An Automated Decision Support System to Assist with Project Planning, Program Management and Work Flow Analysis of an Enterprise

NBS Enterprises Competition Sensitive

Natasha J. Schebella / CEO & Owner
703-851-0233
nschebella@nbsenterprise.com

Gary S. Schebella / Chief Scientist
703-999-1849
garyschebella@nbsenterprise.com

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1.0 Introduction

In view of budget cuts and sequestration, Government agencies are in the process of assessing their overall program plans and project priorities. The process requires the associations of numerous dashboards which delineate topics such as schedules, costs, risk, resources, contracts and personnel. Manual procedures and limited decision making software are employed to associate the disparate data sources. Even so, additional decision support capabilities, not currently available for assessment efforts, are desirable to provide management courses of action automatically and to prioritization projects without disrupting current procedures.

NBS Enterprises (NBS) is foremost in the development of scheduling and management decision aids. For example, if a new project is proposed as an addition to an agency program and no additional funding is available, a manager is interested in the project impact upon schedule, priorities and risk. Answers to this query, by a staff operating without automated decision support, require several days. Similar procedures apply to the elimination of projects that exceed budget constraints.

Once data are available, the NBS decision support system (DSS) associates the dashboards and provides answers within hours or minutes. Further, NBS has developed a set of optimization algorithms, premises upon the Lean Methodology that assist with planning, forecasting and prioritization.

Applications of the NBS management software address the issues of sequestration, budget constraints and work flow, as well as the monitoring of project progress:

1) Domain specific user interface showing dashboards and optimization results
2) Association of dashboards into a comprehensive optimization model
3) Integration capability with domain data and the World Wide Web
4) Continual quantitative assessment of ongoing projects
5) Optimal addition and removal of projects in response to overall program objectives
6) Optimal partial reduction of project resources which minimize schedule slippage
7) Work load balancing in response to priorities and personnel skill levels
8) Value analysis and forecasting
9) Response to queries.

Because the algorithms are fully developed, their applications produce great savings in costs and assessment times necessary for planning without the necessity of research and development.

2.0 System Processing and Data Flow

Big data are a primary component of the NBS paradigm for project planning and program management.

Data of various types in the form of video, text and numbers are collected and transformed to a format that the NBS tool suite is able to process.

The tool suite produces a model that replicates a physical system in mathematical terms. By exercising the model, performance statistics are generated (how well does a system work?). The model also optimizes a system (How things can be made better). As new data are generated, the system learns and continually provides answers to queries. The process differs in that it is able to measure performance and to optimize simultaneously, it also provides forecasting of what courses of action are required now and in the future. As long as data are input, processing never stops.

Each flow of unstructured data is transformed into a format that is compatible with a common representation scheme. A separate, structured database is composed for each data stream and is given the characteristics of metadata. Metadata are data about data. They assist with the transformation of asynchronous data inputs to model inputs. A metadata element comprises a unique set of rules creating associations for any asynchronous event of significance. The associations are produced in a continuous mode. Once new associations become available, dependencies with other associations are identified, as well as timing statistics: means and variances for event completions. The associations are first represented as a semantic net and then inserted into a quantitative context model which represents an entire scenario of interest: assets, timelines, and dependencies. The context model is exercised producing performance statistics and impact analysis. In addition to a general context, optimization algorithms are appended. The additions address specific issues such as scheduling and project management. Based upon the results of analysis and optimization, a course of action, with a rationale for selection, is presented for consideration to a decision maker.

