Reliability Growth

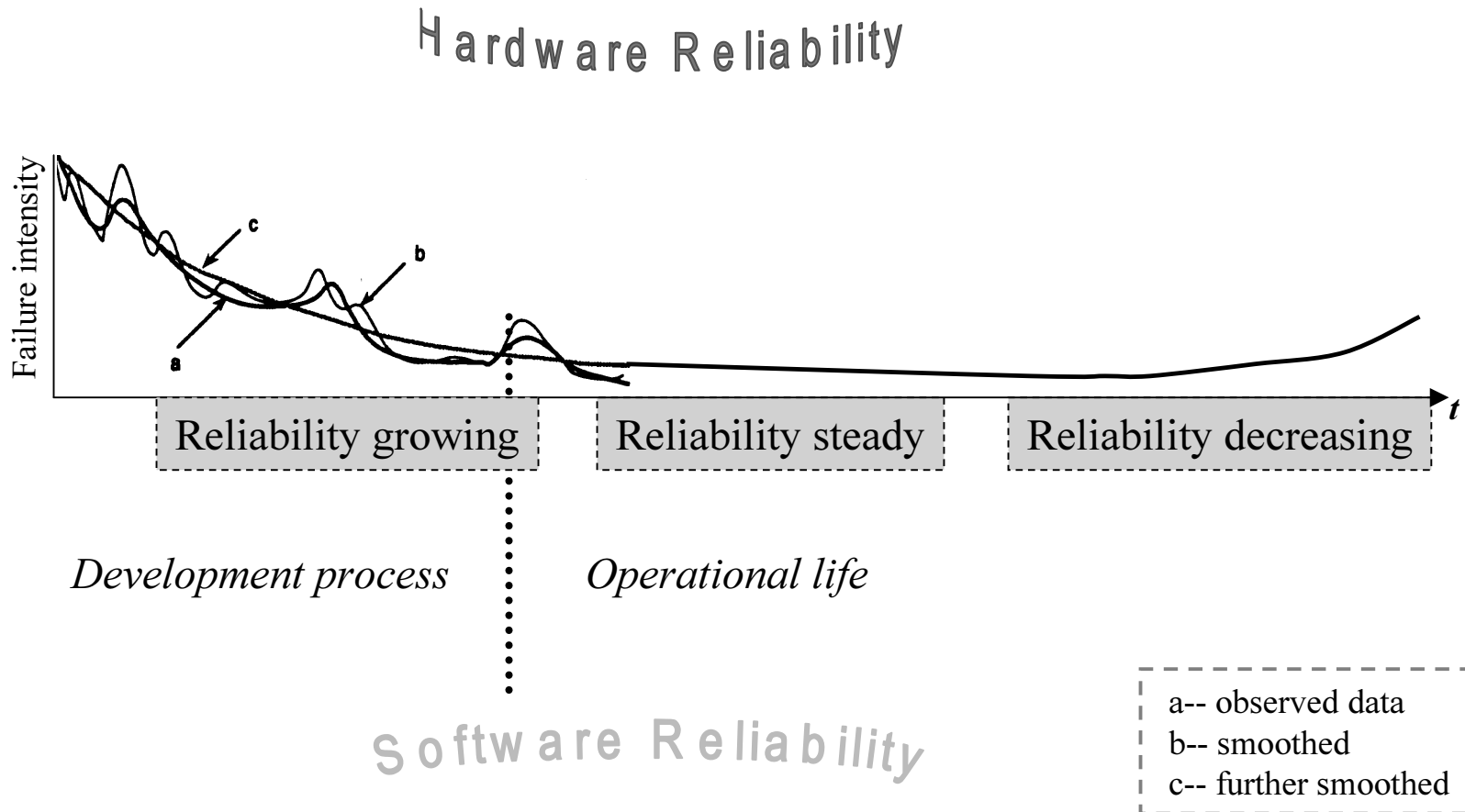**Ying Shi /Feb.18**

849 - Dependable Embedded System
Phil Koopman

Outline

- **Overview of system life cycle**

- **What's RG**

- **What's RG Model and more about it**

- **Attention with RG application**

- **Conclusion and Future Work**

- **References**

System life cycle

Hardware Reliability

Failure intensity

c

b

a

| Reliability growing | Reliability steady | Reliability decreasing |

t

Development process *Operational life*

Software Reliability

a-- observed data
b-- smoothed
c-- further smoothed

RG Concept

- ## *Not* a definition:
  - **RG is a concept that is being used as the basis for planning equipment reliability tests, assessing reliability improvement for changing equipment configurations (ref.2)**
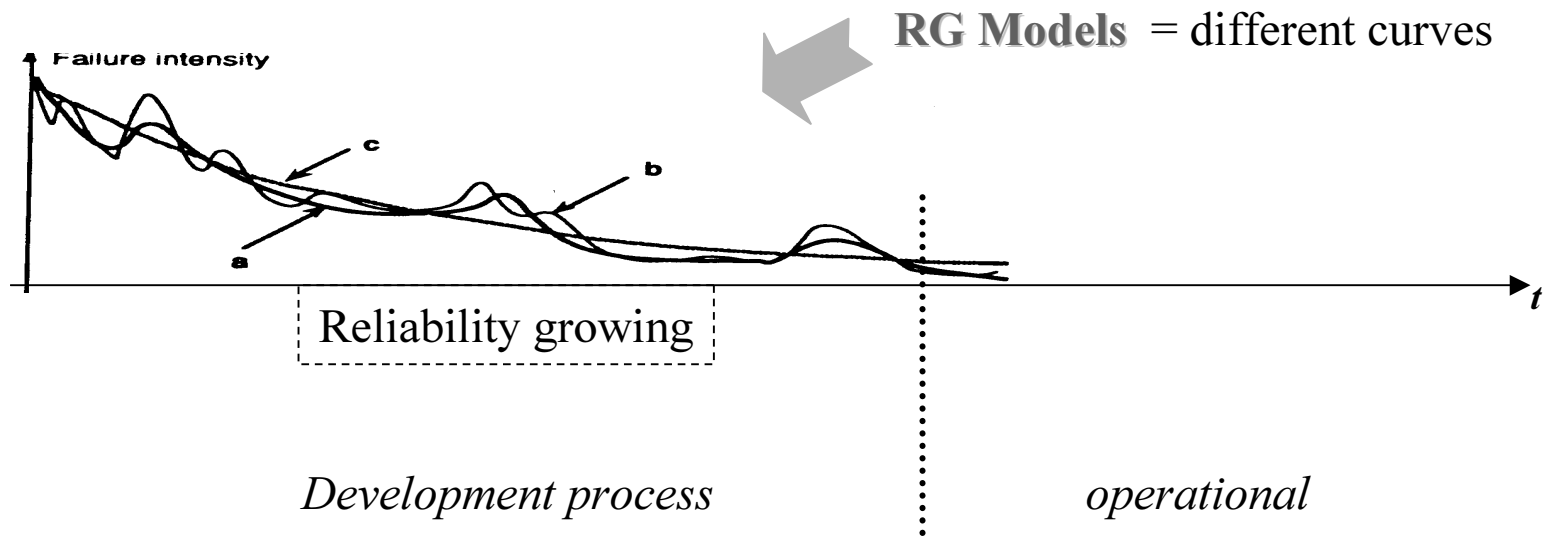 - **TAAF (test,analyze, and fix) almost an synonym of RG**

- ## Definitions: ("jargon", Meth)
  - "An improvement in reliability over time due to changes in the product design or manufacturing process is called RG" Principles of successful Reliability Growth applications, L.Crow, P.Franklin, and N.Robbins 1994 R&M
  - "the positive improvement of the reliability of equipment through the implementation and permanent removal of failure mechanism", Reliability Growth Testing , feb.3.1978
  - "the positive improvement in a reliability parameter over a period of time due to changes in product design or the manufacturing process", Reliability Growth Management, feb,13,1981
  - "The improvement in reliability that results from correction of faults" IEEE standard glossary of SE terminology. 1991
  - " the system's ability to deliver correct service is improved(stochastic increase of the successive times to failure)" J.C.Larprie Dependability:Basic concepts and Terminology,1992

RG Model

Hardware Reliability

RG Models = different curves

Failure intensity

c

b

a

Reliability growing

Development process   operational

Software Reliability

RG Model (cont.)

