Measuring the Impact of Situational Awareness on Digitised Force Effectiveness

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# Study Overview

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<th>Study Aim</th>
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| To measure the impact of differing Communications Information Systems (CIS) capability on force effectiveness (FE) at the tactical level | • BG level  
• Land oriented  
• Comparing a baseline analogue BG (Clansman) with two Epochs of digitally enabled BG (BCIP5) |
| Develop methodology  
Conduct pilot study |  |

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<th>Hypothesis</th>
<th>Conclusions</th>
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| ‘ the digitisation of a BG HQ, its superiors, subordinates and BG enablers improves the timely delivery of appropriate effects, leading to improvements in Blue force effectiveness ’ | • Successfully developed and applied innovative analytical method for measuring benefits of CIS  
• Results showed that Blue force effectiveness and C2 effectiveness improve with the introduction of digitised CIS |

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Overview of Method

Network Modelling

Information

Networks

People

JOINT ACTION

SITUATION AWARENESS

Performance of Actions

Decision

Level 1

Level 2

Level 3

Comprehension of Current Situation

Projection of Future Status

Rapid & Deliberate Planners, Indicators of Collective Behaviour

Individual Factors

State of the Environment

Feedback

Abilities

Experience

Training

Goals and objectives

Perceptions of Elements in Current Situation

Level 1

Level 2

Level 3


UNCLASSIFIED
Ground truth is ‘where units are in the model’

Perception is ‘where the comd(s) think the units are’

Comd(s) work based on the contents of their perception not Ground Truth

Blue Locs

Acquired Red

BLUE Comd’s Perception
Situation Awareness (SA) Analysis

**Level 1 SA**
Perception of Elements

**Level 2 SA**
Comprehension

**Level 3 SA**
Projection

Underpinning Subjective Self-Rated Analysis (SART and COSAQ)

\[ \text{WISE 'Perception'} \]

\[ \text{Indicators of Collective Behaviour (ICB)} \]

«

\[ \text{lates the contribution made to SA by the} \]
\[ \text{itions achieved by the organisation (i.e.} \]
\[ \text{y / neutral picture) and information about} \]
\[ \text{ide units, using positional accuracy and} \]
\[ \text{osition compared to ground truth.} \]

\[ \text{Uses the acquisitions achieved} \]
\[ \text{likely enemy groupings} \]
\[ \text{ding to a measurement of} \]
\[ \text{comprehension of the} \]
\[ \text{uation.} \]

\[ \text{Based on inference of intent} \]
\[ \text{likely enemy groupings} \]
\[ \text{pect to a set of} \]
\[ \text{emy objectives.} \]
Phase 1 Results

Phase 1 of study:

- Developed an initial set of measures for L1, L2 and L3
- Compared Analogue versus Digitised (Epoch 4)
- Calculated L1 for correlation with FE and trialled L2 and L3
- Measured subjective assessments objectively using SART
### Phase 2 Experimental Design

Three cases examined but only one gamed in phase 2

<table>
<thead>
<tr>
<th>Case</th>
<th>Own Side Reporting Frequency (seconds)</th>
<th>Own Side Reporting Delays (seconds)</th>
<th>Enemy/Neutral Reporting Frequency (seconds)</th>
<th>Enemy/Neutral Reporting Delays (seconds)</th>
<th>Peers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analogue</td>
<td>Pl → Coy 30</td>
<td>Coy → BG 360</td>
<td>BG → Bde 360</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>Digitised (Epoch 3)</td>
<td>Pl → Coy 30</td>
<td>Coy → BG 360</td>
<td>BG → Bde 360</td>
<td>0</td>
<td>0</td>
</tr>
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<td>Pl → Coy 30</td>
<td>Coy → BG 360</td>
<td>BG → Bde 360</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Representative of CLANSMAN: Delays on reporting due to manual encryption for insecure voice. The reporting frequency for Bde to report a consolidated ISTAR product to BG was set at 1 hour.

Representative of BCIP Epoch 3: No peer links other than for AH (to BG). No delays have been included for message passing as systems are encrypted. The reporting frequency for Bde to report a consolidated ISTAR product to BG was set at 6 minutes.

Representative of BCIP Epoch 4: Significant number of peer relationships so that an all-informed net is generated. No delays have been included for message passing as systems are encrypted. The reporting frequency for Bde to report a consolidated ISTAR product to BG was set at 6 minutes.

50 replications of each game and the two previous games with IERS.
Experimental Case Study (1)

Force Effectiveness
- The loss exchange ratio improves with the introduction of digitisation (i.e. there are a greater proportion of red losses than blue losses)

C2 Effectiveness
- Level 1 SA is significantly better in the two digitised cases than in the analogue case
- The Epoch 3 case shows higher SA due to more targeted use of ISTAR assets during the game
Comparison of Subjective Measures

Compared Situation Awareness Rating Technique (SART) & Commander’s SA Questionnaire (COSAQ)

- SART actual and perceived scores are a reasonably good match to the COSAQ L2 score
- SART actual follows a similar trend to COSAQ L1 but it is consistently lower
- SART is unable to reflect COSAQ L3
Comparing Subjective & Direct Probe

The graph presents the COSAQ and direct probe L1 SA measures for the Epoch 3 case.

- Direct probe values systematically higher than COSAQ
- Higher COSAQ at start reflects pre-scenario player briefings
- Increase in COSAQ between 30-45 minutes is seen in direct probe measure
- Marginal drop in direct probe measure after 45 minutes consistent with COSAQ
- Trends in direct probe measure similar to those in COSAQ
Comparing Direct Probe – All Cases

Improved SA for Epoch 3 compared with Epoch 4 not expected but was due to difficulties managing game variables

- Level 1 SA is better in both the digitised cases than the analogue
- Shape of curves consistent with key events in cases

Analogue case approaches digitised cases

- Initially: due to ISTAR sweep and ‘flush’ of information to lower levels
- Around 75 minutes: in the close battle

Detailed Results
Correlations – All Cases

Work to date indicates that there is a relationship between FE and C2E and that digitisation leads to significant improvement in both FE and C2E results show that, although force effectiveness improves, there is a greater variation in force effectiveness in the digitised cases when compared to the analogue cases.

There is also a larger variation in overall Level 1 SA in the Epoch 4 cases when compared to the Epoch 3 and analogue cases.
Phase 3 Way Forward

Background traffic IERs represented explicitly in WISE

Explicit model of communications now represented within WISE:

- Representation of communications systems and fixed and mobile networks;
- Representation of physical propagation constraints using the Global Information System Electronic Planning Tool (GISEPPT);
- Throughput delays for messages

Improvements to calculation of situation awareness measures for Level 2 and 3

Constructive simulation only experimentation currently underway to repeat phase 2 assessment
A direct probe method for measuring situation awareness has been developed.

The new analytical method is able to differentiate between changes in CIS options.

The application of the method was successful however experimental control was challenging.

Improvements have been made to the method, are currently being tested with the aim to report them at the next ICCRTS.
Points of contact

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