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Network Requirements Definition and Management System

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Network Requirements Definition and Management System (NRDAMS) Project Report

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Network Requirements Definition and Management System (NRDAMS)

A Prototype Desktop Decision Support System (DSS) for the Project Manager

Statement of Need

Successful projects are based on accurate requirements definition and management. Requirements definition is one of the most crucial steps in the life of a project. In the absence of well-defined requirements, managers cannot properly plan, execute, and manage a project; engineers and developers do not know exactly what to build and test; and customers are unclear on what to expect. Also, there is no way to validate that the system is built to satisfy the stated stakeholder needs.

Requirements definition is a difficult task. The purpose of a requirement is to communicate a business need to a technical expert. It has to enable the technical expert to recognize the technological impact. Missing or misunderstood requirements cost considerably more than programming or testing errors. Fortunately, the ability to define and manage requirements is a learnable and practical skill. Project managers must understand the concept and be able to converse knowledgeably on the subject of requirements with all stakeholders in order to effectively manage the project to its successful conclusion.

After requirements are defined in sufficient detail, it is equally important to have an effective requirements management plan in place. A change management process used to track requirements changes is absolutely essential to the accuracy of the requirements in relation to the functionality of the system being tracked.

NRDAMS is a web-based tool that provides the Project Manager with access to educational sources on the topics of networking, requirements, and configuration management. NRDAMS also provides the Project Manager with the current operational view and a proposed operational view of the network topology to help facilitate key management decisions as exemplified in a case study. The case study will show how NRDAMS can be used in an operation and maintenance (O&M) environment.

Project Objectives

The NRDAMS Project Plan outlines the following objectives:

1. Provide the Project Manager with an opportunity for education in the areas of general networking, network requirements definition and management, and configuration management.

2. Provide a current prospective of the current operational network environment.

3. Provide a view of the proposed operational network environment.

Project Deliverables

The NRDAMS Project Plan outlines the following deliverables:

1. Prototype desktop Decision Support System (DSS) (file drawer, data-oriented)

    a. Web-enabled.

    b. Data Views in pre-specified reports.

    c. Ability to access on-line educational resources.

    d. Ability to access on-line information on case study current O&M environment.

e. Ability to access on-line information on case study proposed environment.

2. Processes and templates for network requirements definition
    a. Web-enabled.
    b. Data Views in pre-specified reports.
3. Processes and templates for network requirements management
    a. Web-enabled.
    b. Data Views in pre-specified reports.
4. Change Management
    a. Change Management Process.
    b. Documentation Requirements.
    c. Testing Process.
5. Requirements Documentation on NRDAMS.
6. Lessons Learned on NRDAMS development, design, and the prototyping process.

Current Industry Practices

There are several Commercial Off-The-Shelf (COTS) packages that offer Requirements Engineering (RE) capabilities. Dynamic Object-Oriented Requirements System (DOORS) is a commercially available requirements management and data-modeling package. Its complexity and expense are prohibitive for some businesses. Information on DOORS can be found at **http://www.telelogic.com**. SpeeDev is another requirements management tool. However, this package also can be too expensive and

overly complex for smaller companies. Information on this package can be found at http://www.speedev.com/goog_req_mgmt_o.asp.

The case study, The Mind's Eye, is a small company that recognizes the need for requirements engineering. The focus of the case study is on the Network Operations Manager's desire to review and forecast network topology changes in relation to an upcoming merger with another company. Commercially available packages are too expensive and overly complex for serious consideration at this point in time. The Network Operations Manager for The Mind's Eye wants an uncomplicated, efficient desktop system that provides him with an avenue for education on general networking and requirements practices as well as providing a cost-effective method by which to compare current and proposed network topology changes.

Project Scope

The scope of work is the construction of the NRDAMS prototype and the detailing of supporting processes for its implementation, use, and maintenance. The objectives of NRDAMS are as follows:

1. Provide an educational opportunity for the Project Manager in the following areas:
    a. General Networking Concepts.
    b. Requirements Definition.
    c. Requirements Management.
    d. Configuration Management.
2. Provide the capability for the Project Manager to view the current operational network environment.

