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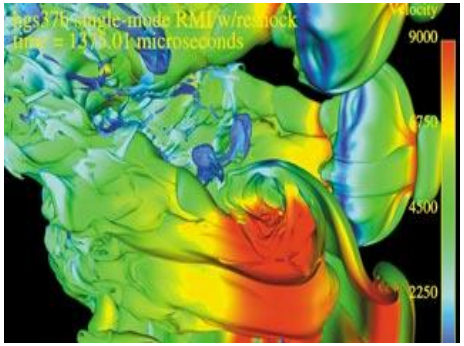

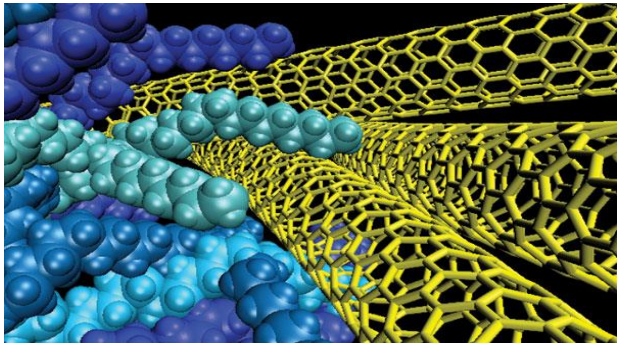

Harnessing the Beast:

Using Model Based Systems Engineering (MBSE) to Manage Complex Research Software Environments

U.S. DEPARTMENT OF ENERGY
NNSA National Nuclear Security Administration

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Introduction

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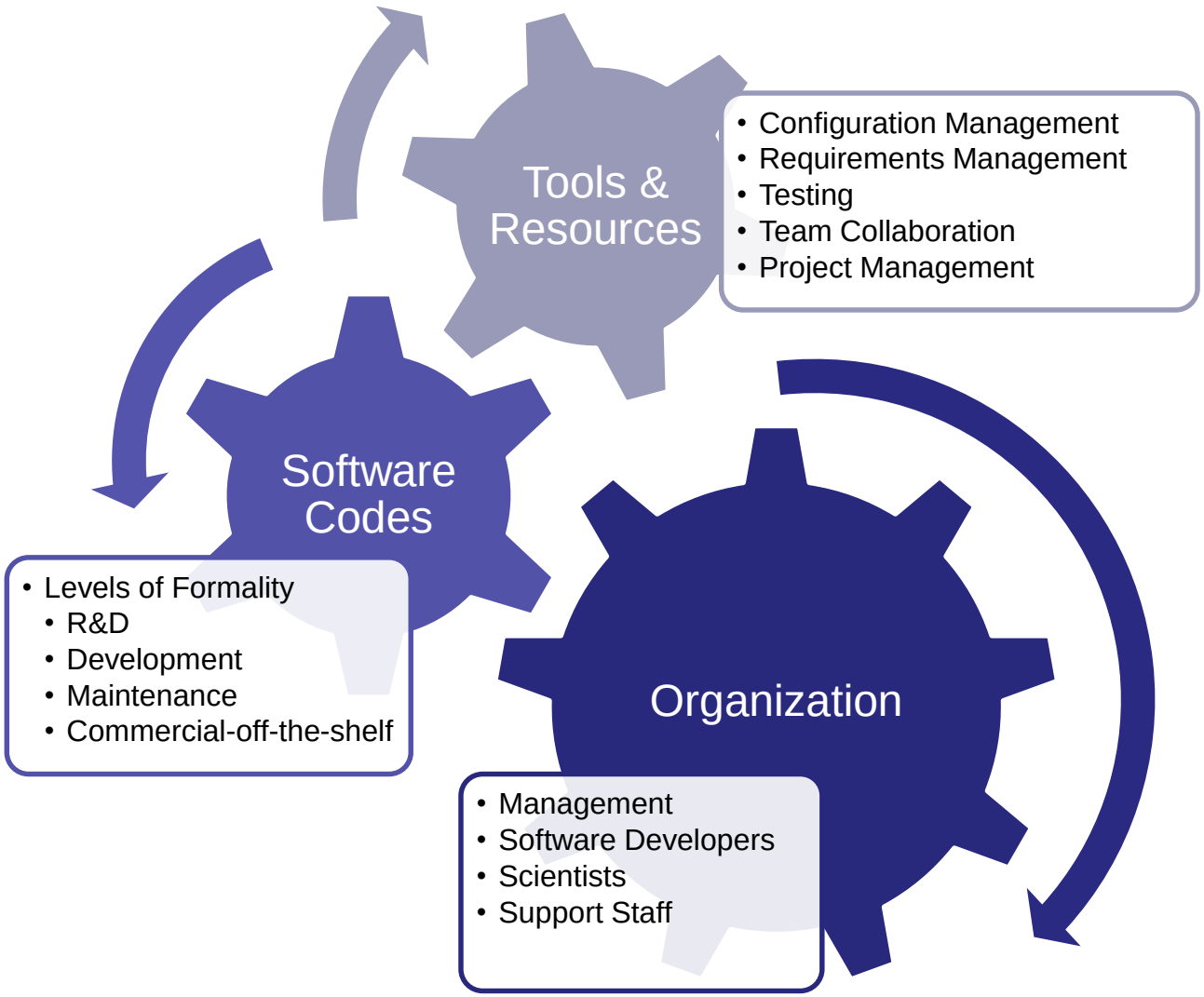
- Background
  - Software engineering
  - Software process improvement
  - Project management
  - Capability Maturity Model Integration (CMMI)
    - Appraisals (software & systems)
    - Implementation (software & systems)
  - Systems engineering
    - Model based systems engineering (MBSE) in non-traditional environments
  - Data analysis
    - Decision support
    - Impact analysis
    - Performance monitoring

