detected/known, but only information that is relevant to your needs. As a simple example a coloured map indicating the terrain including streets and houses is useful in a tactical display, where you have to find a fast and safe way through a city. Possible enemy can be displayed as coloured dots. On the other hand when you want to display enemy positions with complex coloured symbols together with additional information about the strength, type and tactical role, a uncoloured map is likely the better solution because it reduces the complexity. Therefore, it is quite obvious that different levels of abstraction of the information must be available for the user to "zoom" in to view different information domains. This is well known for map applications where more detail shows up when you zoom in more and more (capitals, large cities, all cities, villages etc.). It is possible for other types of information to be visualised/handled similarly for network and data analysis.

A good example was given during this workshop in the presentation "Reduction of complexity: an aspect of network visualization" (Prof. Jan Terje Bjørke, Norwegian Defence Research Establishment, NOR). Here different levels of abstraction of a complex network were seen after every iteration of combining single nodes into hypernodes.

With this form of abstraction one could start a situation report with a very abstract level, i.e. compressed data (showing only hypernodes in the presentation mentioned above). The ability to drill down to detailed information must be provided. With such an approach we assume that a higher level of compression is appropriate for experienced users whereas a lower level of abstraction is more convenient for less experienced users.

To make sure that the user is not overwhelmed with too much information, one must be able to switch on and off different layers of information as required.

2 RELIABILITY AND UNCERTAINTY

The main topic of discussion was the aspect of **reliability and uncertainty** of collected information. We concluded that the quality of information must be shown to the user in some manner. This can, for instance, be done by error bars in a chart histogram, by colour indication of uncertainty or dashed display representing the conformity of the data. Nevertheless the usability of the display has to be taken into account: when too much information is shown the user gets irritated, not informed, i.e. information overload.

An interesting feature of a visualisation tool concerning reliability/uncertainty might be the possibility to show/hide uncertain information. This means that the user can show only that information which has a given level of certainty. On the other hand by indicating the uncertainty or just showing the uncertain information in the visualisation tool the user becomes aware of the uncertain information and can therefore decide what to do to gain more certain information on a given object/aspect, or to what extend to use the uncertain information. So this feature will support the command of operations to get a complete and assured picture. The same aspects also apply for the reliability of information.

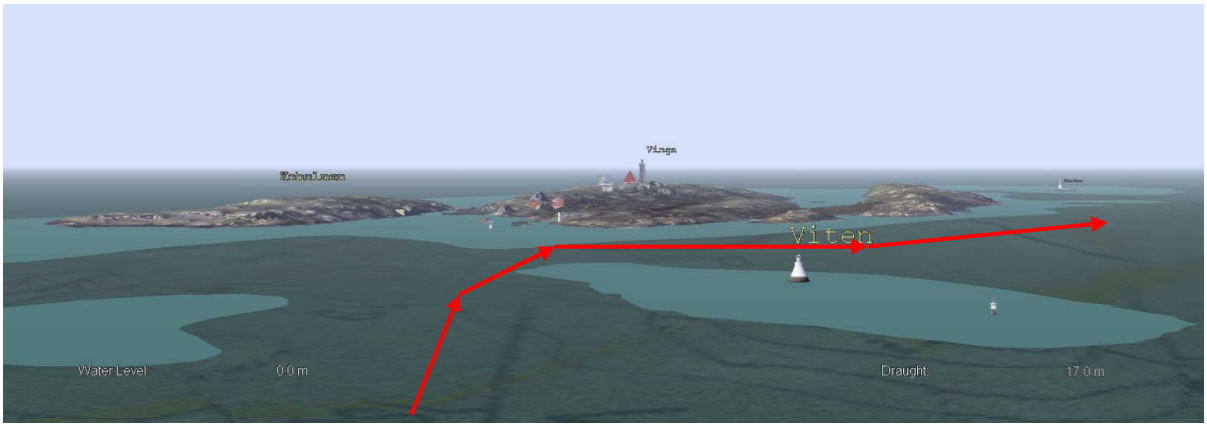
A special kind of uncertain information is predicted information. This information has to be clearly marked as predicted (e.g. track prediction of mobile object when hidden).

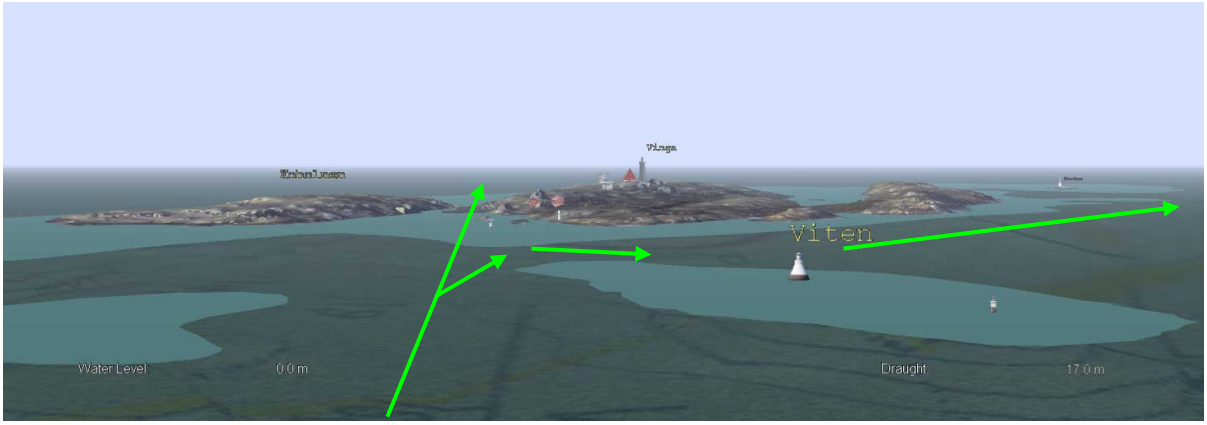
And be aware: an important aspect of information reliability is derived from knowing whether the required information is available about a certain object, area or frequency range. For example, in a map display of RF emitters it is important to indicate that in a given area there are no sensors to detect emitters. For social networks this would mean: if we know that person X is not using email, s/he will never appear in a visualisation of an email network in a given group.

