SYSTEMS ENGINEERING RESEARCH CENTER

Insights on Digital Engineering Impact on Design Cycle Time with the LyneisRework Cycle

Stephanie Sharo Chiesi, Stevens Institute of Technology

Advisor: Dr. Paul T. Grogan

STEVENS INSTITUTE OF TECHNOLOGY

SERC DOCTORAL STUDENT FORUM 2022

Agenda

- Motivation
- Digital Engineering implementations addressing cycle time
- TheLyneisRework Cycle
- How would DE implementations impact the Rework Cycle?
- Future Work

Motivation

- DoD Digital Engineering Strategy
  - Published June 2018, Guideline published 2020
  - Modernize design, development, operation and sustainment
  - Transform acquisition and implementation
  - **Improve speed** for critical capability delivery to the warfighter
  - Connected data in a digital environment
  - Continued evolution of the strategy: DE Measurement Framework, etc.

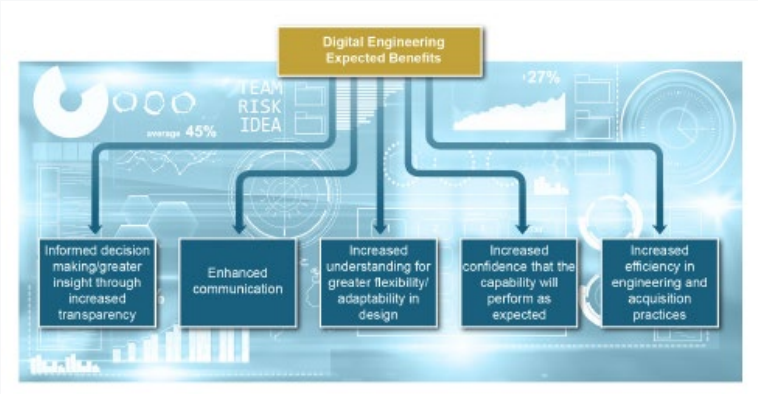
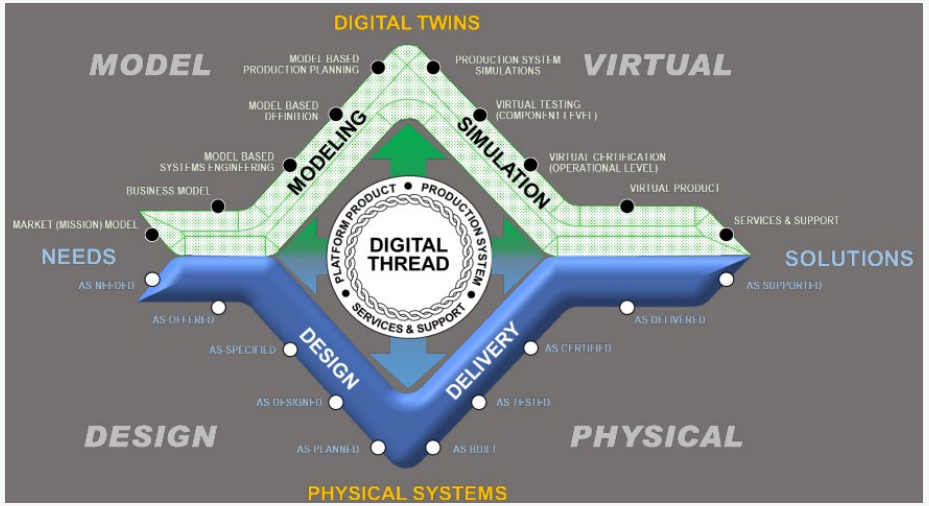


