2002 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM

JOHN F. KENNEDY SPACE CENTER
UNIVERSITY OF CENTRAL FLORIDA

PROGRAM AND PROJECT MANAGEMENT FRAMEWORK

Cassandra D. Butler
Program Coordinator
Department of Computer and Information Sciences
Miles College

Tracey Fredrickson - KSC Colleague

ABSTRACT

The primary objective of this project was to develop a framework and system architecture for integrating program and project management tools that may be applied consistently throughout Kennedy Space Center (KSC) to optimize planning, cost estimating, risk management, and project control. Project management methodology used in building interactive systems to accommodate the needs of the project managers is applied as a key component in assessing the usefulness and applicability of the framework and tools developed. Research for the project included investigation and analysis of industrial practices, KSC standards, policies, and techniques, Systems Management Office (SMO) personnel, and other documented experiences of project management experts. In addition, this project documents best practices derived from the literature as well as new or developing project management models, practices, and techniques.

1. INTRODUCTION

The purpose of this work was to develop a framework for integrating project management tools being used at KSC so that they may be easily accessed and efficiently used from a central system architecture, as administered through KSC's Systems Management Office (SMO) under the Directorate of Safety, Health and Independent Assessment. The goal this project management framework was to reveal proven principles that establish the basis for project management success and methods for integrating those principles to form a reliable system.

The National Aeronautics and Space Administration (NASA) and KSC have designed a thorough system of well-defined policies and procedures based on traditional project management techniques. Investigation and analysis of project management strategies revealed that many different software applications are being used to generate project management tools. However, there is no integrated system to assist project managers in completing the compliance requirements while using these applications. Such a system would provide opportunities for project teams to collaboratively share project responsibilities and allow project managers to spend more time managing project requirements rather than learning new project management systems.

KSC SMO, based on research and development prior to commencement of this project, had determined that project success would likely be improved by providing a consistent means for project managers and team members to access and complete project requirements as delineated by policies and standards. According to most project management authorities, more projects are unsuccessful than successful (Levine, 2002; Walker, 2000). Researchers also agree that prior to deciding on a project management tool, organizations must carefully evaluate the reliability of internal policies, procedures, and practices (Trepper, 2000). Thus, initial tasks included investigation of applicable policies, procedures, tools, and techniques.

Due to competition for limited project resources, successful project management requires the use of tools to access scope, time, cost, risk, and quality (Project Management Institute, 2000). Tools used for these purposes are most often computerized today, although they come in numerous forms. While many project management tools and techniques are integrated into project management software applications, many are also developed using other software such as Microsoft Access, Excel, Outlook, PowerPoint, and Word.

Project management software generally makes available tools such as work breakdown structure (WBS), task list, Gantt chart, calendar plan, task usage chart, network diagram or PERT chart, critical path analysis, and earned value analysis that are used to help project managers and project team members in accomplishing scope, time, cost, and quality management (Schwalbe, 2002; Barkley and Saylor, 2001). However, Barkley and Saylor (2001) indicate that quality is actually the fundamental goal of project success leading to successful integration of cost and schedule. The integral relationship between managing quality and managing metrics necessitates evaluation of the metrics used by SMO as well (TenStep, 2002). The KSC SMO uses a diverse network of rationale-based metrics with specific goals based on its mission.

This research project used the trials of industry and academia to develop a project management architecture for integrating software applications used at NASA KSC that will promote effective management of scope, time, cost, and quality via access to an integrated web-based system designed for that purpose.

More specifically, project managers at NASA KSC need the following capabilities:

- To use project management software and systems without the necessity of being an expert in the framework of the project management system and how it works.
- To access the project management system at any time from any place while maintaining organizational security.
- To have instantaneous, automatic notification to team members that task requirements or action items have changed.