- **Why**
  - reduce cost + time, both v.s. traditional reliability demonstration tests

- **How**
  - a growth model utilizes and explains growth test results; and gives an early reliability indication of where the test is headed and how it's getting there (Meth)

- **Categories of RGM**
  - deterministic   v.s.   probabilistic *
  - continuous   v.s. discrete *

Robustness of Reliability-Growth Analysis Techniques, 92 annual R&M symposium

A Survey of Discrete Reliability-Growth Models, IEEE Trans.on Reliability, Vol,45,NO.4,96

Apply RG Model

| RG Test Results | | where the test has been how it's getting there |

RG Model
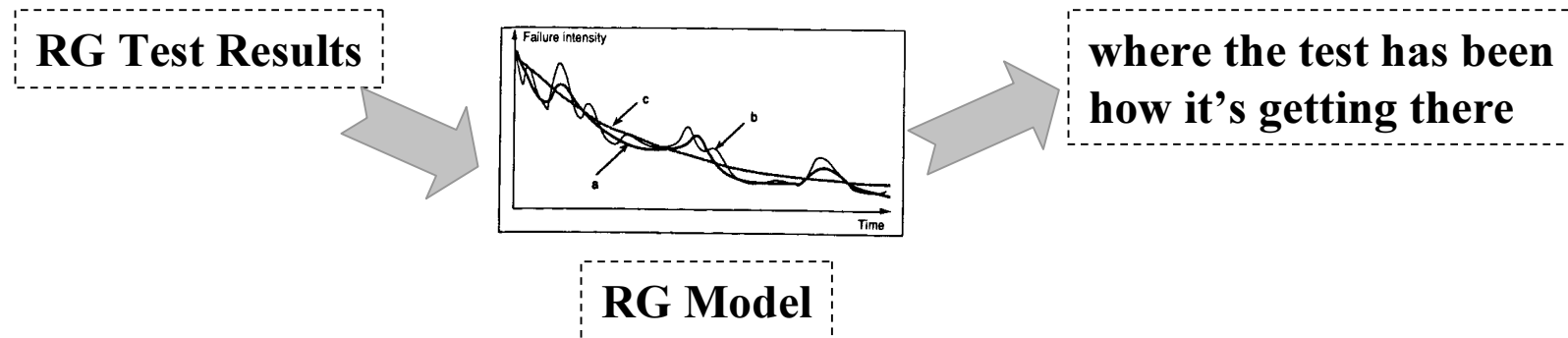
Issues::

- **RG Test - Coverage** *Experimental-Design Techniques in Reliability-Growth Assessment, 1992 proceedings annual reliability and maintainability symposium*