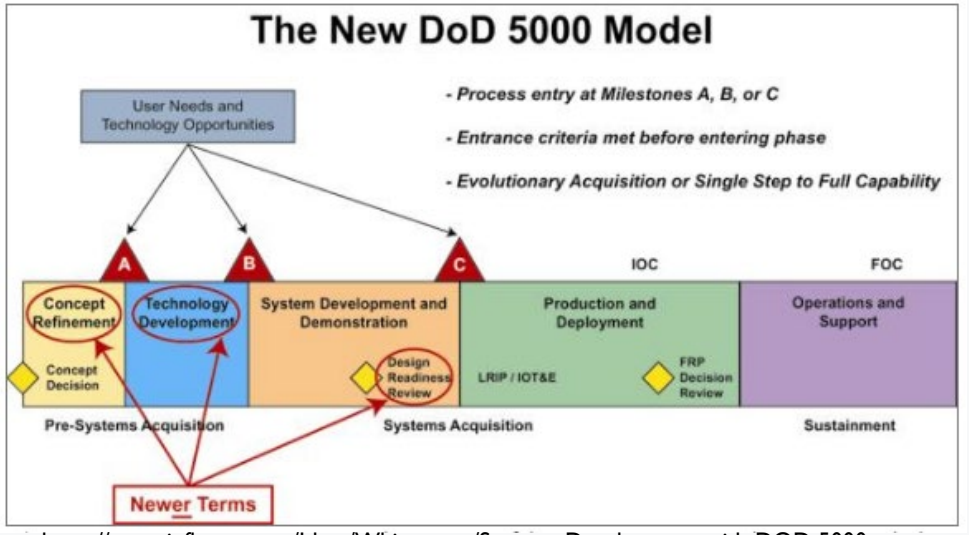
Image credit: DoD Digital Engineering Strategy, June 2018

Digital Engineering Implementations to address Cycle Time

- Integrate tools and data exchange methods to remove gaps
- Automate tasks that do not involve human decision-makers
- Reduce human entry errors



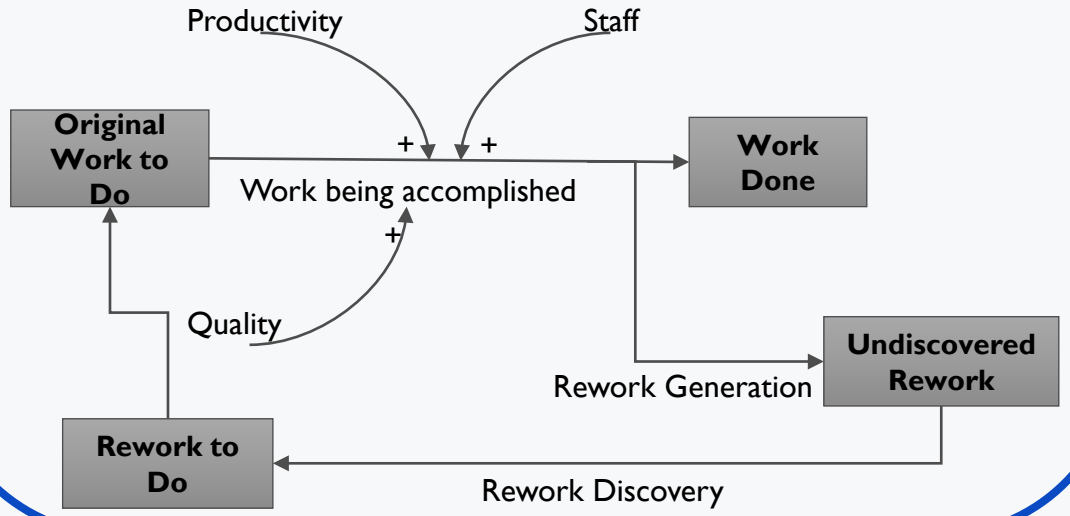
INCOSE: https://www.incose.org/docs/default-source/midwest-gateway/events/incose-mg_2018-11-13_scheurer_presentation.pdf