Complexity

The state or quality of being intricate or complicated.

- For this presentation, we are focused on system complexity, not software complexity.



Managing the Complexity

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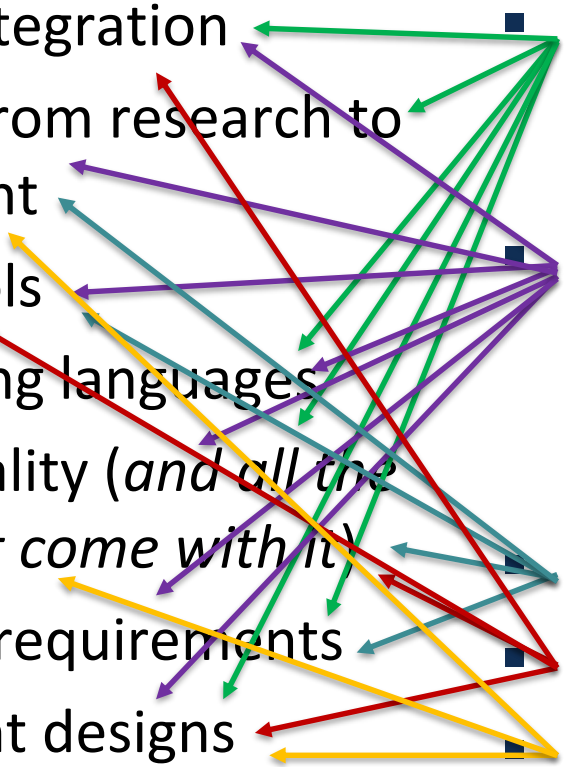
Product Issues

- Software integration
- Transition from research to development
- Support tools
- Programming languages
- Product quality (*and all the "ilities" that come with it*)
- Competing requirements
- Independent designs



People Issues

- Conflicting customer needs
  - Internal and external to the system
- Plethora of code teams
  - Experience levels
  - Funded from within and outside the system
- Multitude of managers
- Multiple physical locations
- Organizational structure changes

Complexity Management: "As-Is" State

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- Management Structure and Hierarchy
  - Software codes and teams are chunked into five different program elements
  - Program element management reports to a program director
- Dependence on Tribal Knowledge
- Meetings
  - Design Reviews
  - Peer Reviews
  - End-user Office Hours
- Agile Software Development Methods
- Support Tools

