Information Modeling for Systems Integration

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Introduction

The Information Model presented was developed to provide an enterprise solution to information management. It provides a map to the application and integration of program and system elements. The model is tool independent, it provides a guide for modeling and simulation applications, tool capabilities, tailoring and deployment. Model elements and results embedded within the Information Model and tools are customized to automate the workflow defined in the model including the production of work products.

Following this modeling approach creates a daily work environment that facilitates integrated data development following preferred processes and reflecting modeling results in further proposals and products. Once the workflow and processes become an integral part of the data development it becomes easier to understand the impact of discoveries and changes on the program. This in turn supports ease of identifying solutions to integration and development problems. Ingenuity in design allowing program development to utilize existing structures in new ways is enabled through this approach.

In addition using an information model approach allows simultaneous “live” views of the data from different concerns including management and IPTs. The inclusion of program concerns such as Risk and Test gives a more complete response to problems and issues in those areas.
About Us

BBII provides experts in Systems Engineering and Architecture. The company has developed an Information Model approach to integrating program functions. Customers include Bombardier, Northrop Grumman, NASA, SAIC, Sikorsky, the State of Texas, ViaSat, and others. BBII has maintained partnerships with a variety of tool vendors. BBII can provide a team to identify the model, modify the tools, write instructions, mentor and train staff, develop data, provide systems engineers, systems architects and engineering support.

Claudia Rose is the president and creator of BBII, a Systems Engineering Consulting and Support Company. She has presented papers on Systems Engineering tools and processes at INCOSE, NDIA and AFCEA conferences and others. She has served on boards of directors in recent years that include INCOSE San Diego, NDIA small business forum, AUVSI and the La Jolla Cove Swim Club. She holds an MAIT (Master International Transactions) from George Mason University, with studies Tribhuvan University Kathmandu, and a BA from the University of Wisconsin-Madison. Her research has focused on bringing order out of chaos. She has worked as a consultant on Health and Development projects at The World Bank and USAID, presented papers on the health development policy process, created databases for canning companies and personal trainers, before bringing the special organization credo of BBII to the world of systems engineering.
Information Model Benefits

- **OPTIMAL DESIGN**
  - The information model facilitates a design where gaps in the satisfaction of operational needs drive an adaptive solution to reduce the gap
  - The information model facilitates the development of alternative approaches at higher levels, up to re-characterization of the operational needs, to allow an overall design solution which better satisfies the operational needs of the platform
  - Characterized by measures of effectivity

- **ENTERPRISE ARCHETECTURE**
  - Tie together stakeholders and represent their needs
  - Tie together System Elements
  - Integrate Management

- **WORKFLOW AUTOMATION**
  - Allows information to be viewed in its entire context
  - Work products including specifications and reports are produced as byproducts of the database
  - Collaboration is supported as part of the workflow

- **DESIGN ASSURANCE**
  - Disciplined Systems Engineering process
  - Validation
  - Verification
Why this Approach?

• Providing the best value solutions
• Use of modeling and tools that allow team members to collaboratively integrate their work with the entire program
• Collaborating to produce better options with existing resources
• Finding new ways to accomplish new objectives within existing framework
• Identifying and evaluating options throughout the program development process
• Re-characterize statements of need and higher level requirements to allow innovative and ingenious solutions
**DoD-AF**