3. Provide the capability for the Project Manager to view the proposed operational network environment.

Performance/Evaluation Measures

The performance and evaluations measures of the NRDAMS Project consist of:

1. A functional prototype.
2. A requirements definition process and associated documentation.
3. A requirements management process and associated documentation.
4. A change management process and associated documentation.
5. Complete planning documentation.

Project Work

What is a Project?

What is similar about the following activities: building a bridge, installing a wireless network, launching a new product in the marketplace, and remodeling a home? These activities are all projects.

The Project Management Institute (PMI) is the premiere industry professional organization and its standards are internationally accepted in project management. PMI defines a project as: "... a temporary endeavor undertaken to create a unique provide or service. Temporary means that every project has a definition beginning and a definite end. Unique means that the product or service is different in some distinguishing way from all other products or services. For many organizations, projects are a means to response to those requests that cannot be addressed within the organization's normal operational limits" (Project Management Institute (PMI), 2000, p. 4). Characteristics of a

project include objectives, scope, schedule, cost, resources, organizational structure, size, and complexity.

Once a potential project is identified, an organization must determine the resources required. The scope of the project must be analyzed along with a determination the probability of successful completion based on the resources available. After gaining this understanding, an organization will then determine if the project should proceed.

A Project Manager is responsible for creating high-level feasibility plans and detailed project plans as well as staffing the project team. A Project Manager is often referred to as a juggler, keeping aloft many balls that reflect the various aspects of a project's development. Common activities include leadership, management, customer relations, technical problem solving, conflict management, team management, risk management, change management, and budgeting. Collectively, these activities fall under the umbrella of project management.

What is Project Management?

Project management is an activity that covers and organizes all the interactions involved in a project. PMI defines project management as: "... the application of knowledge, skills, tools, and techniques to project activities to meet project requirements" (PMI, 2000, p. 6).

Project Managers make decisions to keep the proper proportion among the factors of quality, scope, risk, schedule, and cost. The balance will naturally shift as the project progresses. Project managers make decisions ranging from the trivial to the significant. The wise Project Manager does not rely on "lady luck" in the decision-making process. As a solid guideline, a good outcome is a direct result of making a good decision.

The soundness of a decision depends on the quality of the available information and the number of options available at the time of the decision. It is important to analyze and measure the proposed decision and suggested alternatives for impacts on the entire project. An action, or failure to take an action, in one area will inevitably affect other areas.

To assist the Project Manager with such decisions, there are resources available for industry professionals. PMI has organized the project management process into five process groups that are composed of one or more processes each.

1. Initiating processes – authorizing the project or phase. Project management techniques related to this process group include setting up the project initiation team, project initiation plan, and management procedures.

2. Planning processes – defining and refining objectives and selecting the best of the alternative courses of action to attain the objectives that the project undertaken to address. Project management techniques related to this process group include developing a WBS, creating a project schedule, risk management, developing a communication plan, and budget preparation.

3. Executing processes – coordinating people and other resources to carry about the plan. Project management techniques related to this process group include executing the project plan, monitoring progress, and communicating project status to stakeholders.

4. Controlling processes – monitoring and measuring progress regularly to identify variances from the project plan so corrective action can be taken when necessary to meet project objectives. Project management techniques related to this process group

include making changes to the project plan, making configuration change as required, and adjusting the schedule and budget as necessary.

5. Closing processes – formalizing acceptance of the project or phase and bringing it to an orderly end. Project management techniques related to this process group include conducting post-project meetings, closing out with the customer, and finalizing all project documentation. (PMI, 2000, p. 30).

For efficient management, projects are often organized into phases. Collectively, these phases are referred to as the project life cycle. Each of the defined phases is concluded with a set of deliverables that then feed into the initiation process group of the next phase. The Process Groups are repeated within each phase because project management has an iterative nature. For further efficiency, the process groups and associated processes can be grouped into nine knowledge areas: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communications, Management, Project Risk Management, Project Procurement Management. Ideally, Project Managers are well versed in, or at the very least, familiar with, the fundamentals of project management as outlined by the industry professional association, PMI.