Complexity Management: "To-Be" State

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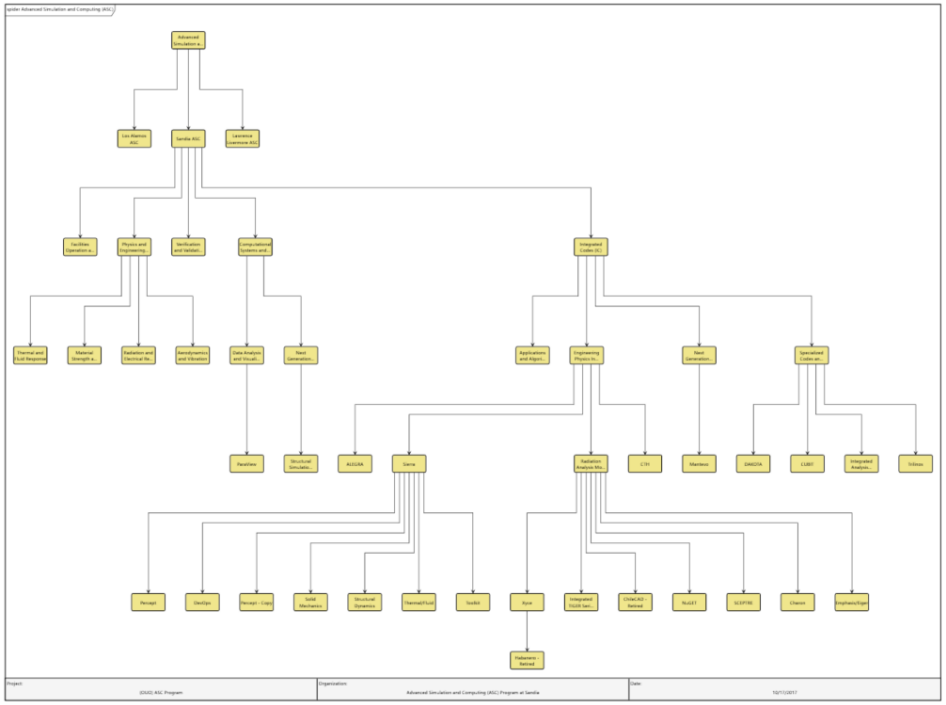
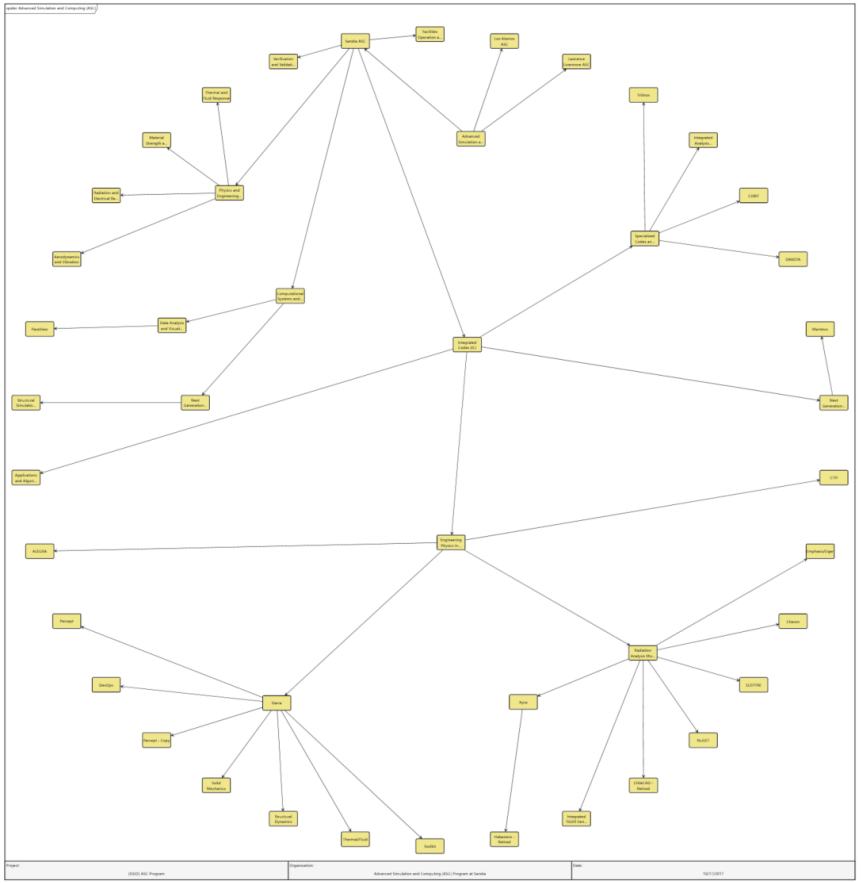
- Resilient Architecture for Migration and Sustainability of Software (RAMSS)
  - Use Model-based Systems Engineering (MBSE) to model the organizational system
    - Model people, software codes, interfaces, etc.
    - Use Vitech's GENESYS tool to manage the organizational model
  - Use outputs from the model to inform data visualizations
    - Support management decision and impact analyses
    - Provide situational awareness to clearly demonstrate the current environment so that changes impacting the future are based upon fact
    - Inform prioritization of software process improvement efforts
    - Use Tableau to develop dashboard visualizations that pull from the MBSE model

