

SIMULATION-BASED REQUIREMENTS ENGINEERING FOR ARMY ENTERPRISE XXI

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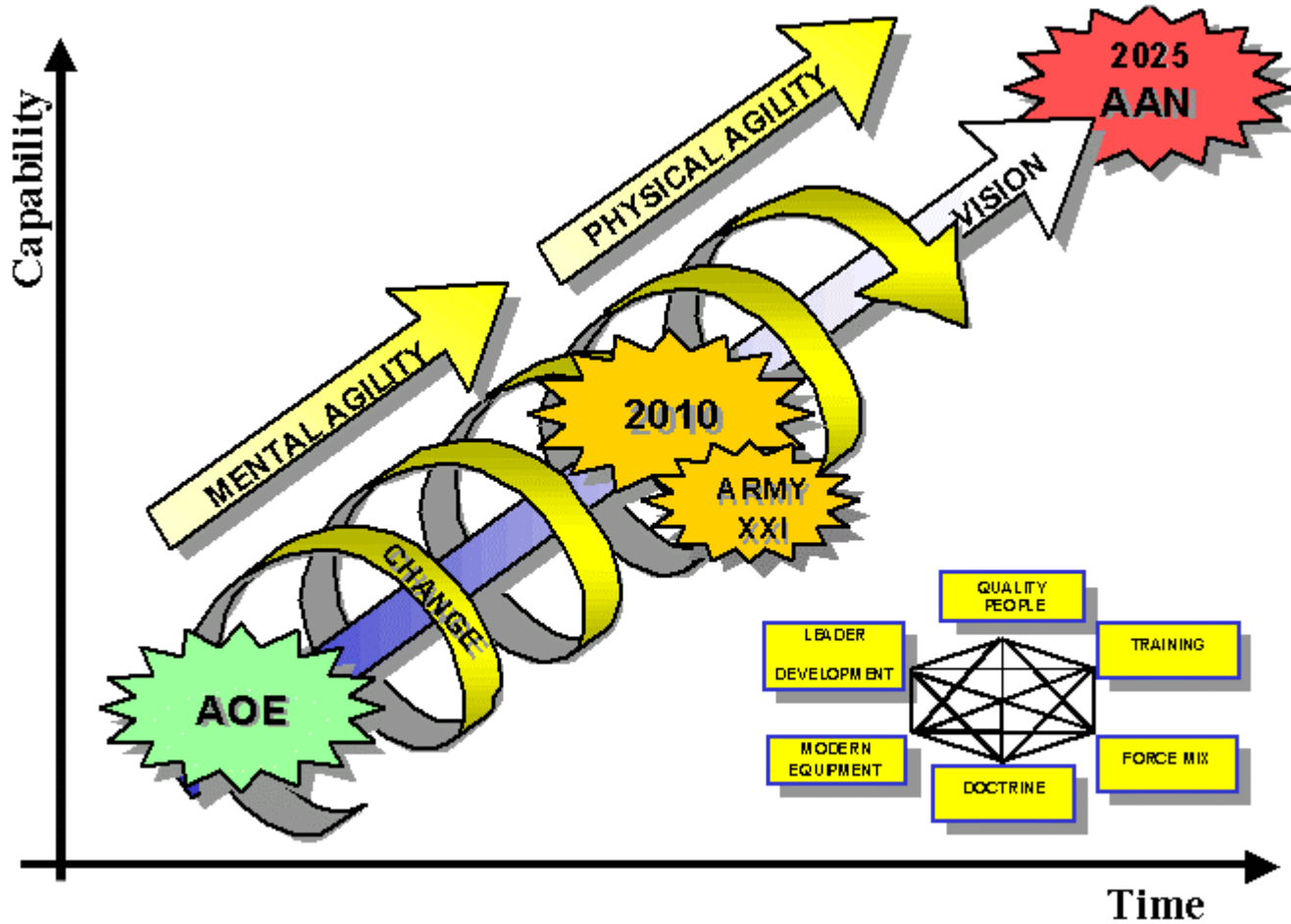


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From AOE to Army XXI to AAN



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Rationale for Army Enterprise XXI

- ***Information Superiority*** is the key to successful operations on the 21st Century battlefield.
- Army Enterprise XXI provides a focused C4/IT approach to enable the Army to evolve from today's *platform-centric force (Army of Excellence)* into a *network-centric force* in 2010 (Army XXI) and, finally, into the *knowledge-centric force* of 2025 (Army After Next).
- This evolution will provide soldiers with the ability to capitalize on knowledge capital obtained from unlimited access to a global, seamless, secure enterprise network to achieve information superiority.