Life Cycle Models

Generally, there are two life cycle models at play during a life of project: the project management life cycle and the systems development life cycle. The systems development life cycle (SDLC) can be broken down into two subtask life cycle models, the systems engineering life cycle model and the software life cycle model. The informed

and effective Project Manager recognizes the existence of these life cycles and endeavors to symphonize each to the other.

The technical processes that can be in the realm of the systems development life cycle include: stakeholder requirements definition, requirements analysis, architectural design, implementation, integration, verification, transition, validation, operations, maintenance, and disposal. The project management life cycle often has the following processes: project planning, project assessment, project control, decision-making process, risk management process, configuration management, and information management.

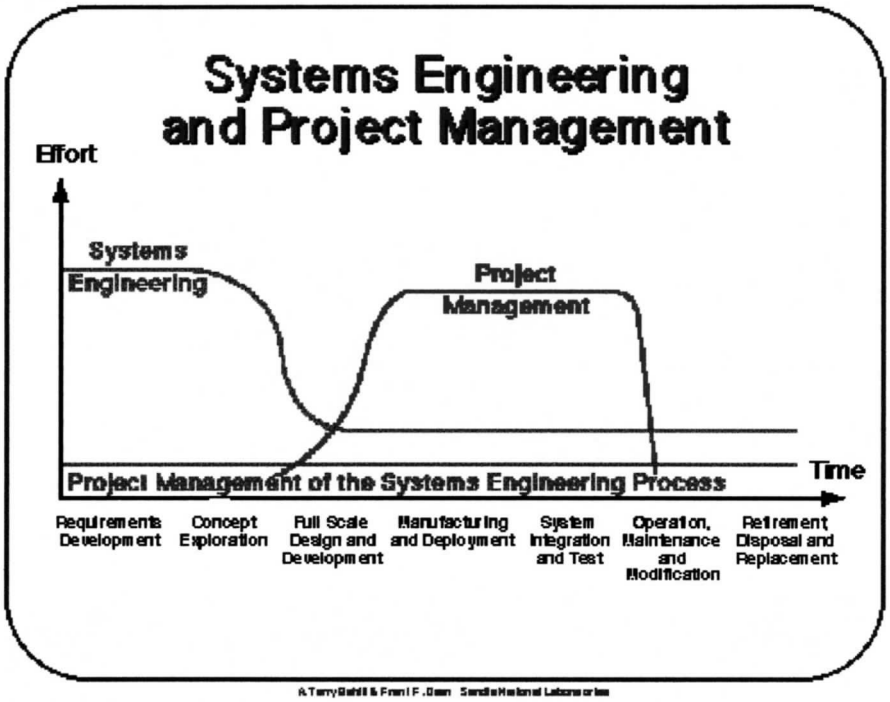

Figure 1. A chart showing the interrelation between the systems engineering life cycle and the project management life cycle. From "What is Systems Engineering," by Frank F. Dean, 1999, retrieved on April 6, 2004 from http://gd.tuwien.ac.at/systeng/bahill/whatis/284.html.

There are several formally recognized system development life cycle (SDLC) models available for use in projects, such as the waterfall model, the incremental model,

and the prototype model. A project may hold to one defined model during its development and implementation. However, some professionals believe that the various systems development life cycle models are more complementary than exclusionary (Davis, 1997).

The prototype life cycle approach was used for NRDAMS. This approach was used because the Network Operations Manager desires to get a better understanding of the workability of the approach by demonstration and refinement before approving its final design. In the case study, the prototype would not be discarded, but would evolve into the final product through iterative development-test-demonstrate cycles. For this development work, the spiral development model was utilized. The spiral development model is cyclic in nature, incrementally growing the degree of system definition and implementation. Stakeholder commitment to applicability of the system is then more assured as the development process moves along.