RAMSS Operational Architecture

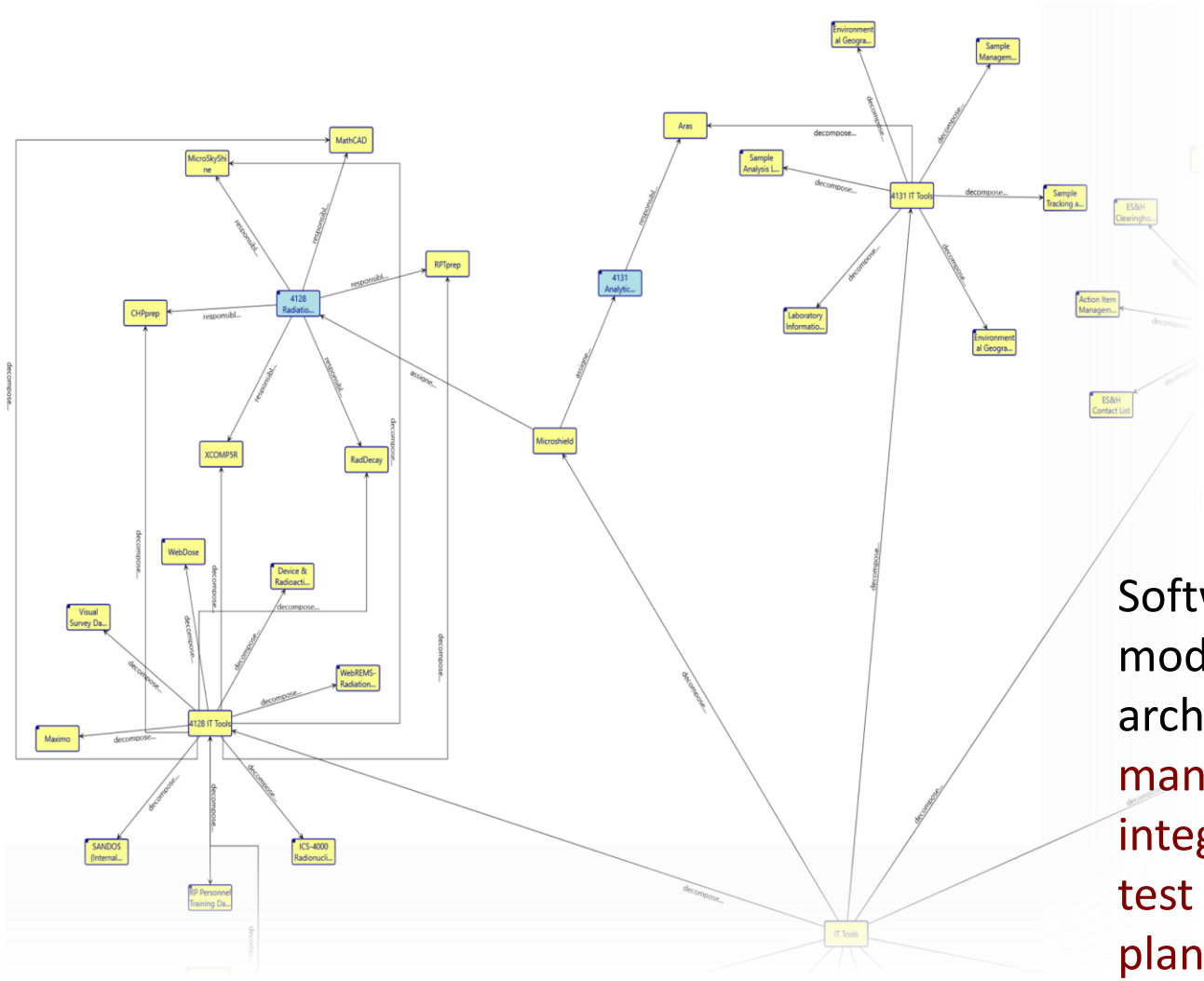


Different views of organizational structure provide insight into areas with more complexity.



Organizational models are part of the operational architecture and will be used to manage programmatic requirements, capabilities, and processes.

RAMSS System Architecture



A documented system architecture provides visual insight not available in the “As-Is” state.

Software components modeled within the system architecture will be used to manage software code integration and assimilation, test integration, and release planning.