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Requirements Engineering

- **Requirements Engineering:** is a specification of needs as analysis components for use during systems development.

(Ramamoorthy & Tsai *IEEE Computer*, Oct. 96)

- **Objectives of Requirements Engineering:**

Determine feasibility and cost of project.

Provide means to check consistency and completeness of requirements.

- **Achieved through:**

Prototyping

Simulation



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Effective Requirements Engineering

- Effective requirements engineering is critical to the success of *Army Enterprise XXI*.
- Effective use of the spiral development model or any other iterative method requires specified requirements.
- Absent clear, concise requirements, it is impossible to determine when one development phase is done and the next phase should begin.

How do you know when you are done?



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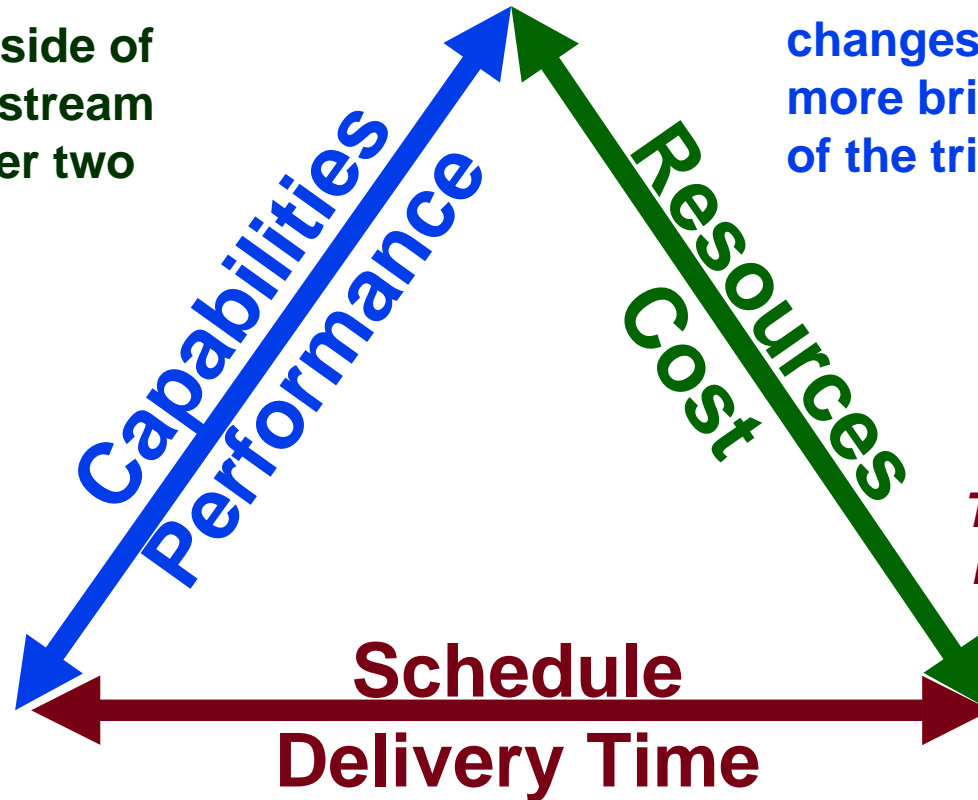
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Bounding Software Requirements

Changing one side of the triangle upstream affects the other two downstream

The further downstream changes are made, the more brittle the other sides of the triangle



Time is a constantly increasing function



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From Prototyping to Requirements

- Time should not be wasted building significant functionality into a prototype.
- The prototype code **MUST NOT** be used as the basis for production code.
- Prototyping must continue until test users are satisfied with the front end they see.
- Move to next stage when the user is satisfied with the anticipated functionality demonstrated by the prototype.