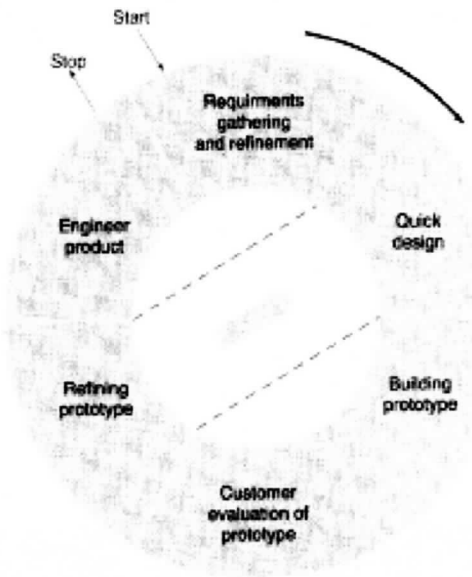

Figure 2. A figure representing the prototype life cycle. From "Software Engineering", by R. Pressman. Columbus: McGraw-Hill (2000), p. 27.

Case Study

The Mind's Eye is a graphic arts company started in 1997 by Darren Smith and Rob Newman. Each man had previous experience in the graphic arts industry with commercial firms. They decided to start their own business in order to retain more artistic control over their creations. The Dallas-based firm has grown by leaps and bounds due to the favorable business climate, effective marketing strategies, the focus on personal service and customer satisfaction, and the talented and dedicated talented staff.

The Mind's Eye has been conducting merger discussions with Visual Tiger, another graphic arts company. The merger is due to be approved by May 2004 with full consolidation by November 2004. Visual Tiger will be subsumed in its entirety by The Mind's Eye. The Mind's Eye will then be split into two divisions, commercial and private

graphic arts. Steve Miller, the Network Operations Manager at The Mind's Eye will be the Project Manager for the network operations upgrade. He wants the NRDAMS prototype to be completed for evaluation by May 2004 and fully operational by June 2004.

Project Managers are often not technical experts in the area that they are responsible for managing. This is an unrealistic expectation. Steve Miller started out as a networking specialist, but moved into management at an early juncture. He is an adept line manager and has acted as a Project Manager in the past for other activities. Steve is acutely intent on ensuring that the resulting network be a secure and stable environment that is able to provide service guarantees to applications and network services to the staff in order to have no impacts on the company staff or the customers.

Steve has a good project team assembled. However, Steve disdains micromanagement, but wants to be involved "one level down" in the project. He has not been introduced to the company's requirements management program or to the configuration management process. For Steve, the NRDAMS system answers his concerns for the "one level down" look. He wants an opportunity to research network working terminology, network management concepts, and configuration management concepts. Through the use of NRDAMS, Steve can access network diagrams that are not overly technical, but provide a basis from which to build ideas, thoughts, and comments on as the project progresses. NRDAMS will also enable Steve to view the configuration management aspect of the project by following policies at the company.

Requirements Definition

Problem from poor requirements are persistent, pervasive, and costly. A recent study of problems in mission-critical defense systems identified poor requirements as a major problem sources in two-thirds of the systems examined (The Standish Group, 1994). Requirements definition is critically important to the success of any project, regardless of size or complexity. The requirements definition activity can be scaled as appropriate, but must be executed.

Requirements definition emphasizes the understanding and specification of the problem to be solved rather than the solution. This focus captures the valid requirements without over-constraining the subsequent design or implementation. Faulk (1997) cites the source of most requirements errors is the failure to accomplish one of the following goals:

1. Failure to understand what was required of the software by the stakeholders.
2. Failure to capture the requirements or subsequently communicate the requirements effectively to other parties involved in the development.
3. Failure to effectively manage the effects of changing requirements or ensure the downstream development steps including design, code, integration, test, or maintenance to the system requirements.

These failures will almost certainly produce a system that does not meet expectations of the customer, mostly likely over budget, and behind schedule.

documentation, and supporting processes (Department of Defense Systems Management College, 2001). Configuration management is the formal program for managing change from an established baseline. It ensures that all proposed changes are properly reviewed and approved before implementation. Notification and coordination is provided to users and other resources necessary for the approval and execution of the planned change. A review of the implemented change is conducted following the modification to ensure no unexpected ramifications resulted and to ensure the change is documented accurately.

