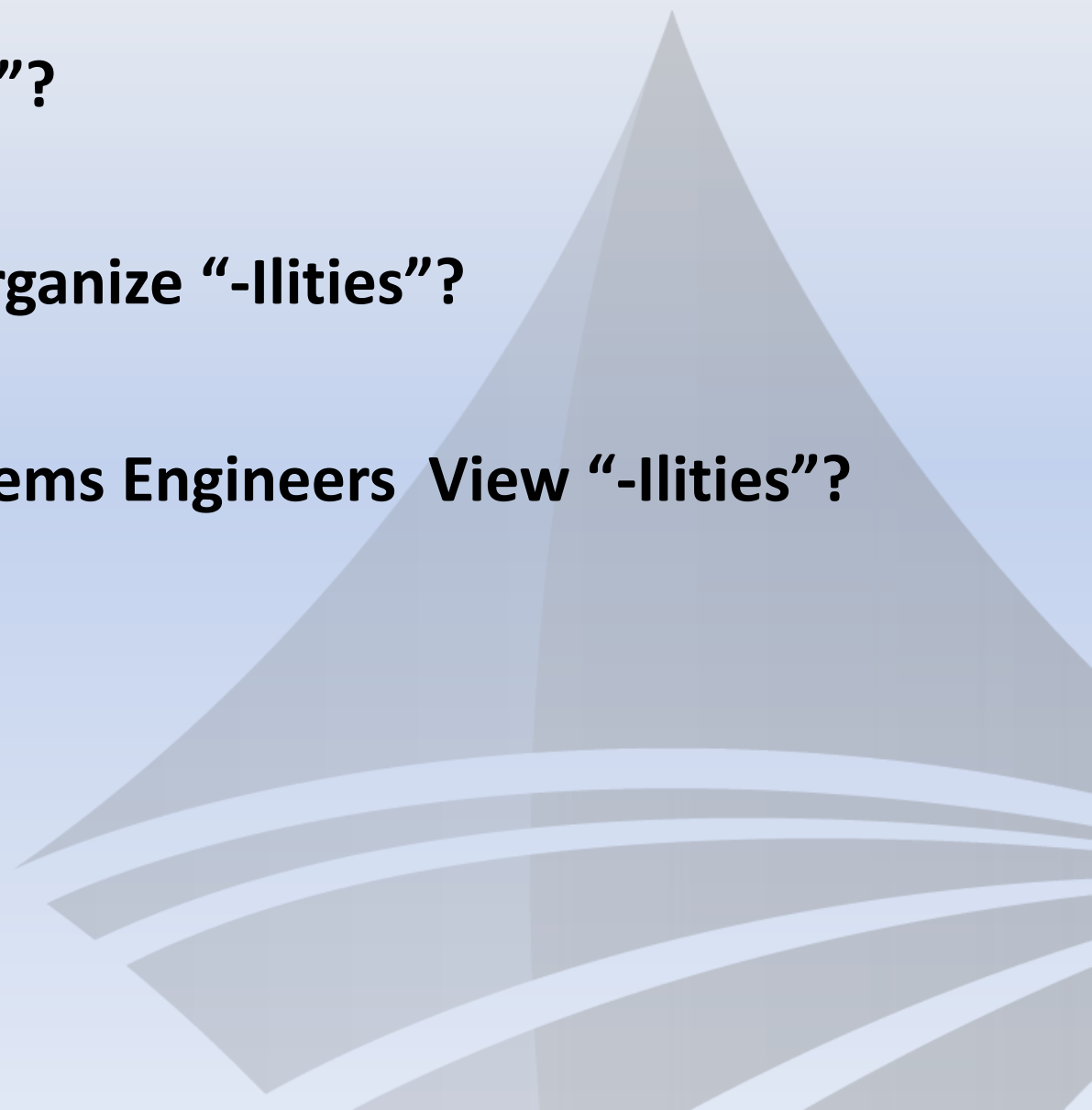


The Forgotten “-ilities”

James D. Willis, Jr.
SPEC Innovations
10440 Balls Ford Road
Suite 230
Manassas VA 20109

Topics

- **What is an “-Ility”?**
 - **How might we organize “-Ilities”?**
 - **How Should Systems Engineers View “-Ilities”?**
 - **Summary**
- 
- A decorative graphic on the right side of the slide. It features a large, light blue pyramid shape that tapers towards the top. Below the pyramid, there are several horizontal, wavy lines in shades of light blue and white, creating a sense of motion or a stylized landscape.

Most Common Lists of -ilities

RAM-T (Eng)

Reliability
Availability
Maintainability
Testability

RASR (DBs)

Reliability
Availability
Scalability
Recoverability

RAMS (Safety)

Reliability
Availability
Maintainability
Safety

RASUI (SW)

Reliability
Availability
Serviceability
Usability
Instability

FURPS (SW)

Functionality
Usability
Reliability
Performance
Supportability

Are there more –ilities?