3 THE HUMAN FACTOR, THE ROLE OF THE OPERATOR AND THE DOMAIN

Next a few statements are listed concerning **the human factor, the role of the operator and the domain** in which s/he is working.

Operators have to use tools, but they will use them only if they see a real benefit and ease of use. Therefore, tools have to use common known visualisation techniques (e.g. Standard international cartographic representation) or, when new displays are introduced, they have to be well defined (simple and clear) and the user has to be trained to use these displays. This means, that a display of a map with arrows representing the direction of a ship and the distance to go is well known and consistent with course plotting for marine navigation (see picture below with red arrows). But if you take the length of the arrow as representing the velocity of the ship this would give a completely different picture (see picture below with green arrows). This kind of display is quite unusual and therefore not easy to understand, even though the green arrows provide significant meaning.





Redundancy can be a great help for effective visualisation, because not all people are the same and realise things in the same manner. For example, there are people who like to have a project timetable listed in a table. On the other hand some find it much easier to see the complete picture in a project gantt chart (like MS Project). So to help the user, the same information could be displayed in different manners (e.g. table and gantt chart). On the other hand, even in one display information can be visualised in two different ways, this helps to provide a quick impression. For example, traffic lights indicate the fact that you have to stop in two ways: the colour (red) and the position (upper light). This feature of traffic control enables colour blind people to get their drivers licence, because they get their information from the position of the light.

As stated often during the workshop, the visualisation must be simple, clear and well defined. But the definition of simplicity depends on the role and the task of the operator. For example, in a tactical situation the visualisation has to be very simple and clear, because time critical decisions have to be made by the operator who maybe not an expert in analysing situation reports and graphical representations. On the other hand, in a strategic situation the decision maker is likely to be a well educated analyst, who is accustomed to dealing with detailed information, complex scenarios and has to assure a high degree of accuracy of the information he is reporting. So a much more complex display and highly sophisticated tool is necessary and appropriate.

Additionally the usability of the same display (e.g. 3-Dimensional display with latitude/longitude in x/y plane and time in z) is more or less helpful depending on the domain

- health investigation, Marcus Lem ☹
- RF communication, Vera Kamp ☺

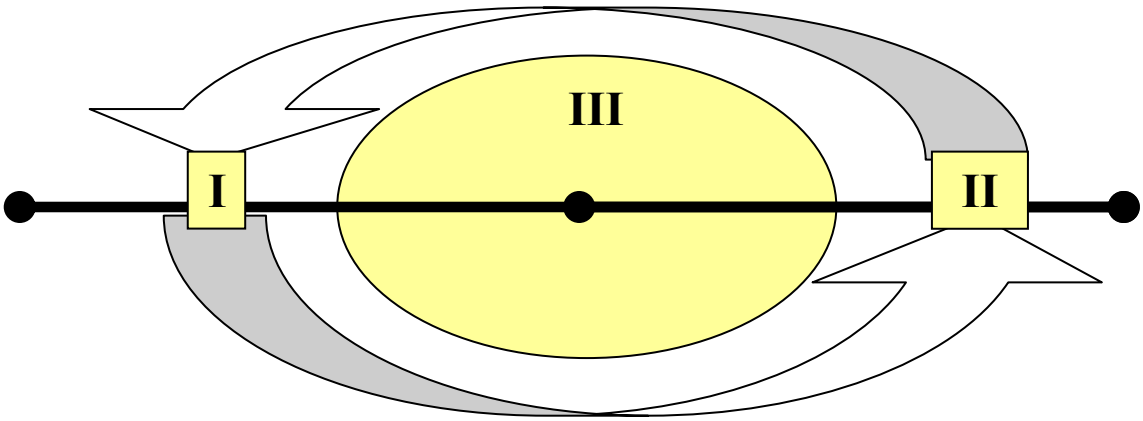
4 PROCESS OF GAINING SITUATION AWARENESS

The **process of gaining situation awareness** was discussed. Generally speaking, situation awareness is the result of collected information, background information and the combination as interpreted by human beings.

- SITUATION AWARENESS = DATA + CONTEXT + INTERPRETATION

A visualisation tool can support the operator or analyst by displaying the collected information and background knowledge more or less mechanically (step I). This visualisation can now be interpreted by the operator (II). These two steps can be iterated several times, when new data/information can be

included, interpretation results can be displayed and highlighted as new information and the cycle repeats. In this iterative way a tool should support the operator with help by manual and/or automated algorithms and tools to analyse displayed data (III).



Iterative process to increase of situation awareness

5 DATA FUSION

As a last point the importance of **data fusion** was discussed. By fusing the data the amount and the quality of information may increase. But this means that, for example, the information from a radar sensor and an optical sensor should be fused such that with the radar the 3-Dimensional position is measured and with the optical information the identification of an object can be achieved. Of course, with this information the position with an identification label can be displayed on a map. So the information from the different sensors must be combined by the visualisation tool. Data fusion must avoid misrepresentation. For example, if four sensors report 40 targets, the fused data should be able to discriminate sufficiently to present only 40 targets – not 160.