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Evaluation and Assessment of DoD Maintenance Records Using Natural Language Processing

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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?

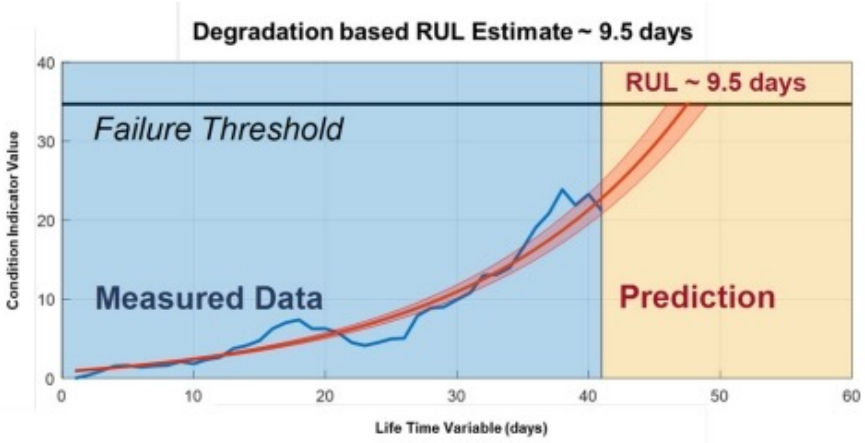
Scheduled Maintenance

- 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

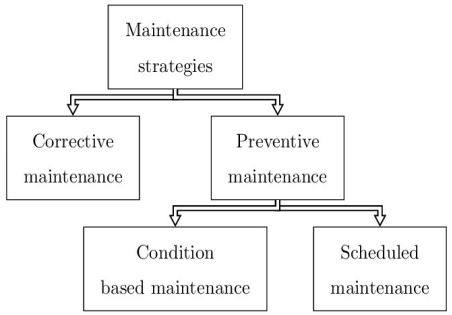
Maintenance Text Processing

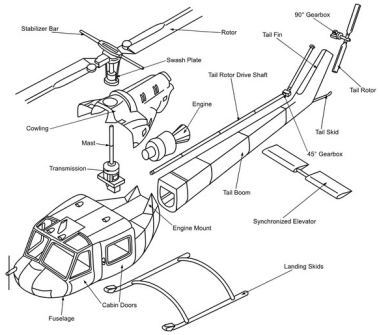
Record Categorization for improved RAM

Predicting labels individually revealed dependencies

Maintenance Cause

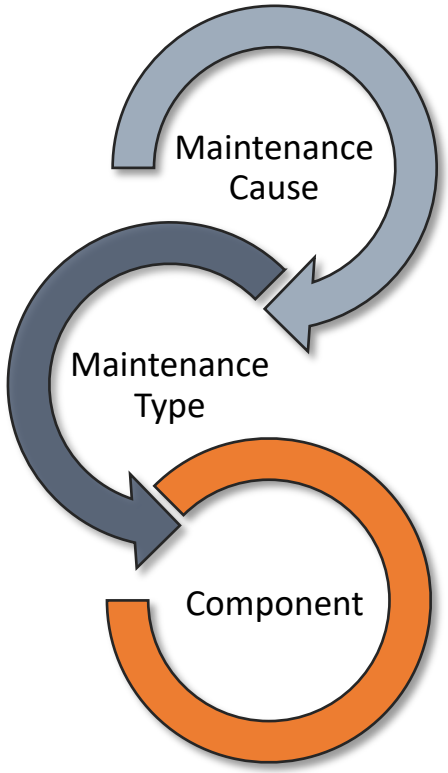
Maintenance Type





Component Label

Over 1200 unique labels



Learning Using Privileged Information (LUPI) model

NLP and ML methods produced 93% accuracy across all three labels

Maintenance Text Processing

Sensor Data Correlation for Predictive Maintenance