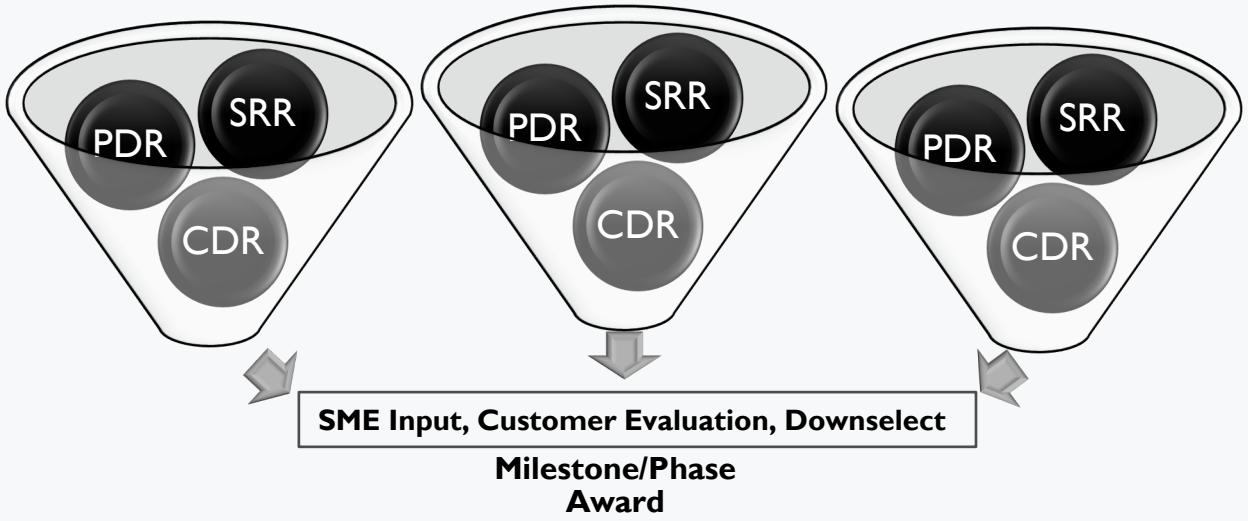
https://www.inflectra.com/Ideas/Whitepaper/Systems-Development-with-DOD-5000.aspx

How Do we Evaluate Success at Reducing Cycle Time?

- Within Design Cycles
  - Automated tasks
  - Reduce human touch time and entry errors
  - Do not replace human decision-making

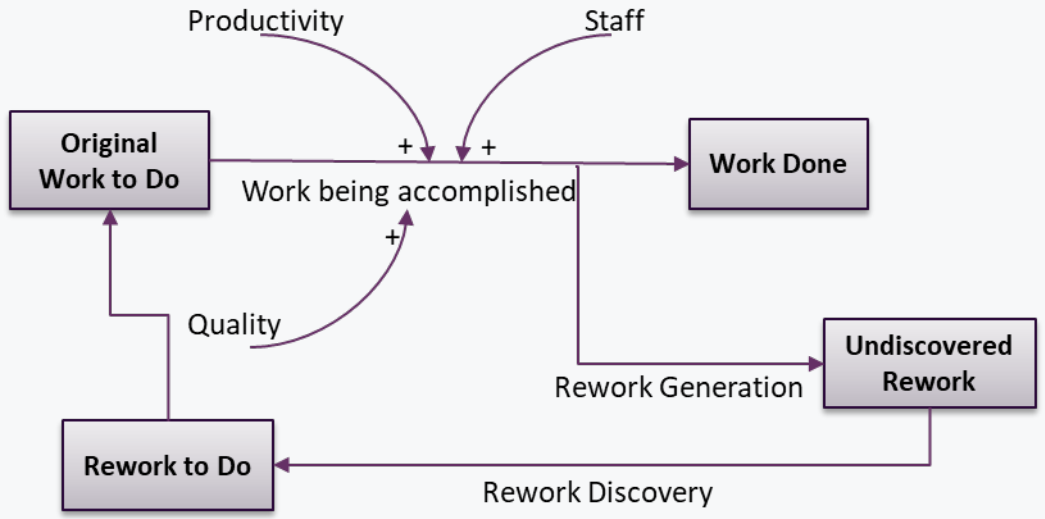


- Decision-Making in Lifecycle Progression
  - Large human decision-making involvement
  - Uses outputs of DE and design cycles for decision-making