Accessibility	Executability	Performability	Supportability
Accountability	Extensibility	Portability	Suitability
Adaptability	Evolvability	Practibility	Survivability
Administrability	Fidelity	Practicality	Tailorability
Affordability	Flexibility	Predictability	Testability
Agility	Functionality	Producibility	Traceability
Availability	Integratability	Recoverability	Trainability
Capability	Interoperability	Reliability	Transportability
Composability	Interpretability	Repeatability	Trustability
Configurability	Maintainability	Responsibility	Understandability
Compatibility	Manageability	Reusability	Upgradability
Demonstrability	Mobility	Scalability	Usability
Deployability	Modifiability	Serviceability	Verifiability
Durability	Operability	Stability	Vulnerability

What is the Definition of “-lity”

The developmental, operational, and support requirements a program must address (e.g., availability, maintainability, vulnerability, reliability, supportability, etc.).

*INCOSE Systems Engineering Handbook v. 3.2.1
INCOSE-TP-2003-002-03.2.1 January 2011*

What is an “-ility”: Other Terms

“Feature”

“Constraints”

“Characteristic”

“Attribute”

“Quality Goals”

“Other properties”

Most Common: Non-functional requirement

Functional vs Nonfunctional Requirements (SW)

Functional	Nonfunctional
Product features	Product properties
Describe the work that is done	Describe the character of the work
Describe the actions with which the work is concerned	Describe the experience of the user while doing the work
Characterized by verbs	Characterized by adjectives

Search Software Quality <http://searchsoftwarequality.techtarget.com/answer/Functional-and-nonfunctional-requirements>

Functional	Nonfunctional
Specific Functions and behaviors	Criteria that can be used to judge the operation of a system
System Design	System Architecture
What a system is supposed to DO	What a system is supposed to BE
	Characteristic of a system that applies across a set of functional or system requirements.

Software Architecture Notes:making the ilities come true <http://www.softwarearchitecturenotes.com/architectureRequirements.html>

MBSE: LML Top-level Schema

- **Show that for SEs the it is necessary for us to work Functional with nonfunctional**

Are there more –ilities?

Accessibility	Executability	Performability	Supportability
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How Can We Organize “-ilities”?

How can we organize this disparate List?

- **Lifecycle phase**
- **Dependency and Priority**
- **Cost and value**
- **Criticality**

Group these by

- **Relationship**
- **Timeline on Lifecycle**
- **Dependencies**
- **Aggregation**
- **Priority**
- **Value**

Questions:

- **Do -ilities describe the product**
- **Are they more associated with SE functions leading to design?**
- **Do they drive product design**
- **Are they key to ensuring the product parts can be integrated?**
- **How do they relate to SE processes?**