RAMSS System Architecture Attributes

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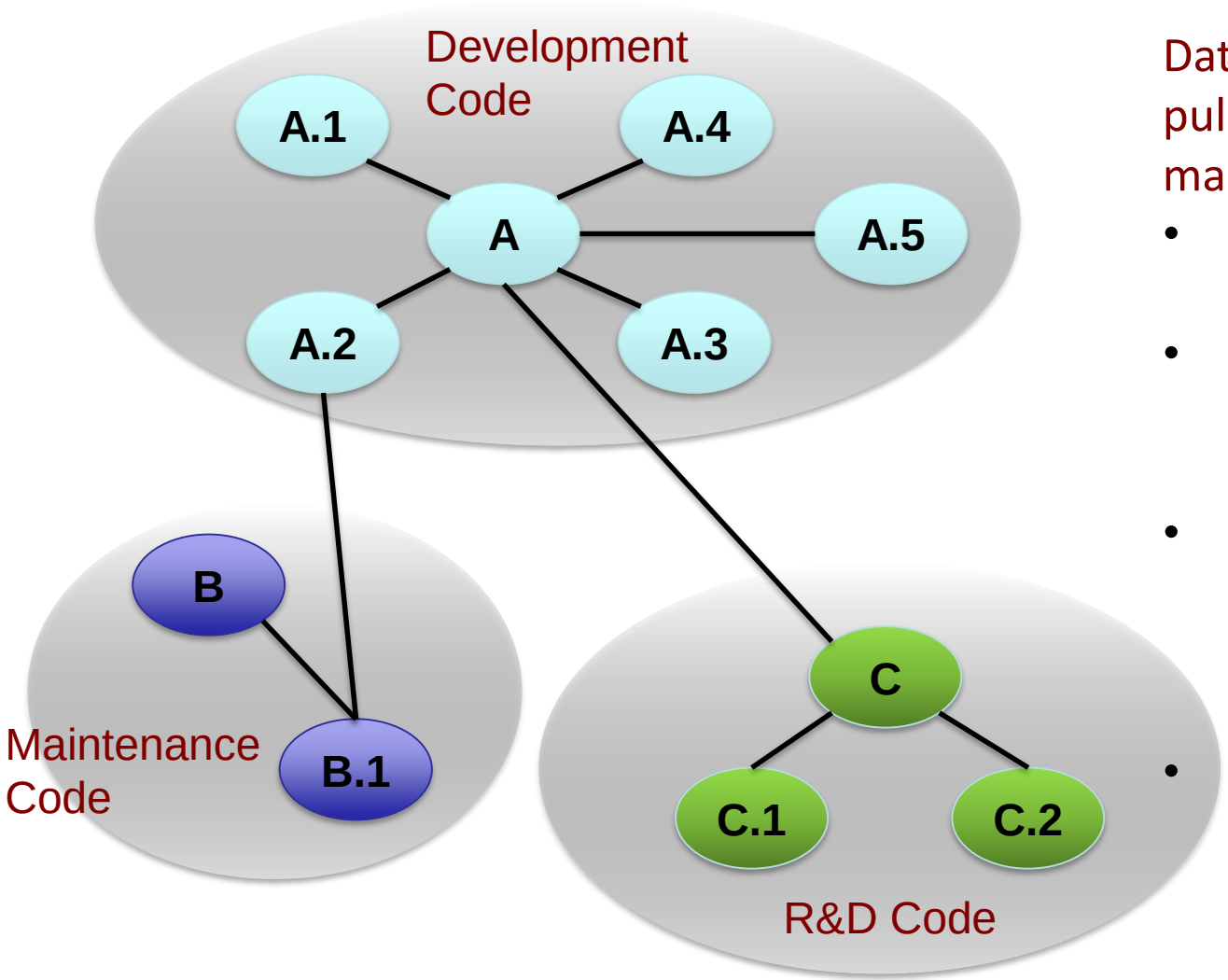
- Interfaces
- Assessment results
- Graded risk levels
- Code type (maintenance, development, R&D, COTS, etc.)
- Primary code uses
- Tools associated with code development
- Test methods and types
- Team leadership information
- Code development languages and environments
- More to be discovered…

