

**COMPARISON OF MODULE USAGE OF PROJECT
MANAGEMENT INFORMATION SYSTEM AND SUCCESS RATE
OF CONSTRUCTION PROJECTS: CASE STUDY**

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Presented to
The Academic Faculty

By

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**COMPARISON OF MODULE USAGE OF PROJECT
MANAGEMENT INFORMATION SYSTEM AND SUCCESS RATE
OF CONSTRUCTION PROJECTS: CASE STUDY**

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[To my friends and family who supported me through this long and fruitful journey.]

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LIST OF ABBREVIATIONS

ACR	Anticipated Cost Reports
IT	Information Technology
PMIS	Project Management Information System
RFI	Request for Information
OAC	Owner, Architect and Contractor
PR	Public Relations

SUMMARY

When searching for primary sources of literature about Prolog Manager, secondary literature sources were discovered, which casually mentioned Prolog Manager, not as a stand alone software platform, but used in conjunction with other software systems. Although Meridian Systems markets Prolog Manager as a do-it-all, stand alone platform- the evidence I collected suggested otherwise. Propaganda supporting the use of Prolog Manager was uncovered-what was surprising was the lack of scholarly material about one of the fastest growing software programs within the construction industry.¹ In conjunction with literary searches, research of the use of Prolog Manager on specific projects at Company X, a Fortune 500 company with 139 billion in revenue in 2007, were conducted. Qualitative inferences were collected from interviews with Company X and Meridian Systems, as well as quantitative documentation of Prolog Manager use at Company X as the foundation of evidence. Although the interviews of IT managers, at Company X and Meridian Systems, gave me valuable insight to their perceived benefits of Prolog Manager, their statements were not established facts. An added weakness of resulted from my limited access of sensitive financial documents. In the end, the data gathered established a correlation, with limitations, between the use of Prolog Manager modules and “unique Company X projects” successes at the organizational level.

¹ Meridian Project Systems Named One of the Nation's Fastest-Growing Companies By Inc Magazine. (11 October). *PR Newswire*, 1. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 84018654).

CHAPTER 1

INTRODUCTION

1.1 Digital Usage in Construction

What percentage of the 656,434 construction related establishments in the US use construction management technology throughout the construction process? According to the US Census Bureau, 1,332 of those establishments are located in Georgia.² In 2008 *Constructech* magazine published a comprehensive study of construction management professional technology choices. According to the 2008 National Construction Technology Survey approximately 60% of respondent commercial firms describe their approach to buying/using technology as aggressive/very aggressive.³ If construction is about delivering a built asset that is of high quality and efficiency, wouldn't most companies use all the tools and processes available at the highest organizational level possible? A major assumption is made that Prolog Manager is an effective Project Management Information System. Saying Company X will benefit from more module use with Prolog Manager system is not the same as saying they will suffer from lack of module usage. If a company has already attained success using manual systems it successes may continue. To be as successful as possible, maximum utilization of all modules of Prolog Manager at the "unique project type" organizational level is necessary, and correlations can be made between higher module usage and greater project successes with this type of company size and structure.

² <http://www.census.gov/epcd/ec97brdg/INDXSIC2.HTM#C>

³ <http://www.specialtypub.com/constructech/techsurvey>

1.2 Prolog Manager

Prolog Manager is a computer software program that is used in the construction industry, to facilitate quality control through paper and process management. New software can create more chaos for reluctant users who are not using it to its full potential. The scope of this research is to explore the use of Prolog Manager at a Fortune 500 company, with 139 billion in revenue in 2007, located in Atlanta, Georgia-Company X. If reluctant users understood the benefit of using all the functions available with Prolog Manager, they would use more functions. Increased use of functions, in Prolog Manager, could correlate to more success of construction projects by increasing the quality and efficiency while at the same time decreasing the overall cost. Decreases in cost can be realized by decreasing the number of change orders which through the efficiency of a good management system/program (Prolog Manager) if use to its full potential.

Project success rate for this study is defined as $\text{ACTUAL COST} / \text{ESTIMATE OF COST}$. The analysis of the actual cost compared to the estimated cost is an important indicator of a certain company's ability to manage the projected fee or profit with the Prolog Manager. If the company is using Prolog Manager to estimate costs and better that cost using Prolog Manager's efficiencies, this can be the beginning point of a successful project. If potential end users clearly understood all the benefits Prolog Manager offered they would use more functions and see better results.

Meridian Systems, the distributor of Prolog Manager, suggested during the semi-structured interview, that Prolog Manager enhanced quality control through its automated operational processes. Meridian felt the reports created by Prolog Manager can be used

as a tool, but its automated system works better integrated within an organizational structure. The database can be used to compile and manage the paperwork, but it can also be used to simultaneously communicate to and manage all the team members. The Project Team website suggests the following:

Prolog® Manager, from Meridian Systems®, provides complete project control by automating all aspects of the construction lifecycle, from project design to close out. By delivering in-depth project management features across projects and programs, Prolog helps both large and small organizations deliver their construction projects on time and on budget.”⁴

1.3 Different Modules of Prolog Manager

The five core modules available with Prolog Manager are: Purchasing, Cost Control, Doc Control, Field Admin, and Admin. Of these five core modules, three of them are typically used on projects: Cost Control, Doc Control, and Field Admin. The other two core modules, Purchasing and Admin are not typically used daily. On construction projects, all the materials to be used are organized at the beginning of the project. Thus, the beginning of the project is when you would typically use the Purchasing module. As far as Admin, most administrative duties are used in the beginning for project startup procedures and at the end for project during closeout procedures. Although I will focus on the other three modules, it is important to note of

⁴ http://www.projectteam.com/PrologManager_2008.pdf

the four modules: Doc Control has the most functions and is used the most throughout the project, on a daily basis, because of its higher volume.

In the Cost Control module you can track the project budget and the project costs, create records for all of the contracts, purchase orders, and invoices within the project and track contract changes. The following forms are available in the Cost Control module: Tracking Lump Sum Contracts, Tracking Unit Price Contracts, Tracking Contract Changes, Tracking Backcharges, Application for Payment, Budget, Budget Control, Change Order Requests, Contract Invoices, Contracts, General Invoices, Potential Change Orders, Prime Contract Change Orders, Purchase Order, Catalogue, Purchase Orders, Revenue Codes, and Subcontract Change Orders.