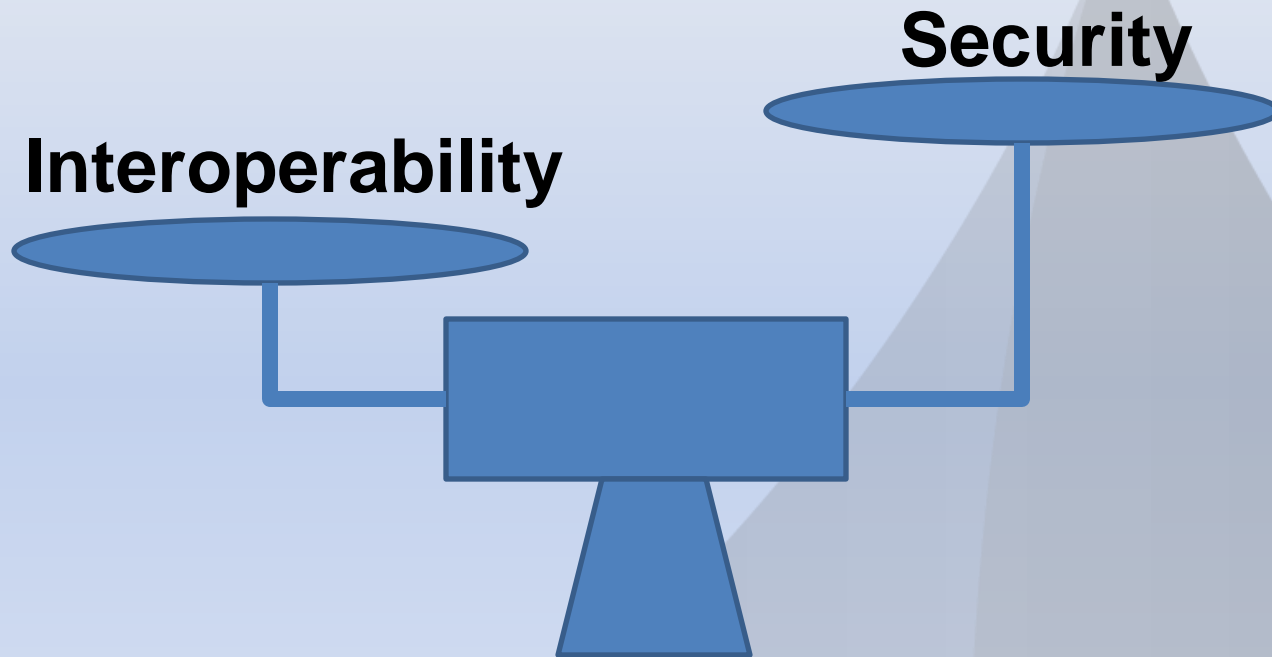
Similar Pairs

Interoperability - Compatibility

Flexibility - Adaptability

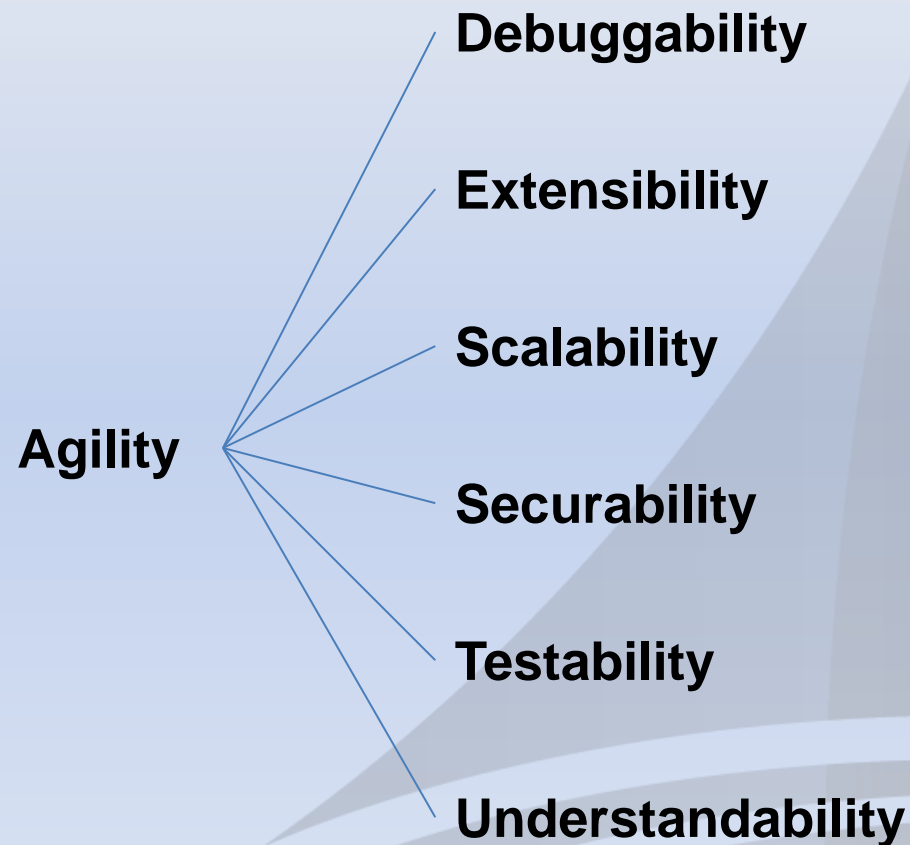
