679th Armament System Squadron

Integrity - Service - Excellence

Common Methodology for Calculating Fuze Reliability

NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

52nd ANNUAL

FUZE CONFERENCE

"Smart Fuzing – Adding Intelligence to Fuzing Solutions"

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Unclassified

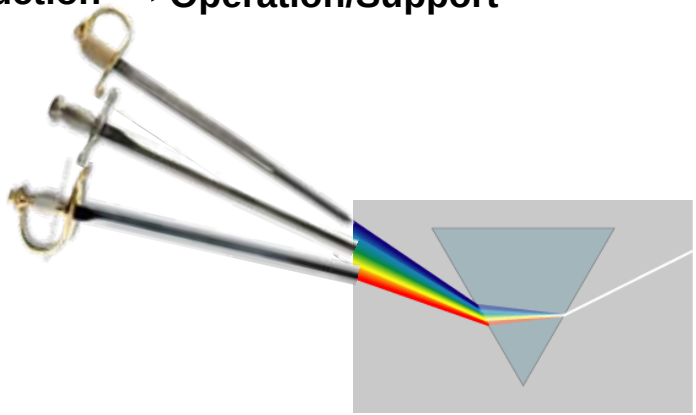
Overview

- **Problem – How can performance reliability of a fielded fuze system be evaluated across fuzes from different DoD Services.**

- **A look at reliability over the product life cycle**

  Concept/Feasibility → Design/Development → Production → Operation/Support

- **Methodology Approaches:**
  - **Army (Artillery)**
  - **Navy (Air-Ground Bomb Fuzes)**
  - **Air Force (A-G)**



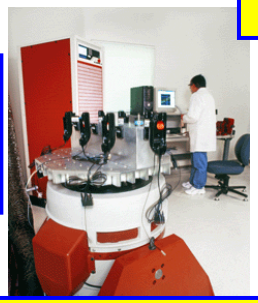
- **Brief descriptions of positive and negative aspects of the different approaches**

- **Consideration for a Joint Services approach**

Problem Statement

- **Air Force, Navy, and Army collect similar types of data to determine fuze reliability:**

Development & Operational Tests



Qual./FAAT/LAT

Training Missions

	Name	Failure Rate	MTBF
MIL-217	MIL21...	7.778 fpmh	128555.718 Hrs
Block	1	0.0635 fpmh	15734989 Hrs
Block	2	0.0106 fpmh	94247704 Hrs
Block	3	7.704 fpmh	129793.179 Hrs
Block		7.704 fpmh	129793.179 Hrs
Micro, EEPROM		0.0815 fpmh	12259815 Hrs
Micro, EEPROM		0.0815 fpmh	12259815 Hrs
Capacitor		0.0101 fpmh	98148936 Hrs
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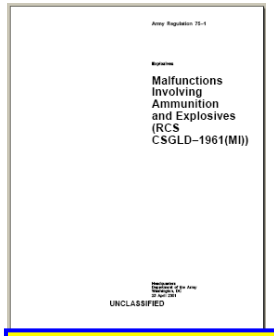
Transistor, LF FET		0.0612 fpmh	16334742 Hrs
Micro, Digital		0.0343 fpmh	29105188 Hrs
Micro, EEPROM		0.0815 fpmh	12259815 Hrs
Switch		7.311 fpmh	136777.406 Hrs
Diode, Low Frequency		0.00928 fpmh	107741992 Hrs
Resistor		0.0077 fpmh	129860232 Hrs