In the Field Admin module the superintendent's job involves managing daily jobsite activities. At the end of the day, the information gathered by the superintendent through job walks and conversations with the foremen needs to be written down or recorded. The following forms are available in this module: Daily Details, Daily Work Journal, Events, Field Work Directives, Inspections and Tests, Material Inventory, Notices to Comply, Punch List, and Safety Notices.

1.3.1 Doc Control Module

The Doc Control Module, unlike the other modules, is separated into divisions. This is where the bulk of paperwork and coordination happens. All the correspondences among team members and all project recording happen under Doc Control. The Doc Control Module has four divisions, called sub sections, as follows; Project Communication, Project Drawing Organization and Log, Tracking System for Assigning Tasks on Logs, and Organizational Tracking for Submittals. In each of the sub sections

there are 3-4 sub-sub sections. The first sub-sub section, Project Communication has Meeting Minutes, Conversation Log, Transmittals and Correspondence Log. The second sub-sub section, Project Drawing and Organization Log, has Drawing Packages, Drawings and Specification Forms. The third sub-sub section, Tracking System for Assigning Tasks on Logs, has Hotlist, Issues, Request for Information and Closeout Log. The fourth and last sub-sub section is Organizational Tracking for Submittals which has Submittal Packages, Submittal Register and Submittal Transmittals. The fourth level, under these sub-sub sections, is the entry point for information. The information entered into these modules in the Prolog Manager System is the responsibility of all team members. The architect may input drawings while the construction manager may input Request for Information (RFI).

To further analyze, let's discuss each sub-sub section under the Document Control Module where the raw information is inputted. Meeting Minutes sub-sub section is where users can manage minutes of any type of project meeting. Prolog Manager Getting Started help refers to these meeting types as "meeting sets." Some examples of meeting sets are weekly subcontractor meetings, OAC meetings, or safety meetings. All team members have live access to meeting minutes and can receive automatic updates when meeting minutes are uploaded to the project network. See "Exhibit A"⁵ for an example of meeting minutes summary history.

⁵ http://www.lavc.edu/propa/minutes_pdf/FMP1.12.06.pdf

The Conversation Log sub-sub section creates a record of any important project information exchanged through conversations. During conversations or immediately afterwards, users can record what was discussed as a project record. Prolog Manager enables team members to schedule a follow-up reminder for another conversation if necessary. See “Exhibit B”⁶ for an example of a conversation log entry.

With the Transmittal and Correspondence Log, the user can create transmittal cover sheets to attach to items used on projects. For example, when the project engineer sends samples to the architect, the transmittal will be attached as the record of this activity. The transmittal is a back up record of project activities and correspondence, a cover sheet, confirmation page and fax record all in one. Drawings Specifications and Packages creates a time stamp and dated record of the original drawing or specification along with any revisions made. By electronically organizing and dating the drawings and specifications users can track every design concept or change for a particular project. See “Exhibit C”⁷ for examples of Transmittal and Correspondence Cover Sheets.

The Hotlist form assigns a list of tasks to the responsible persons and tracks the progress of each task until it is completed. Any issue that arises on a particular project can be tracked on the Issues form. For example, when bad weather affects a project, team members can keep track of weather delays and

⁶ <http://www.pssgroup.com/PDF/PrologSampleReports.pdf>

⁷ http://www.lavc.edu/propa/minutes_pdf/FMP1.12.06.pdf

print reports showing the sequence of events surrounding this issue. See “Exhibit D” for examples of a Hotlist form.

Request for Information (RFI), questions are created to log and track the history of project related the original query, follow up questions and answers. The RFI can also track whether drawing or schedule updates are required. The Closeout forms electronically records the items which need to be turned over at the end of the project, including warranties, record drawings, operations and maintenance, and final lien releases. See “Exhibit E”⁸ for an example of a Request for Information data entry.

1.4 Specific Aims

1.4.1 Specific Aim 1

My aim was to collect data using library searches on current usage of Prolog Manager at the organizational and individual project level. I wanted to compare multiple-case studies in order to find compelling information about Prolog Manager module usage within construction companies. My original plan to collect data for my thesis included searching on-line and conducting library searches for literature reviews and journal articles. I expected to find scholarly evaluation, based on primary or secondary sources about construction and current technology, especially Prolog Manager. However, the construction industry is not as heavily filled with research and academic

⁸ <http://www.pssgroup.com/PDF/PrologSampleReports.pdf>

exploration as other industries, so it was not surprising that there was a lack of investigation into the multifaceted uses of the Prolog Manager system.

Without success uncovering research or case studies relating to the uses of Prolog Manager, I looked to a single case study and interviewing the distributor and Company X for my analysis. A detailed case study of Company X can represent a significant contribution to knowledge and theory building as well as provide a basis on which further studies can be based. My experience direct experience using Prolog Manager combined with historical data from Company X created an opportunity to observe and analyze a system that had not been heavily discussed in the past.

1.4.2 Specific Aim 2

My next aim was to analyze the data gathered while conducting interviews and compiling historical data of construction projects at Company X. I was limited to a sufficient sample size of construction projects documented in Atlanta, Georgia in the last three years at Company X. The IT manager at Company X submitted random project data, showing prolog module usage and project costs, for the first 10 institutional projects that were quickly accessible within the Prolog Manager database. I also had several phone conversations with the IT manager at Meridian Systems in order to document how Meridian Systems felt Prolog Manager was benefiting Company X.

CHAPTER 2

METHODOLOGY

2.1 Library Review on Prolog Manager

In order to investigate potential relationships between Prolog Manager module use and project successes, I searched multiple sources of data on construction projects. I searched for literature reviews on Prolog Manager to see what others were saying. As Neil J. Salkind said “Research sources are where you obtain the information you need to make your argument.”⁹ The reference librarian at Georgia Tech Library and Information Center aided me in collecting Articles (Databases) and eJournals. The main databases I used were Academic Search Complete, ProQuest Research Library, Lexis Nexis Academic, JSTOR, and Web of Science. The scientific journal searches on Prolog Manager resulted in data using Prolog as a programming logic interface. There were detailed articles about the Prolog formulae and syntax language. The Lexis Nexis search provided information on legal issues surrounding proprietary software licensing related to Prolog Manager. The ProQuest search results led to PR business wires and general descriptions about the benefits of Prolog Manager. The interesting thing about the ProQuest results was the findings which showed that Prolog Manager was not being used as a stand alone system which provided complete project control. Instead, Prolog Manager was being used in conjunction with other project management software systems.