Furthermore, the author determined and documented an architecture for a system that will eliminate redundancy by automating project team tasks to allow the transfer of data from forms, templates, and other required documentation into a knowledge base for integrated and distributed project management. To accomplish this end, project management experiences in aerospace industry and public sector as well as review of the literature led the author to explore basic questions regarding integrated project management. Based on project management methods, theory, and years of project management experience of the author, desirable characteristics for integrated project management in a web-based environment include, but are not limited to:

1. Simple processes
2. Powerful processes
3. Form-based interfaces for easy connection to existing data sources, input and modification by non-project management personnel
4. Well-organized, consistent data
5. Quick-scan dashboards
6. In-depth reports
7. Consistent and reliable security

2. INVESTIGATION AND RESEARCH

Project work initiated with an investigation into the policies and operations of the NASA KSC Program and Project Management organization; the Systems Management Office (SMO). The Systems Management Office acts as an agent for the KSC Center Director, KSC's CFO and the NASA Chief Engineer (Code AE) to assure that development efforts and mission operations are being planned and conducted based on a sound engineering and project management basis with appropriate controls and management of technical risks. The Systems Management Office also houses KSC'S Chief Engineer who ensures engineering excellence in the execution of Programs and Projects. The SMO Organization Structure web page provides member names, position descriptions, and other contact information.

The SMO website is based on sound principals of using project management tools which have been characterized according to the principal project management phases and activities. These tools provide a basis for enforcing the use of standards, review processes, and foremost to define quality in terms of deliverables (Trepper, 2000). While project management methodology has remained constant for almost 20 years, research revealed two fairly new method improvements that warrant mention: 1) Total Project Control (TPC) (Devaux, 1999) and Critical Chain Analysis (Newbold, 1998). Although not a project management method, TQM or Total Quality Management programs, popular in the 1980s, should have been included in project management methodology according to both Devaux (1999) and Newbold (1998. In addition, many organizations are modifying project management systems and developing internal applications to address specific project management issues. For example, the United States Air Force

(USAF) has developed PAPIE, a Visual Basic 6 program that links to a SQL 7 database to track requirements and provide standardized process management and more (Personal Communication, Henry D. Akin, July 1, 2002). The Hampton Group (http://www.4pm.com) uses an "achievement-driven project management methodology" which includes a measured achievement in addition to a budget, schedule, and completion date for each component of the project plan.

While not included in this document, a gap analysis of NPG 7120.5, the primary document governing the operation of SMO against the SMO website was done to determine if all policy requirements are handled in the SMO website. Additional information regarding Center documentation including program/project management reports was gathered from the NASA/KSC TechDoc 2.0 System Document Manager and Search Manager User's Guide (KSC-TD-01005) and website (http://tdsearch.ksc.nasa.gov/). The SMO website, organized into three categories: SMO/Resource, Functional Areas, and SMO Services was approximately 20 percent complete with policies, procedures, tools, techniques, responsibilities, and reference documents at the beginning of this project. During the course of this project, Tracey Fredrickson has consistently applied improvements and modifications to the SMO site, expediting its release on July 19, 2002. Therefore, the SMO site is ready to initiate an integrated architecture prototype, as detailed in the Conclusions section of this report. Figure 1 illustrates the basic framework for this system.

2.1 Project Management Applications

Research revealed that several project management applications and support systems for project management have been previously investigated and selected for use at the Center. Although the real-time sharing offered by some applications is attractive, they are not feasible for large project management teams unless they include a collaborative infrastructure (Penã-Mora and Dwivedi, 2002). Telelogic DOORS (http://www2.telelogic.com/products/doorsers/doors/index.cfm), SAP R/3 Project System, and Scitor PS8 incorporate interaction protocols, information policies, and meeting structures that are much more appropriate for large organizations like NASA KSC. Distributed database technology offers potential for integrating project management requirements through common functional tasks and reporting requirements and is readily accomplished using Java programming. Java has been shown to be an excellent programming language for designing interfaces for web-based applications as well as distributed systems incorporating such tools. The following website contains links for companion products for Microsoft Project http://www.projectmanagement.com/tools.htm. Such applications demonstrate how Microsoft Project can be the focal point of a web-based application for integrating project management tools.