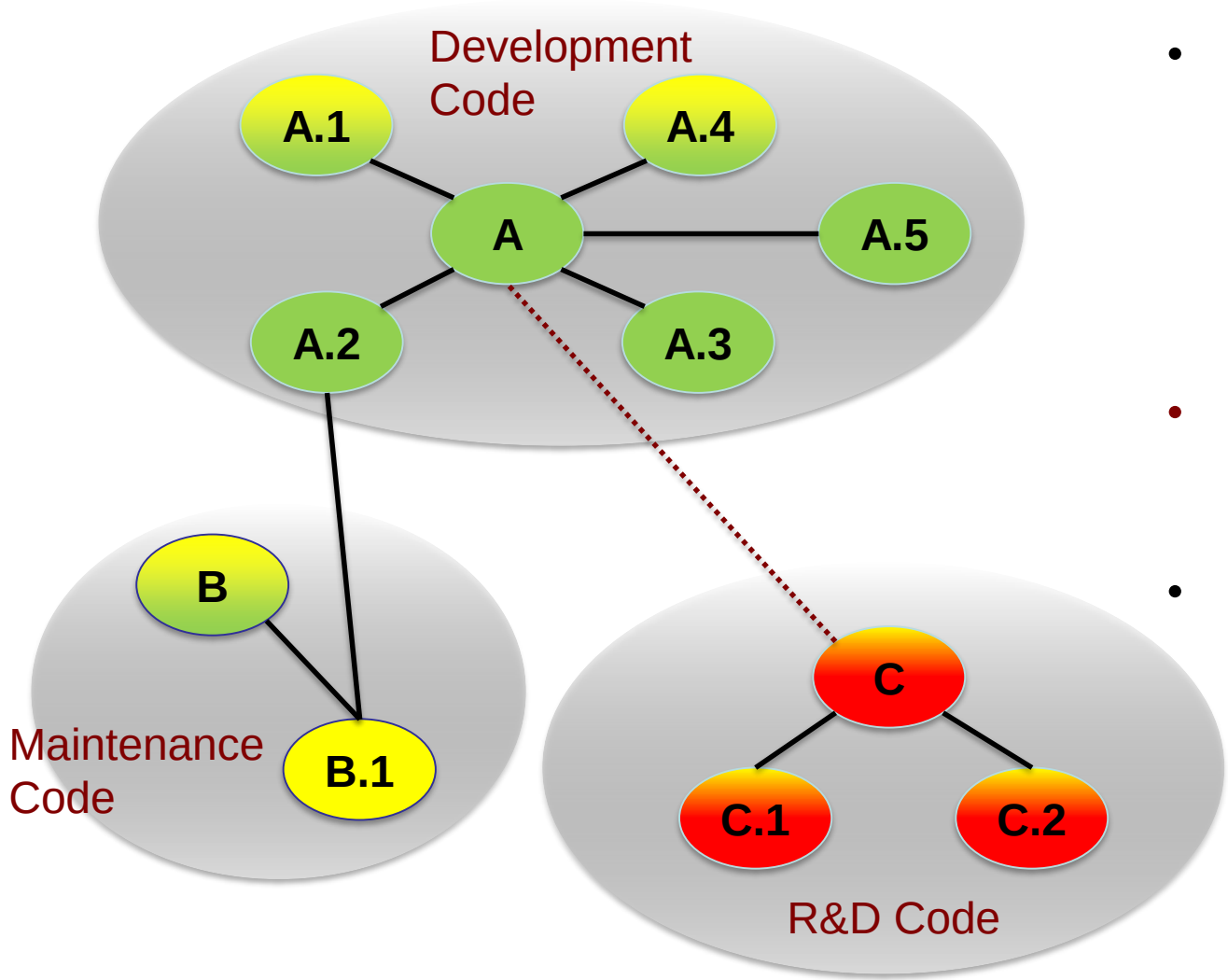
RAMSS Data Analytics



Data from the MBSE tool is pulled to inform management decisions.

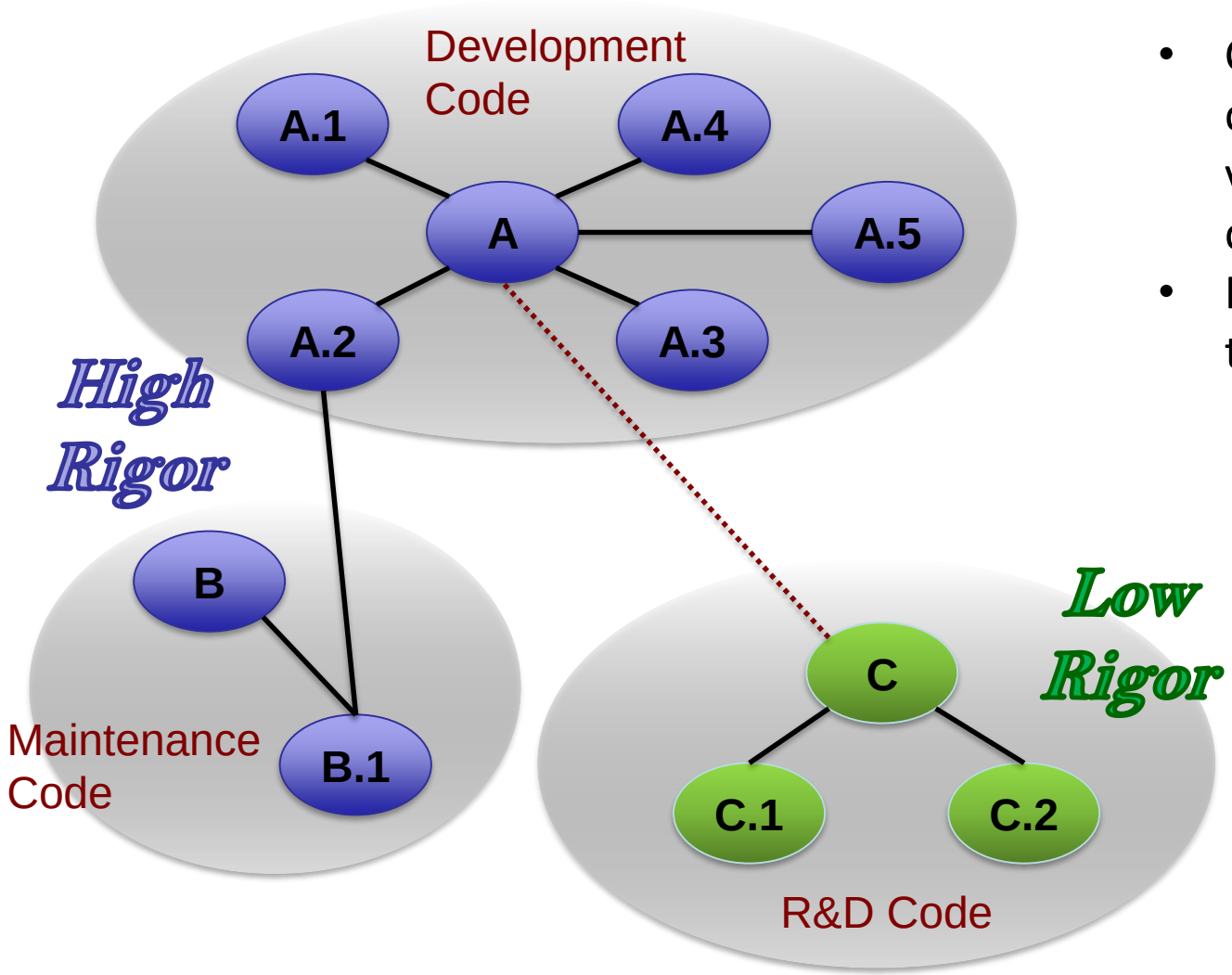
- Readiness of R&D codes for development
- Areas where cross-team integrated testing may benefit the product line
- Identification of areas where software development processes may need to be aligned
- Etc.