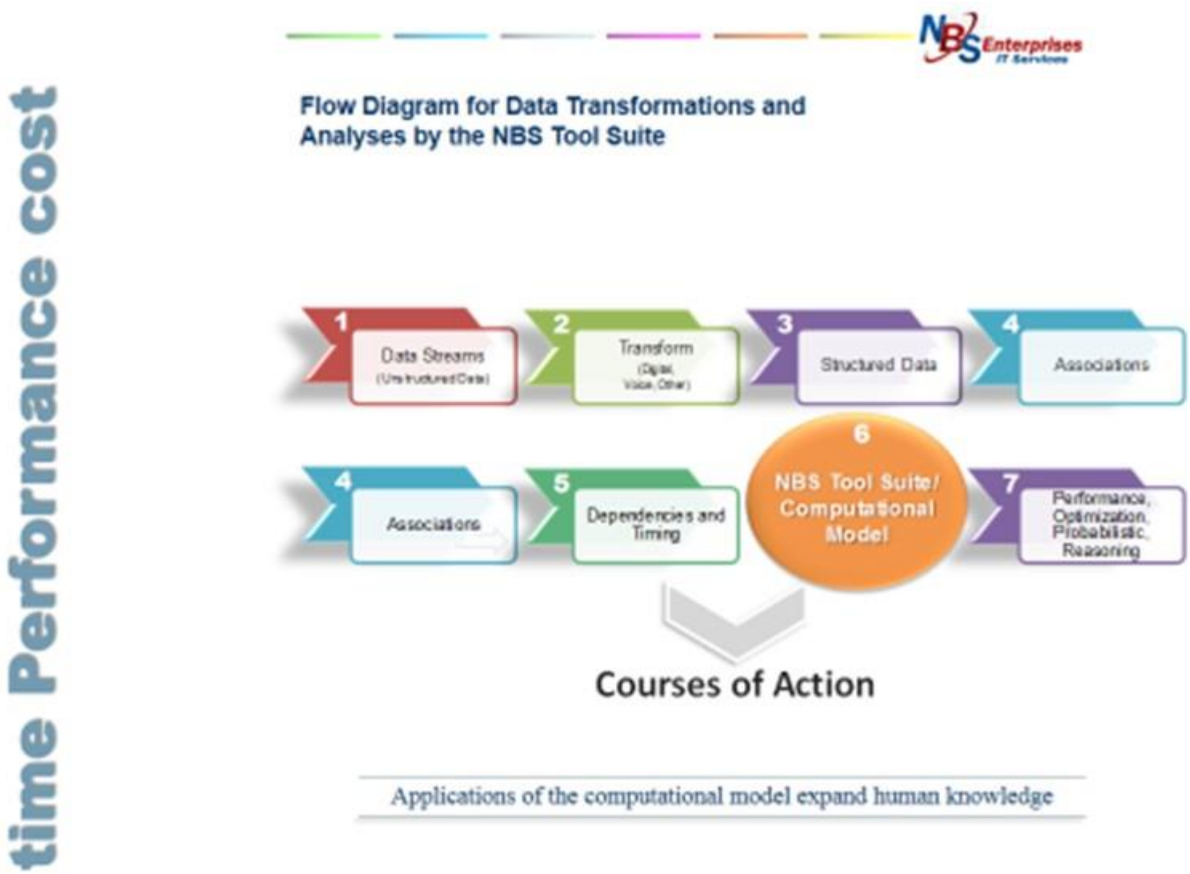


Exhibit 1: Transformation of data to models

3.0 Concept of Operations

Concept of operation for both project management and work assignments are outlined below. A context model is prepared for an enterprise. Many facets might be included in the context model such as resources, contracts and schedule, as well as technologies and costs. A data extractor transitions disparate data to structured databases while domain specific metadata (business rules) interface with each database. Given that a new set of data is obtained, which represents a program change; associations are formed within the appropriate metadata and mapped to the context model. The context model is expanded to include the additional information and is exercised to display the impact of the change. For the case of work assignments, the context model is exercised to produce an optimal allocation of workers to jobs.