- **RG Sensitivity Assessment - Parameter Selection** *Robustness of Reliability-Growth Analysis Technique, Ellis, 1992 proceedings annual reliability and maintainability symposium*
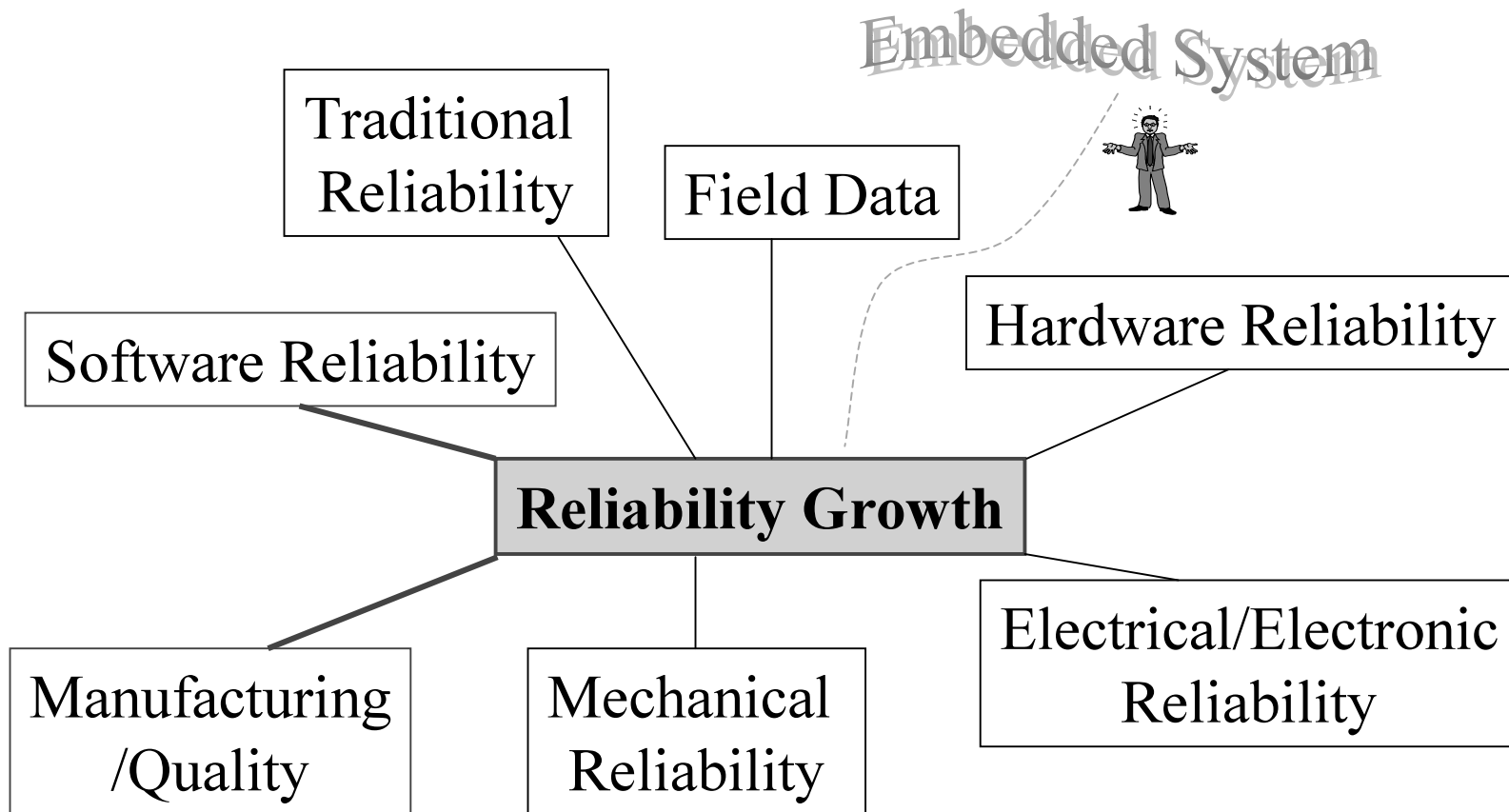
A Critic View *(Meth)/ Extra Attention*

- **Conditions where *reliability learning curve* concept seems to fit**
  - models a **single** reliability development test activity
  - requires **failure analysis** and **corrective actions** as part of test activity
  - applies to equipment that operates **continuously**

- ***Reliability learning curve* applications**
  - reasonable ::
    - determine approximate reliability test time requirements
    - monitor rate of reliability improvement in test
  - *unreasonable* ::
    - predicting equipment reliability, either current or future
    - used to combine different types of reliability test

Connections widely

Embedded System

Traditional Reliability

Field Data

Hardware Reliability

Software Reliability

Reliability Growth

Manufacturing /Quality

Mechanical Reliability

Electrical/Electronic Reliability

Conclusion and Future Work

- ## Current State
  - Work towards Operational stage almost infeasible, which means RG is almost the only place to work on in order to improve system reliability

- ## Attention

So many RGM tools, really beneficial, BUT not only better choose as simpler one as possible

  - Always *avoid* applying RGM *out* of proper range
  - Always stay *critical* how much can one or a combination of parameters measured can really tell you about system reliability, or how accurate

- ## Future work

  - simple, robust, sensitive RGM
  - High coverage test generation tool

Reference

- **Reliability-Growth Myths and Methodologies: A critical View, M.Meth**, *1992 Proceedings Annual Reliability and Maintainability Symposium*

- **Learning curve Approach to Reliability Monitoring, J.T.Duane**,*IEEE Trans.on Aerospace, vol.2, April 1964*

- **Paper: Achieving Reliability Growth on Real-Time System, C.Lane and J.Morrison**, *1994 proceedings Annual Reliability and Maintainability Symposium*

- **Conferences/Journals**:
  - **Reliability and Maintainability Symposium**
  - **IEEE on Reliability**
  - **Software Reliability Engineering Symposium**

- **Books**: *hmm… sorry … ('_*)*