A Usability Framework for Digital Engineering Software

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Disclosure Statement

"The views expressed are those of the author and do not reflect the official policy or position of the US Air Force, Department of Defense or the US Government."

Driving Factors

- The Department of Defense is adopting Digital Engineering and modernizing

- 2010 - Systems Engineering Leading Indicators (SELI) Guide

- 2022 - Digital Engineering Measures: Research and Guidance
  - "Despite the maturity of these indicators, few complete examples of actual measurement exist, primarily due to the lack of tools that can quantitatively track these measures."

- Usability Research can provide quantitative measures
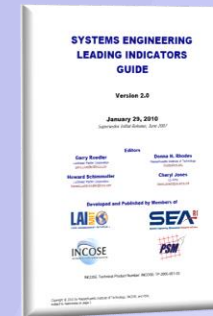
Digital Engineering 2018

Cloud 2018

Digital Modernization 2019

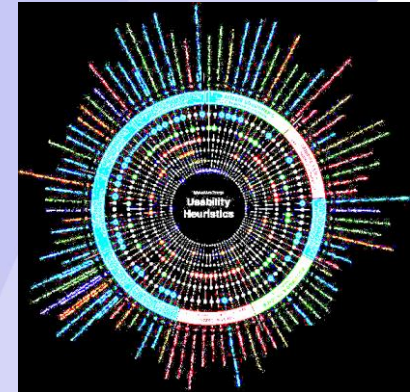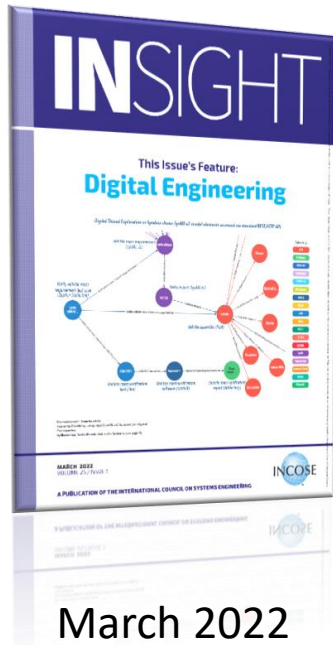Software Modernization 2021

SELI 2010

DE R&G 2022

Overview

Digital Engineering

Usability

INSIGHT

This Issue's Feature:
Digital Engineering

March 2022

Composition

Digital Twin

Digital Thread

Authoritative Source of Truth
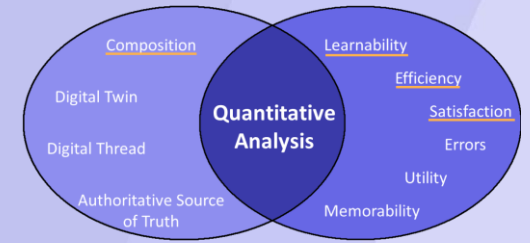
Quantitative Analysis

Learnability

Efficiency

Satisfaction

Errors

Utility

Memorability
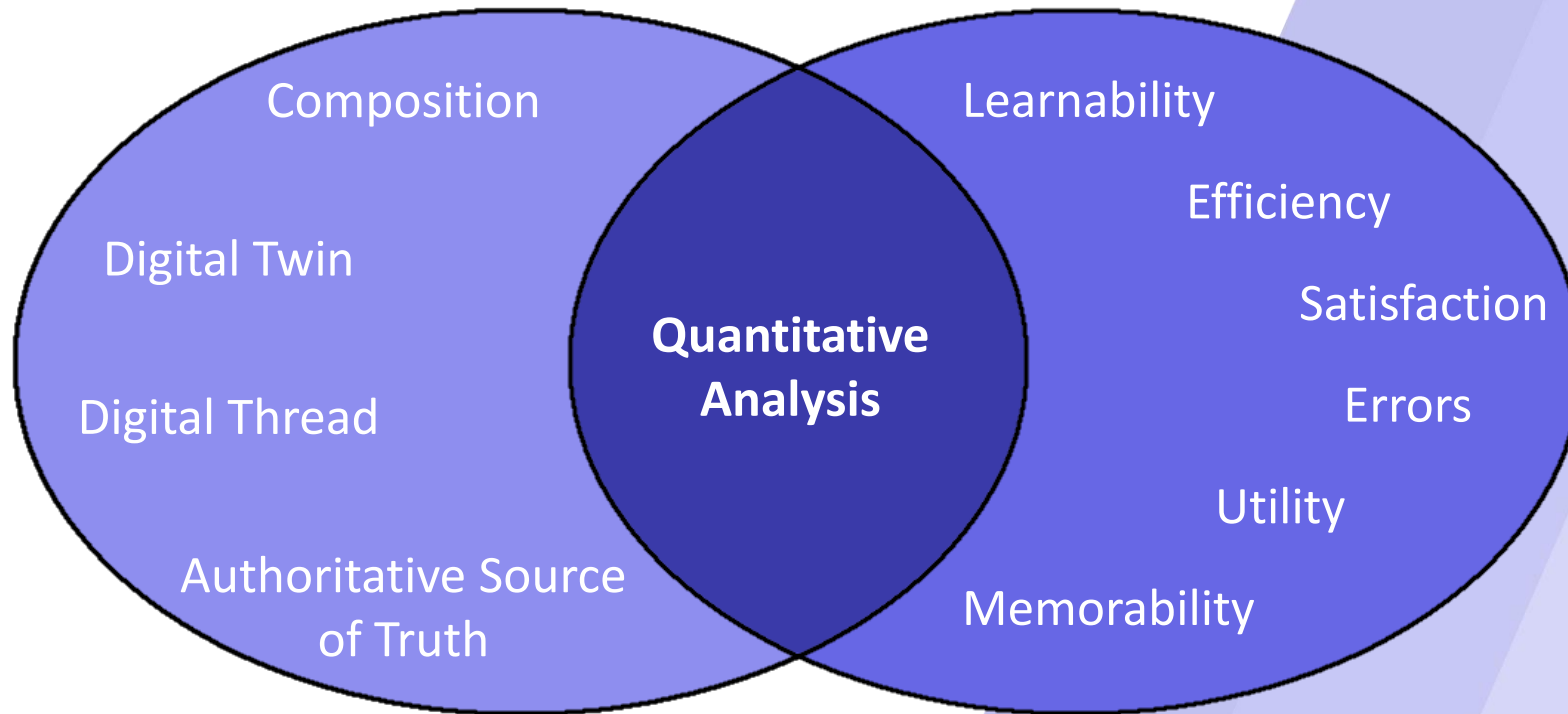
Michael Kritsch
UX Collective

