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A Computer Tool for Modeling C4I Applications

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A Computer Tool for Modeling C4I Applications

Luqi

Jennifer Z. Guan



Naval Postgraduate School
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 necessary



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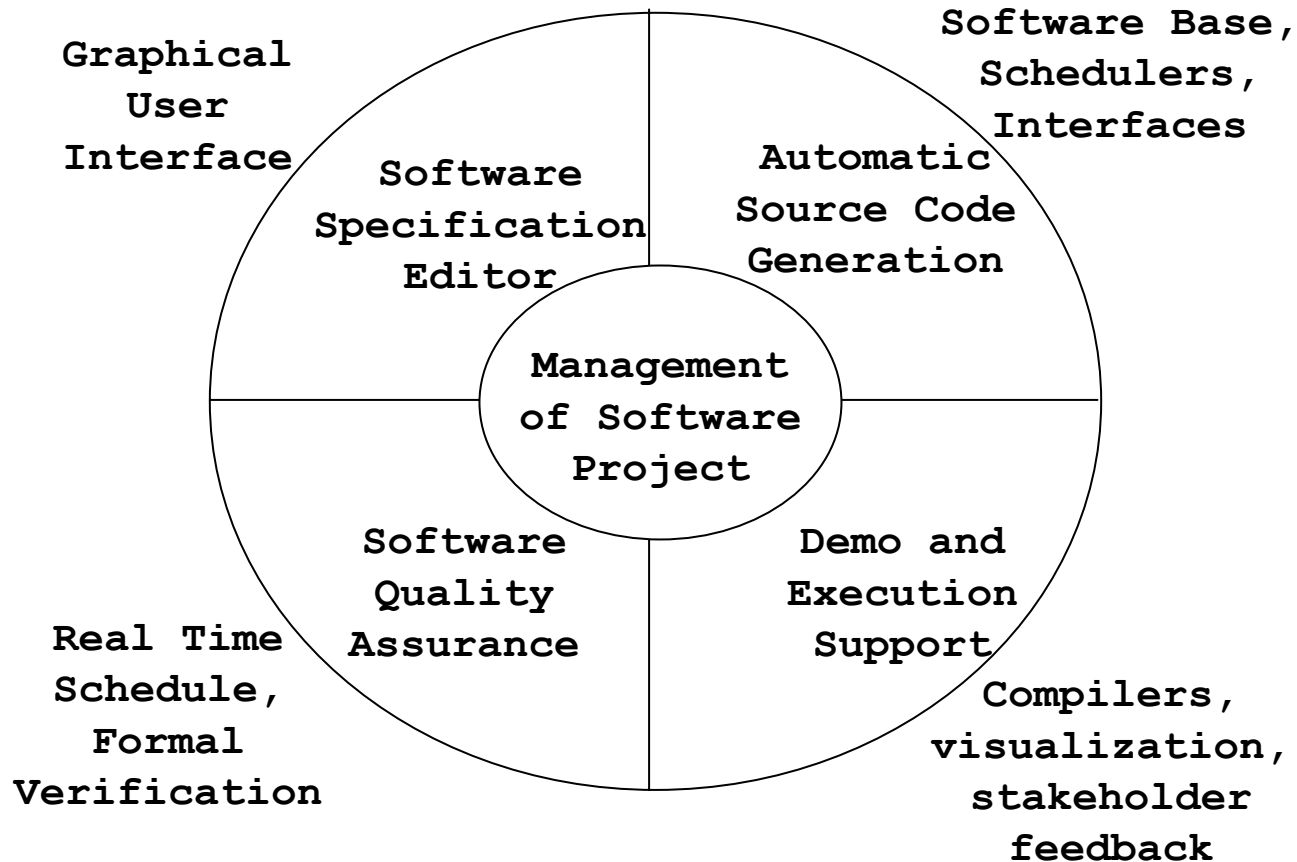
- **CAPS-PC Supports:**
 - Modeling system architecture and behaviors
 - Building system skeleton from the prototyping models
 - Test and evaluation of property constraints
 - Automatic generation of mini scale software programs
 - Extensive interaction between the designers and the users



