U.S. Army Research, Development and Engineering Command

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Systems Thinking in Fire Control Software Development

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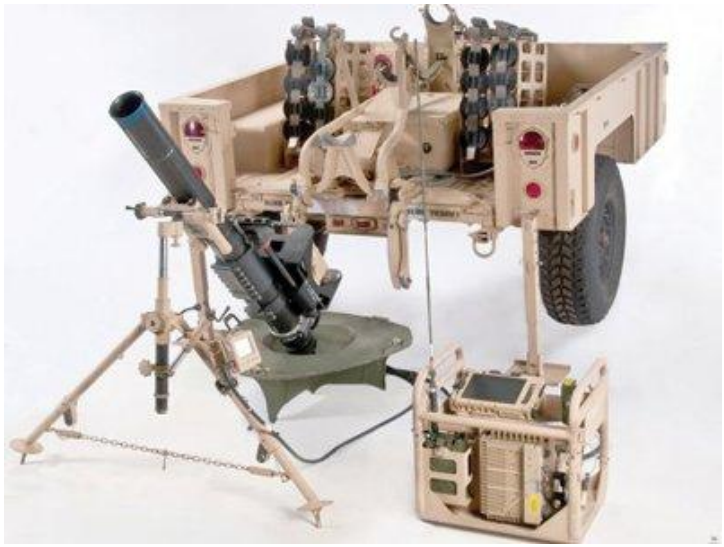
- ARDEC Intro
- Intro to Fire Control Systems
  - Brief description
  - Examples
- Intro to Systems Thinking
- Systems Thinking in the SW Dev Process
  - Example Cases
  - Key Points
- Conclusion

- U.S. Army Armament Research, Development and Engineering Center (ARDEC)
  - Located at Picatinny Arsenal, NJ
  - Mission: Empower, unburden, and protect the Warfighter by providing superior armaments solutions that dominate the battlefield.
  - What does that mean?
    - Developing advanced weapons, ammunition, and fire control systems
- Weapons and Software Engineering Center (WSEC)
  - Sub-division of ARDEC
    - Software design and development

- What is a Fire Control System?
  - Software & hardware that enables:
    - Digital communications
    - Fire missions
    - Ballistic calculations
    - Point and shoot
    - Movement
  - Purpose:
    - Digitize manual gunnery
  - Applied to:
    - Towed Artillery
    - Mortars
    - Self-Propelled Artillery

- Artillery Fire Control:
  - M119 (Towed 105mm)
  - M777 (Towed 155mm)
  - Portable Excalibur Fire Control System (PEFCS)
  - Paladin (Self-propelled 155mm)

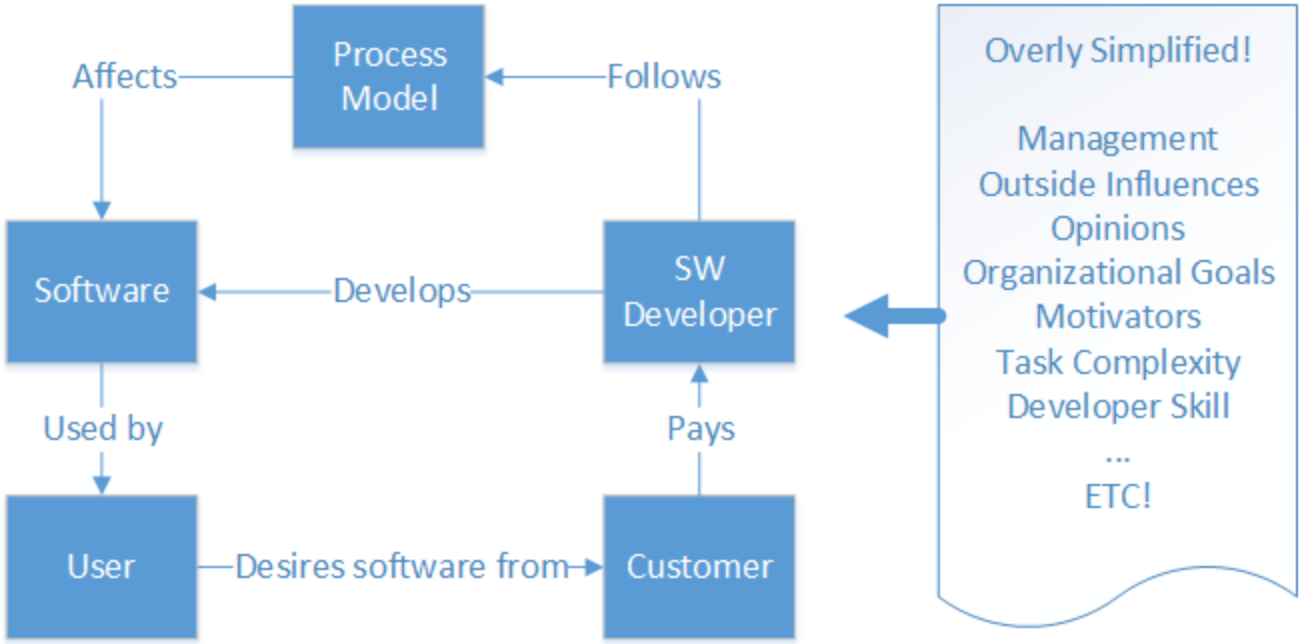
- Mortar Fire Control:
  - Mortar Fire Control System (MFCS)
  - Lightweight Handheld Mortar Ballistic Computer (LHMBC)
  - Dismounted 120mm (MFCS-D)
  - Precision Lightweight Universal Mortar Setter System (PLUMSS)