⁹ Salkind, Neil J. (2006). *Exploring Research*. Sixth Edition. *Pearson Prentice Hall*, pg. 202.

For example, project management systems like Timberline¹⁰, J.D. Edwards¹¹ and Deltek¹² were being integrated with Prolog Manager. The difficulty of locating existing documentary information about Prolog Manager usage on construction projects, led me to conducting interviews and analyzing raw data of Prolog Manager use submitted by Company X.

2.2 Analysis of Prolog Manager Use by Company X

Additional data was collected by conducting semi-structured phone interviews with the distributors of Prolog Manager, Meridian Systems. I contacted the IT manager at Meridian Systems in order to record the ways Meridian Systems felt Prolog Manager was benefiting Company X. The objective of this approach was to gain insight to the views of the distributors of Prolog Manager as well as the users of Prolog Manager. Meridian Systems conceded that there is no one correct use of Prolog Manager-some of Meridian client companies used the factory settings while others made extensive alterations to mirror their other current systems in use. Most of Meridian Systems client customers used Prolog Manager for specific functions at the individual project level-not at an integrated organizational level. The Cost Control, Reporting, and Security Manager modules were rated the strongest modules available on the software market by most users. The areas where Meridian Systems improved with its later editions were the

¹⁰

<http://proquest.umi.com/pqdweb?did=1440531421&sid=7&Fmt=3&clientId=30287&RQT=309&VName=PQD>

¹¹

<http://proquest.umi.com/pqdweb?did=585502272&sid=7&Fmt=3&clientId=30287&RQT=309&VName=PQD>

¹² <http://proquest.umi.com/pqdweb?did=56841605&sid=7&Fmt=3&clientId=30287&VName=PQD>

Purchasing and Metric Manager modules. This exploration of both, the supplier view and client view, helped to paint a more complete picture of the value placed on Prolog Manager modules. My analysis did not take into account the various ways each company may choose to adapt and use Prolog Manager. I assumed that all the companies adapted Prolog Manager to fit the existing workflows at the project level. If factory settings were used, it is assumed to be used because it worked with the existing systems already in place.

The data collected by conducting semi-structured phone interviews with the IT manager at Company X, informed me that they were using the Prolog Manager to manage cost and risk. To further investigate this claim I requested archival records of Prolog Manager usage and project successes. My definition of acceptable use of Prolog Manager included the complete use of software modules, that is, using it in its entirety. My definition of project successes was the ratio of projected/estimated budget divided by actual budget. As previously noted, I relied on the records submitted by Company X - thus the records of (module usage) variables have already been predetermined using existing data of submitted construction projects. My initial analysis included Prolog Manager modules use each having the same level of importance, giving non-use a value of 0 and use a value of 1. The IT manager argued that Company X valued more Prolog Manager modules some than others. Some modules were essential to a projects success while others were nonessential.

A weighted module system was created in consultation with Company X to account for this differing perceived importance of each module. Each module was rated on a scale of one through five; modules with less importance were ranked lower with a

value of one, while those with the most importance were ranked higher with a value of five. For example the modules in the Submittal Register and Submittal Packages were valuable and assisted the project manager in managing and tracking items throughout the project therefore, this was ranked with a number of 5 in the Prolog Project Matrix¹³. In contrast, the Submittal Transmittal cover sheet made it easy for the project engineer to produce a transmittal, but did not provide any added value, since completing a submittal transmittal requires tandem use of submittal register and packages, so it was ranked with a number of 1 in the Prolog Manager Project Matrix¹⁴. Although Company X insisted on using a weighted system, the weighting of the modules did not alter the resulting order of each project module use.

Although this weighted module system accounts for differing perceived values, I will not elaborate on the detailed reasons for each of the values placed. Company X views the measurement of a successful project, different from my definition, as “meeting or exceeding the projected fee and owner’s satisfaction.” The IT Manager suggested I analyze the success of construction projects based on the ratio of projected fee divided by actual fee instead of projected cost divided by actual cost. The more accurate view of project successes should take into account the projected fee and actual fee because of the types of contracts typically used by Company X. The majority of Company X construction projects included contingency or reserves. The allocated contingency or reserve funds remaining after the project is completed may be applied to the project cost

¹³ Refer Appendix G and Appendix H.

¹⁴ Refer Appendix G and Appendix H.

in the form of added scope or may be returned the Owner. The unused money whether returned to the Owner or added to another scope of work should be used to analyze the successes of construction projects at Company X. This data for the unused money was not made available during the research process so the actual cost-fees, profit and other intangibles need to be considered in future studies.

CHAPTER 3

RESULTS

3.1 Library Review on Prolog Manager

Prolog Manager is a complex, data base logic system that claims to automate all construction project information in real time. Prolog Manager is considered the company standard Project Management Information System (PMIS) at Company X. Only if an owner requests a different software system does Company X deviate from the company standard. My findings consisted of propaganda praising the Prolog Manager system, without any tangible data or research to verify the claims that were made. There were multiple PR newswires readily available describing how Prolog Manager software would save time and money on construction projects. Letters from Prolog Manager users praised the product with the message that Prolog Manager was a one size fits all package- it helped my company, letters implied, so it can help yours. One company called “Q and D Construction” reported their perceived benefits of the software when the company was involved in a court case. They felt their competent construction was proven through their

competent documentation using Prolog Manager. Q and D Construction in Sparks NV had this to say about how Prolog helped their legal issues.

“We had a court case where, because of our Prolog documentation, we won,” states Crutchley. “We had identified a concrete issue in the beginning of the project and documented our concerns through multiple RFIs and the submittal process. When the concrete failed, we had the documentation to support our case.” This was a project that had been closed out two years earlier and Q&D was able to go into its Prolog database and easily search for the documentation needed. “Prolog probably saved us thousands of dollars on this one incident alone,” adds Herron. “And the judge was impressed by how organized we were.”¹⁵¹⁶

It seems to be all about the competent documentation. The following case reported by the New York Times could have been avoided with proper documentation and processes of all team members. When a subcontractor certification is in question or about to lapse, Prolog Manager could have alerted the project team through automated reminders and suspended work until inspection were verified.