- **AV-1 Overview and Summary Information**
- **OV-4 Operational / Command Vignettes**
- **Relationships Chart**
- **Trades To Model**
- **Functional Traces To Use Case**
- **Modifications**
- **Gov’t Use Cases**
- **50 External Data Structure**
- **Risk Mitigation Planning**
- **Issue**
- **Essential All AV-1 Information**
- **OV-6a Operational Description of emerging standards that are expected to apply to the given architecture, within an appropriate set of timeframes**
- **SV-10a System Information/Data Exchange Matrix**
- **OV-4a Operational Rules Model**
- **SV-10b Systems Operational Event-Trace Documentation of the data requirements and structural business process rules of the Operational View**
- **OV-7 Logical Data Model**
- **SV-10c System-specific refinements of critical sequences of events described in the operational view**
- **SV-2 Systems Component Architecture**
- **SV-3 Systems Functional Decomposition**
- **SV-4 Systems Functionality**
- **SV-5 Operational Technology**
- **OV-1 High-level Operational Concept Graph**
- **OV-4b Operational Event Trace Description**
- **SV-11 Physical Data Model**
- **SV-6 System Information Exchange Matrix**
- **SV-10b Systems Rules Model**
- **SV-10 System Technology Forecast**
- **SV-7 System Budgets**
- **SV-11 Physical System Interface Description**
- **SV-7 System Inheritance**
- **SV-2 System Design and Interface Hierarchy &**
- **SV-3 Systems Matrix**
- **SV-4 Systems Functional Traceability Matrix**
- **SV-5 Operational Information Exchange Matrix**
- **SV-1 System Interface Description**
- **SV-1 System Performance Parameter Matrix**
- **SV-3 System Technology Forecast**
- **SV-4 System Technology Forecast**
- **SV-3 Physical Model**
- **SV-11 Physical Test Plan**
- **SV-11 Physical Verification Results**
- **SV-11 Physical Management**
- **SV-11 Physical Work Breakdown Structure**
- **SV-11 Physical Work/Cost/Management Taxonomy**
- **SV-11 Physical Test Plan**
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- **SV-11 Physical Management**
- **SV-11 Physical Work Breakdown Structure**
- **SV-11 Physical Work/Cost/Management Taxonomy**
Information Model (Sources)

- Primary Source Document
- Knowledge Experiences
- Via Interviews
- Standards, Specifications & Policies
- Work Breakdown Structure
- Work/Cost/Management Taxonomy
- Best Practices
- Customer Use Cases
- A Day in the Life
- Design Software Architecture
  (See Additional Chart)

- System View
  - Information Exchange
  - R Interface
  - Component Architecture
  - Interface Hierarchy & ICD Document Structure

- Management View
  - Included Requirements
  - Performance Models
  - Executable Models

- Project View
  - Operational View
  - Financial View
  - Work Breakdown Structure

- ICD Document Structure
  - Proposal
  - Design
  - Software
  - Architecture
  - Risk Mitigation Planning

- View
  - System
  - Operational
  - Design

- Risk
  - Risk Mitigation Planning
  - Risk Analysis

- Models
  - Models
  - Software
  - Requirements
  - Design

- Usage
  - Customer Use Cases
  - Best Practices

- Modeling
  - Use Cases
  - Operational Use Cases
  - Proposals

- Test
  - Test Plan
  - Test Case

- Risk
  - Risk Mitigation Planning
  - Risk Analysis

- Presentations
  - A Day in the Life
  - TACSITS
  - OPSITS

- Risk
  - Risk Mitigation Planning
  - Risk Analysis

- Work Breakdown Structure
  - Work/Cost/Management Taxonomy

- Design Software Architecture
  (See Additional Chart)
**Management View and Standards**

- **TV-2 Standards Technology Forecast**
  Description of emerging standards that are expected to apply to the given architecture, within an appropriate set of timeframes.

- **TV-11010 10 Technical Architecture Profile**
  Extraction of standards that apply to the given architecture.

**Standards, Specifications & Policies**

**Work Breakdown Structure**
- **Generates**
  - System Spec
  - Segment Specs
  - Detailed Task Des.

**Taxonomy**
- **Generates**
  - Work/Cost/Management
  - Standards, Specifications & Policies
System View

MODELS
- Functional Flow Block Diagrams
- Use Cases
- Activity Diagrams
- Sequence Diagrams
- State Diagrams
- Performance Models
- Executable Models

Diagram View
- Trade Studies

Function Performed By
- Software Requirement Specification

Functional Decomposition
- System View
- Component Architecture

Interface Hierarchy & ICD Document Structure

ICD Document Tree
- Design Software Architecture

Symbolic references

Generates
- Symbolic references

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Operational View
Decomposition OV examples

OV-1 High-level Operational Concept Graphic
High-level graphical description of operational concept (high-level organizations, missions, geographic configuration, connectivity, etc.)