Digital Engineering as the Rework Cycle

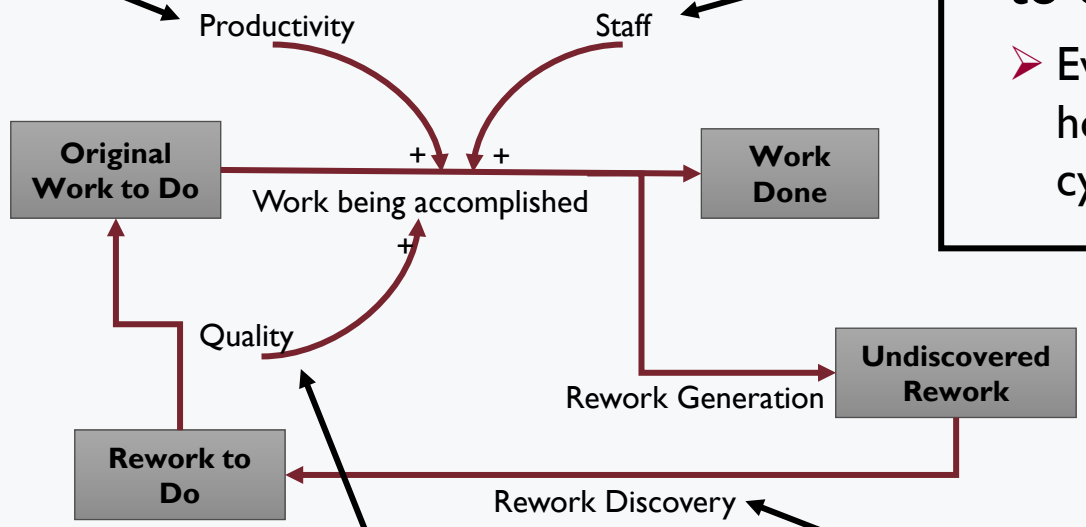
- Dr. James M. Lyneis, MIT
  - Systems Dynamics Model for Project Management
  - System Dynamics can translate theories to equations representative of social and physical systems, such as engineering design cycles
    - Descriptions of processes, interactions are converted to stock and flow equations
    - Model can be simulated to identify impacts of change
    - Both direct and indirect impacts can be represented in the model via feedback loops



The basic rework cycle

How does DE impact time to complete the rework cycle?

- DE automation reduces human delivery time for other tasks, thus increasing productivity
  - Evaluate a range of factors to see how DE automation increasing productivity impacts cycle time