“The New York Times reported on March 20, 2008 the city inspector was charged in the crane collapse investigation in New York City March 15, 2008. “The Buildings Department inspector was also charged with lying to the New York City authorities about inspecting the

¹⁵ <http://www.pcigrp.com/pdf/Q&D.pdf>.

¹⁶ <http://74.125.47.132/search?q=cache:QcFKNQwHzQJ:www.pcigrp.com/pdf/Q%26D.pdf+court+cases+prolog+manager&hl=en&ct=clnk&cd=3&gl=us>

crane that collapsed on Saturday afternoon, killing seven people, injuring dozens of others and causing property damage. They said the failure to inspect the crane on March 4 may have been the cause of the failure of the nylon strap, which led to a large steel collar coming loose. According to the commissioner of the Department of Investigation, a call to 311 was made reporting concerns about the stability of the crane. The city inspector made entries on a Building Departments inspector's route sheet indicating he followed up on the call and inspected the crane the next day at the construction site at 301 East 51st street. In response to the collapse, the commissioner is preparing a full audit of the entire cranes and derricks unit and ordered that associated applications and paperwork be made available on the web for the public.”¹⁷

It is possible; this crane collapse could have been prevented with the proper automated project oversight and controls.

A major part of the management of construction has to do with effective control and management of the construction process and paperwork. There should always be a verifiable paper trail for all construction activities. In the OSHA standards 29 CFR 1926.550 (a)(5), “The employer shall designate a competent person who shall inspect all machinery and equipment prior to each use, and during use, to make sure it is in safe operating condition. Any deficiencies shall be repaired, or defective parts replaced before continued use. The employer shall maintain a record of the dates and results of

¹⁷ <http://cityroom.blogs.nytimes.com/2008/03/20/city-inspector-is-charged-in-crane-case/?pagemode=print>

inspections for each hoisting machine and piece of equipment.” To ensure safety compliance, the project manager or competent person would accompany equipment inspectors during inspection and documentation processes.¹⁸ Automated real-time database systems, including Prolog Manager, were created to make routine processes such as this. After a certain level of documentation, end users may experience paper and information overload, without a robust and automated process of organizing and compiling volumes of project information.

3.2 Overview of Prolog Manager Usage by Company X

The Meridian IT Manager felt that most of the companies using their Prolog Manager system were not concerned about using the system at the company organizational level. It seemed different departments, for the most part, did not use the same systems or processes. Most companies, especially Company X, used Prolog Manager more as a tool to satisfy a specific function at the project level within the company. The IT Manager drew parallels between the amount of Prolog Manager module usage and the level of structure already existing at client companies. It seemed to him, the companies with a more structured organization seem to use more modules of Prolog Manager, while companies with less structure seemed to use fewer modules. The Meridian IT Manager did not have any data besides personal observations to substantiate this claim. Although my research was limited to Company X this claim could be further analyzed in the future. When Company X needed to control cost and risk, Meridian System placed more

¹⁸ <http://www.osha.gov/pls/oshaweb/owadisp.showdocument?ptable=STANDARDS&p id=1076>

importance on the Cost Control module. Table III: Prolog Manager Project Weighted Project Matrix uses values 0-5 to reflect these weighted modules' as previously discussed and Table II: Prolog Manager Project Unweighted Matrix, using the value of 1 and 0 with 1=use and 0=nonuse, is included to consider differences between the two. The 10 project start and end dates are listed below.

Because Company X placed more value on certain modules more than others it later mandated the use of the Cost Control and Reporting modules while the other modules were highly recommended. The Cost Control module creates Anticipated Cost Reports (ACR) using cost events, budgets, contracts, change orders, and invoices. The ACR shows potential risks at all times throughout the construction project. The Reporting Module is used to compile all the raw data in an organized way. While there may be some projects still using Excel spreadsheets, Prolog Manager is the company standard. The IT Manager at Company X believes, Excel did not allow him to standardize and control the formulas all the project managers were using. In addition, he felt, Excel does not have an essential function which compiles data automatically and creates reports for analyzing raw data.

I compiled the unprocessed data onto the weighted Prolog Manager Matrix to expose any inherent correlations between Prolog Manager utilization and bottom line profit margin on selected projects.

PROJECT DATES	Start	Finish
Project 1	10/2/2008	12/31/2008
Project 2	6/27/2008	1/21/2010
Project 3	8/17/2007	1/16/2009
Project 4	3/17/2007	4/1/2009

Project 5	8/12/2007	4/1/2009
Project 6	10/3/2006	8/1/2009
Project 7	11/5/2006	3/2/2010
Project 8	11/19/2005	12/11/2008
Project 9	9/3/2006	10/31/2008
Project 10	6/10/2006	7/4/2008

When I observed the data of all 10 projects at the individual project level, no definite correlations were made. The data was further scrutinized using different groupings at the organizational level. All the successful projects and unsuccessful projects were graphed separately to further probe concealed relationships. No correlations were made between the module use and project successes. At the organizational level the project list included a lot of university projects because Company X has a lot of experience with this project type. This led me to arrange the projects based on typical (university projects) and unique (assorted) Company X projects.

This arrangement immediately uncovered a correlation of module use and project success. Company X is paying for all the Prolog Manager modules but not one submitted project used all the modules available. If a company is investing time and money on Prolog Manager, is it getting the most out of the software when all the modules are not used? As discussed earlier, we learned that companies such as Company X interfaced Prolog Manager with additional software platforms instead of using all the Prolog Manager modules, this could lead to inconsistencies when trying evaluating the efficiency of Prolog Manager as a stand alone system. Repeated experiments should be done in the future using Prolog Manager as a stand alone system to see if the results support my findings. Further inquiries can help explain how much use of modules results

in bettering a Company's projected cost? Since there was no project that used all the modules, future research is need to find the accurate benefit of module usage reflected in a project using all the modules available. At what point is it beneficial before the effect tapers off? I looked for answers to these questions when interpreting the Prolog Manager Project Matrix.

Though my research uncovered correlations between project success and the use of Prolog Manager modules and supplemental features, some of these other questions were left widely unanswered in this scope.