RAMSS Data Analytics - Transition



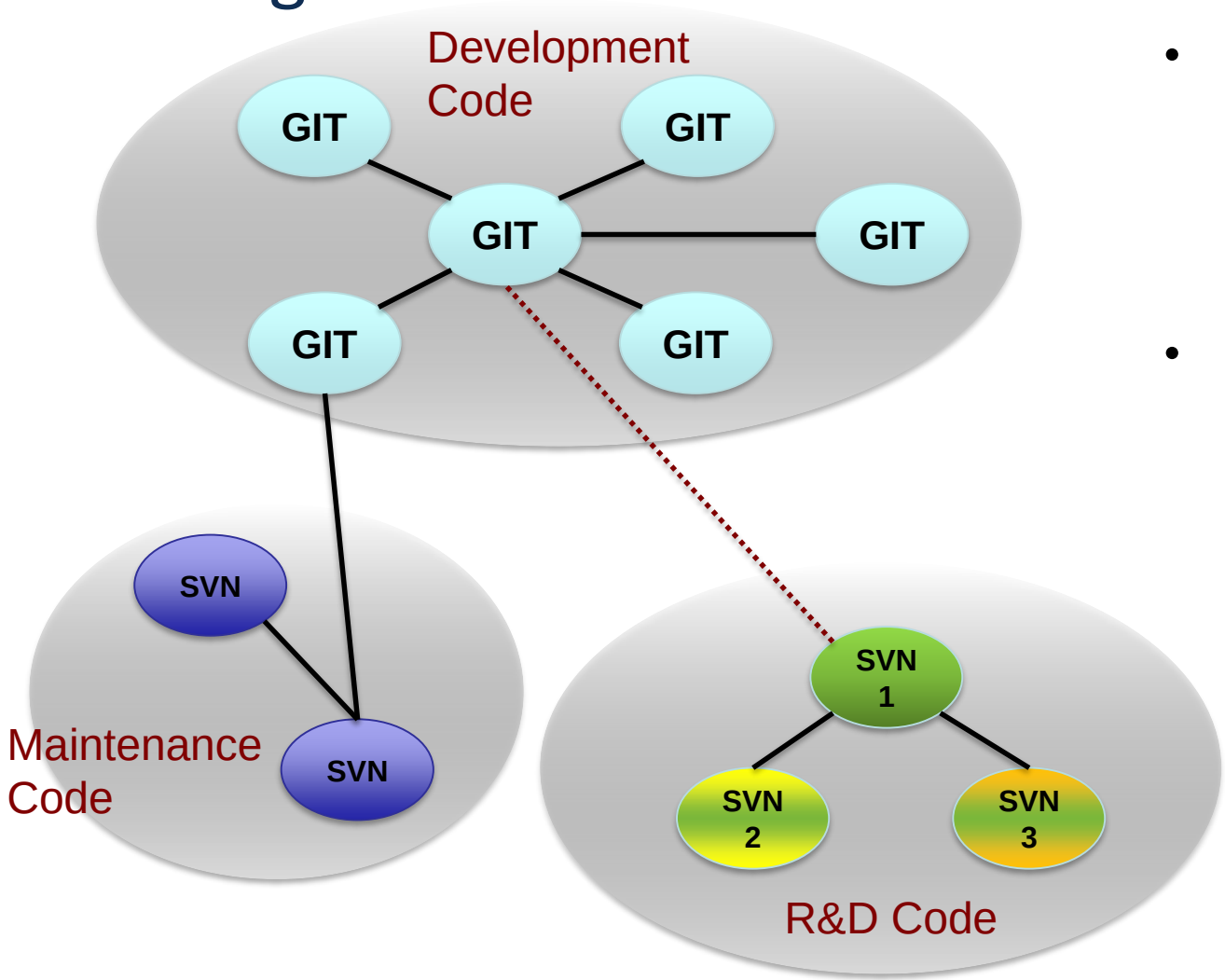
- Information pulled from the model provides insight needed for transitioning R&D code into a development environment.
- "Readiness" can be gathered from past assessment data.
- Risk management