OV-2 Operational Node Connectivity Description
Operational nodes, activities performed at each node, connectivity and information flow between nodes

OV-3 Operational Information Exchange Matrix
Information exchanged between nodes and the relevant attributes of that exchange such as media, quality, quantity, and the level of interoperability required

OV-4 Operational Activity Model
Activities, relationships among activities, I/Os, constraints (e.g., Policy, guidance), and mechanisms that perform those activities. In addition to showing mechanisms, overlays can show other pertinent information.

OV-5 Operational Activity Model
Documentation of the data requirements and structural business process rules of the Operational View

OV-6 Logical Data Model

Behavioral Spec
Service Architecture
Component Architecture

- **SV-1 System Interface Description**
  - Identification of systems and system components and their interfaces, within and between nodes.

- **SV-2 Systems Communications Description**
  - Physical nodes and their related communications laydowns.

- **SV-3 Systems Matrix**
  - Relationships among systems in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs existing interfaces, etc.

- **SV-4 Component Architecture**
  - Component Architecture

- **SV-5 Trade Studies**
  - Trade Studies

- **SV-6 System Information Exchange Matrix**
  - Detailing of information exchanges among system elements, applications and H/W allocated to system elements.

- **SV-7 System Performance Parameter Matrix**
  - Performance characteristics of each system(s) hardware and software elements, for the appropriate timeframe(s).

- **SV-8 Legacy**
  - Legacy

- **SV-9 Mars Lander**
  - Mars Lander

- **SV-10 Interface Hierarchy & ICD Document Structure**
  - ICD Document Tree

- **SV-11 Physical Data Model**
  - Physical implementation of the information of the Logical Data Model, e.g., message formats, file structures, physical schema.

- **SV-12 Report History Script**
  - Symbolic references generates

- **SV-13 Release Report**
  - Interface Hierarchy & ICD Document Structure
SV-8  System Evolution Description
Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current system to a future implementation.

SV-9  System Technology Forecast
Emerging Technologies and software/hardware products that are expected to be available in a given set of timeframes, and that
Keys to Successful Information Model Implementation.

- Reuse of (tailored) tools and models for each deployment
- Understanding the impact of changes on the entire program
- Processes which facilitate innovative changes
- Integrated work environment
- Ability to translate change at one level to changes at all levels within the WBS
- Understanding what needs to happen (Operational Requirements)
- Identification of gaps between operational needs and selected approach
- Value system to support focus on narrowing gaps with most impact
- Infrastructure which encourages and supports alternative approaches which can better satisfy higher level needs
- Infrastructure which supports rapid evaluation of the value and impact of alternative approaches
- Thinking outside the scope of current solutions
Support Structure

• Integrated Information Model to facilitate common understanding and collaborative work environment
• Operational Requirements
  – Operational models
  – Flexibility to restate operational models and capabilities to meet original objectives with alternative approaches
  – Ability to recognize the value of enhanced or new capabilities
• Linkage of operational needs to design requirements
• Operational models
  – Facilitate understanding of needs
  – Organize information
• System and design models
  – Facilitate understanding of system and design
  – Organize information
• Continuous validation
• Measures of Effectivity and a Value System
• Best Practices
• Lessons Learned
Validate Requirements to Satisfy Operational Needs

- Validation is a continuous ongoing process to make sure the right thing is being done.

- Capturing Satisfaction Arguments as the analysis, decomposition and design proceeds identifies gaps early at a time they can be more easily resolved.

- Measures of effectivity can be integrated with satisfaction arguments.

- Formal Validation will tie together elements of the Information Model to validate that the operational needs are satisfied.
Conclusion

An Information Model based approach supports an optimal design enhancing program capabilities. It drives a collaborative work environment reducing rework, revealing issues and supporting needed changes in an efficient manner.

The Information Model approach provides a roadmap for enterprise development through integration of corporate knowledge and experience. It supports the information maturity processes through their integration in elements of daily workflow. It reduces rework in preparation of work products and in the work process.

Models are key to both characterizing System Performance and relating this to the operational needs through the measures of effectivity.