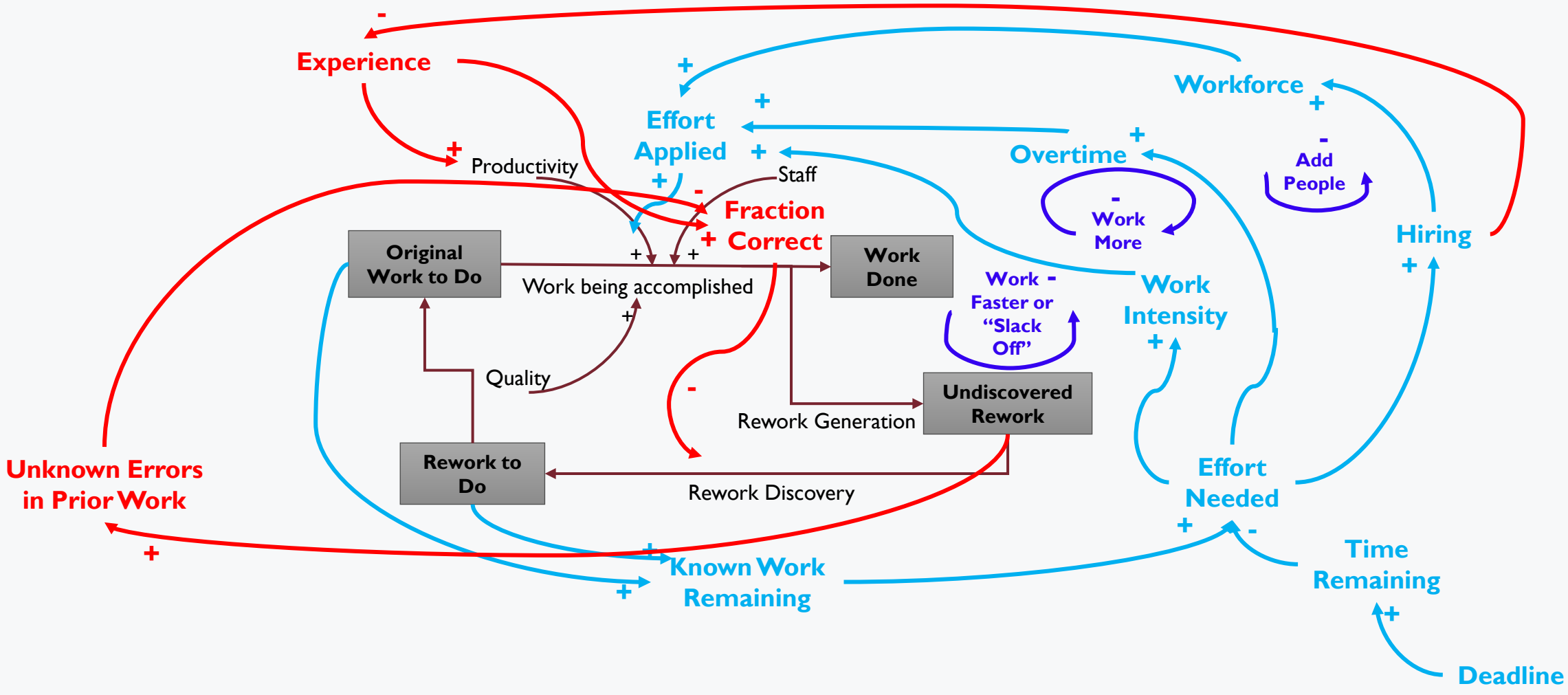


- DE automation may decrease the Staff required to complete tasks
  - Evaluate a range of staffing to see how DE staff reduction impacts cycle time

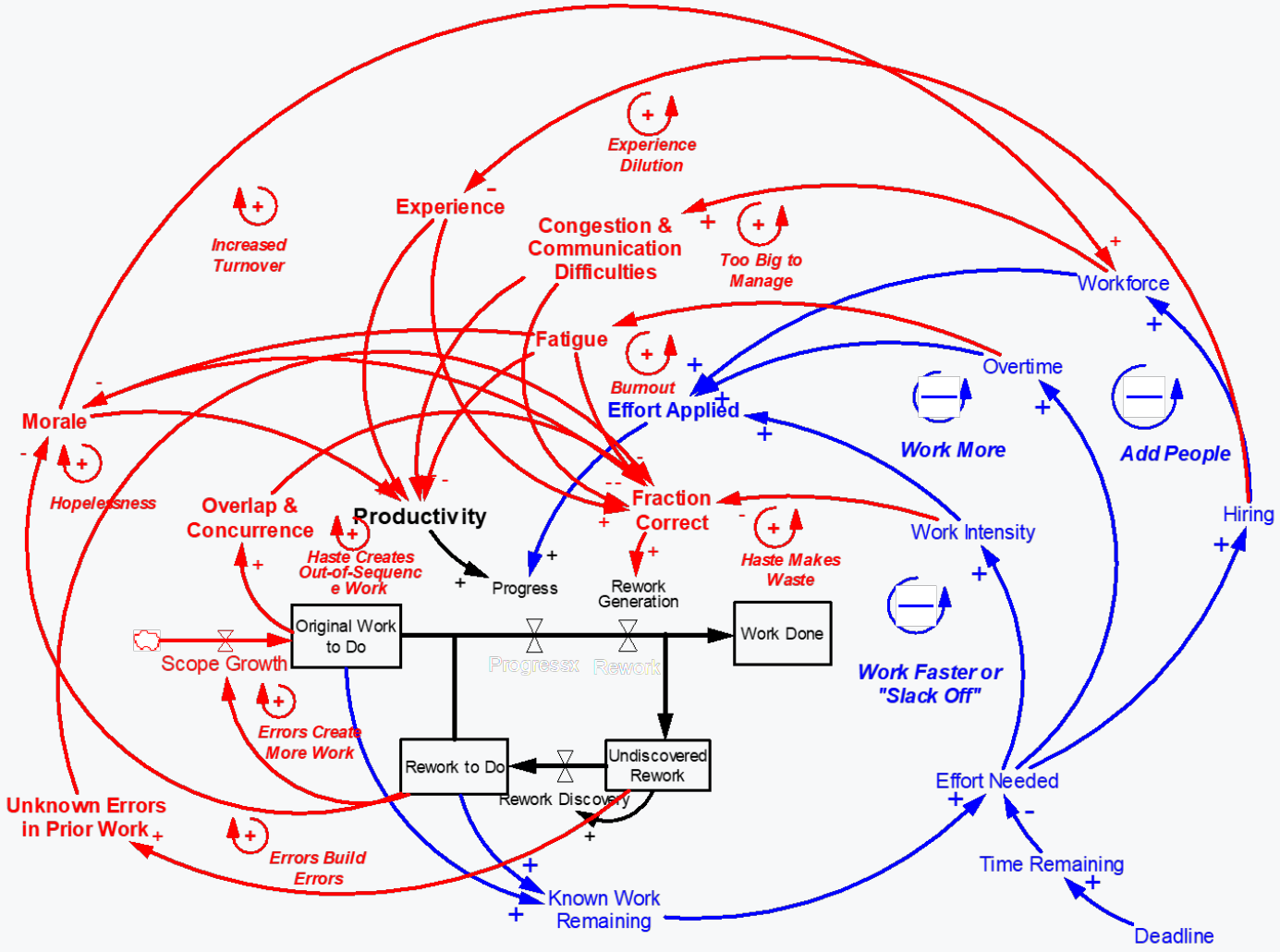
- DE implements automated error checking
  - This increases Quality and reduces the Undiscovered Rework stock