The entire NBS approach to management is premised upon the Lean Methodology. Rather than simply identifying dashboards and probable issues, procedures are restructured to do more with less. Lean encapsulates several enterprise enhancements:

1) Continuous learning and everyday improvement.
2) Reduced variation and the elimination of waste.
3) Long term approach.
4) Improved value not just locally, but globally.
5) Provision of what is needed at the right time.
6) Focus not just on results, but how results are achieved.
7) Continuous enhancement and value add for an enterprise.

3.1 Project Planning

A scenario for project planning is presented whereby a manager requests an answer to a program issue, which must be addressed by the staff.

1) Program Manager issues a request (e.g., what is the status of each project contained in the overall program?).
2) Identify all relevant data from disparate sources (resources, contracts, schedule).
3) Establish the requirements of each project,
4) Review the contents of dashboards and define requirements for each project (e.g., costs, schedule, resources, risks, personnel, dependencies).
5) Apply metadata to develop associations of the dashboards: if-then-else, distribution functions for project timelines).
6) Insert the associations into a context model of the entire program: position each project within the context model.
7) Develop and retrieve relationships for all contracts: e.g., change in a project schedule when personnel are extracted or resources are delayed, cost of contract changes.
8) Impose all constraints: e.g., some contracts cannot be changed.
9) Define a measure of effectiveness (MOE): e.g., schedule delay, program cost, risk.
10) Exercise the context model using a simulation tool (GPPS) to assess program performance with variable risk factors.
11) Quantify all project factors such as funds expended versus work completed.
12) Isolate problem areas: e.g., no resources available, explosive cost overrun, unacceptable schedule delay.
13) Conduct trade off, sensitivity and impact analysis.
14) Report recommended course of action with supporting analyses to the Program Manager.

3.2 Program Management

A scenario for project management is presented whereby a manager requests an answer to a program issue, which must be addressed by the staff.

1) Program Manager issues a request (e.g., what is the impact on the enterprise program for the addition of a new project without the availability of new resources?).
2) Identify all relevant data from disparate sources (resources, contracts, schedule).
3) Extract and display relevant data,
4) Transition relevant data to metadata format (dependencies on existing projects, resources, and contract timelines).
5) Define the requirements for the new project: e.g., personnel, resources, dependencies, desired time of completion).
6) Apply metadata to develop associations: if-then-else, distribution functions for the new project timelines).
7) Insert the associations into a context model of the entire program: position the new project within the context model.
8) Develop and retrieve relationships for all contracts: e.g., change in a project schedule when personnel are extracted or resources are delayed, cost of contract changes.
9) Impose all constraints: e.g., some contracts cannot be changed.
10) Define a measure of effectiveness (MOE): e.g., schedule delay, program cost, risk.
11) Exercise the context model using a simulation tool (GPPS) to assess program performance with and without proposed project insertion.
12) Optimize the enterprise program, using GPPS, in response to the desired MOE: minimize the impact of switching resources from existing contracts to the new project.
13) Isolate problem areas: e.g., no resources available, explosive cost overrun, unacceptable schedule delay.
14) Using GPPS, conduct trade off, sensitivity and impact analysis.
15) Report recommended course of action with supporting analyses to the Program Manager.
16) Project deletions are addressed using procedures similar to those noted above.

3.3 Work Flow Analysis

1) Program Manager issues a request (e.g., How should available labor teams be allocated to jobs so that overall performance of an enterprise is maximized?).
2) Identify all relevant data from disparate sources (resources, jobs, schedule, priorities,
    a. And costs).
3) Extract and display relevant data.
4) Transition relevant data to metadata format (labor skill levels, team size, individuals required for special cases).
5) Define partial projects: (Job can be completed with a subset of workers).
6) Identify project timelines and constraints.

