A Computer Tool for Modeling C4I Applications

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June, 2003

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- **C4I System Development should**
  - Satisfy user needs
  - Produce high quality products
  - Be flexible to meet changing mission requirements
- **Requirement Elicitation and Clarification (Human+ Computer)**
  - Humans are mainly responsible for the command and control activities
  - Software requirement documentation seldom explicitly defines/separates the human's responsibilities from those of the computer system
  - Operation and performance of the systems are flexible and change dynamically

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- **Rapid Modeling/Prototyping**
  - Define the requirements via formal specification
  - Verify the requirements via mini scale modeling/prototyping for user interviews
  - Refine the requirements via gathering feedback from operators and supervisors throughout the chain of command
  - Iterative process to clarify the requirements
  - **Benefits:** decrease the development risk, reduce the cost and time of the development thereby improving the efficiency

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- **Requirements of C4I Applications**
  - Correctness and reliability
  - Multi-factor influences
  - Strict constraints (i.e. hard real-time constraints)
  - Complex and dynamic interface
- **Development of C4I Applications**
  - Precisely define the requirements
  - Clarify the specification
  - Correctly implement the specification
  - Instantly collect feedback
  - Refine the requirements accordingly
  - Repeat as necesssary

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- **CAPS-PC Supports:**
  - Modeling system architecture and behaviors
  - Building system skeleton from the prototyping models
  - Test and evaluation of property constraints
  - Automatic generation of mini scale software programs
  - Extensive interaction between the designers and the users

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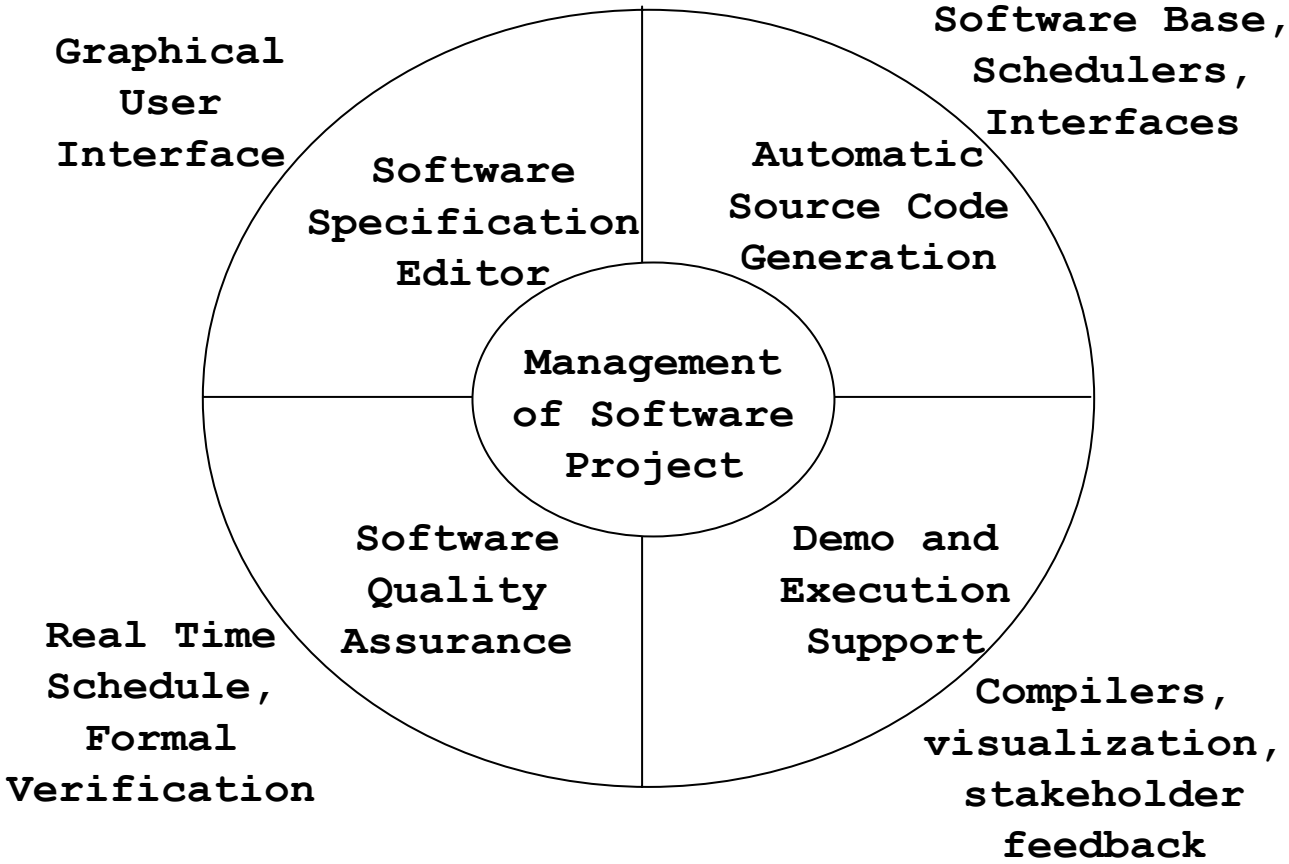
- **CAPS-PC Conceptual Model**