Availability - Reliability

Dynamic Relationship



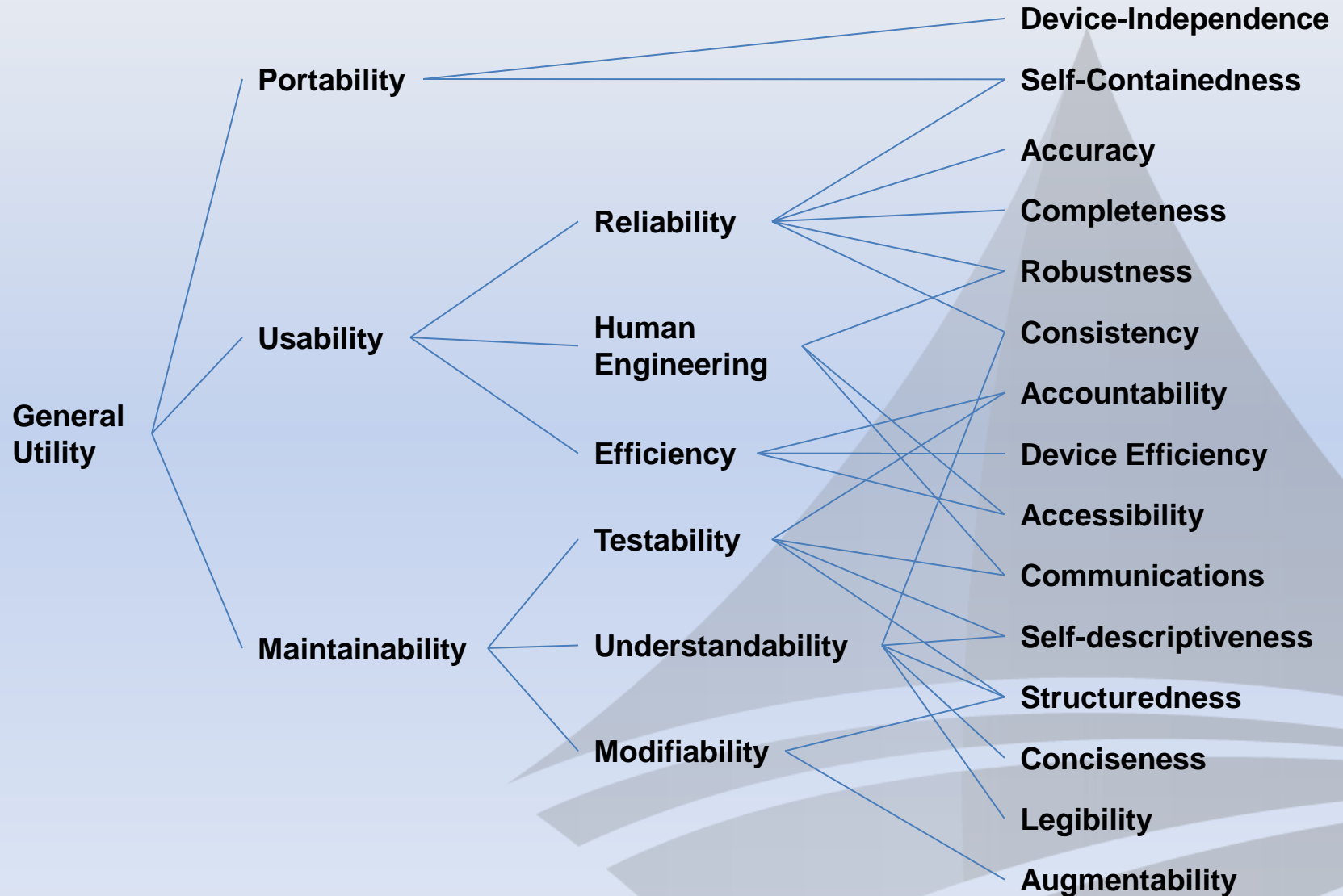
*Seeking to establish and maintain balance between two attributes
in a dynamic environment*