7) Insert job's resource and personnel requirements into a context model of the entire program.
8) Develop and retrieve relationships for all jobs: e.g., change in a project schedule when personnel are extracted or resources are delayed, cost of contract changes.
9) Impose all constraints: e.g., some job allocations cannot be modified.
10) Define a measure of effectiveness (MOE): e.g., schedule delay, program cost, risk.
11) Exercise the context model using the JMS scheduling tool to maximize program performance.
12) Optimize job allocations on a daily basis in response to the desired MOE.
13) Isolate problem areas: e.g., no resources available, explosive cost overrun, unacceptable schedule delay.
14) Conduct trade off, sensitivity and impact analysis.
15) Report recommended course of action with supporting analyses to the Program Manager.

3.4 Algorithm Examples

Examples of computational algorithms in the NBS tool suite:

First algorithm purpose: Transition project dashboards and Gant chart information from a COTS project management software tool to an integrated model that computes all costs, schedule and risk factors interactively. Use the Lean methodology to optimize project utilities.

Second algorithm purpose: Remove entire project(s) in order to meet a required cost reduction:

After receiving descriptions of projects from Microsoft Project, impact of removal is computed for each project .Projects with a least value of priorities are removed until required cost reduction is obtained. Priorities can be modified by program personnel.

Third algorithm purpose: Instead of entire projects being removed, portions of projects are selected and removed. Options are selected which fulfill required cost reduction while minimizing the schedule slip, risk or some other measure of effectiveness (MOE). Again, schedule slips or risks are computed after receiving project definitions from Microsoft Project. Cost reductions for an option are calculated by summing the reductions for resource removal and the cost increase incurred because of an extended schedule.

Forth algorithm purpose: Workers are not assigned correctly. There are enough workers or resources available to fill every slot so priorities need not be considered. Workers or resources are allocated so all projects are satisfied.

Fifth algorithm purpose: Workers or resources are not assigned correctly. There are fewer workers or resources available than required so priorities are considered. Reallocation is made so program achievement is maximized.

Sixth algorithm purpose: Workers are allocated optimally as a function of skill levels. There are less actual workers than required for each skill so priorities are considered. Allocations are made in response to a selected measure of effectiveness: e.g., project slippage, risk, cost.

Seventh algorithm purpose: Issues of cost, risk and schedule slip are addressed singularly as well as the association of all three. No skill levels are considered.

Instead of project priority, one of the three is first selected for minimization. Then the three are associated for a composite optimization.

The emphasis given to cost, risk and schedule add up to one (1). The emphasis is specified by program personnel or computed using Microsoft Project inputs. The associations reduce the futility of dashboard analysis.

4.0 Benefits of Automated Decision Support

The benefits of the NBS decision support system are:

1) Automated processing and association of disparate data sources.
2) Rapid response to queries
3) Courses of action on a daily basis
4) Impact analysis, risk assessment, prioritization
5) Analytical forecasting

Appendix A: Corporate Background

NBS Philosophy and Expertise

Political and positional success is directly tied to leadership's ability to lead their organizations, to identify and capture 'at hand' efficiencies, make sound/pragmatic resources optimization decisions, and then continually drive tangible 'continuous process improvements'. Both novel and noble objectives, which are absolutely essential in today's economic reality.

NBS Enterprises has the right Enterprise Resource Optimization (ERO) model and enabling algorithmic toolkit to empower senior executives with the insight necessary to identify and execute the best course of action for their organization. The NBS tool suite is known as Time-Lives-Cost (TLC). We are ready to help senior executives who are addressing a mandate to capture cost savings and efficiencies across their operations.

History

NBS Enterprises (NBS) is a woman owned small business founded in 2005 by Natasha Schebella..

We have capabilities and experience in three major areas: 1) Decision Support, 2) Information Technology (IT) Solutions and Services and 3) Staffing Services. NBS has personnel that routinely deliver in adverse environments both in the US and abroad, all focused on serving the same mission: the advancement and security of the United States.