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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

Modeling of MD System

MD_missile.psd | CAPS-PC (Computer Aided Prototyping System) - Education Version

Project Edit Prototype Databases Exec Support Windows Help

Save Prototype / Files Translate Schedule Compile Execute

OP TERM [arrow] [pencil] TYPE SPEC [clock] DESC [O] [undo] [redo] [checkmark]

- MD_missile
 - Missile_rad...
 - launch_mis...
 - check_threat
 - display_tac...
 - control_mis...
 - ↑ missile_track
 - ↑ launch_angle
 - ↑ tactical_status
 - ↑ target_range
 - ↑ intercept_angle
 - control_scud
 - display_scud
 - scud_radar
 - ↑ launch_status
 - ↑ launch_status
 - ↑ launcher_position
 - ↑ scud_track
 - ↑ scud_status

Translate Result Schedule Result Compile Result

prototype Ada files

Save required

Start | SE... | Ya... | Mic... | IC... | unt... | sys... | C:\... | MD... | Kin... | Le... | EN | 10:09 AM



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- **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**

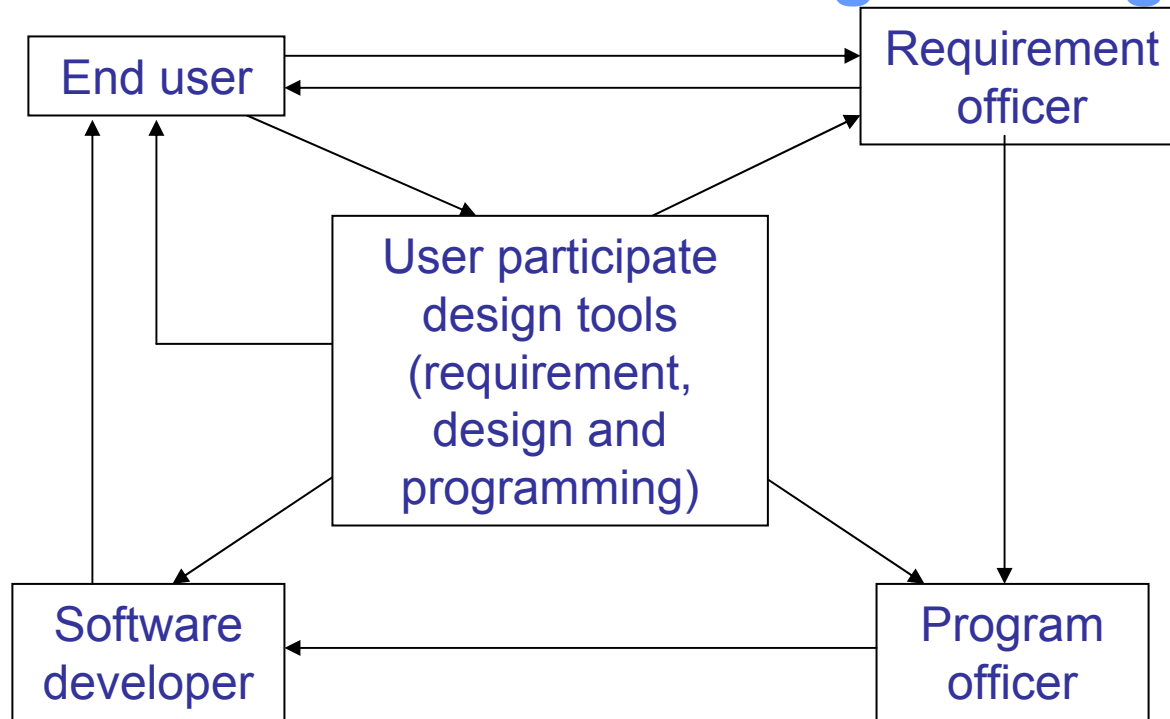
- For system specification, design, prototype, and implementation
- Features of CAPS-PC:
 - Graphical Interface for formal specification
 - Multi-level Information Representation
 - Project Management
 - User Centered Design with Human Factor Considerations
- CAPS-PC can do:
 - Time Constraints
 - Conditional 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