RAMSS Data Analytics - Process



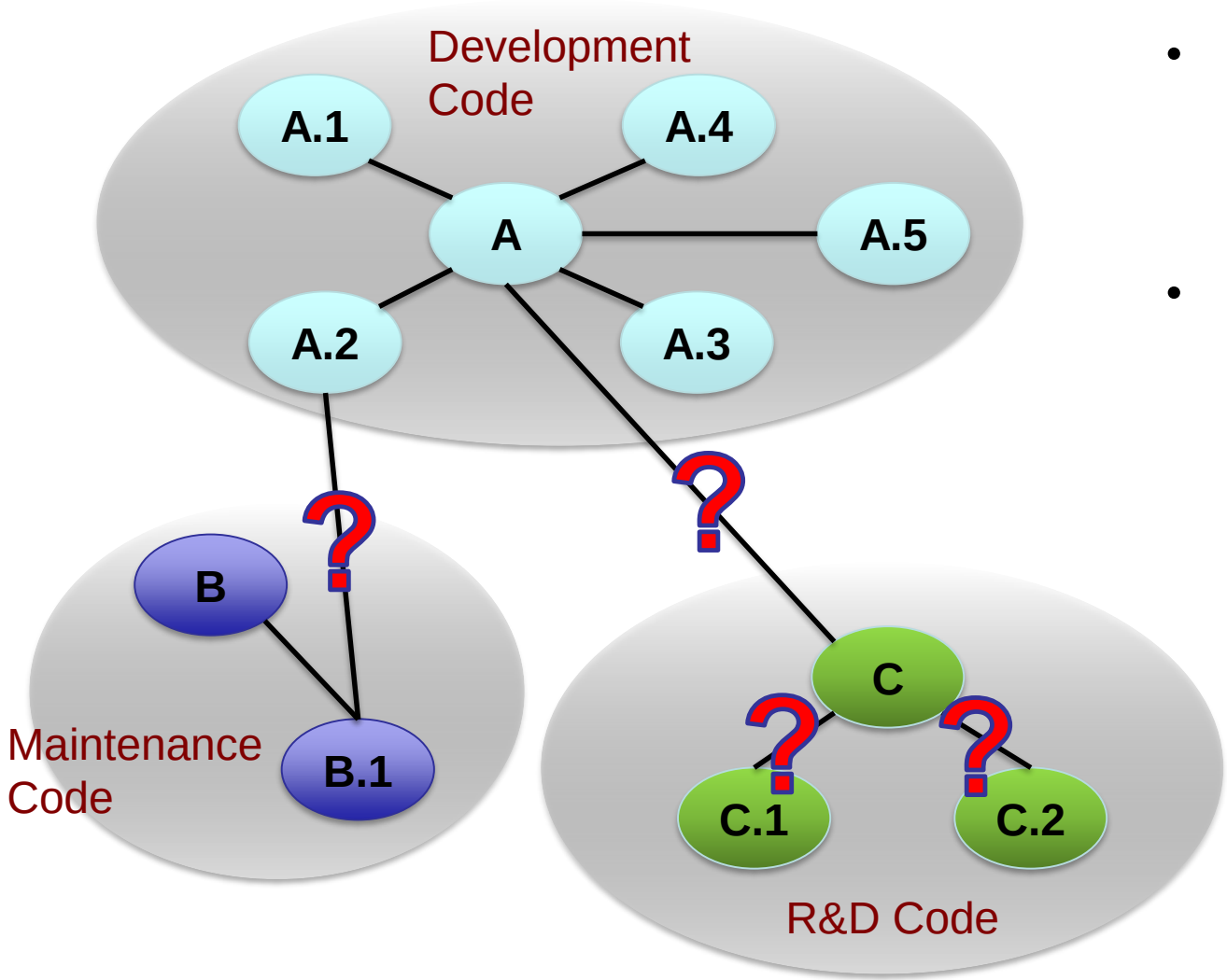
- Code team development processes vary based upon their development phase.
- Integration requires teams to align some:
  - Rigor levels
  - Processes
  - Tools

RAMSS Data Analytics – Configuration Management



- Configuration management influences code releases, code integrity, and code integration.
- When codes interface, configuration management decisions need to be made.

RAMSS Data Analytics - Testing



- Testing often creates bottlenecks with code integration and data transfer.
- Visualizations help understand where these bottlenecks occur and where to develop test strategies to avoid issues.

Comments & Questions

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