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- **Procedures for System Modeling/Prototyping by using CAPS-PC**
  - Draw data-flow graphics
  - Compose the formal specifications
  - Model and generate the software architecture
  - Define the simulated software interface
  - Generate the executable program
  - Demonstrate the running program
  - Collect feedback on the system requirements
  - Refine the system model and prototype

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- **Design of C4I Systems**
  - Multi-level Information Representation
  - Project Management
- **Communications in C4I System Development**
  - Unified Document Representation
  - Multi-view Presentation
  - User-centered Design
- **Generation of C4I Systems**
  - Support the design of the software interface
  - Automated Code Generation
    - 100% compiler error free code

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- **System Goals:**
  - **Reduce the workload of designers**
    - Providing contextual information for design tasks and scheduling
  - **Maintain consistency**
    - Syntax consistency
    - Consistency between data communication, input constraints and output constraints
  - **Documentation generation**
    - Unified software knowledge representation
    - Customized software documentation--contents and style depend on user needs (formal specification, graphic, diagram, checklist …)

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- **Information and Control System (MD system) needs to**
  - **Receive and process data in real time**
  - **Correctly identify the scud**
  - **Satisfy the resource constraints**
  - **Track and destroy the missile**

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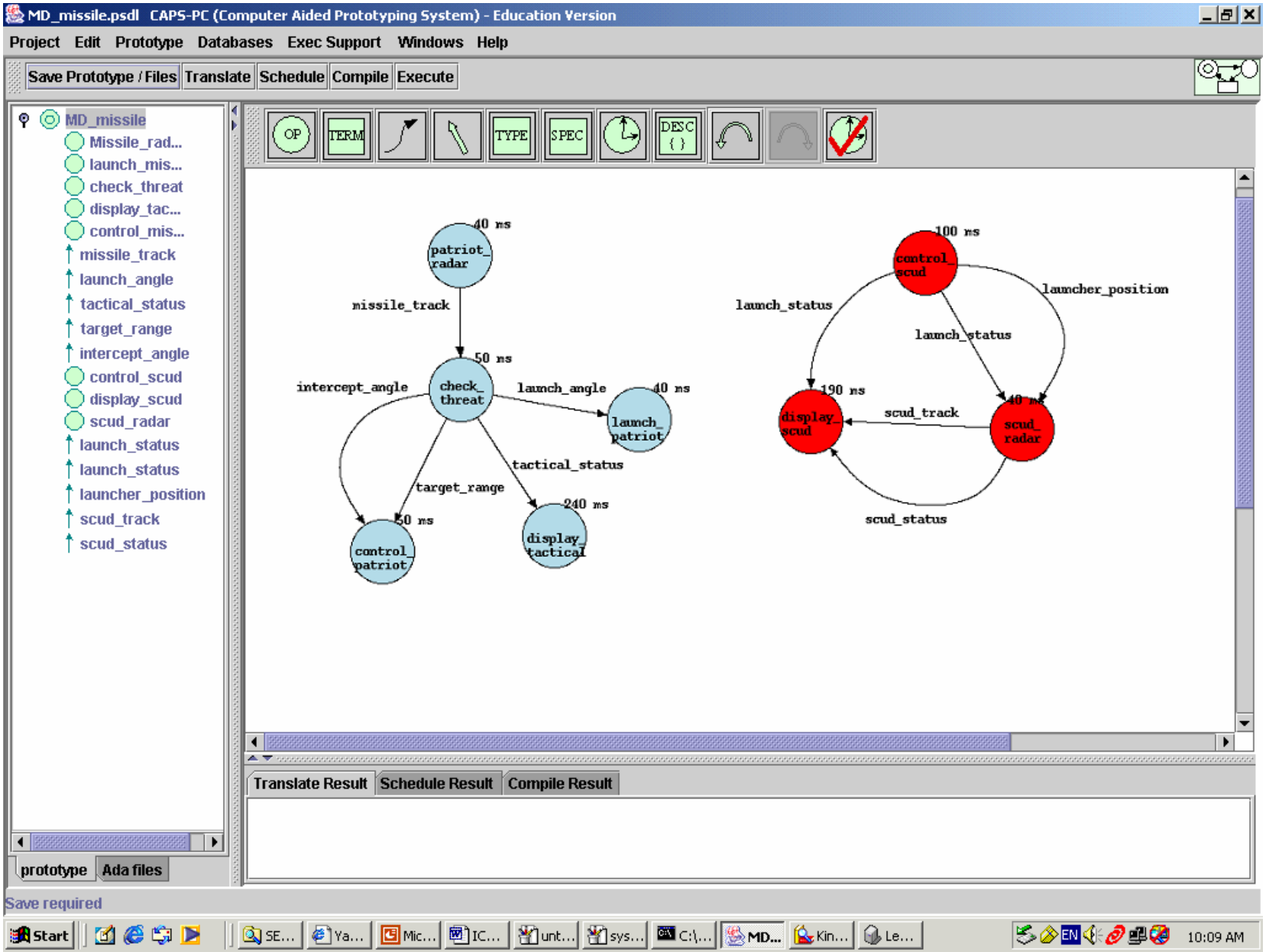
Modeling of MD System



- **Benefits of C4I System Modeling via CAPS-PC**
  - **Models → Prototype → Documentation**
  - **Knowledge contained in the documentation supports system development and evolution**
  - **Promotes customer, user and sponsor involvement in the system development**
  - **Produces high quality software**
    - Specification generation
    - Completeness checking
    - Design with syntax checking
    - Translation with semantic checking

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- **Conclusions**
  - **Modeling and prototyping can help to insure the quality and reliability of C4I systems**
  - **Benefits of using CAPS-PC for development**
    - Formulate and validate requirements via executable model demonstrations
    - Assess feasibility of system design
    - Enable early testing and integration of completed subsystems
    - Support evolutionary system development
    - Produce high quality, reliable and flexible software
    - Avoid schedule overruns

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Thank you!

Questions?