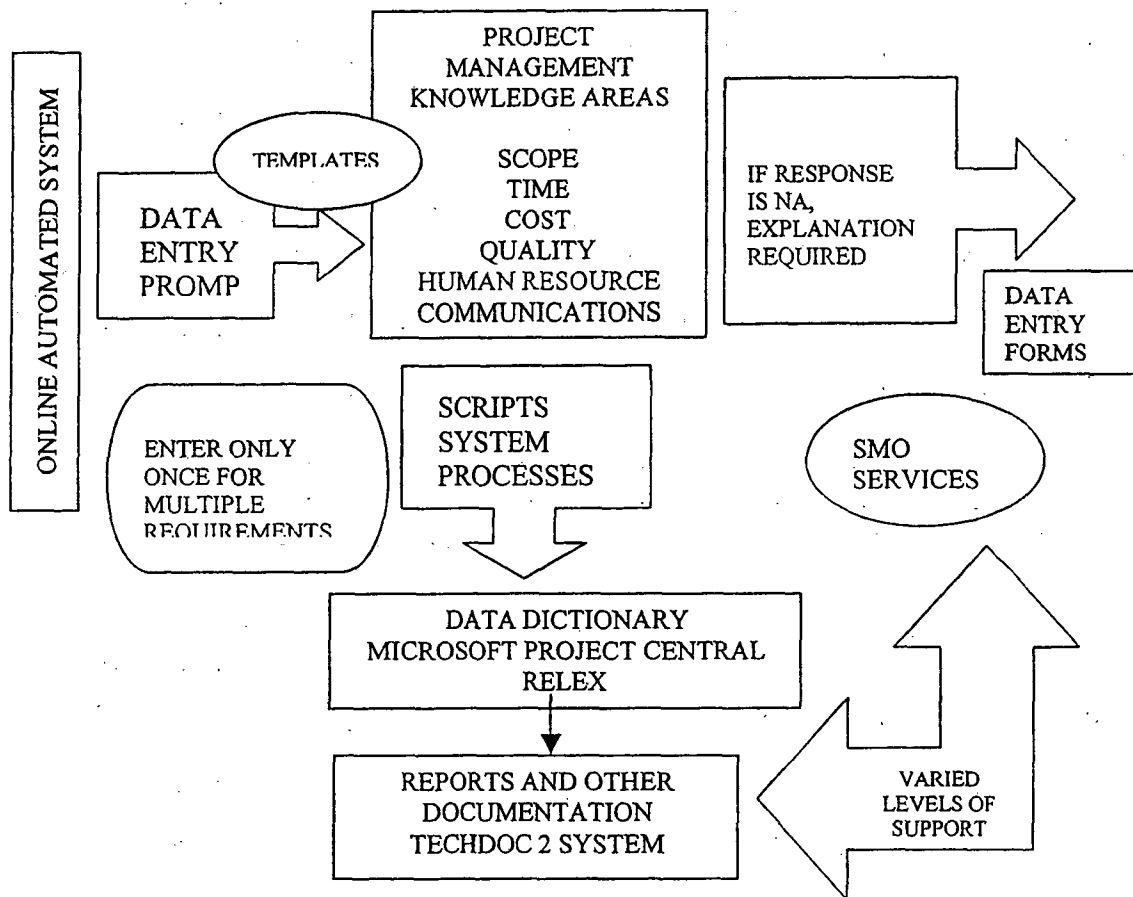Figure 1. Prospective SMO Web-based Intranet Architecture

2.2 Project Management Document System

The Tech Doc 2.0 System (http://tdsearch.ksc.nasa.gov/) uses a graphical user interface type interface similar to Windows Explorer to provide access to NASA documents including those specific to KSC. In doing so, the system provides electronic access to a limited number of project management reports. This system should also be integrated into the Project Management Integration System so that project managers and team members have a central location for the most current project management reports, thereby retaining consistency for the TechDoc System objectives. A Project Management Tools Questionnaire was developed, however, not completed as part of this project.

3. RESULTS

While the NASA KSC SMO has access to several effective project management tools, use of these tools by project managers appeared to be less than optimal. Therefore, a major objective was determined to be the optimal participation of project managers in project management activities (Levine, 2002). A system designed to comply with guidelines while offering consistent support to assure project managers that they and their team members have entered data required to retain an accurate picture of project status and direction is essential to optimal participation. An additional impediment to the implementation of a

feasible project management system, according to Levine, is that program management is usually complex in its requirements and execution. Therefore the author proposes the development of an architecture based on what may be referred to as the three Es of project management: efficient, effective, and easy. The proposed architecture is based on these features. Equally as important is the development of a framework designed to encourage a proactive method rather than a cycle of problem solving (Penã-Mora and Dwivedi, 2002). Of course, to achieve efficiency, project management software along with the structural framework for processing data must be supported by the implementation of real-time analysis capabilities, as corroborated by Penã-Mora and Dwivedi.