- DE implements automated notifications
  - This reduces the Time to Discover Rework through automated alerts

But how does DE address other feedback loops?

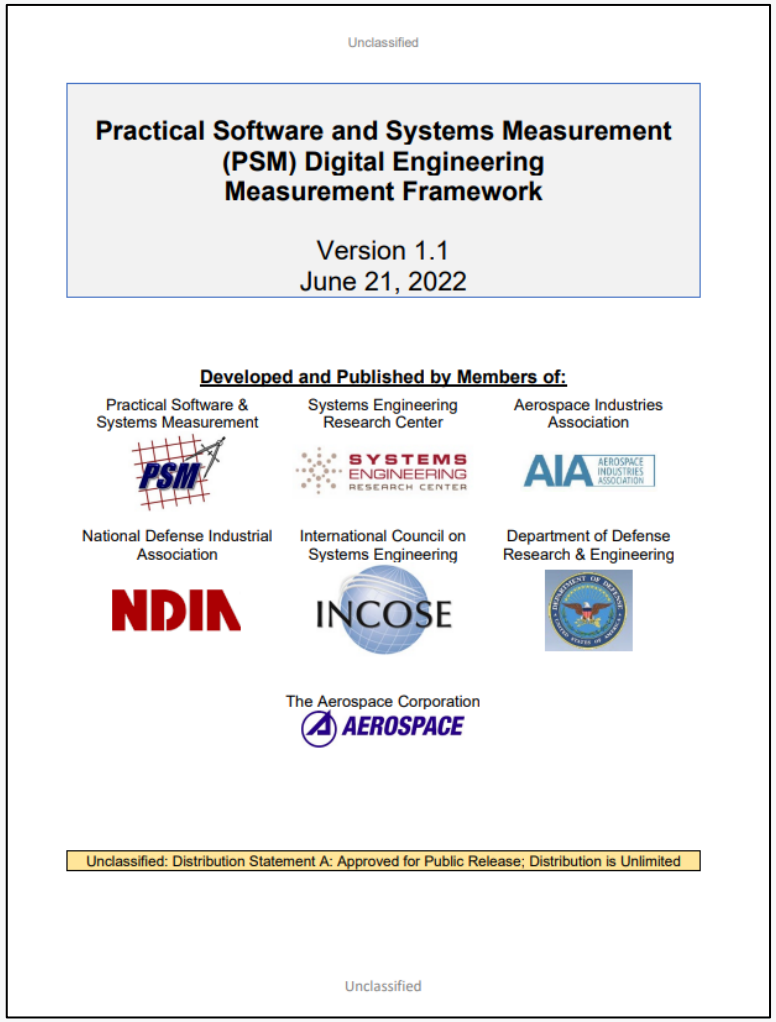


The “Qualitative” Model



Next steps for impact of DE using the Rework Cycle

- Perform sensitivity analysis of expected DE impacts on the Rework Cycle elements
  - Understand where expected benefits have greatest impact
  - Identify changes that could occur due to feedback loops
  - Identify potential new causal loops created by DE
- Determine if this study reinforces or brings new discussion to the DE Measurement Framework


Unclassified

Practical Software and Systems Measurement (PSM) Digital Engineering Measurement Framework

Version 1.1
June 21, 2022

Developed and Published by Members of:

Practical Software & Systems Measurement

Systems Engineering Research Center

Aerospace Industries Association

National Defense Industrial Association

International Council on Systems Engineering

Department of Defense Research & Engineering

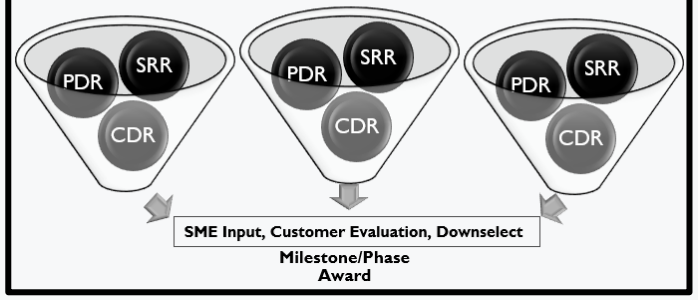
The Aerospace Corporation

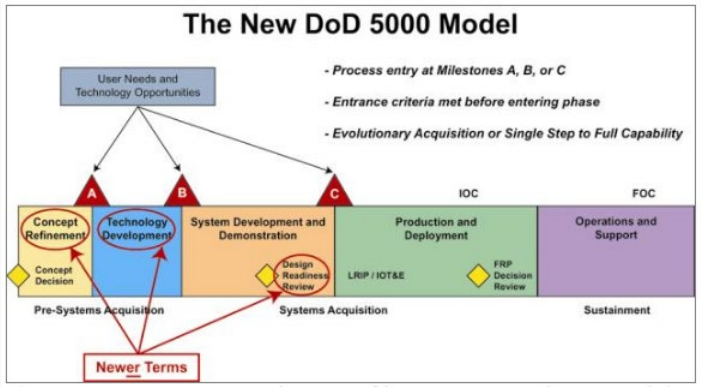
Unclassified: Distribution Statement A: Approved for Public Release; Distribution is Unlimited

Unclassified

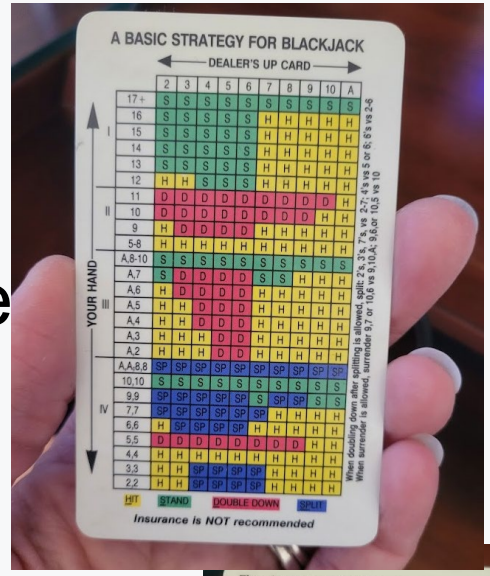
Future Work for DE impact on Cycle Time

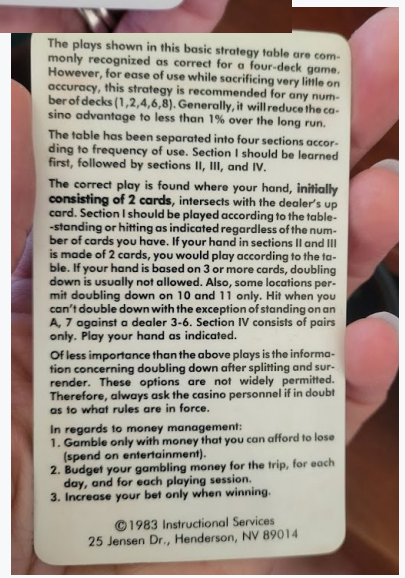
- Decision-Making in Lifecycle Progression
  - Large human decision-making involvement
  - Uses outputs of DE and design cycles for decision-making





- Study behavior of decision makers using Agent Based Modeling (ABM) and a surrogate model
  - Define agents to represent decision-making behavior
  - Evaluate how DE changes the environment and changes decision-making behaviors
  - Review impact of behaviors on cycle time





SYSTEMS ENGINEERING RESEARCH CENTER

THANK YOU

Stay connected with us online.