- Systems Thinking Definition
  - A set of synergistic thinking skills used to understand complex systems and predict their behavior.
    - See “wholes” and “parts” simultaneously
    - Understand how system structure causes behavior
    - Recognize interconnections and feedback loops
    - Predict dynamic behavior
    - Simplify through abstractive modeling
  - Seeing the world “differently”
  - Not intuitive

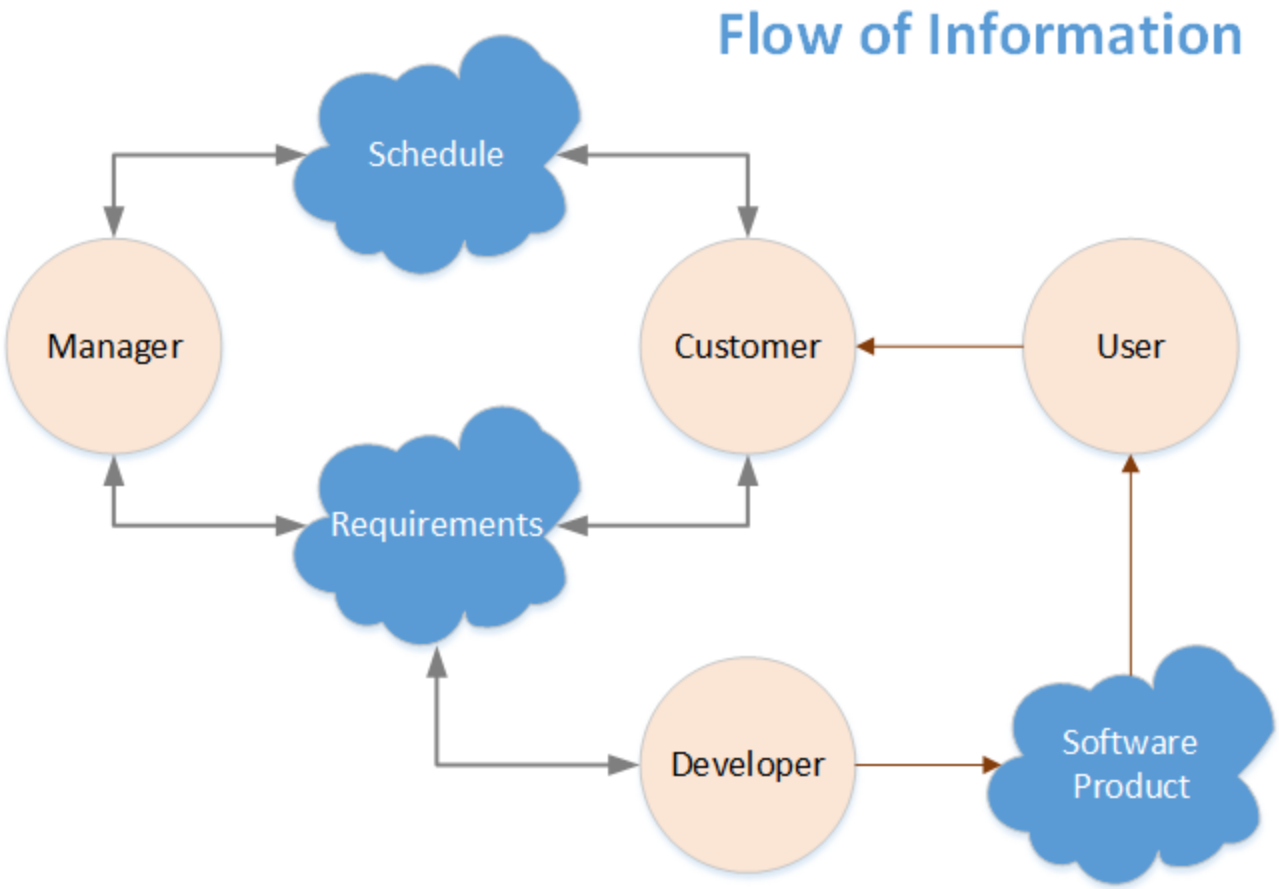
- How does this relate to software development?
  - Software dev process is a complex system
  - Not to be confused with the software itself!
  - Development process has:
    - Many elements
    - Interconnections
    - Feedback loops, delays
    - Uncertainty