A configuration management program will provide the definitive knowledge of the present, documents historical actions, and aids in planning for the future. Change control is the process by which the configuration management approach is implemented. The Project Manager is responsible for schedule, technical, and technical implications of change and cannot delegate this responsibility.

Testing

Testing is an important project activity. Too often chaos is introduced into the project by not paying adequate attention to testing.

Good requirements are verifiable. Test planning should begin to when the requirements definition activity is begun. These areas go hand-in-hand. Testing can be conducted as actual, simulated, or a code walk-through. Ideally, there is an independent test group available either through outsourcing or contained within the organization. More often than not, however, testing is performed by the developers or engineers involved in the project's development to begin with. There are great benefits in having formalized test plans, test cases templates, and a formal gated review process. The system can be proven as being fully tested to its stated requirements.

Network Requirements Definition and Management System

NRDAMS is a standalone, Decision Support System. It satisfies the needs of the Project Manager in the case study for the "one level down" look. It was built as a DSS to support nature of the tool as well as the nature of the prototyping approach.

Why a Decision Support System?

Information systems analysis and design is a complex and challenging enterprise. Project managers often employ tools to assist with analysis, review, and project management activities. These tools assist the Project Manager by increasing the awareness of the value of the use of requirements management for networks and configuration management benefits.

The Decision Support System (DSS) approach was selected for this tool because it will be used to assist management in making business decisions. It clearly defines the problem to be solved, namely Steve Miller's "one level down" look. This view will enable him to keep up with the network information flow, and he can respond more effectively, and in a more informed fashion, to the ever-changing network needs of his company.

The Executive Information System (EIS) concept could have been used, but Steve Miller wanted a prototype that could eventually be used by a larger audience, including his team and other managers within the company. An EIS is designed to support top management, and therefore is more communication-oriented and less quantitative nature than a DSS. Generally, a DSS is concerned with more complex, longer-term decisions.

(Schutzer, 1991). The NRDAMS prototype is a desktop DSS. It has enterprise capabilities with a few minor changes.

NRDAMS Capabilities

NRDAMS provides web-based access for three major areas of interest for the Project Manager. These three major areas are education, network requirements, and configuration management. The opportunity to learn more about networking topics, requirements, or configuration management is presented to allow the Project Manager to easily access resources directly related to NRDAMS topics. The heart and soul of NRDAMS are the areas of network requirements and configuration management. These areas allow the Project Manager to easily access information on these topics as implemented at the company.

The first major area is focuses on education for the Project Manager. The opportunity is presented to learn from selected information on these topics:

1. Networks and Topologies.
    a. Network Terminology.
    b. Network Topologies.
    c. Network Case Studies.
    d. The current network vendor – CISCO.
2. Requirements Concepts.
    a. The Importance of Good Requirements.
    b. Gathering Requirements.
    c. Writing Good Requirements.
    d. Maintaining Requirements.

3. Configuration Management Concepts.

    a. Configuration Management Terminology.

    b. The Importance of Good Configuration Management.

    c. Configuration Management Case Studies.

The second major area within NRDAMS is network requirements. This area provides the Project Manager easy access these items:

1. Network Requirements Definition Process.
2. Network Requirements Document.
3. Current Network Connectivity diagram.
4. Proposed Network Connectivity diagram.

The third major area within NRDAMS is configuration management. This area provides the Project Manager with access to these items:

1. Documentation on The Mind's Eye Network Configuration Management Process.
2. Documentation on The Mind's Eye Network Configuration Change Process.
3. Current configuration change request reports.
4. Documentation on the Testing Process.

NRDAMS provides the prototype functionality as outlined in the NRDAMS System Requirements Document (SRD). The Mind's Eye uses exclusively Microsoft Office software, so the entire tool is composed of these packages. For prototype purposes, the web server used is called Sokkit. Sokkit is an open-source web server tool kit that

utilizes Apache, PHP, and MySQL. It was written in HTML, JavaScript, and uses Cascading Style Sheets (CSS).

NRDAMS has a "comfortable" look and feel, and its features are user-friendly. The Project Manager does not want a tool that he has to spend a lot of time learning how to use. NRDAMS is easily maintained.