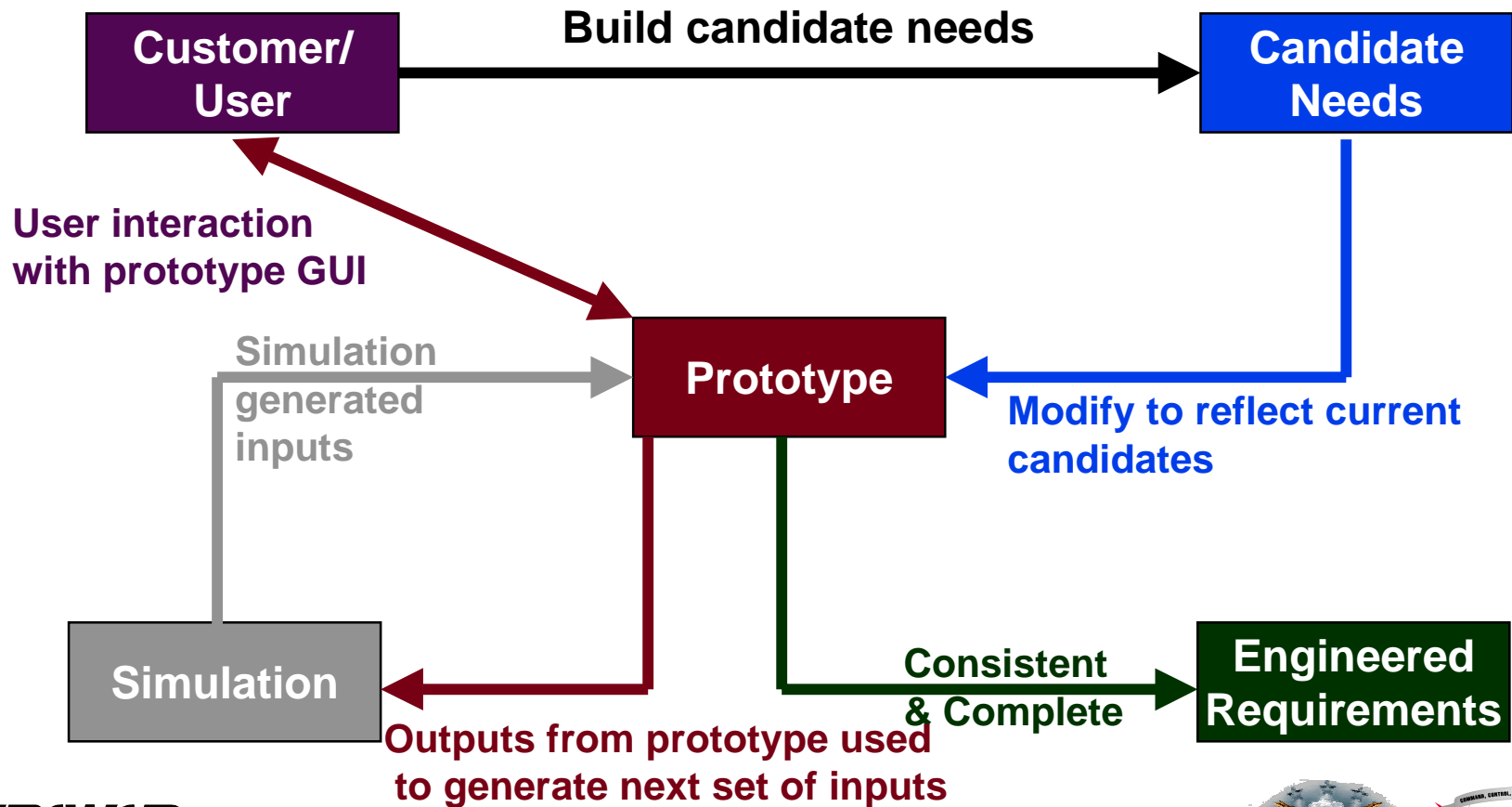


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Prototyping, Simulation and Requirements