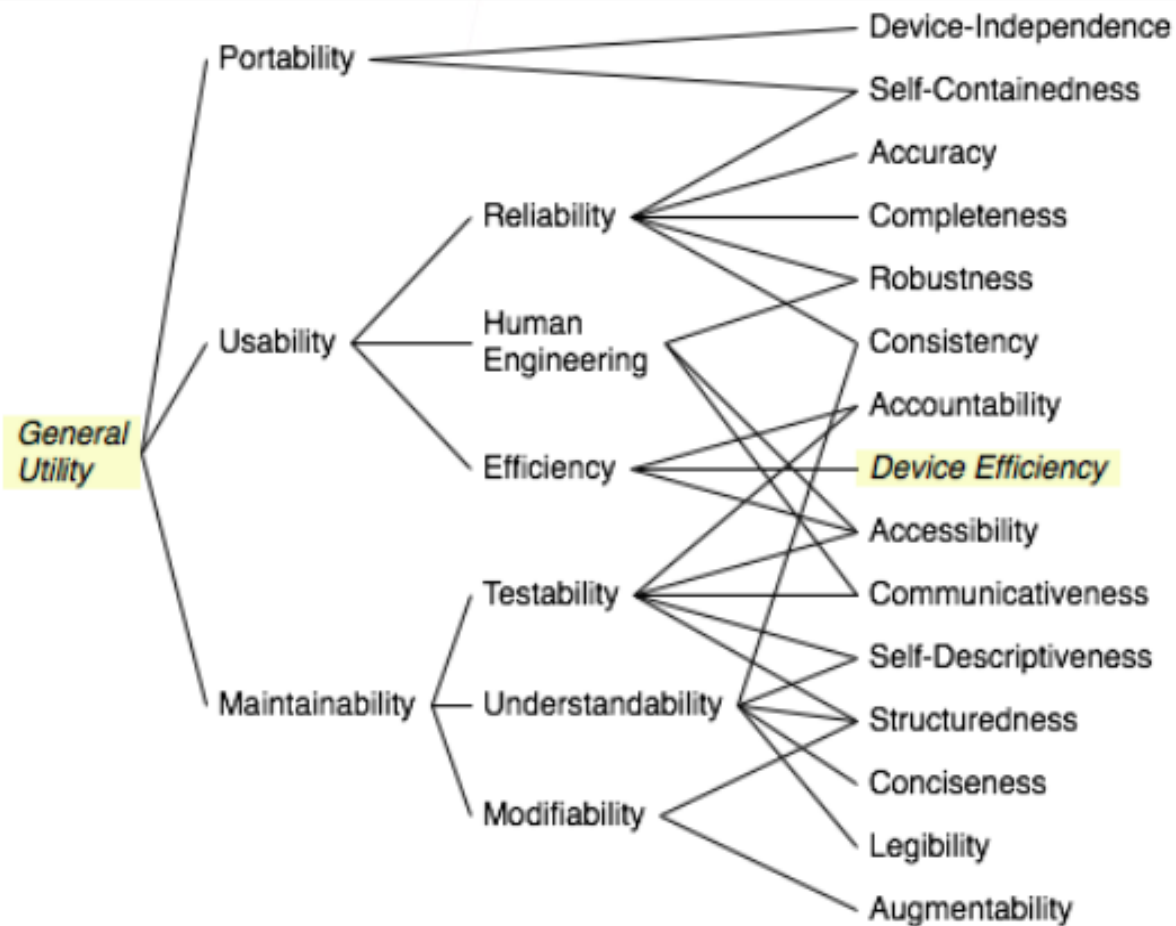
Hierarchical Relationships: Example 1



http://en.wikipedia.org/wiki/List_of_system_quality_attributes

Hierarchical Relationships: Example 2





Boehm+Brown+Lipow1976 fig.1, corrected to match qualities named in text
 "General Utility" and "Device Efficiency" are not defined there

How Should Systems Engineers View “-ilities”?