Tools/Models

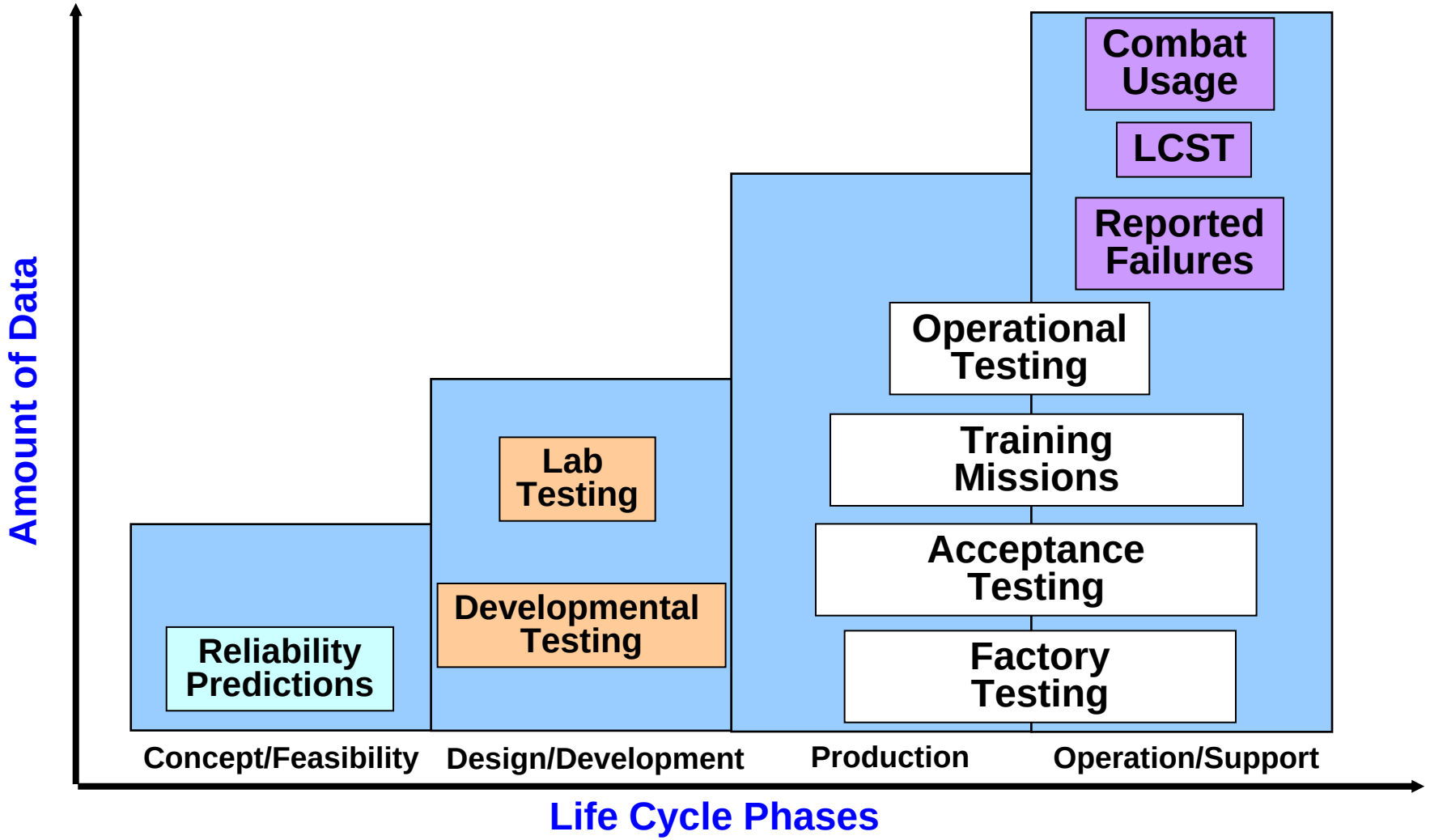
Combat Usage



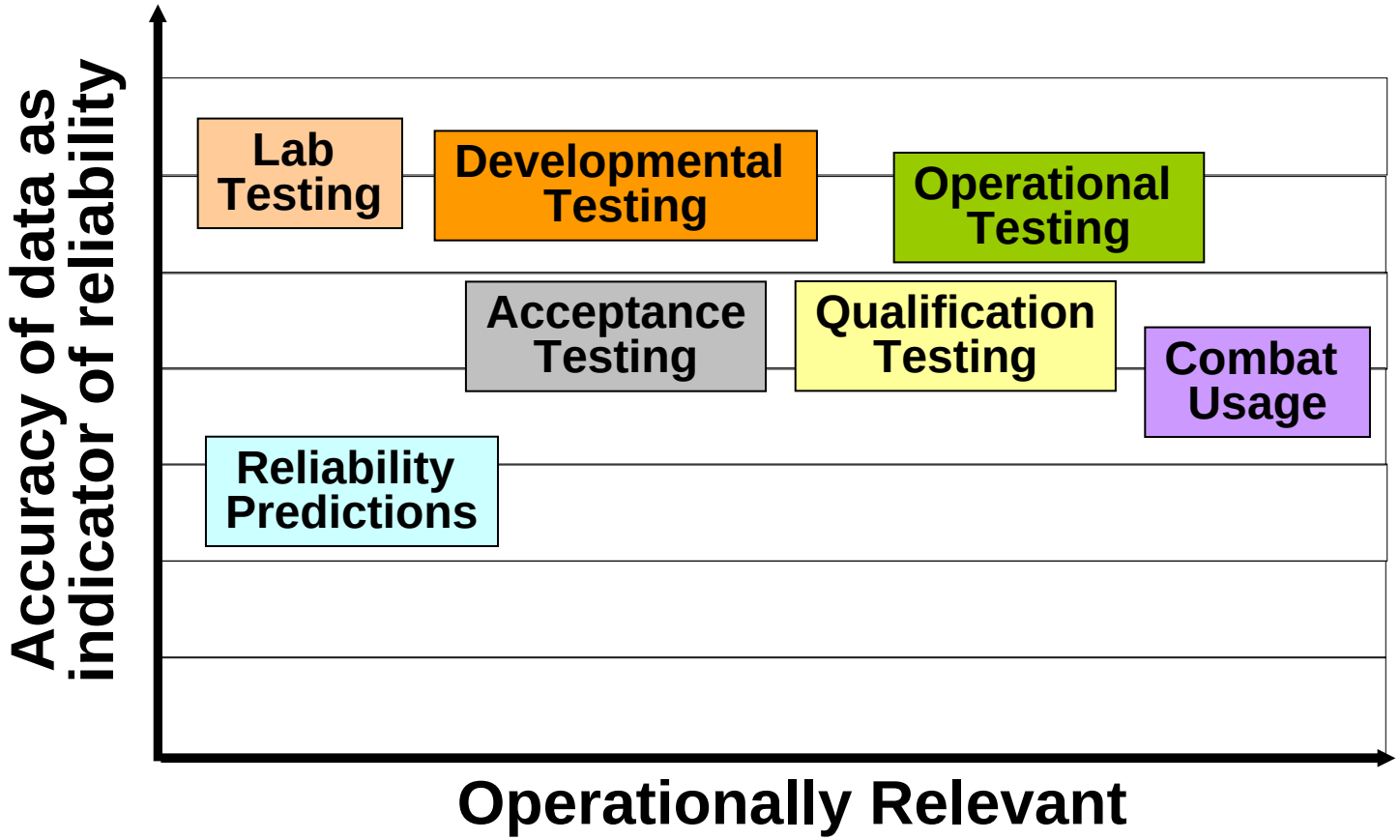
Field Reports

- **Ultimately the data is used differently by the Services to track and report reliability**
  - **Can pose problems, especially for Joint Fuze Programs.**

Product Life Cycle Phases & Reliability Data



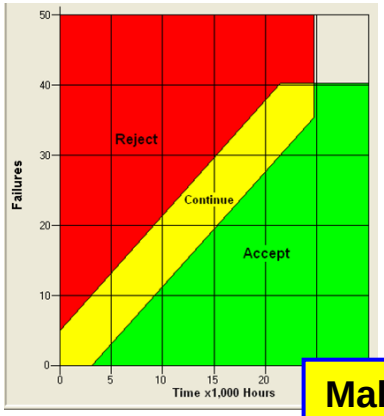
Accuracy & Relevancy of Reliability Data



The reliability of interest is that which uses the most accurate data indicating the fuze is successful in performing its required functions, over the duration of the mission, in an operationally relevant environment.

Methodology Approach – Army

- **Army Fuze Reliability (AR-702-6) includes data from:**



Malfunction Inv. Pgm

Qual. & FAAT

Operational Testing

Stockpile Reliability Pgm

Lot Acceptance Testing

Methodology Approach - Navy

- **Navy (Air-to-Ground) Fuze Reliability includes data from:**

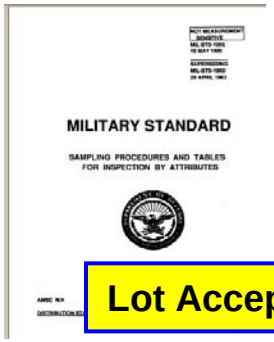
LCST

Combat Usage

Qual. & FAAT

Operational Tests

Conventional Ordnance Performance Evaluations



Lot Acceptance Testing

Methodology Approach – Air Force

- **Air Force (Air-to-Ground) Fuze Reliability includes data from:**

LCST

Qual. & FAAT

Combat Usage

Operational Testing

Weapon System Evaluation

Lot Acceptance Testing

All Methodologies: Positive Aspects

- **FAAT & Qual Testing – Verifies production representative fuze meets requirement.**
- **Operational Testing/Training Testing – Environment is controlled and operationally relevant.**
- **Lot Acceptance Testing (LAT) – When long term trends have been established, it is an Indicator of consistency that was established during FAAT.**
- **Deficiency Reports – Documented problem or failure.**