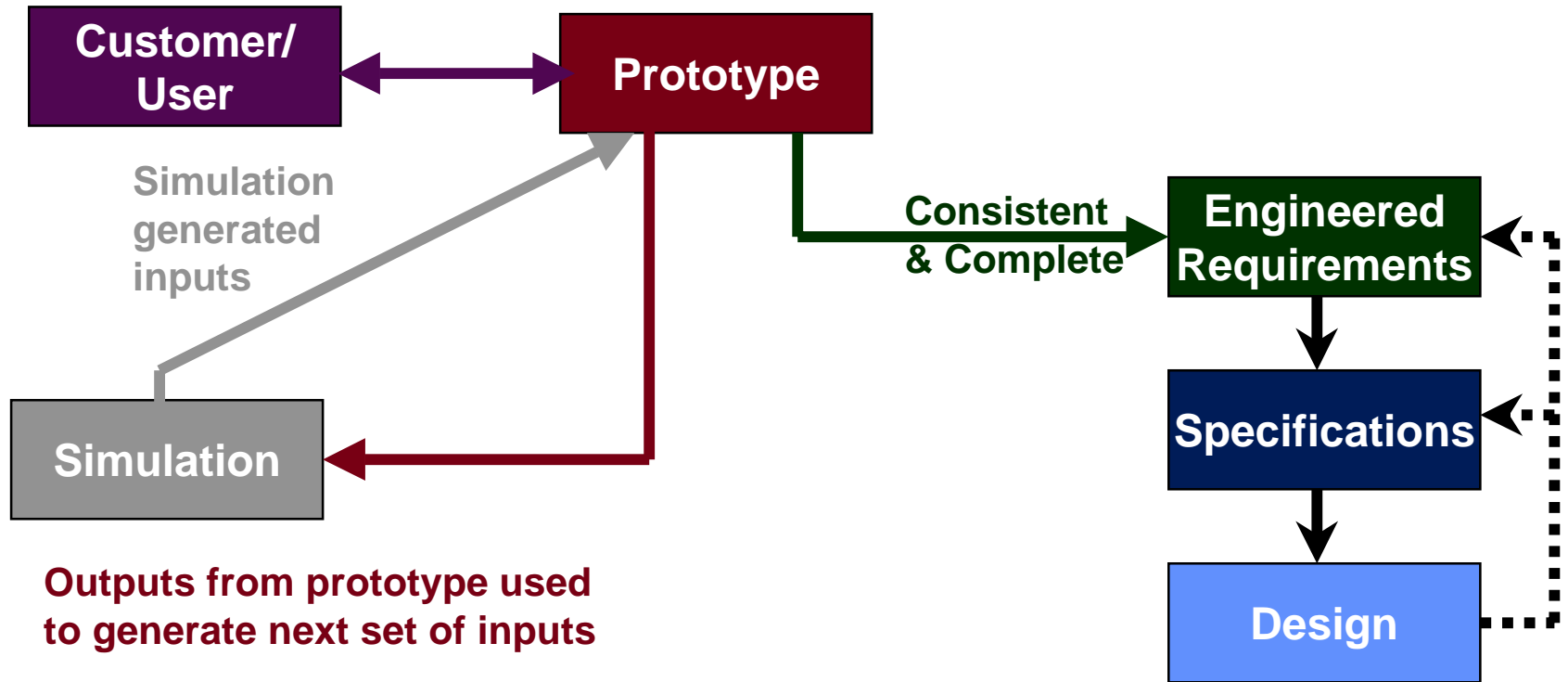
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Simulation-Based Acquisition

User interaction with prototype GUI



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Simulation-Based Acquisition

- Integrating simulation-based prototyping into a software engineering-based spiral development model is consistent with and supportive of *Army Enterprise XXI*.
- Simulation-Based Acquisition (SBA) is a key strategy outlined in *Army Enterprise XXI*:

An industry best practice.

SBA will allow all parties to interact during system development so that the resulting system reflects their combined interests with all necessary trade-offs reconciled in an optimal manner.

Complimentary risk management strategy to spiral development.



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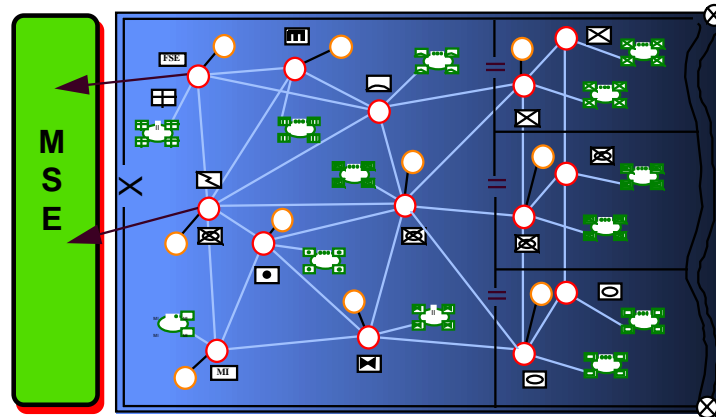
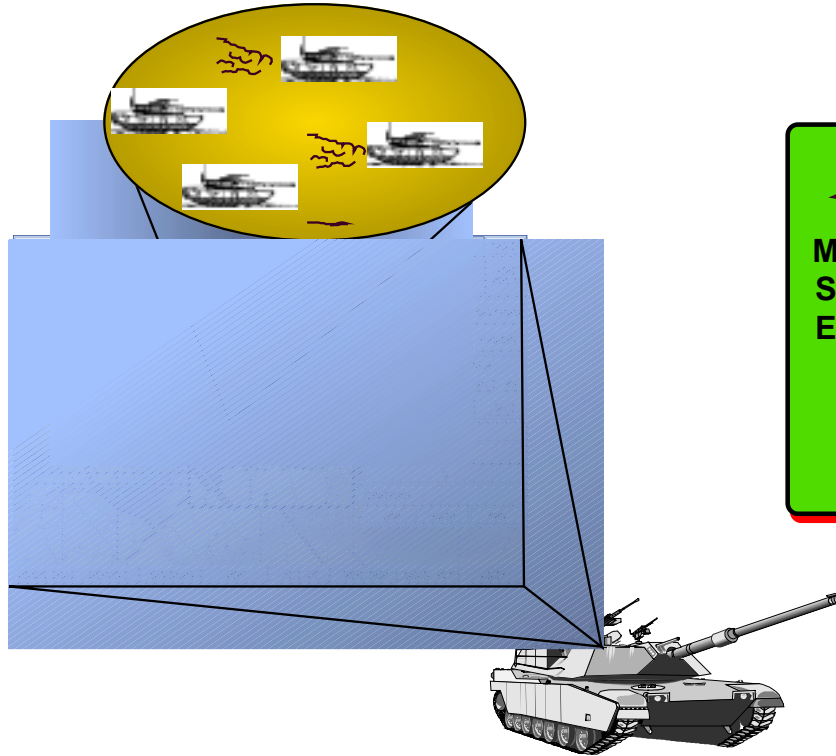
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The Emerging Digitized Battlefield

