

**Statement of Work (SOW)**  
**Lincoln Laboratory-MIT Joint Research on**  
**Understanding the Challenges to Net-Centric Systems and Mitigating**  
**Approaches**

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The Problem

For decades, **organizations across the spectrum of private industry and government have noted the limitations to information sharing and the resulting problems caused by “stovepipe” information systems.** Despite this recognition, occasional “crises” (e.g., Y2K and 9-11), and various technological and organizational efforts, these problems largely continue to persist and continue to impact information quality in the enterprise (e.g., timeliness, completeness, consistency, believability, and at times even accuracy).

Within the DOD, the net-centric doctrine has been around and official policy for nearly a decade, but the **legacy systems that still exist and, to a large extent, the new systems that are built often have more of a “stovepipe” rather than “net-centric” (or SOA) character.**

**The research questions are:**

- **why is the change from “stove-pipe” to “net-centric” proceeding so slowly** and running into roadblocks and bottlenecks even in an organization that has a hierarchical command structure with top level buy-in to the net-centric concept.
- **what mitigating technological, managerial, and organizational approaches and interventions** can be introduced to improve the speed of transition and the quality of the resultant end product systems.

An improved understanding of the dynamic process of evolutionary IT systems development will help in identifying necessary policies, incentives, and command and control structures for migrating towards the net-centric vision.

Outline of research project

The evolutionary information system development process involves the dynamic interaction of many stakeholders and processes that can lead to markedly different outcomes depending on how the overall process is managed and how incentives influence decisions made by various stakeholders. This phenomenon is related to the classic problem of incremental planning and implementation resulting in systems which deviate from the designed architecture even though each development step along the way made sense to the relevant decision-maker at the time.

The research will build on successful prior results in applying System Dynamics to the software development management process. The proposed research focus will apply the System Dynamics

approach, as well as employ other related research processes (e.g., organizational theory, economics) as relevant, to modeling the roles and interactions of key stakeholders and their actions to identify management policy levers that can influence and improve the evolutionary acquisition process.

An overlapping three phase research effort will be used, as follows:

The **first phase** will use a System Dynamics analytic approach to identify and investigate the stakeholders and processes that are involved in acquiring and sustaining IT systems along with their incentives, interactions, and dynamics. As concrete examples, we can look back at systems acquired over recent years and the budgetary and other managerial policy shifts that were happening in that time frame. This will give us an understanding of the moving parts and dynamics that can influence the outcome. We will work with Government collaborators and Lincoln Laboratory to identify measures of IT system features that differentiate net-centric from silo or other types of systems. These measures will help clarify different meanings of the term “net-centric” in usage and serve as a framework for evaluating successful development outcomes.

The **second phase** (which will overlap the first) will apply our knowledge of actors and actions to develop a System Dynamics model that would relate policy variables to process outcomes. This will include the various and diverse factors, both short-term and long-term, that influence programs, including budget allocations (and changes to budgets), changes requested by commanders or influential officials, development contractor behavior, and other factors identified in the first phase. It is typical that considerable insights will be uncovered in the process of creating and reviewing the resulting model.

The **third phase** will involve “running” the System Dynamics model simulation both (a) to validate its ability to recreate previous situations and (b) to study the likely outcomes of various possible changes to improve future outcomes.

#### Proposed Period of Performance

November 1, 2010 to October 31, 2011

Each of the three phases is estimated to be about 4 months.

#### Deliverables, Timetable, and Periodic Progress Review Meetings

##### *Deliverables:*

The primary deliverables will be **interim reports** at the end of each of the three phases, as well as a **consolidated final report** that covers the entire scope and findings of this effort.

We envision that versions of these reports, likely abbreviated, would be eventually published in the scholarly literature.

In addition, the System Dynamics model(s) produced, both in graphical form as well as the software version, will be provided as a deliverable.

### *Timetable:*

Assuming a start date of November 1, 2010, the report deliverables would be approximately:

February 28, 2011 (or 4 months after start) – Phase 1 interim report

June 30, 2010 (or 8 months after start) – Phase 2 interim report

October 31, 2010 (or 12 months after start) – Phase 3 interim report & Final report

### *Periodic Progress Review Meetings:*

Periodic project review meetings will be held bi-monthly.