As true with most of the project management methods used today, the current design is inefficient for adequately handling all sources of change (Petrie, Goldmann, and Raquet, 2000). The large number of projects and responsibilities involved in project management at KSC requires a system to eliminate duplication and assure both the project schedule and required changes are instantaneous and automatic. Based on the assessed requirements and the current system capabilities, the author determined that an investigation of processes and techniques to automate project management software requirements using tasks, reports, and activities commonly executed by project managers and their team members on a daily basis was the best methodology for investigating solutions. This decision led to the investigation of several methodologies including Distributed Integrated Project Management (DPIM), Customer Relationship Management (CRM), and Enterprise Resource Planning (ERP). An integrated system designed based on each of these methods would be optimal. However, based on funding and organizational requirements, it may not be practical to integrate all into the system initially.

3.1 Short-term Versus Long Range Plans for the SMO Site Functionality

Short-term considerations for improving the SMO site function include using process plans, flow charts such as KDP-KSC-P-2603 to make completing requirements more intuitive for project managers by automating the flowchart contained in the template. For example by clicking the Start link in the automated version of a KDP-KSC-P 2602 template would appear on the screen so that it could be completed online or printed. Ultimately, the systems would be designed to track the user's status in the project implementation process thereby revealing where the project manager stopped during the last session. While ERP software is very effective for incorporating the information used by many different functional areas into one computer-based system, it is also very expensive, difficult to deploy, high maintenance, and takes a great deal of time to implement (Mello, 2002). CRM software, if properly implemented, has been proven to produce invigorating savings. However, the software is extremely complex and time consuming because of all of the customer relationships that must be integrated (Baldwin, 2002). Therefore, the author recommends further investigation of the benefits and cost of ERP and CRM technologies, while incorporating a common graphical interface to access the applications already deployed at KSC.

3.2 Distributed Project Management (DPM): A Solution with Promise

For large complex organizations such as KSC, DPIM is the most feasible of the methods reviewed for integrated project management. Petrie, Goldmann, and Raquet (2000) describe DPIM as an intense form of "Process Coordination" that infuses design, planning, scheduling, execution through distributed institutions and engineering disciplines as well as computer tools. Distributed project management offers the most versatile and effective solution to integration and automation for project management. This technology, while continuing to advance as a result of research and development in varied work sectors, has shown significant benefits (Ly, 1997; Matsutsaka and Hara, 2000; Collaborative Strategies, 2001).

4. CONCLUSIONS

Research into the organizational structure, practices, and procedures has lead to a determination by the author that the project management deficiency experienced at KSC is a result, in part, of lacking a system to streamline the processes required to meet internal and external standards relative to project management and to eliminate redundancy imposed when program and project managers must enter data for documents that are a normal part of their functional activities and again as a part of project management procedures.

4.1 Overall Infrastructure for Integrating Project Management Information Technology

Research during the course of this project indicates trends from data-focused project management to people-focused distributed project management support the framework proposed herein (Collaborative Strategies LLC, 2001). This framework of automated tasks incorporated from templates, standards, procedures, and techniques is based on computer-aided interactions of individuals throughout the organization. Thus, such interactions will result in automated entry within the Program Management Information System (PMIS). The proposed PMIS may be deployed using a web-based graphical interfaced to integrate commercial off-the-shelf (COTS) software, application service providers (ASP), custom designed software, or a combination of these. For example, Project Insight Project Management Software (http://www.project-management-software.org/) is an enterprise web-based project management software providing Gantt charts, calendars, tasks, risk, resource, time/billing discussions, files, security, Microsoft Project, Microsoft Project Central (Microsoft, 2000) integration and more. Figure 2 shows the system architecture of such an application. Review of the literature shows that Microsoft Project's custom programming language, Visual Basic for Applications (VBA) can be used to computerize recurrent tasks, interact with other Windows applications, and develop high-level custom reports quickly and easily. VBA can be used to create routines to dynamically adjust resource assignments and schedule information. This programming language is designed to develop macros to associate Microsoft Word documents, Excel workbooks, Access database applications, and PowerPoint presentations with specific tasks in the Microsoft Project application. Routines can also be designed to create and use "boilerplate" project templates. Probably most useful for designing systems to be used by individuals who do not specialize in using project management software is the capability to use VBA to create menus and toolbars to organize customized Microsoft Project functions on each user's desktop based on specified parameters.