The Digitized Battlefield is Characterized By:

Situational Awareness
and Battle Command



TACTICAL INTERNET

The Trend is to Push Information
and Automated Systems Forward
From Battalion to Fighting Platform



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Requirements Engineering for Distributed Systems

- Distributed systems are constrained both by bandwidth and cost.
- Military distributed systems can no longer be over-engineered to simply provide the maximum technically feasible throughput with maximum connectivity.
- Requirements engineering distributed software is challenging because of the non-trivial hardware and bandwidth issues as well as the stochastic nature of distributed system usage.



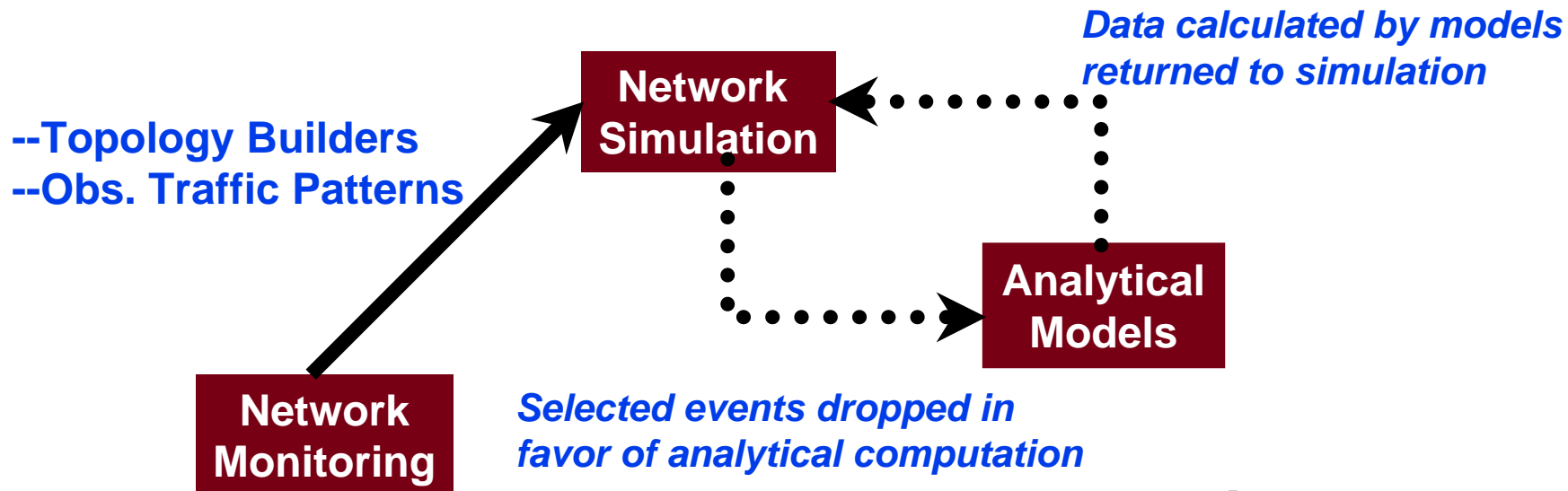
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An Integrated Approach

- An integrated approach using analytical modeling, monitoring and reusable network objects ameliorates some of the challenges associated with network simulation.