NBS possesses exceptional talent in the management and technical administration of global requirements for the Department of Defense and numerous commercial businesses. The experience that NBS has gained through programs with customers include the Defense Threat Reduction Agency (DTRA), the Office of Naval Research (ONR), the Department of State and the Diplomatic Telecommunications Service – Program Office (DTS-PO), and the Washington Metro Transportation Services, which enables us to skillfully and efficiently coordinate and execute complex planning and decision support.

Decision Support

NBS has developed logistics decision support algorithms for the Marine Corps, Navy and the Coast Guard. We have also developed optimal assignment for Hospice organizations, matching personnel and resources with patient requests. Based upon our understanding of logistics distribution and the routing of transportation vehicles, we have developed a full compendium of algorithms that provide courses of action for management, communications systems, and the design of sensor exploitation systems. We have also conducted studies and analysis of weapons of mass destruction and have devised exploitation systems that assist in the denial of terrorist threats.

IT Solutions and Services

NBS has been serving the Intelligence, DoD and Civilian Communities for 9 years. We have successfully delivered solutions in the areas of Information Assurance (IA), Enterprise Architecture, IT Transformation and Modernization, ITIL, Risk Management, Data Center transformation modernization, Security Assessments and Design, cloud environments, Human

Resources, and Logistics and Mission support. We specialize in delivering exceptional results on projects with our trained, certified and cleared staff in the most widely used technologies.

Staffing Services

NBS provides direct staffing, temporary to permanent staffing, and temporary staffing in the intelligence, DoD and civilian communities, specializing in information technology and information assurance. The personnel include individuals with top-level clearances and experience. NBS also provides skilled individuals for accounting and financial services, as wells as program and administrative support. We have a reputation for responding rapidly to meet our customer needs.

Appendix B: Approach to Solutions

We 1) review and document the specifics of customer operations, 2) conduct simulations, modeling and optimizations to provide performance statistics of current operations, 3) assess new concepts and technologies and assist with the transition from the current simulation developments system to a "to-be" environment, and 4) develop a decision support system (DSS) that will optimize total systems operations. We accomplish the following:

Review of Current Operations and Data

We review documents, data and projects. We identify information sources and interpret formats, data fields and content of all data files.

Architectural Analysis

We evaluate information processes, review operations and facilities, interview personnel and contractors to acquire an understanding of the current environment.

Metrics and Measures of Effectiveness

Metrics are obtained from a customer or developed by JMS which reflect what is to be measured during project evaluations or work assignments. If metrics appear to be incomplete, additional metrics and measures of effectiveness are defined.

Requirements Analysis

Based upon metrics, MOE definitions and customer interviews, a set of requirements is defined. The requirements indicate the types of information that are most useful to a customer and the development of decision support and value analysis.

Data Structures

Customer data are selected for appropriate input for optimization and analysis. Using a set of ontologies (business rules), each dashboard is structured into data formats which are compatible for input to the NBS project management and assignment tool suites.

Algorithm Refinement

Although a comprehensive set of algorithms exist for applications of value analysis, issues related to domain specific metrics and requirements are considered. Any enhancements required for the NBS tool suite are provided so that specified requirements are fulfilled.

Incremental Analysis

Because all projects are not interrelated, the entire spectrum of simulation efforts is partitioned. Each partition is assessed separately and value analysis is developed incrementally.

Decision Support System

An assessment of projects, their enterprise values and the impact of change with respect to program performance, cost, risk and schedule slip is provided by NBS. For assignments, an optimized set of labor teams to work requirements is provided.

Reporting

NBS provides briefings of results as requested by a customer. At the conclusion of the effort, a final report and a consolidated briefing is delivered.