Every second review (the even numbered reviews) would roughly coincide with the completion of a phase and review of the findings from that phase. These reviews should be face-to-face and the locations could rotate between Government facilities, Lincoln Laboratory, and MIT.

The odd numbered reviews could be either face-to-face or via VTC or web conference as mutually determined.

### Resources

The research will benefit from the collaborative effort and support from Subject Matter Experts (SMEs) within the Government and Lincoln Laboratory.

This collaboration is especially important for the first phase (though it will be useful throughout the project.) In addition to direct information from SMEs, support documents and sources will be needed. Some initially identified data sources include:

- Acquisition rules and regulations familiarization: [www.dau.mil](http://www.dau.mil) (training courses, etc)  
<https://www.acquisition.gov/> (rules)
- DIA specific vehicles for IT  
<http://www.dia.mil/contracting/site.htm> (6.6 Billion IT services contract for DIA / IC)
- Culture & Organizational awareness studies (pending stakeholder buy-in)

Examples include:

- DIA Knowledge Lab studies
- DIA Human Capital studies
- DoD / IC studies on workforce, management, organizational areas
- Study specific investigations (facilitated with gov. support)
- Access to Defense Counter Intelligence and Human Intelligence (DCHC) requirements analysis documents (pending classification review)
- Unclassified capability reports on IT systems supporting DCHC
- Access to Information Technology leaders and workers developing, implementing, and maintaining DCHC systems
- Access to customers (organizational and functional) of IT systems supporting DCHC (for perspective / use comparison of IT systems, etc)

- Partnership with other FFRDC working with DCHC (Pacific Northwest National Lab - Dept. of Energy)
- Use of DIA Knowledge Lab expertise for structuring and facilitating candid feedback from communities

### Brief Biography of Principal Investigator

#### *Dr. Stuart Madnick*

Professor Stuart Madnick has been a faculty member at M.I.T. since 1972. He has served as the head of MIT's Information Technologies Group for more than twenty years. During that time the group has been consistently rated #1 in the nation among business school information technology programs (*U.S. News & World Reports*, *BusinessWeek*, and *ComputerWorld*). He has also been an affiliate member of MIT's Laboratory for Computer Science, a member of the research advisory committee of the International Financial Services Research Center, and a member of the executive committee of the Center for Information Systems Research. Dr. Madnick is a prolific writer and is the author or co-author of over 300 books, articles, or reports including the classic textbook, *Operating Systems* (McGraw-Hill), and the book, *The Dynamics of Software Development* (Prentice-Hall), which received the Jay Wright Forrester Award for "Best Contribution to the field of System Dynamics in the preceding five years" awarded by the System Dynamics Society. He has also contributed chapters to other books, such as *Information Technology in Action* (Prentice-Hall).

His current research interests include information aggregation, connectivity among disparate distributed information systems, database technology, software project management, and the strategic use of information technology. He is presently co-Director of the PROductivity From Information Technology (PROFIT) Initiative and co-Heads the Total Data Quality Management (TDQM) research program. He has been the Principal Investigator of a large-scale DARPA-funded research effort on Context Interchange which involves the development of technology that helps organizations to work more cooperatively, coordinated, and collaboratively. As part of this effort, he is the co-inventor on the patents "Querying Heterogeneous Data Sources over a Network Using Context Interchange" and "Data Extraction from World Wide Web Pages."

He has been active in industry, making significant contributions as a key designer and developer of projects such as IBM's VM/370 operating system and Lockheed's DIALOG information retrieval system. He has served as a consultant to major corporations, such as IBM, AT&T, and Citicorp. He has also been the founder or co-founder of several high-tech firms, including Intercomp (acquired by Logicon), Mitrol (acquired by General Electric's Information Systems Company), Cambridge Institute for Information Systems (subsequently re-named Cambridge Technology Group), iAggregate (acquired by ArsDigita which was subsequently acquired by Red Hat), and currently operates a hotel in the 14th century Langley Castle in England.

Dr. Madnick has degrees in Electrical Engineering (B.S. and M.S.), Management (M.S.), and Computer Science (Ph.D.) from MIT. He has been a Visiting Professor at Harvard University, Nanyang Technological University (Singapore), University of Newcastle (England), Technion (Israel), and Victoria University (New Zealand).