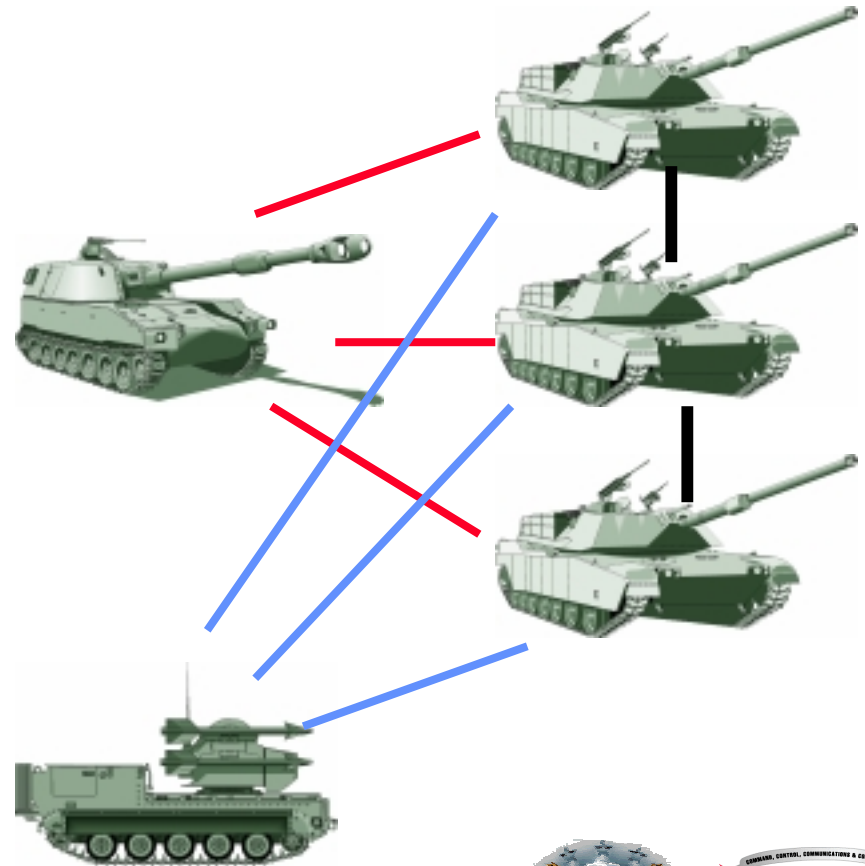
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Simulating an Operational Architecture

1. Template against battlefield laydown
2. Determine system connectivity and traffic loads
3. Validate against doctrine



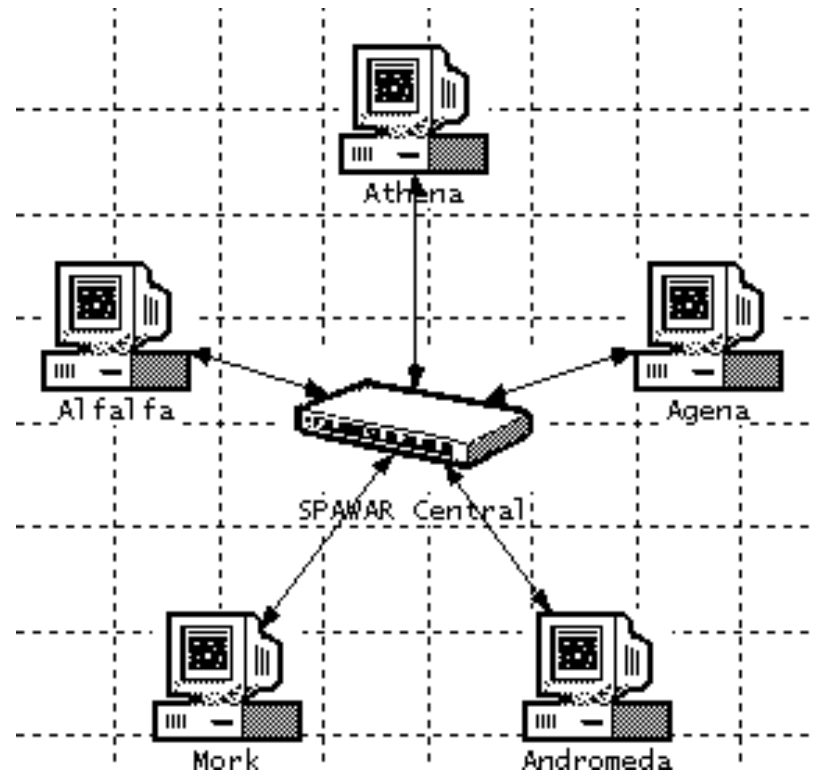
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System Architecture