What is a System?

...combination of interacting elements organized to achieve one or more stated purposes.

...an integrated set of elements, subsystems, or assemblies that accomplish a defined objective. These elements include products (hardware, software, firmware), processes, people, information, techniques, facilities, services, and other support elements.

*INCOSE Systems Engineering Handbook v. 3.2.1
INCOSE-TP-2003-002-03.2.1
January 2011*

What is a System?

People



Things

Processes

What is a System?

People

Operability
Suitability
Survivability
Trainability
Understandability

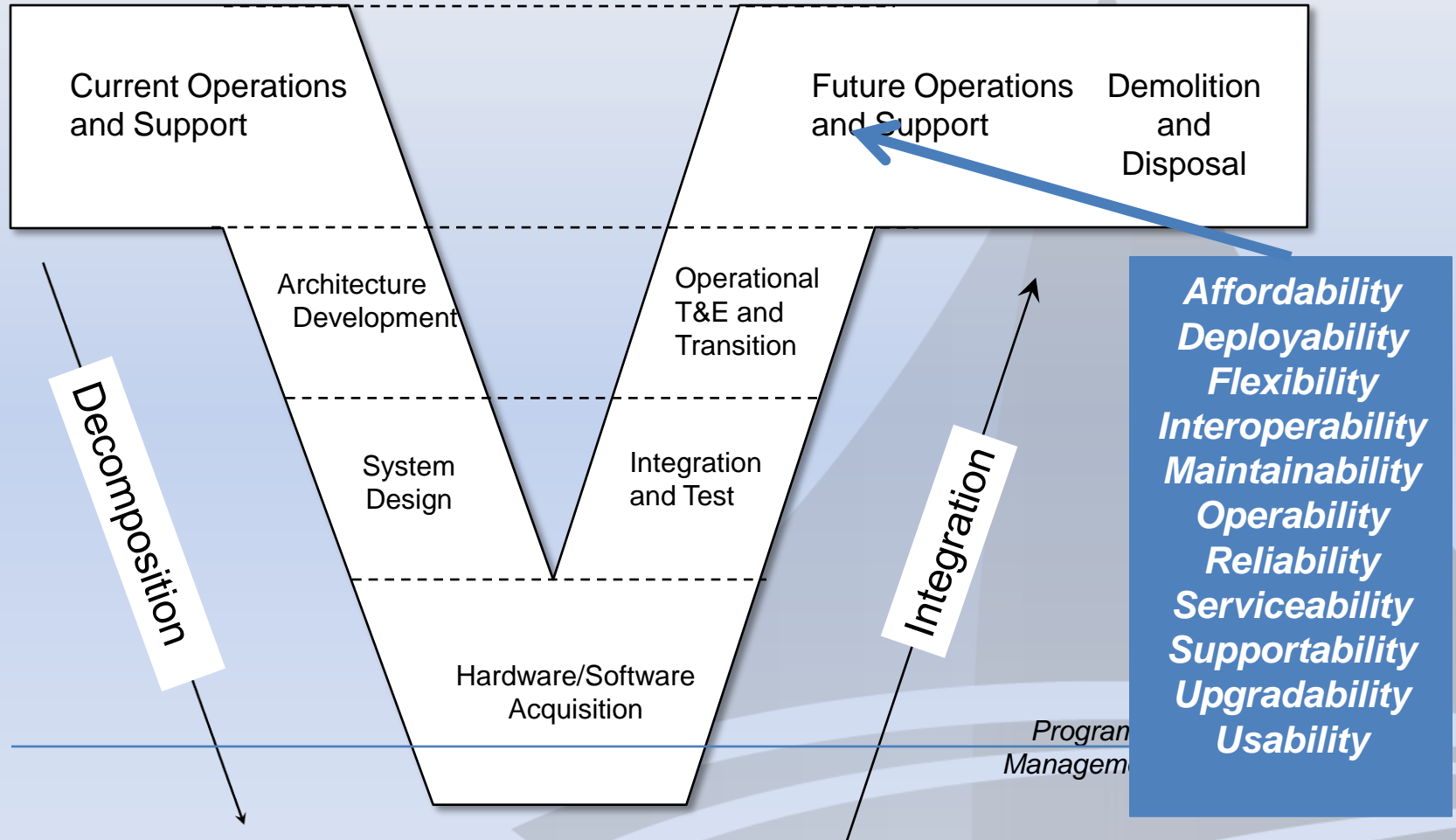
Things

Affordability
Adaptability
Agility
•
•
•
•
Usability
Verifiability
Vulnerability

Processes

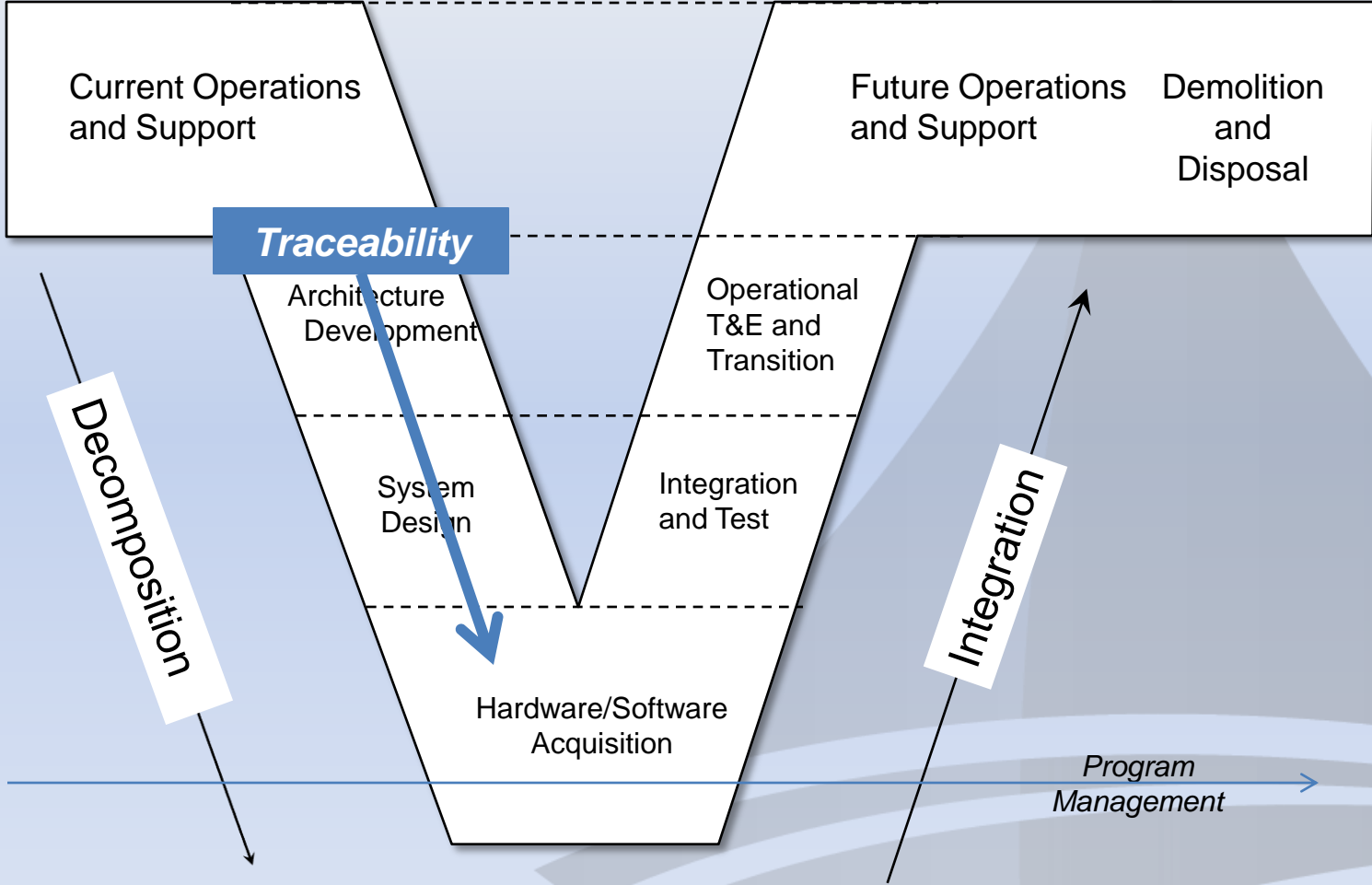
Integratability
Performability
Repeatability