4.2 System Resources Required for the PMIS

The primary resources required to design the proposed automated system are:
- Server w/Intel Pentium 75 MHz or higher or similar processor, 10–20 MB available hard disk space, and 16 MB RAM or more
- Windows 95 or 98, Windows NT 4.0 with Service Pack 3 or later, or Windows 2000
- Microsoft Internet Explorer 4.01 or later, or the Browser Module for Microsoft Project Central
- Appropriate number of Microsoft Project/Project Central 2000 licenses
- Microsoft Visual Basic for Applications
- The Microsoft Project 2000 Resource Kit
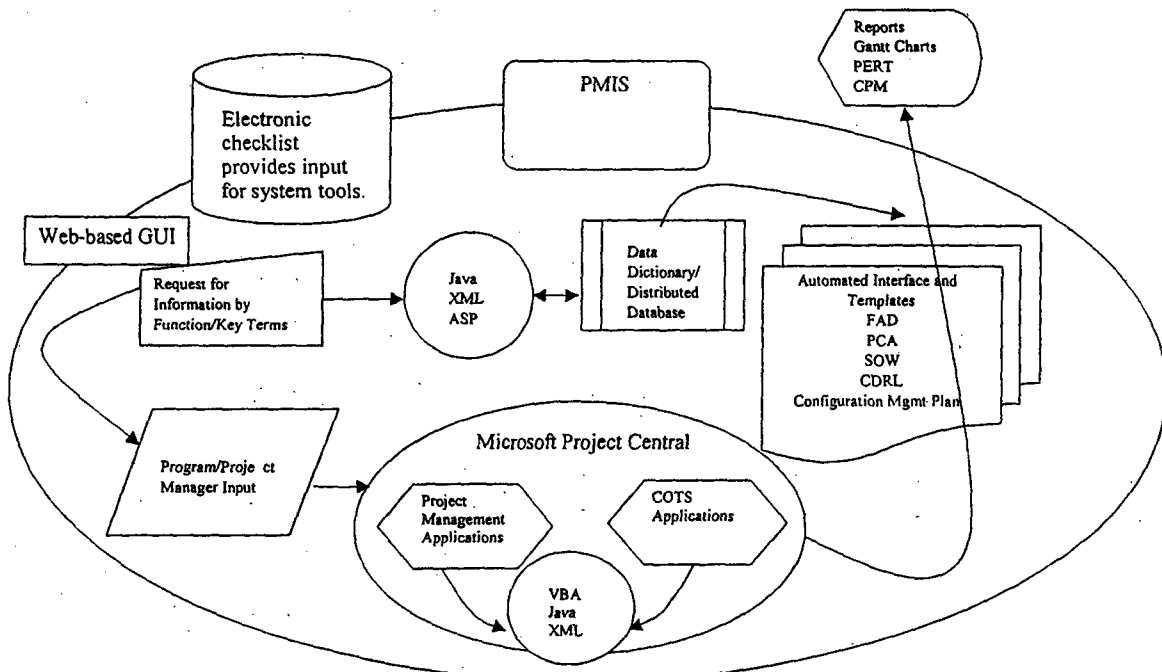- The Microsoft Project 2000 Software Development Kit

Figure 2. Program Management Integration System (PMIS) Architecture

Resource and Development Kits are free of charge and may be retrieved from the Microsoft World Wide Web site http://www.microsoft.com/office/project/prk/2000/appndx/toolbox.htm. Microsoft offers the Microsoft Project 2000 Software Development Kit http://msdn.microsoft.com/library/default.asp?URL=/library/sdkdoc/pr2ksdk/default.htm to assist developers in designing applications to interface Microsoft Project, Microsoft Project Central, and other applications. While a COTS application often will not meet all requirements, Resource Development Kits and programs like AsOne (http://www.as-one.com/ONE/SilverStream/Pages/pgAs1home.html) allow organizations to design custom interfaces and project management tools integration architectures without the need to redesign components of the software application that already exist and have demonstrated a record of success.

Unfortunately, research of the literature revealed that one of the most prevalent problems faced by organizations attempting to institute more efficient systems is the lack of implementation (Pfeffer and Sutton, 2000). However, because the SMO system of tools helps managers link performance metrics to budget formulation, thus enabling more focused and more effectively managed spending, the proposed PMIS holds greater prospects for implementation. Too often, research and development does not result in installation of recommended systems and approaches. Thus, organizations such as KSC should include in research and development projects such as this a requirement to evaluate and test the results within a specified period of time. A major component of that evaluation should be creating a KSC-wide project group to implement a prototype based on assessment of the results of this project.