1. Built on standards specified in technical architecture
2. Determine system connectivity and traffic loads based on operational architecture
3. Validate against operational architecture



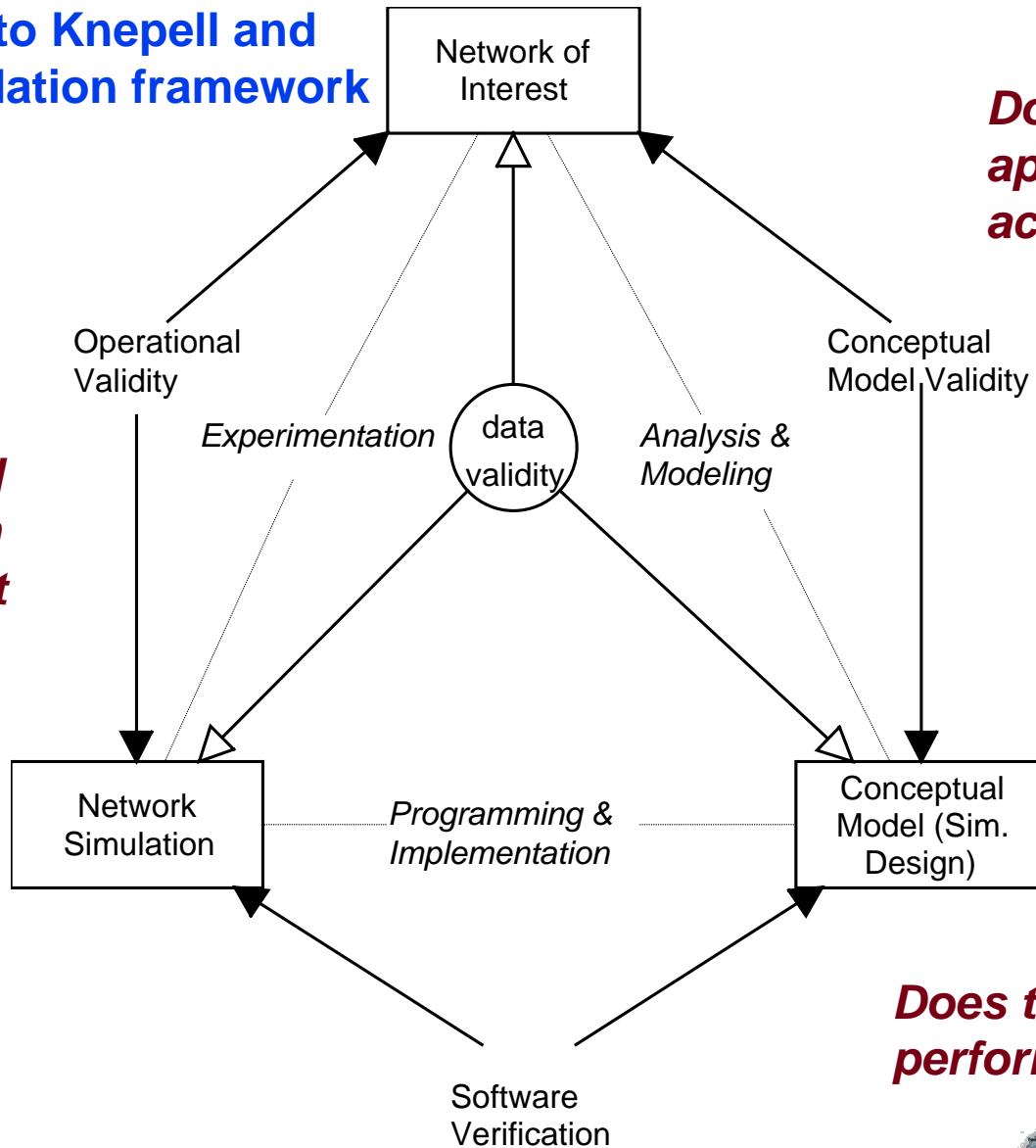
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A modification to Knepell and Arangno's validation framework

Does the model implementation correctly reflect the network?



Do the predicted approximate the actual results?