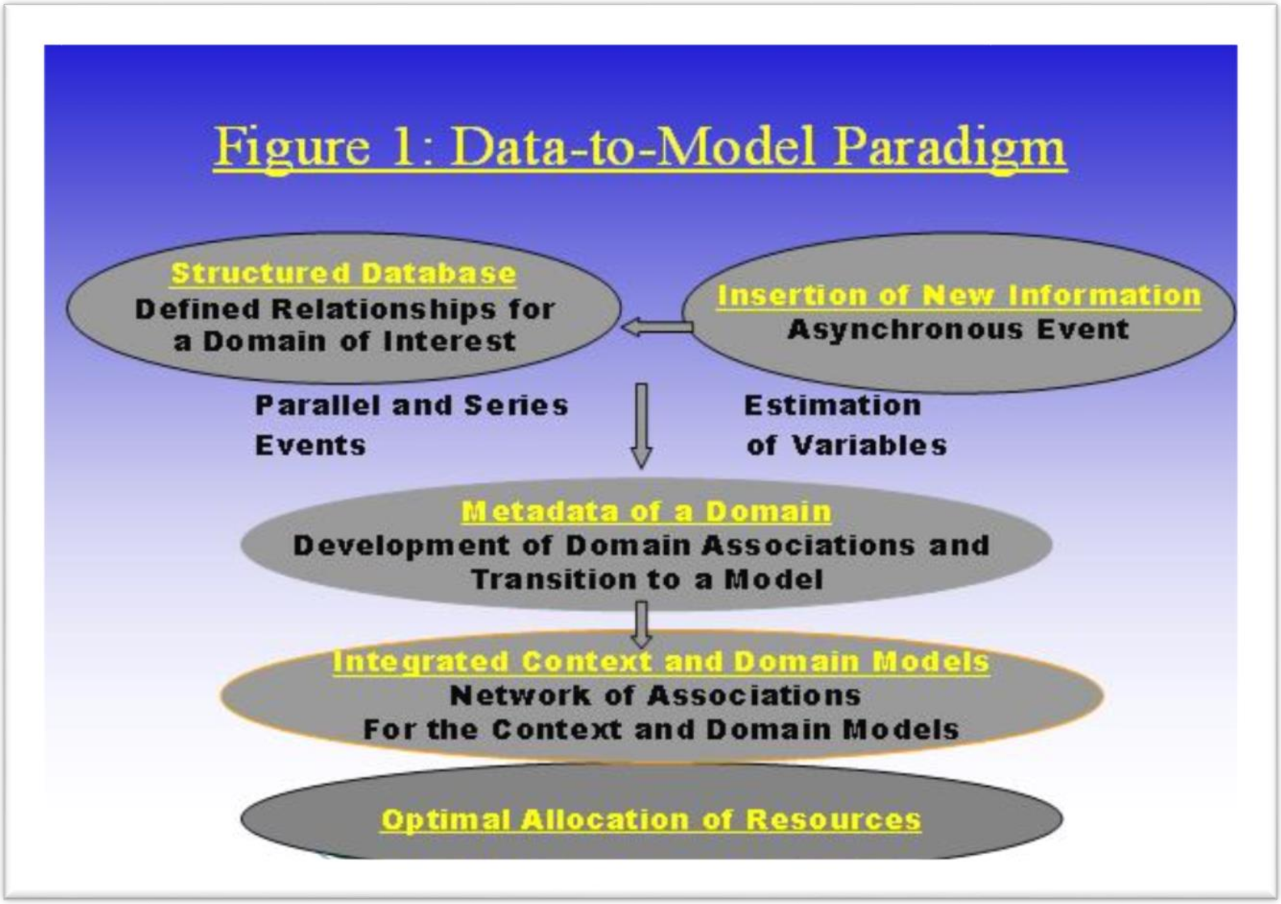
Appendix C: Concept of Operations

NBS Tool Suite Capabilities

The NBS Enterprises (NBS) software tool suite provides a decision support system (DSS) that improves the effectiveness of program managers by associating multiple variables and developing courses of action automatically. The DSS is based upon Petri net modeling, a well-known technique for looking at processes and systems. The approach is ideal for the building of resource-optimization systems for an enterprise. Built in concert with logical and representational engines, and good data, a decision system built around Petri nets offers almost instantaneous views and calculations for current situations within an enterprise along with a fast means of simulating changes in a system as a whole.

