Evaluation and Assessment of DoD Maintenance Records Using Natural Language Processing

Presentation by Maria Seale, PhD
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Motivation

Enormous Problem Space

O&S costs account for ~ 75% of DoD platform lifecycle costs

The OIB sustains approximately

• 339,290 vehicles,
• 280 combatant ships and submarines, and over
• 15,340 aircraft and supporting critical safety items.

Roughly $92 billion of DoD’s total FY2019 $687.8 billion expenditure was applied to maintenance activities and services.”

- FY20 Industrial Capabilities Report to Congress
Motivation

Reliability ✧ Availability ✧ Maintainability

Goal: Improve RAM metrics

Challenges:

- Vehicles exposed to harsh and hostile environments
- Field maintenance is difficult or unsafe
- Unscheduled maintenance decreases availability
- Undiscovered fleet-wide trends can compromise safety
Maintenance Philosophies

Where does text processing fit?

Scheduled Maintenance
- Time-based
- Actual condition not considered
- Improve reliability and availability
- Can be less costly

Condition Based Maintenance
- Rely on sensors and other indicators to determine best maintenance time
- Not possible to monitor all components
- Potentially greater failure risk based on thresholds/algorithms

Optimize by including predictions on maintenance needed before next visit

Mining text data can improve maintenance across philosophies
Maintenance Text Processing
Record Categorization for improved RAM

Maintenance Logs

Fleet-wide metrics are needed to assess trends and issues

RAM Metrics

~ 10% of records are manually labeled

~ 90% of data are not labeled

Supervised Learning

100% labeled data

Supervised Learning

100% labeled data
Predicting labels individually revealed dependencies

Maintenance Cause

Maintenance Type

Component Label

Over 1200 unique labels

Learning Using Privileged Information (LUPI) model

NLP and ML methods produced 93% accuracy across all three labels
How can we use available data to enable predictive maintenance?

Logbook data describes the problem that occurred in the **past**

Sensor data indicates a problem as it occurs in the **present**

Together, they can inform predictive maintenance models for the **future**
How can we use available data to enable predictive maintenance?

1. Logbook data describes the problem that occurred in the past.

2. Sensor data indicates a problem as it occurs in the present.

3. Together, they can inform predictive maintenance models for the future.
How can we leverage collected data for new purposes?

- Data have been collected on some platforms for decades
- Understand organizational goals and priorities - **RAM**
- Goal-centered data exploration starting with text
  - Categorization
  - Impact
  - Data linkage
Thank you!

FOR MORE INFORMATION:

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