Systems Engineering Lifecycle



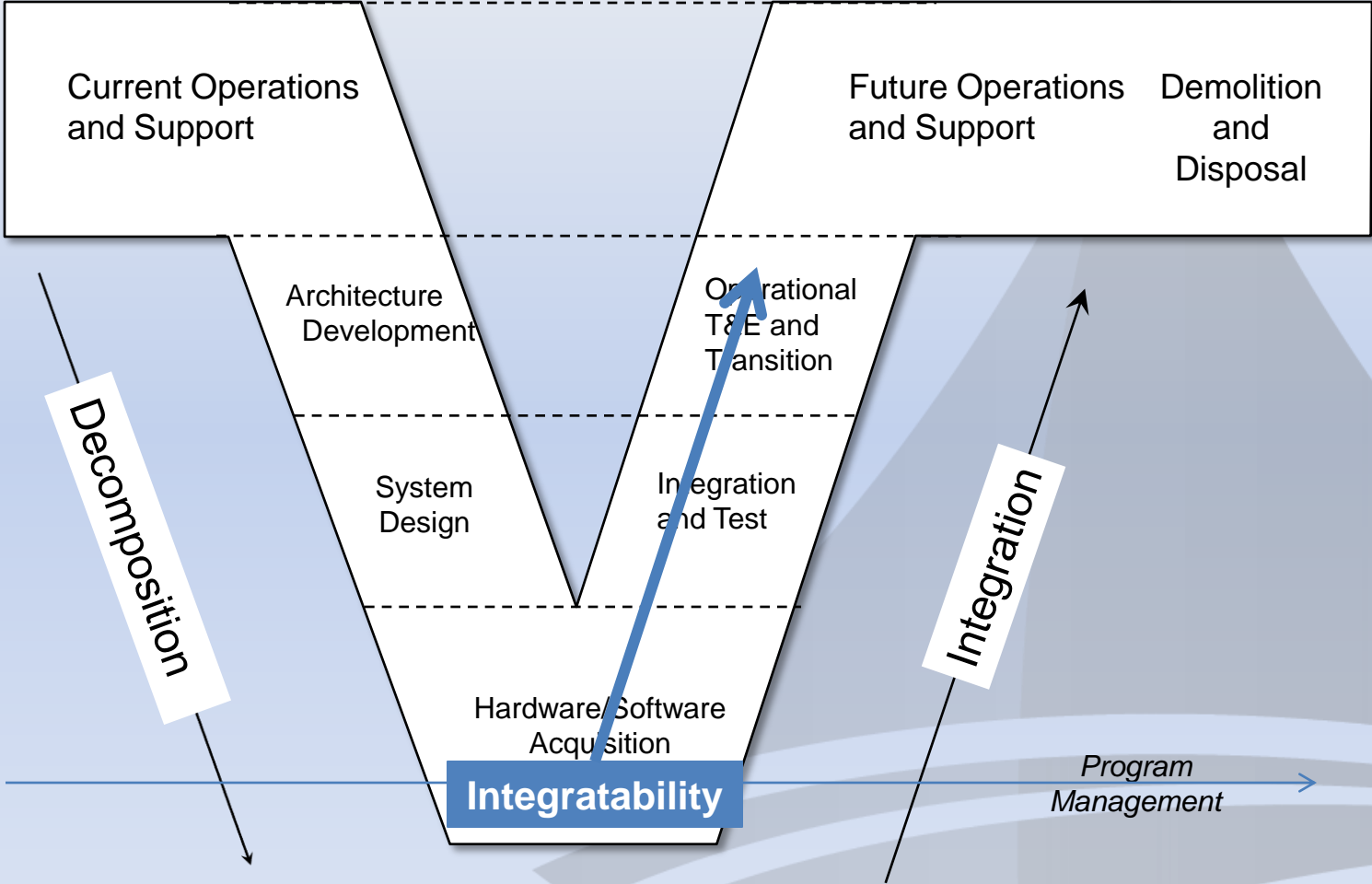
INCOSE Systems Engineering Handbook v. 3.2.1
INCOSE-TP-2003-002-03.2.1 January 2011