TABLE I

TEN "COMPANY X" PROJECTS

PROLOG MANAGER WEIGHTED PROJECT MATRIX ANALYSIS

■ ModuleUsage = Module Used / # Module ■ Success = Projected Cost/Total Cost

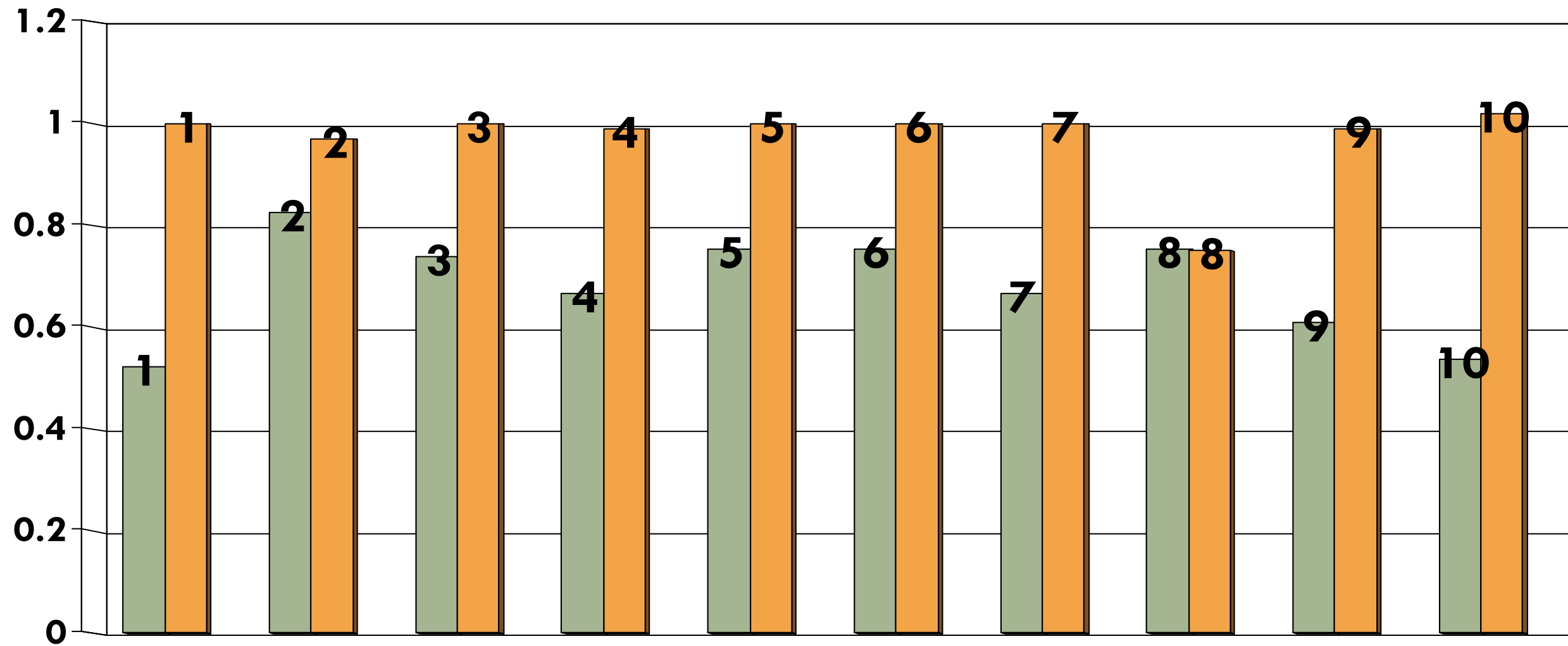
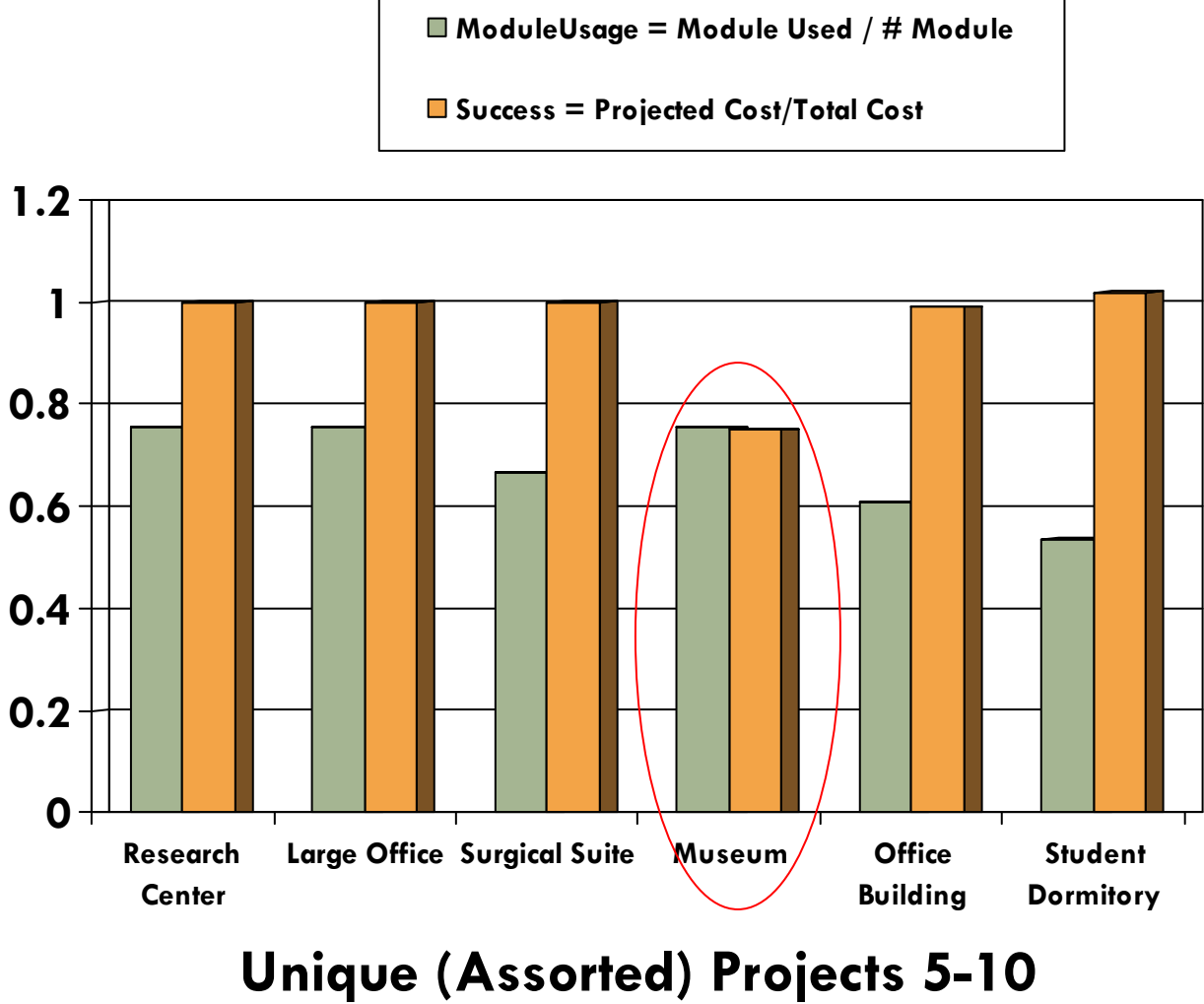
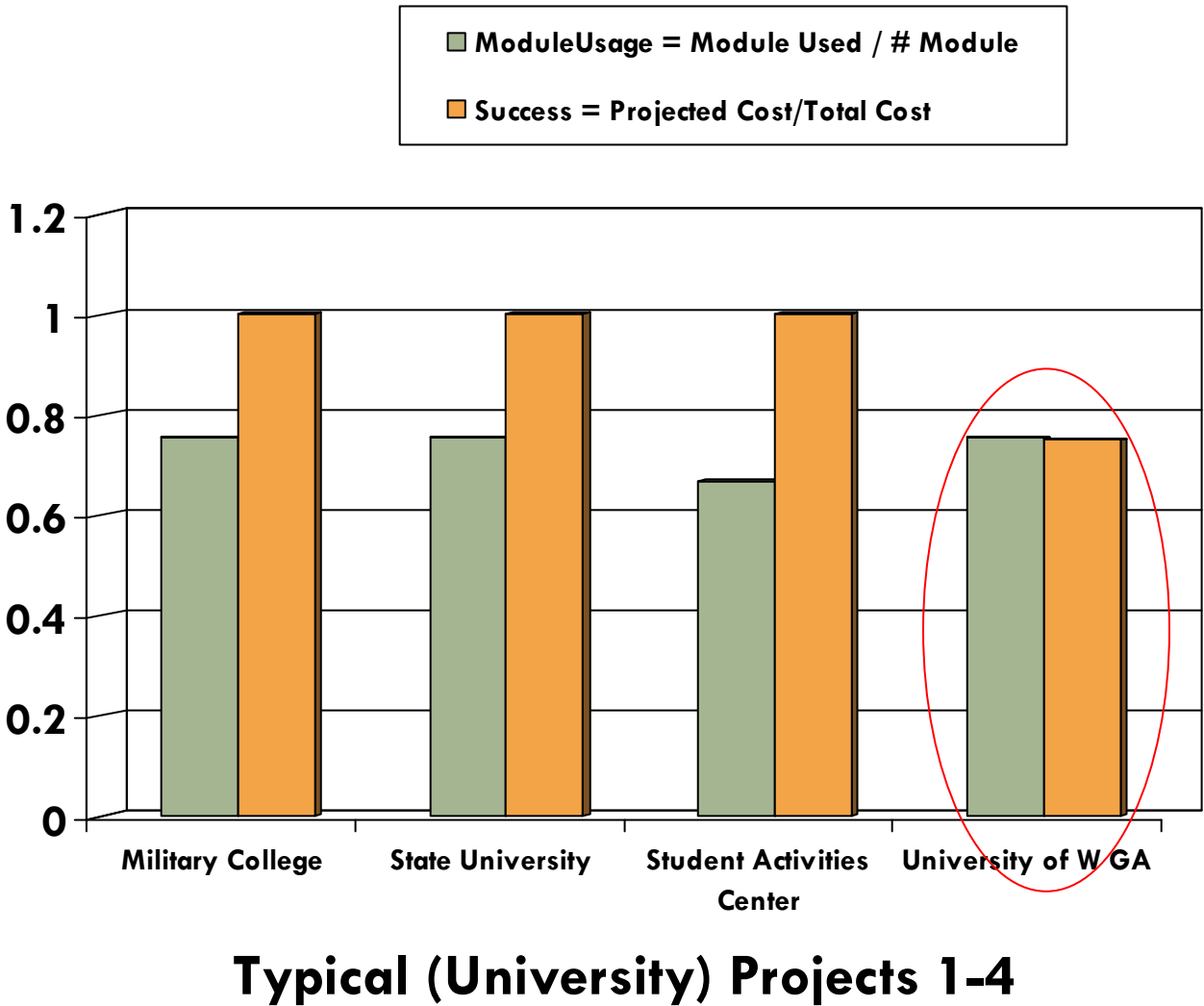