Opportunities for enhancements outside of the initial prototype capabilities include:

1. A database can be created to show specific information on the network gear, workstations, and other hardware.

2. The Mind's Eye could use the open-source features of the Sokkit web server toolkit to provide some flexibility from the company's reliance on Microsoft domain. Monetary benefits could potentially be hand by using open source software packages.

3. The company's formal project management methodology, processes, and procedures could be represented in the tool.

4. An organizational chart for current and proposed staffing might have been useful.

Conclusion

This report has demonstrated both the need for good requirements definition as ask as a management process for those requirements. The link between requirements and project success was clearly delineated.

This report outlined the project objectives, deliverables, scope, and schedule. NRDAMS demonstrated its competencies, as outlined in the project plan, in providing

information to the Project Manager to promote more efficient and effective network decisions. Awareness of the importance of requirements definition, requirements management, and configuration management will significantly enhance the likelihood of success of a project. This is the goal of all project managers … project success!

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Appendix A – NRDAMS Work Breakdown Structure (WBS)/GANTT Chart

ID	Task Name	Duration	Start	Finish	Predecessors	W T F
1	**Network Requirements Definition and Management System (NRDAMS) Prototype**	**89 days**	**Fri 1/2/04**	**Fri 5/7/04**		
2	**Project Management Tasks**	**84 days**	**Fri 1/2/04**	**Fri 4/30/04**		
3	Provide Weekly Status Updates to Evaluation Team	84 days	Fri 1/2/04	Fri 4/30/04		
4	Update Lessons Learned Document	84 days	Fri 1/2/04	Fri 4/30/04		
5	**Decision-Support System**	**84 days**	**Fri 1/2/04**	**Fri 4/30/04**		
6	**Prototype Requirements**	**14 days**	**Fri 1/2/04**	**Thu 1/22/04**		
7	Define Prototype Requirements	7 days	Fri 1/2/04	Mon 1/12/04		
8	Document Prototype Requirements	7 days	Tue 1/13/04	Thu 1/22/04	7	
9	Design DSS Prototype	21 days	Fri 1/23/04	Mon 2/23/04	8	
10	Build DSS Prototype	36 days	Tue 2/24/04	Tue 4/13/04	9	
11	**Test DSS Prototype**	**13 days**	**Wed 4/14/04**	**Fri 4/30/04**	**10,17**	
12	Write Test Plan	7 days	Wed 4/14/04	Thu 4/22/04		
13	Execute Test Plan	13 days	Wed 4/14/04	Fri 4/30/04		
14	**Supporting Decision-Support System Processes**	**38 days**	**Fri 1/23/04**	**Wed 3/17/04**		
15	Define Requirements Definition Process	10 days	Fri 1/23/04	Thu 2/5/04	8	
16	Define Requirements Management Process	14 days	Fri 2/6/04	Thu 2/26/04	15	
17	Define Change Management Process	14 days	Fri 2/27/04	Wed 3/17/04	16	
18	**Prototype Evaluation**	**1 day**	**Fri 5/7/04**	**Fri 5/7/04**		
19	Presentation to NRDAMS Project Team	1 day	Fri 5/7/04	Fri 5/7/04	11	

Appendix B – NRDAMS Project Lessons Learned

What went well?

The status reports, in both duration and content, kept the MSIS Evaluation Team appropriately informed.

The MSIS Evaluation Team kept in touch with MSIS candidate throughout the development process.

The tool is well organized.

The tool contains relevant information as presented in the requirements document.

The tool meets the stated requirements.

What did not go well?

The tool became overly complex and lost its essence for a while in the development process. A prototype is serves as a basis or standard for later stages. It is an early example of the potential final product.

There should have been more guidance documented on prototype desirables, not only strict requirements. The flexible nature of the prototype approach supports this.

There should have been more focus on the use of Microsoft Office products for the entire tool from the beginning since the case study company was depicted as being a heavy user of this technology. Too much emphasis was placed, in the beginning of the project development, on open- source technology applications whereby the company probably would have wondered how that software suite got introduced into the prototype tool.

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