The decision-making tools, however, require experience in the building of large scale models that incorporate timing values and other relationships into a computational environment grounded by optimization algorithms.

Fundamentally, many structured databases are aligned that represent singular topics such as resources, technology and schedule. The databases are not mapped to a composite data warehouse; rather each feeds a domain specific set of metadata representations that produces associations of events, their inputs and outputs (I/O), and probabilities and times to accomplish the events. Associations are further mapped to a context model that is executed to compute performance statistics. Figure 1 displays a flow diagram of a process that when implemented produces responses to queries based upon relationships between disparate databases.



Conditions and Requirements of Decision Support

Conditions

An effective assessment solution includes more than integrated commercial off-the-shelf tools (COTS). Additions must be made in the form of metadata processors and algorithmic enhancements.

Namely, analytical capabilities for existing database management systems are restricted to linear and inaccurate solutions to user queries. For example, resource leveling addresses projects that have more work than people. These tools simply extend a schedule to make all work possible in an expanded time frame. The tools provide a visual display and an experimental approach to a program solution. Given that resources are fixed, personnel and physical assets are switched from current projects to the new start by inspection. A Critical Path Method (CPM) is run subsequently to quantify the impact of change relative to a selected measure of effectiveness (MOE). The assessment process is iterative, time consuming and complex. A more useful decision support system (DSS) provides an automated means of deriving optimal solutions. Answers are produced in minutes rather than hours with minimal human oversight. Once a new project is defined, changed or deleted under conditions of limited resources, personnel and assets are removed from current projects and assigned to new projects so that a program impact is minimized. An MOE might be schedule, costs, values and priorities of projects, or program risk. In addition to optimization, the DSS provides sensitivity analysis, impact analysis, and "what-if" experimentations.