- Software Development System
  - Is this accurate?
  - All models are wrong, some are useful. (George Box)



- Case 1: Code Reviews
  - Traditional approach – mandate reviews
    - Policy resistance (classic systemic problem)
  - What's the system?
    - All developers "lazy?" No!
    - Humans like to perceive value
    - Recording results = context switching
  - Solutions?
    - Improve information flow
    - Make recording easy
    - Many more, depends on system

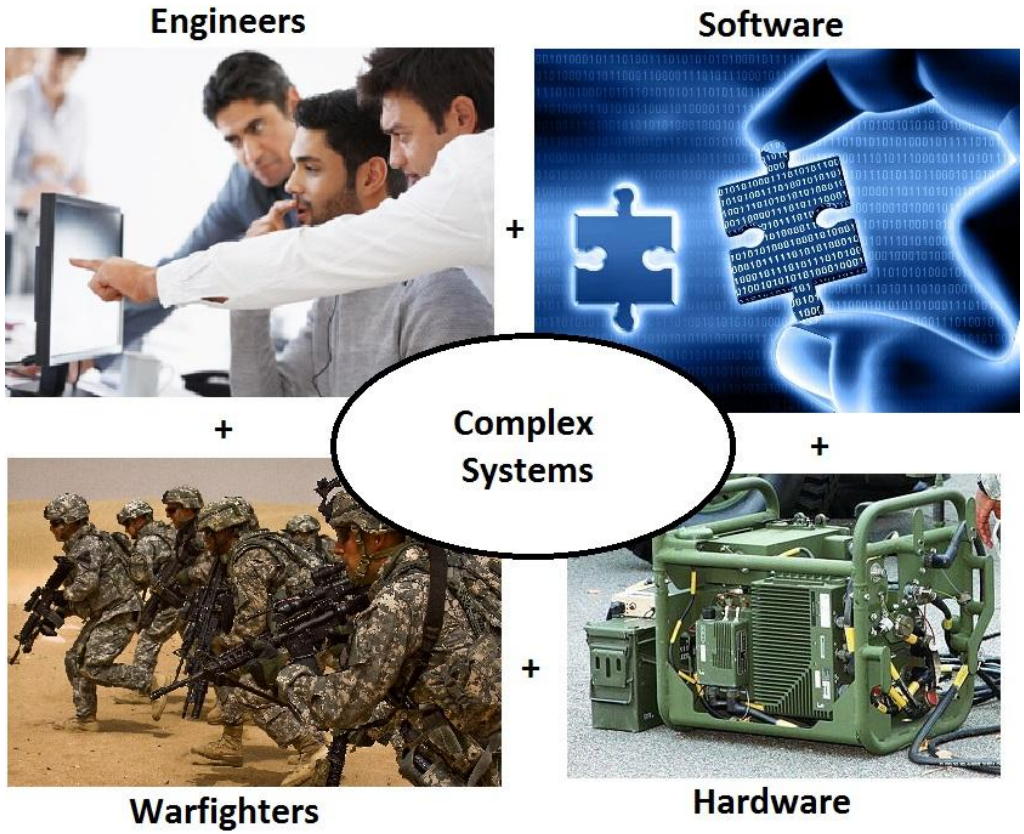
- Case 2: Information Flow
  - What's wrong with this picture?



- Case 3: Improving Productivity
  - "Crack the whip?" – No!
  - One Systemic Option: Minimize Distractions
    - Context switching
    - Fire-fighting
    - Bugs
    - Constant "urgent" requests
  - Best Practices
    - Clear task
    - Devote X time per day to task
    - Target deadline
    - Empowerment – devs know their purpose

- Systems Thinking Key Points
  - The software development process is a system
    - It has humans, humans are complex
    - Information flow
    - Lags and delays between decisions
    - Feedback loops, many of which might not be intuitive
  - Problems require systemic investigation
    - There is no blame! (Senge 1990)

- Systems are everywhere!
  - Software development is no exception.
  - Systems thinking is a transferable approach.



- Questions?

- Contact:

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