TABLE II

“COMPANY X” PROJECTS SEPARATEC BY UNIQUE AND TYPICAL PROJECT TYPES

PROLOG MANAGER WEIGHTED PROJECT MATRIX ANALYSIS WITH OUTLIERS CIRCLED



3.3 Different Modules of Prolog Manager Used by Company X

The five core modules available with Prolog Manager are: Purchasing, Cost Control, Doc Control, Field Admin, and Admin. Of the five core modules available with Prolog Manager, the Prolog Manager Project Matrix on Table III analyzed the three core modules typically used on Company X projects: Cost Control, Doc Control, and Field Admin. The Cost Control is the most important module followed by the Doc Control module. Company X relies on Cost Control to track potential risk and reflect what is happening financially on each construction project. The Doc Control is used to track all the communication during construction between team members. The Field Admin is used to track the physical construction as it progresses.

This analysis will focus on these main core functions as well as two of five supplementary modules used. The five supplementary modules available are Report Manager, Query Manager, Database Utilities, Word Processing, Security Manager and Messaging. The two supplementary modules used at Company X are the Security Manager and the Report Manager. The Security Manager controlled access to project information by setting restrictions on who can log on and what type of information they can access. The Report Manager generates project reports sorting and filtering project data entered by users. To focus on the main analysis the sub-sections as explained in the DOC Control Module chapter are listed on the Prolog Manager Project Matrix Table but

not shown the graphs. Each Prolog Manager Project, reflecting the core modules and sub sections, is graphed on the y-axis of each Prolog Manager Project Matrix¹⁹.