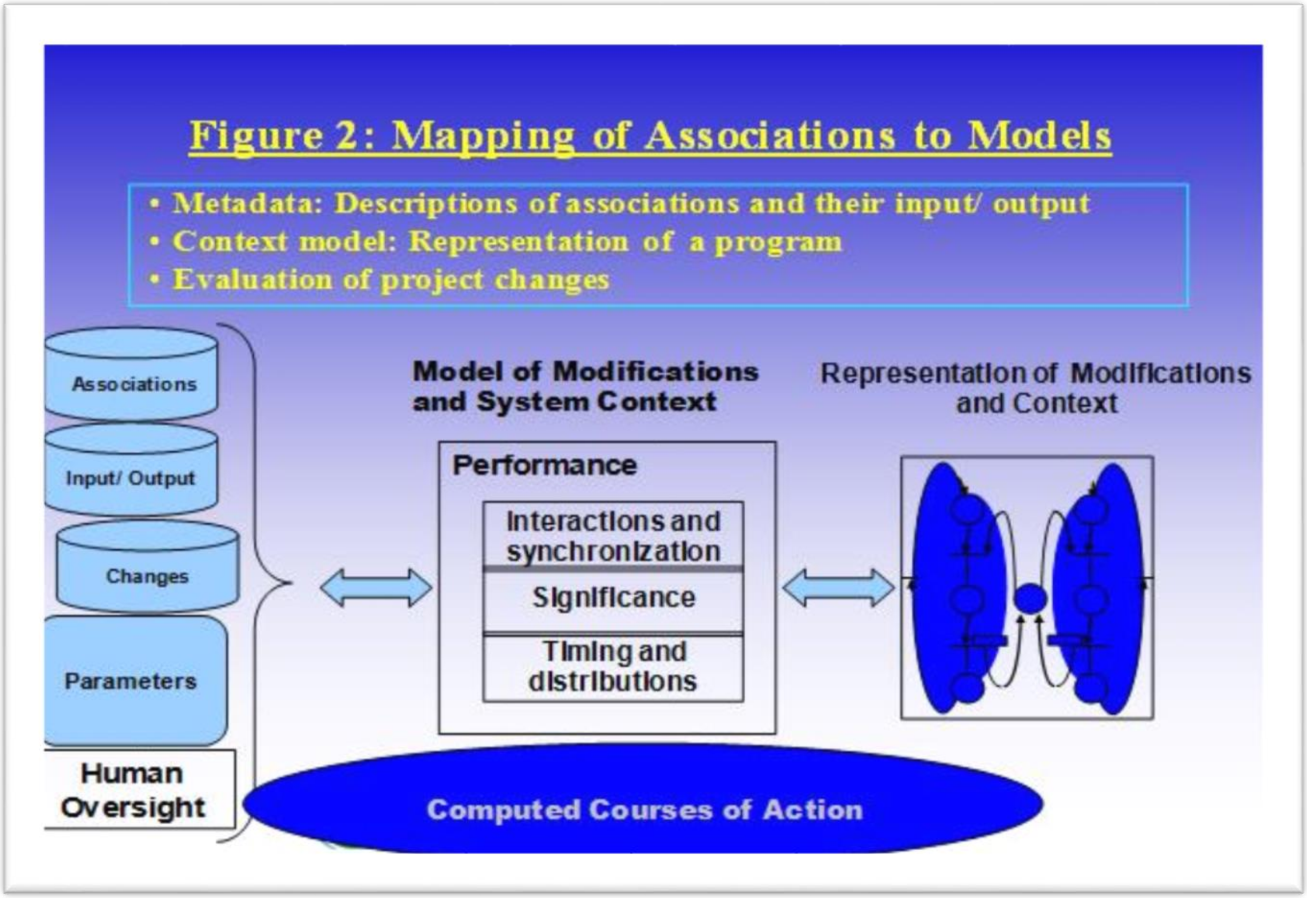
Requirements

The rationale of planning and architectural analysis is to produce data structures that support the DSS. An understanding early on of what needs to be represented is critical to costs and performance of decision support tools. A solution indeed requires tools which extract and transition data, but simple displays of contracts or schedules in and by themselves do not address queries. Metadata tools need to either be purchased or developed that produce a "virtual database", which not only represents descriptions of program categories (schedule, resources, contracts), but also the associations between segments of the disparate sources of data. Further, a collection of relationships is necessary to conduct trade-off and sensitivity analysis. An example is the change in schedule duration for a project with respect to the skill levels and quantities of personnel. Data are converted to models that when exercised respond to queries and assist with the selection of courses of action.

A DSS application must be thoroughly planned so that the contents of a database not only comprise category extractions, but also the metadata to feed a DSS. Without planning, a solution is incomplete and many revisions to data structures become necessary later in a planning phase of project additions and deletions.

Metadata

An extractor produces structured databases, which are transitioned by metadata to a definition of associations. The associations are further transitioned and positioned within a program context model that feeds analytical equations or a simulation of a program. By exercising the model, performance statistics are derived which encapsulate actions initiated by an asynchronous situation, as well as the context model, which represents an entire program. Figure 2 shows a mapping for an instance of contract modification.



General Purpose Problem Solver

The backbone of the DSS and a system representation is a general purpose problem solver (GPPS) that employs one network representation to permit semantic net associations, performance computations and optimization. The primary representation of the existing tool suite is a rule-based encapsulation of a network or any complex system. Optimization is always accomplished in the context of a systems model. Only one measure of system effectiveness can be optimized while all system variables are balanced to best achieve an objective. The variables represent competing measures of performance such as minimum cost versus schedule to maximize the effectiveness of an agency program. Further, impact, sensitivity and what if analyses are achievable for any proposed project changes. A myriad of algorithms orchestrates the optimization and performance analysis procedures.

One representation scheme encapsulates all facets of associations-optimization-performance capabilities.