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Backup Slides

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- **CAPS-PC**
  - **For system specification, design, prototype, and implementation**
  - **Features of CAPS-PC:**
    - Graphical Interface for formal specification
    - Multi-level Information Representation
    - Project Management
    - User Centered Design with Human Factor Considerations
  - **CAPS-PC can do:**
- Time Constraints
- Conditional Output and Execution
- Timer
- Exception Definition and Handling
- Formal and Informal Description

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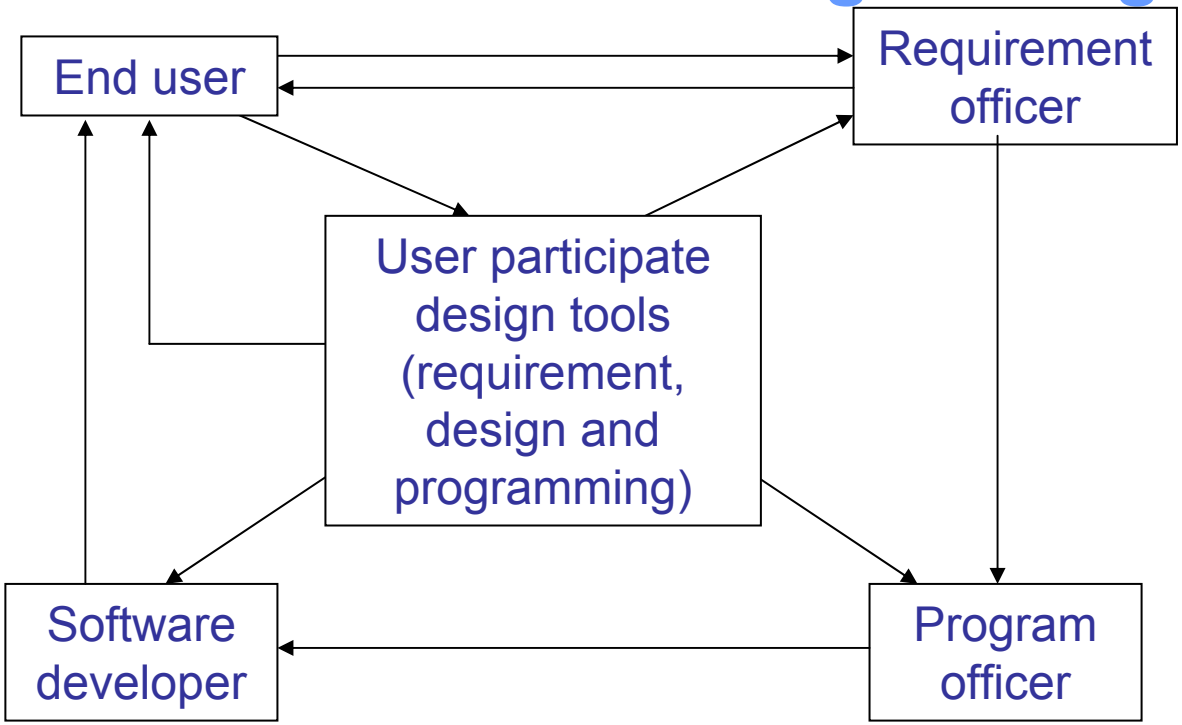
- **User centered Software Engineering**