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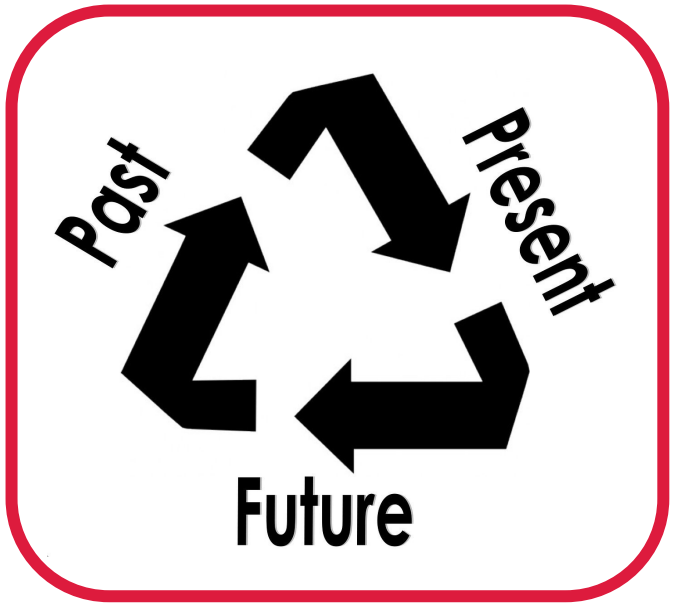
How can we use available data to enable predictive maintenance?

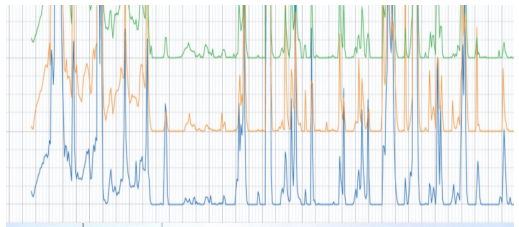
1

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***

Maintenance Text Processing

Sensor Data Correlation for Predictive Maintenance

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NLP

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3

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Maintenance Text Processing

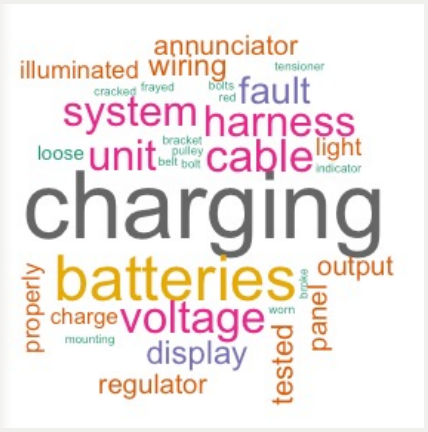
Impact Discovery

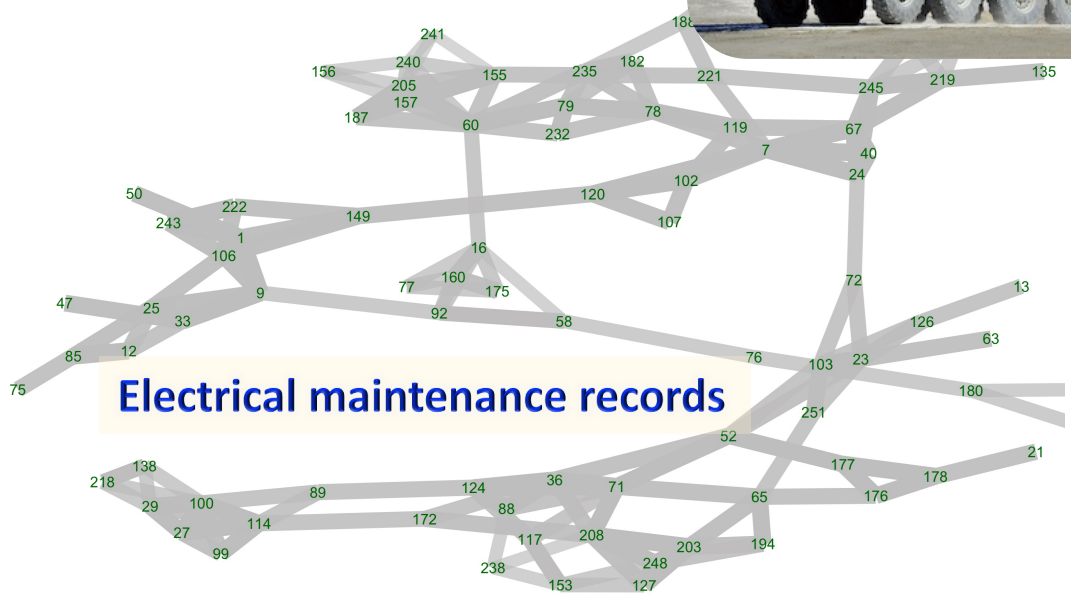
How can we leverage collected data for new purposes?

- 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

Mechanical

Electrical





Thank you!

FOR MORE INFORMATION:

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