Systems Engineering Lifecycle: Traceability

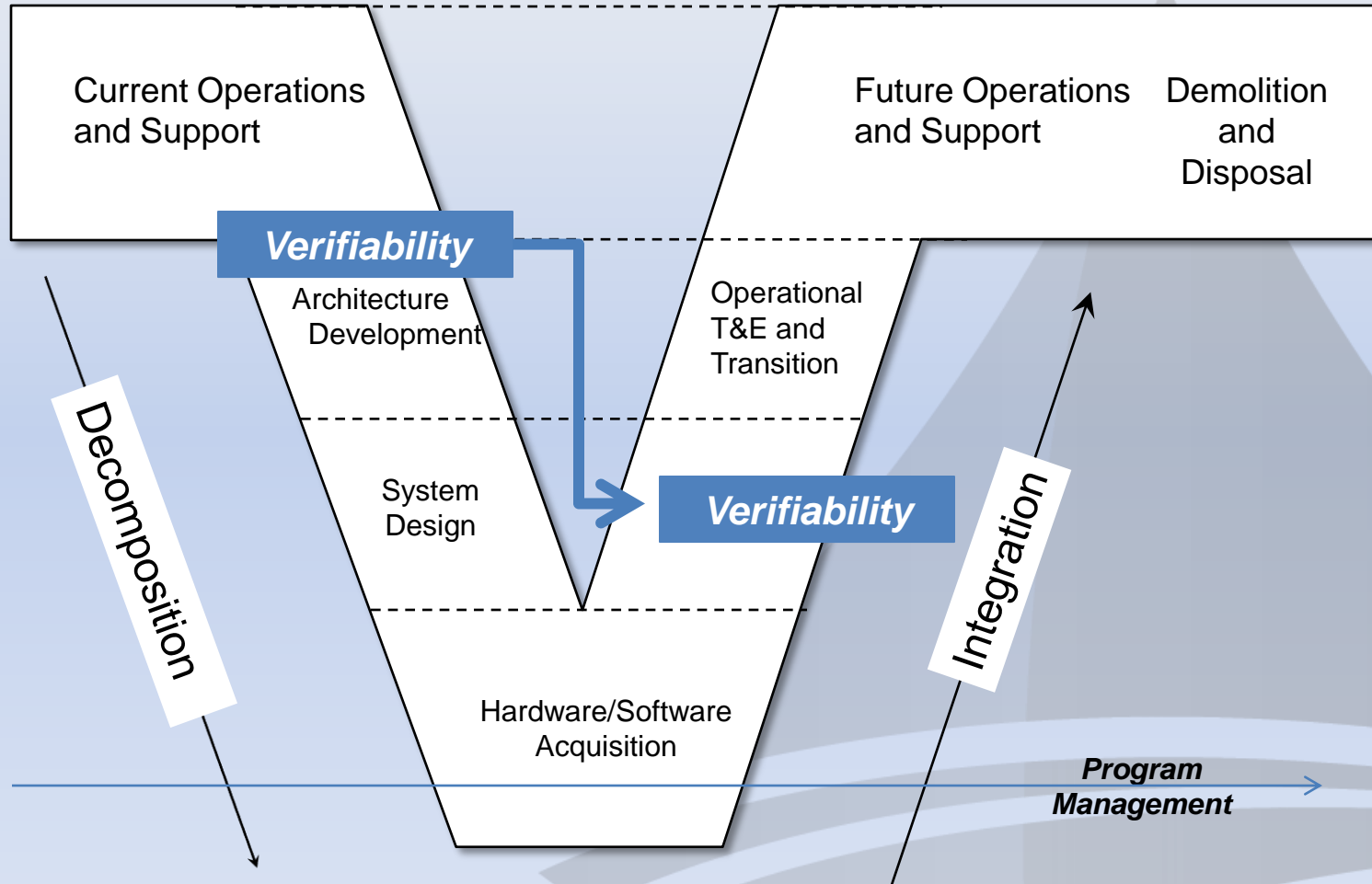


INCOSE Systems Engineering Handbook v. 3.2.1
INCOSE-TP-2003-002-03.2.1 January 2011

Systems Engineering Lifecycle: Integratability



Systems Engineering Lifecycle: Verifiability



Measurement of –ilities

- **Standard measurements – not always agreed to**
- **Some accepted measurements**
 - **Availability - $P_A = 1 - \frac{MTTR}{MTBF}$**
 - **Maintainability - MTTR *mean time to repair (or restore)***
 - **Reliability – MTBF *mean time between failure***
 - **SW Maintainability - Lines-of-code measures, McCabe Measures, Halstead Complexity Measures**
 - **Security – Malware statistics, Firewall statistics, Vulnerability**

-ility Related Research

- **2006-2007 John W. Dahlgren MITRE**
 - **“System Complexity, the “ilities” and Robustness” Project**
- **Current - SEArI Systems Engineering Advancement Research Initiative - MIT**
 - **Research Summit 2011 MIT 21 Oct 2011**
 - **“Ingenuity, Innovation, and the ilities: Creating Capabilities for the Long Run“**

Increasing Emphasis and Demand

In DoD

- **Interoperability**
 - *CJCSI 6212.01E Interoperability And Supportability Of Information Technology And National Security Systems*
- **Producibility**
 - *DoDI 5000.02 Operation of the Defense Acquisition System*
- **DOTMLPF (Doctrine, Organization, Training, Materiel, Leadership and education, Personnel, and Facilities)**
 - *Embedded throughout Joint and Service Standards*

Commercial World...

Even Commercial Interest is Increasing


The screenshot shows a web browser window with several tabs: 'DOTMLPF Analysis', 'Mozilla Firefox Start Page', 'Welcome to DARS Tool', and 'Cloud-ilities | Microsoft Cloud Hub'. The address bar shows 'technet.microsoft.com/en-us/cloud/Video/gg703232'. The page title is 'Cloud News & Features' with a search bar and 'bing' logo. The navigation menu includes 'Home', 'Library', 'Downloads', 'Support', and 'Solutions'. The main content area is titled 'Cloud-ilities' and features a video player with a portrait of Brad Anderson. A caption below the video reads 'BRAD ANDERSON Corporate VP, Management & Security Division'. Below the video, there is a rating section with five stars (4.5 filled), a view count of 341, and social media icons. An 'About This Video' section follows, describing the cloud's benefits. To the right, there is an advertisement for the Microsoft Store with a 'Shop now' button, and a 'Related Videos' section with four video thumbnails and their respective view counts.

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Cloud-ilities




BRAD ANDERSON
Corporate VP, Management & Security Division






Rate: ★★★★★ Views: 341 [✉](#) [t](#) [■](#) [📺](#) [f](#)

About This Video
The cloud is built on providing a key set of "-ilities," reliability, flexibility and agility to the IT Pro who wants to make their role and contribution to enterprise value more important and recognized, according to Brad Anderson, Microsoft's corporate vice president of Management and Security.

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Using the Private Cloud Today	The Public Cloud is On

Summary

- **Little recent SE discussion and writing on “-ilities”**
- **“-ilities” are key system attributes**
- **Many useful and/or necessary “-ilities” are**
 - Not understood well
 - Often forgotten...or ignored
- **Systems Engineers should work to integrate more –ilities into systems development**
- **Recommendation: Increase discussion and interchange among SEs on the topic of “-ilities” and h**