Composition

Digital Engineering

- The process of building and designing a model

- Goal: Understand the elements of a system

- INCOSE Wiki – Six Purposes

Usability

Perception

- Provide alternate views and layouts combined with shapes and colors

Prediction

- Provide initial and advanced fields to edit when adding an element.

Fit Intended Context

- Is the user in a cube or on the factory floor?

Digital Twin

Digital Engineering

- ## DoD Global Horizons
  - "virtual representation of the system as an integrated system of data, models, and analysis tools"

- ## AIAA
  - "A set of virtual information constructs that mimics the structure, context and behavior of an individual / unique physical asset, or a group of physical assets, is dynamically updated with data from its physical twin throughout its life cycle and informs decisions that realize value"

- ## Wright and Davidson
  - **"a digital twin without a physical twin is a model"**
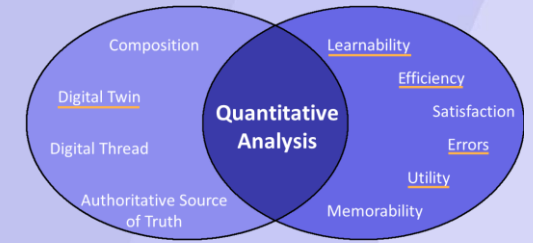
Usability

Memory
- Coordinating with real-world color

Navigation and Reactive Layouts
- Scroll/Zoom and highlight related elements

Goals
- AR/VR/XR views to compare/contrast the digital representation to the physical one.
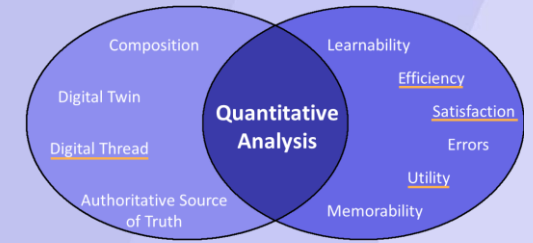
Recovering
- Bounded inputs.

Digital Thread

Digital Engineering

- Process of managing and tracking of changes

- Global Horizons mentions a Digital Thread three times

- Toriello
  - First to mention UI/UX Concepts

Usability

Maintaining Progress

- When updating, save state. Undo/Redo or Versioning/Drafts

Match User Values and Expectations
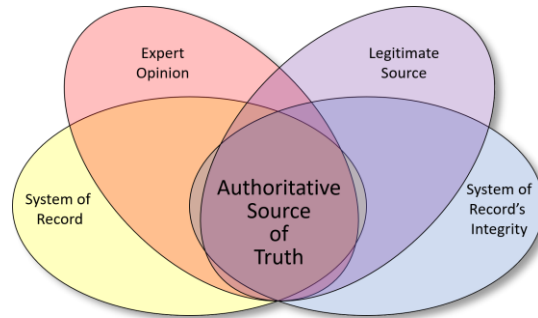
- Support evaluating changes over time

Motivations

- Combine a "Where's Waldo" approach with "whack a mole" to ensure all elements serve a purpose.
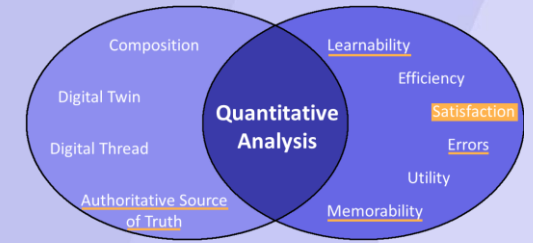
Authoritative Source of Truth

Digital Engineering

- Object Management Group
  - Four Conditions

- 2021 Adventium Labs Report
  - Prevent Vendor Lock-in
  - 3 Objectives to Capture

Usability

The minimization of task switching.
- Chunking Visual elements

Respect Privacy and Security
- Direct Correlation with managing data rights, distribution markings, and security policies

Expecting
- Metadata correlation from deliverables

Reducing Complexity
- Implement distinguishing characteristics for artifacts.

Capturing Interactions

Telemetry metrics

- A qualitative approach

Song and Becker 2014

- Compares novices, intermediates, and experts
- Required extensive use of physical, real-world tangible objects

Physical Interaction	Parallel Digital Interaction
Picking up a marker	Selecting a UI element
Pauses between physical actions	Dwell time between clicking on or moving an element and typing speed.
Using an eraser	Backspace, Delete, right-click -> remove element
Drawing a box/circle/arrow	Adding text, shapes, links

Physical and Digital Interactions

Conclusion

1 As Systems Engineering, MBSE, and DE evolve, the tasks of the knowledge worker will grow alongside them

2 This framework describes the interplay between the two domains

Aggregation of literature review in the DE and usability domains

3 Expands the ability to evaluate both qualitative and quantitive measures of DE software and practices.

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Questions