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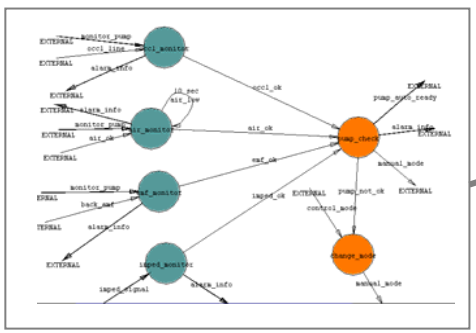
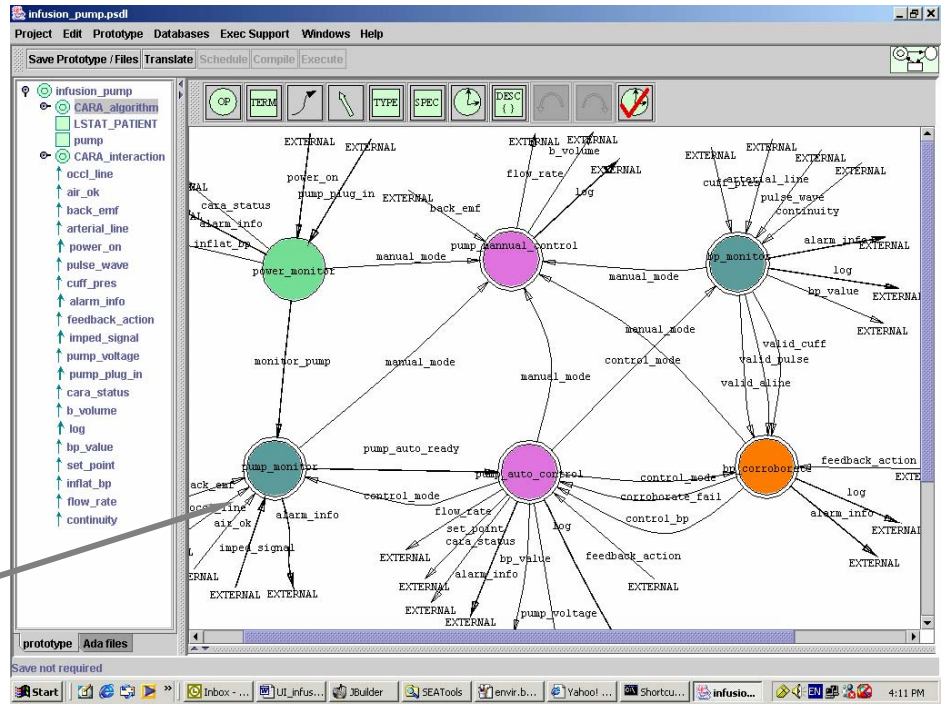
- **Multi-level Information Representation**





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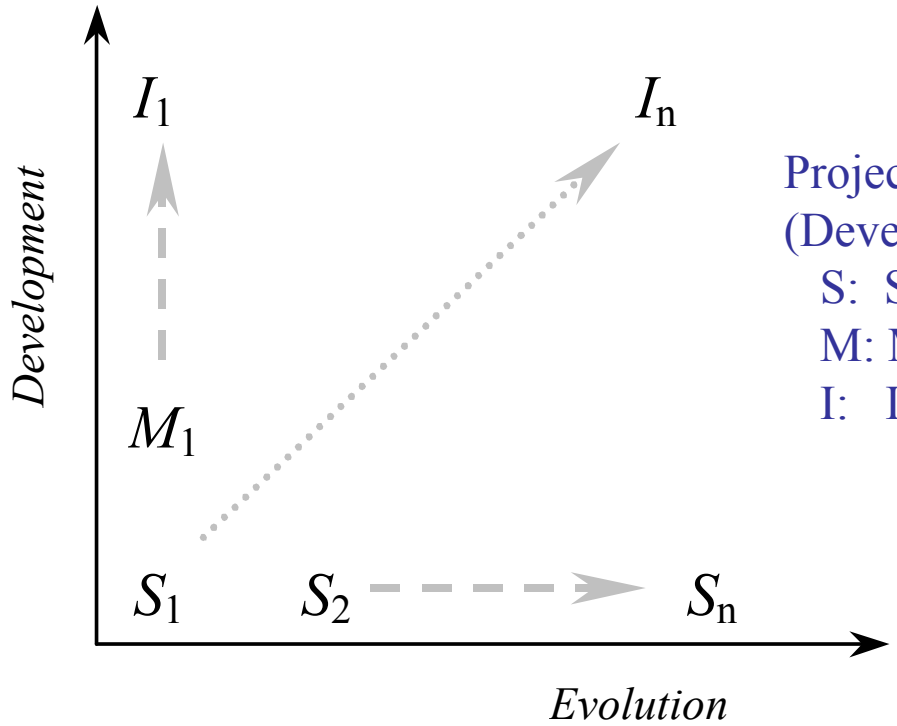
- **Project Management**



Project Management Diagram
(Development and Evolution)
S: Specification
M: Modeling
I: Implementation

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