The number of projects using Prolog Manager are shown on the y-axis while the success of each projects' ratio of projected and actual costs are reflected on the x-axis of each Prolog Manager Matrix. If a construction project is using all the Prolog Manager modules, the ratio = 1.0. The ratio of module use is currently < 1.0 so the goal for construction projects is to get as close to 1.0 as possible. The measurement of a successful project that was used for my analysis was the ratio of projected fee divided by actual cost. The goal is for the construction projects to be equal to or greater than 1.0. Any project with a ratio under 1.0 has actual costs that are higher than originally estimated while projects over 1.0 are spending less money than estimated. I was unable to analyze the construction projects after construction was complete, but before the remaining funds are returned to the owner, because the project data was not made available.

The graphs were analyzed at the organizational and project levels. Although the projects were successful across the board, some were more successful than others. At the organizational level, the university projects were graphed Project 1-4 and the unique projects were graphed Projects 5-10. The most successful projects were the university projects. In each graph there was a project which did not follow the same model as the rest of the data, an outlier. For example the graph of Project 1-4, Project 1 had an unusually low module usage when compared to Projects 2-Project 4. The project

¹⁹ Refer Appendix G and Appendix H.

numerically distant from the results, Project 1, was identified as an outlier, which may have occurred from data entry errors. The unique assorted projects, Projects 5-10, revealed similar correlations. All the unique projects were very close to successful as defined with the exception of Project 8, which was numerically distant from the results. This outlier could have also occurred due to formula input error or various other reasons.

Initially, my definition of module usage and project successes seemed on track to provide complete data for substantial analysis, but when I considered the lack of data relating to the projected fee, project background information, and inner workflows of Company X, my data was incomplete. The correlations which could be made were made, but further research and additional information should be collected in order to verify these results. Company X documents missing essential data regarding projected fee and actual fee may have an effect on the logical conclusions that were made.

3.4 Qualitative Analysis of Module Usage VS Successes

Although significant guidelines measuring the value of modules used by Company X were developed, weighted modules and project success, the correlations made with the qualitative evidence distributed on the Prolog Manager Project Matrix can be strengthened using a larger sample of projects. The organization level results of the Weighted Prolog Manager Project Matrix calculated Project 1 as having the lowest module usage, while Project 2 had the highest module usage. The Weighted Prolog Manager Project Matrix also calculated Project 1 as having the lowest module usage ratio, while Project 2 had the highest module usage. Data examined at this project level can lead to conclusions that increase module usage does not necessarily correlate to higher success rate. It is at the organizational level where correlations of module usage

and projects success can be considered. The separated typical and unique project graphs each show a trend towards a more successful project as more Prolog Modules are used.

Some questions about the data submitted are still unanswered and additional project background data I requested was not submitted. It is also not apparent why the committed costs are different from the projected budget and uncommitted cost.

CHAPTER 4

CONCLUSIONS

4.1 Summary

In conclusion, different perspectives between project success and module usage need to be considered. Further research using the definition of project success needs to be modified to include the projected fee and the actual fee earned. Since adjustments that are continuously made to the project budget, relying solely on the final project cost may skew any analysis if fees and uncommitted costs are not taken into account. Technically the projected budget should have changed as more scope is added or taken away from a project, but that type of project information was not available.

In further studies, the process of protecting sensitive financial information of Company X can be communicated better. Company X needs to trust that all the company's financial data will be secure and not compromised throughout the research process. Setting up better parameters to protect sensitive information may allow additional information to be released and compiled for a more thorough evaluation.

The aim of the research was to identify benefits of maximum utilization of Prolog Manager and where that benefits tapers off as well as the indirect result of

underutilization of Prolog Manager. Since none of the construction projects used all the Prolog Manager modules, it is recommended that a pilot project using all the modules be generated. This would provide a basis for more complete data analysis.

Company X may want to consider investing in two database systems. One data base would be used to analyze data at the project level and the other would be used to analyze the success of all projects at the company level. Since the benefits are different at the individual and organizational levels, possessing both types of records can inform Company X of projects successes at both levels.

APPENDIX A

RAW DATA

Meeting Minutes

URS		LACCD Meeting Minutes				
Open Items - Grouped by Title, Topic with Report Format						
Facilities Master Plan Meeting Meeting 58						
Date	Start	End	Next Meeting	Next Time	Prepared By	Company
1/12/2006	01:30 PM	03:05 PM	1/19/2006	01:30 PM	Tanya Roton	URS Construction Services
Location	Cafeteria Conference Room		Next Location	President's Conference Room		
Purpose						
General Notes	The names of the individuals who attended the meeting are on the attached "Sign-in Sheet."					
Attended By			Non-Attendees			
Los Angeles Valley College - Bruce Thomas			Los Angeles Valley College - Dana Lubow			
Los Angeles Valley College - Carol Weston			Los Angeles Valley College - Ed Nelson			
Los Angeles Valley College - Chuck Ferrero			DMJM/JGM - Patrick Woods			
Los Angeles Valley College - Carlotta Tronto						
Los Angeles Valley College - Don Gauthier						
DMJM/JGM - Jonathan Levy						
Los Angeles Valley College - Juliana Alvarez						
Los Angeles Valley College - Lawrence Nakamura						
Los Angeles Valley College - Marla O'Connell						
Bobrow/Thomas and Associates - Michael Bobrow						
URS Construction Services - Mitch Vaccari						
Los Angeles Valley College - Tom Jacobsmeyer						
Los Angeles Valley College - Tom Lopez						
Los Angeles Valley College - Dr. Tyree Wieder						
URS Construction Services - Tanya Roton						
Los Angeles Valley College - Dr. Yasmin Delahoussaye						
assigned. 12/15/01 The project superintendent Bruce Hanna will be on site next week.						

APPENDIX B

RAW DATA

Conversation Log Entry Interface

The screenshot displays a software window titled "Conversation Log". At the top, there is a table with columns for "Number", "Date", "Time", "Subject", and "Closed". The first row contains the values "0001", "9/5/2000", "08:11 AM", "contracts", and an unchecked checkbox.