Does the software perform correctly?

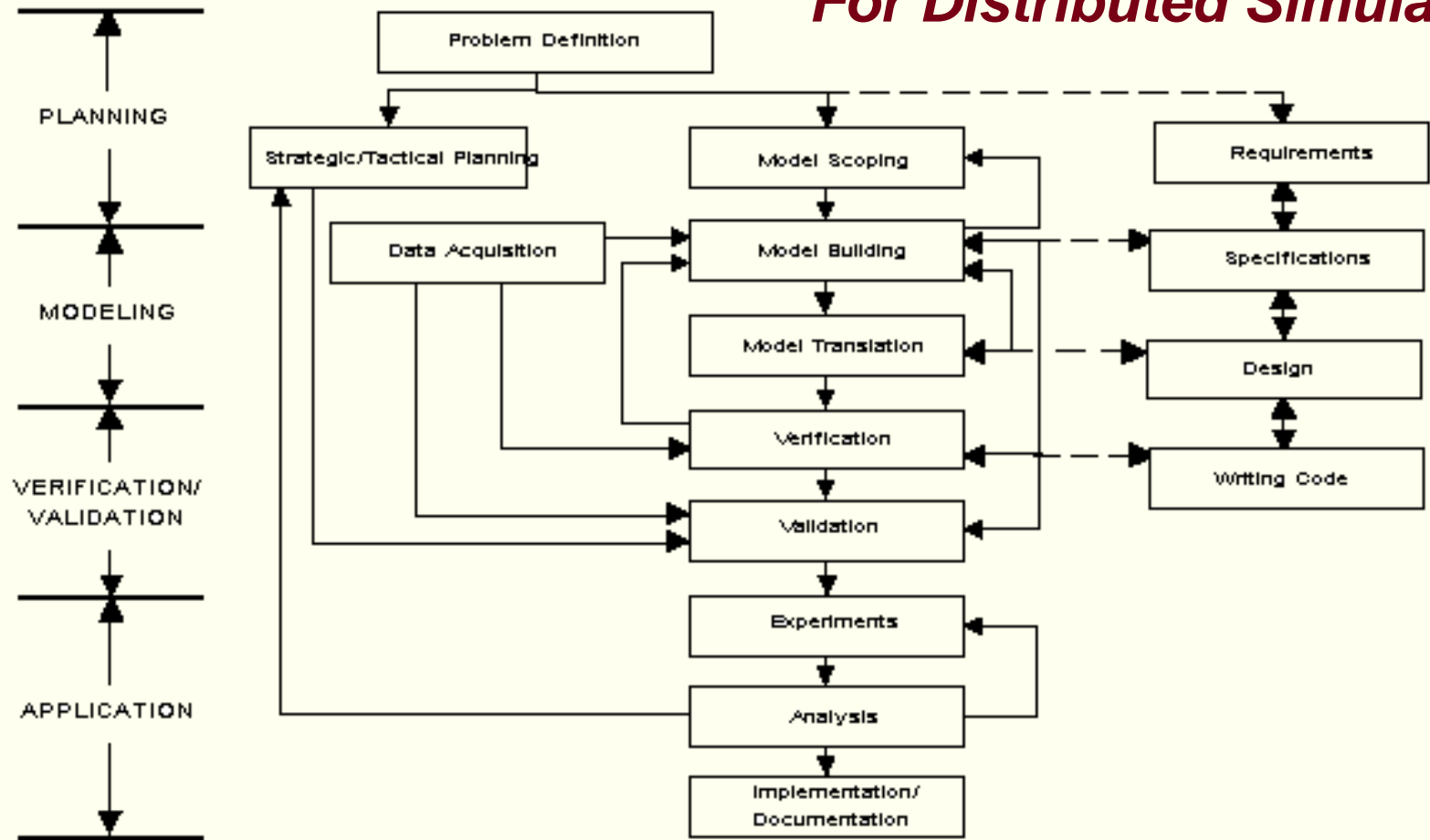


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An Integrated Simulation/Software Engineering Framework For Distributed Simulation



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Conclusions

- Human factors drive requirements engineering.
- Building software is **NOT** the same as building a bridge.
Software is interactive and as such, can be used in many more ways than any civil engineering structure.
- *Army Enterprise XXI* requires aggressive use of simulation-based prototyping in order to realize the benefits of Simulation-Based Acquisition.
- Clearly specified requirements are needed to make spiral development paradigms effective.
- Without clear requirement specifications, spiral development devolves into simply going in circles.



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