36

5. REFERENCES

Baldwin, Howard (2002, March). Prescription for healthier CRM. Retrieved June 17, 2002 from the World Wide Web: http://www.zdnet.com/filters/printerfriendly/0,6061,2854592-92.html

Barkley, Bruce T. and Saylor, James H. (2001). *Customer-Driven Project Management: Building Quality into Project Processes.* (2nd ed.). New York, NY: McGraw-Hill.

Collaborative Strategies LCC. (2001). Executive summary: Distributed project management: Update 2001(Volume 1). Retrieved June 11, 2002 from the World Wide Web: http://www.collaborate.com/news/dpm2001vles.html

Devaux, Stephen A. (1999). *Total Project Control: A Manager's Guide to Integrated Project Planning Measuring and Tracking.* New York, NY: John Wiley & Sons, Inc.

Doyle, W. (n.d.). CLI project management. Implementation of scheduling and contract management software using the CLI project management implementation system. Retrieved May 22, 2002 from the World Wide Web: http://www.clipm.com/

Levine, Harvey A. (2002). Why project management implementation programs fail. Retrieved May 22, 2002 from the World Wide Web: http://www.myplanview.com/expert69.asp

Ly, Eric. (1997). Distributed java applets for project management on the web. IEEE Internet Computing. May-June, Industry Report. P. 21-26.

Marin Research (1998). Project observatory: Connecting your project community. Retrieved April 4, 2002 from the World Wide Web: http://www.marinres.com/pg5doc/admin/admin01_PG5_System_Administration_Manual_Contents.pdf

Mello, Andrian (2002, February). ERP fundamentals. Retrieved June 17, 2002 from the World Wide Web: http://www.zdnet.com/filters,printerfriendly/0,6061,28844319-92,00.html

Microsoft (2000). Microsoft Project 2000 enterprise project planning workbook deployment tool. Retrieved June 11, 2002 from the World Wide Web: http://www.microsoft.com/office/previous/project/workbooks/ProjWB.asp

Neroda, Edward. (1990, Fall). Uses and benefits of microcomputer project management software. Cause/Effect, 13(3). Retrieved June 14, 2002 from the World Wide Web: http://www.educause.edu/ir/library/text/CEM9037.txt

Newbold, Robert C. (1998). *Project Management in the Fast Lane: Applying the Theory of Constraints.* Boca Raton, FL: St. Lucie Press.

Paradigm (n.d.). Project management implementation. Retrieved May 22, 2002 from the World Wide Web: http://www.paradigmmanagement.com/Mentor/PMI.htm

Peña-Mora F. and Dwivedi, G. (2002, January). Multiple device collaborative and real time analysis system for project management in civil engineering. *Journal of Computing in Civil Engineering.*

Okubo, Takao, Matsutsuka, Hara, Hirotaka. (2000, December). System for distributed project management over the Internet: PI-CEE. FUJITSU Science Technology Journal, 36(2), pp. 193-200.

Petrie, C., Goldmann, S., & Raquet, A. (2000). Agent-based project management. Stanford Center for Design Research. Retrieved June 7, 2002 from the World Wide Web: http://www-cdr.stanford.edu/ProcessLink/papers DPM/dpm.html

Project Management Institute. (2000). A Guide to the Project Management Body of Knowledge: PMBOK® Guide. 2000 ed. v1.2. CD-ROM

Schwalbe, K. (2002). *Information Technology Project Management.* (2nd ed.). Boston, MA: Course Technology.

TenStep (2002). 10.0 Manage Metrics.Retrieved May 28, 2002 from the World Wide Web: http://www.tenstep.com/10.0%20Manage%20Metrics.htm

The Hampton Group (2002). Out training provides skills for success. Retrieved May 21, 2002 from the World Wide Web: http://www.4pm.com/adpm/adpmslid/sld010.htm

The Hampton Group (2002). The project office: High-flying PM aces & TV weather people. Retrieved May 21, 2002 from the World Wide Web: http://www.4pm.com/articles/control.html

Trepper, C. H. (2000). Application Development Trends. A project management primer. Retrieved June 14, 2002 from the World Wide Web: http://www.artemisintl.com/lang_en/press_room/in_the_news/adtMag_August01.pdf

Walker, E. D. (2000). An introduction to critical chain project management. Retrieved May 31, 2002 from the World Wide Web: http://sapittoolbox/documents/asp?I=1209