Evidence-Based C2 Metrics: A Survey

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Overview of this talk

Goals and Philosophy

Document Metrics

Process Metrics

Cognitive Metrics

Discussion
Goals

• Use C2 metrics to assess headquarters performance
  … to enable organisational learning.

• Survey literature to find “best of breed” metrics
  … as a basis for further development.
• Want published evidence of **feasibility**

  … can we collect numbers without too much effort?

  … and without disrupting the headquarters?

• Want published evidence of **validity**

  … do the numbers mean anything?

  … metrics nudge organisations towards getting high scores

  … invalid metrics can be harmful, not just useless.
3 Types of Metrics

- Process
- Document
- Cognitive
Document (Product) Metrics

Measuring the outputs of the process
Documents include plans, orders, etc.

Historical example: Guderian, 1940

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**Headquarters, XIX Army Corps**

Operations Department

**Corps H.Q., Soize**

16.5.40

**Corps Order No. 7 for May 17th, 1940**

1. The enemy opposing 1st and 2nd Panzer Divisions has once again been decisively defeated and is withdrawing westward along the whole front.

_XIX Army Corps_ has reached the area west of Montcornet with the mass of its forces. Advance units are moving towards the Oise between Origny and Haméncourt.

_XIV Army Corps_, following behind and to the left of XIX Army Corps, is covering the left flank along the Aisne.

2. XIX Army Corps will continue to advance in a north-westerly direction on May 17th, by-passing St. Quentin and Peronne. Move off 09.00 hrs.

3. The advance will be as follows (for march routes see Annex 1):
   - **Right**: 2nd Panzer Division across the line Origny-Ribémont along march routes 1 and 2.
   - **Left**: 1st Panzer Division across the line Mézières sur Oise- Haméncourt along march routes 3 and 4.

4. **10th Panzer Division** is once again under command. It will follow behind the left wing along the march routes previously numbered (on 16th May) 2 and 3, as far as Norcourt. Then it will send its left wing column through Dizy-le-Gros, Clermont Pierrepont, Haméncourt. Then march route 4 in accordance with Annex 1.

A road will be freed for the right wing column.

5. **The 3rd (Motorised) Infantry Division** is placed under command of XIV Army Corps.


7. **Corps Headquarters**: originally Soize (3 miles east of Montcornet), then moving along march routes 2 and 3.

Signed: Guderian

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**Data Sources**

(From earlier same day)

**Unit SITREPs**

**XIV Corps SITREP**

**Higher HQ**

**ISR**
**Question:** Are plans, orders, etc. understandable?

**Metrics:** Ask readers to summarise key points in their own words, and compare against list of key points from author(s).

**Evidence:** Successfully used by Singapore (Cheah and Fong 2006).

**Problems:** Workload on author(s) and analysts. Subjectivity.
**Question:** Are plans, orders, etc. understandable?

**Metrics:** Ask readers to answer a list of T/F questions

e.g. “Sharing information with NGOs is in line with the Commander’s intent to avoid civilian casualties [T/F]”

**Evidence:** Successfully used in US/Singapore CTF exercise (Thomas, Pierce, Dixon & Fong 2007).

**Problems:** Workload on author(s) and analysts.
Doc: Data Sources

Question: Is the document based on timely data sources?

Metrics: Number of data sources
Recency of data sources

Evidence: Use of these metrics in academia

Problems: Data sources may be implicit, so counting them may be difficult.
Process Metrics

Measuring the process itself
Question: How fast is the process?

Metrics: Time taken to react to events
Time to perform tasks
Throughput of tasks
— all fairly easy to measure

Evidence: Seems obvious that faster is better.

Problems: Must combine timing metrics with quality metrics to avoid encouraging “fast and sloppy” work.
Process: **Breadth**

**Question:** Does the process consider enough options?

**Metric:** Number of COAs (Courses of Action) considered

**Evidence:** Recommended in US *Joint C2 Functional Concept*

**Problems:** “Considered” is a vague term
– danger of token COAs
Process: Workload

**Question:** Are staff overworked?

**Metrics:** NASA Task Load Index and similar metrics

**Evidence:** Widely used, e.g. Cheah and Fong (2006).

**Problems:** Lack of evidence on relationship with HQ performance – when does overwork become dangerous?
**Question:** How well are staff working in a team?

**Metrics:** Various
- e.g. NATO Command Team Effectiveness Model (Essens *et al.* 2005)
  - but no clear winners

**Evidence:** Considerable evidence that teamwork is important

**Problems:** Limited evidence for specific metrics.
No clear consensus on measuring teamwork.
**Process: Interoperability**

**Question:** How well does the agency interoperate with others?

**Metrics:** Various, e.g. OIM: Organisational Interoperability Maturity model (Clark and Moon 2001)

**Evidence:** Seems obvious that interoperability is good. OIM is frequently cited.

**Problems:** OIM is a fairly crude measure (only 5 levels).
Process: Aggregated Measures

Question: Overall, is the process “good”?

Metrics: Aggregated measures such as Headquarters Effectiveness Assessment System (HEAT) and Army C2 Evaluation System (ACCES)

Evidence: Limited.

Problems: Not clear what the final score really means. NATO Code of Best Practice for C2 Assessment says these measures “have limitations.”
Process: **Network Measures**

Organisational Network Analysis sheds light on operation of an organisation

Network produced by analysing communication (email, phone logs, etc.) e.g. Jarvis (2005)
**Process: Network Measures**

**Question:** Is communication effective?

**Metrics:**
- Average network degree
- Average network distance
- and several other measures

**Evidence:** Considerable evidence for average distance. Average degree is less useful.

**Problems:** Data collection may be difficult, especially for face-to-face communication.
Cognitive Metrics

Measuring inside people’s heads

Situational Awareness (SA) metrics
SA: **SAGAT**

**Question:** Do staff have good Situational Awareness?

**Metrics:** SA Global Assessment Technique (SAGAT)

**Evidence:** Very widely used.

**Problems:**
- Needs situation-specific questionnaire.
- Needs “freezes” in operation.
- Better suited to tactical level.
Question: Do staff have good Situational Awareness?

Metrics: Ask a list of T/F questions (as per doc metrics)

Evidence: As per doc metrics.

Problems: Analyst workload.
**Question:** Does the team have good SA?

**Metrics:** Perhaps T/F questions & take worst of team

**Evidence:** Analogy to team shared agreement work.

**Problems:** Nobody seems to know how to do this.
## Metrics Overview

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- Further work needed, especially on Team SA & Coordination
- Need better models of C2 → what needs to be measured

Any Questions?