- **Life Cycle Surveillance Testing (LCST) – Indicator that aging inventory is still reliable.**
- **Combat Usage – When available, it is the most operationally relevant information of fuze reliability.**

All Methodologies: Negative Aspects

- Operational Testing/Training Testing – System may be tested outside of design limits to assess military utility.
- Lot Acceptance Testing (LAT) – Intended as a business agreement between buyer and seller.
- Deficiency Reports – Difficult to determine if fuze system or other system failed.
- Life Cycle Surveillance Testing (LCST) – Goal is to determine aging inventory affects.
- Combat Usage – Too many variables in an uncontrolled environment.

A Joint Services Approach – Qualify Reliability Calculation

- **Successful FAAT establishes the baseline reliability requirement is met.**
- **For reliability reporting post-FAAT, qualify reliability reporting:**
  - $\text{Reliability}_{\text{Lat(AQL)}} = \frac{\text{\# Lots Passed}}{\text{\# Lots Tested}} * 100$
    - **Indicate number of LATs conducted for L/T trend evaluation**
  - $\text{Reliability}_{\text{OT/Training Msns}} = \frac{\text{\# Successes}}{\text{\# Drops}} * 100$
  - $\text{Reliability}_{\text{Combat Usage}} = \frac{\text{\# Successes}}{\text{\# Drops}} * 100$

A Joint Services Approach – Roll Up

- **Standardize a reliability calculation that can be used by all Services as a "snapshot" of available data.**
  - **Especially important for Joint fuze programs**
- **Calculate a weighted average reliability that includes:**
  - **LAT @ 20% weighting**
  - **OT/Training Testing @ 40% weighting**
  - **Combat Usage (when available) @ 40% weighting**
    - **Account for documented fuze failures that are directly attributable to the fuze**

Questions