Below the table is a "General" section with several input fields:

- Logged By:** Adrian Brown
- Company:** Acme Construction Inc.
- Telephone:** 206-555-1212
- Type:** Phone Conversation
- Other Party:** Pat Holden
- Company:** Biggeraco Construction Lt.
- Telephone:** 707-333-3200
- Category:** (empty)

The "Conversation Details" section includes:

- Summary of Conversation:** A text area containing the text: "Called Pat to discuss contract that is overdue. Pat said he had signed it and it was in the mail. I asked to have him fax me a copy."
- Status:** Pending
- Follow Up Notes:** A text area containing the text: "Waiting for fax:"
- Follow Up:** A checkbox that is checked.
- Due By:** (empty)
- Done On:** (empty)

At the bottom of the window is a toolbar with buttons for navigation and actions: "Add", "Save", "Delete", "Refresh", "Close", and "Cancel".

APPENDIX C

RAW DATA

Transmittal Cover Sheet

URS	Transmittal Cover Sheet					
Detailed, Grouped by Each Transmittal Number						
6870 Master Planning	Project # 08V-8.1-6870 Tel: Fax:	URS				
Date: 1/25/2006		Reference Number: 1082				
Transmitted To	Transmitted By					
Dr. Tyree Wieder Los Angeles Valley College 5800 Fulton Avenue Valley Glen, CA 91401 Tel: (818) 947-2600 Fax: (818) 947-2603	Tanya Roton URS 5800 Fulton Avenue Valley Glen, CA 91401 Tel: (818) 756-0950 Fax: (818) 756-0951					
<input type="checkbox"/> Acknowledgement Required						
Package Transmitted For	Delivered Via	Tracking Number				
Information	College Mail	08V.6870.01/6.99				
Item #	Qty	Item	Reference	Description	Notes	Status
001	1.0	Meeting Minutes	Facilities Master Plan Committee	Meeting Minutes of the January 12, 2006 Facilities Master Plan Committee meeting. This meeting was a townhall meeting with discussions about the FF&E Program.		
Cc: Company Name Contact Name Copies Notes						
URS Construction Services		Alexander Main		1		
URS Construction Services		Bijan Sajadinia		1		
URS Construction Services		Bobby Dieken		1		
Los Angeles Valley College		Bruce Thomas		1		
Los Angeles Valley College		Carol Weston		1		
Los Angeles Valley College		Chuck Ferrero		1		
Los Angeles Valley College		Cindy Sardo		1		
Los Angeles Valley College		Carlotta Tronto		1		
Los Angeles Valley College		Dana Lubow		1		
Los Angeles Valley College		Don Gauthier		1		
Los Angeles Valley College		Ed Nelson		1		
DMJM/JGM		Jonathan Levy		1		
Los Angeles Valley College		Joanne Waddell		1		
Los Angeles Valley College		Juliana Alvarez		1		
Los Angeles Valley College		Lawrence Nakamura		1		

APPENDIX D

RAW DATA

Hotlist

COMPANY X

3/27/2009

Owner & Architect Update

Clinic Y

December 9, 2008

<u>Hot List</u>	<u>Resp.</u>	<u>Needed</u>
1 RFI #087	X	ASAP
2 RFI #098	Y	ASAP
3 RFI #099	Y	ASAP
4 Cubicle Curtains and Tracks	X	ASAP
5 Lighting in Waiting Room A02-Phase 1	X	ASAP
6 Humidification In OR's	X,Y,Z	ASAP

<u>Milestones</u>	<u>Resp.</u>	<u>Start</u>	<u>Finish</u>
-------------------	--------------	--------------	---------------

The next meeting will be on Wednesday, December 10th 8:30 AM.

APPENDIX E

RAW DATA

Request for Information Entry Interface

The screenshot shows a software window titled "Request For Information". At the top, there are fields for "Project RFI Number" (003), "Subject" (Base plate welding design), "Importance" (Low), "Official" (checked), and "Closed" (checked). Below this is a tabbed interface with "General", "Notes", "Collaboration", and "Impact" tabs. The "General" tab is active and contains several sections: "Date Created" (4/5/2001), "Date Required" (4/12/2001), "Date Answered" (4/10/2001), a "+/-" field (-2), "Discipline" (Architectural), and "Category" (Drawing Dscrep:). To the right of these are fields for "Author Company" (Acme Construction Inc.), "Authored By" (Andrew Forrest), and "Author RFI Number" (IR-002). Below these are "Answer Company" (EQE-Theiss), "Answered By" (Phillip Shinn), and "Co-Respondent" (Joe Soap). A "Question" text area contains the text: "The weld designs refer to an outdated welding specification that was issued in 1995. The latest specs are from a manual dated 1999. Please confirm which set of standards should be used for welding?". An "Answer" text area contains the text: "Use the 1999 standards for welding standards.". At the bottom of the window is a toolbar with buttons for "Add", "Save", "Delete", "Refresh", "Close", and "Cancel", along with navigation arrows.

Project RFI Number	Subject	Importance	Official	Closed
003	Base plate welding design	Low	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

General | Notes | Collaboration | Impact

Date Created: 4/5/2001
Date Required: 4/12/2001
Date Answered: 4/10/2001
+/-: -2
Discipline: Architectural
Category: Drawing Dscrep:

Author Company: Acme Construction Inc.
Authored By: Andrew Forrest
Author RFI Number: IR-002

Answer Company: EQE-Theiss
Answered By: Phillip Shinn
Co-Respondent: Joe Soap

Question: The weld designs refer to an outdated welding specification that was issued in 1995. The latest specs are from a manual dated 1999. Please confirm which set of standards should be used for welding?

Answer: Use the 1999 standards for welding standards.

Buttons: Add, Save, Delete, Refresh, Close, Cancel

APPENDIX F

RAW DATA

DETAILED STATISTICS FOR CONSTRUCTION ESTABLISHMENTS

Construction industries - Finder by 2-digit SIC

Includes only establishments with payroll. Introductory text includes scope and methodology.

Go to bridge	SIC	Description	Establish-ments	Sales, receipts, or shipments (\$1,000)	Paid employees	Annual payroll (\$1,000)
		Construction industries	639,482	834,794,940	5,567,052	170,962,019
↓	15	Building construction--general contractors and operative builders	184,517	365,551,249	1,269,288	39,852,106
↓	16	Heavy construction other than buildings construction--contractors	39,542	126,864,247	851,595	29,218,233
↓	17	Construction--Special trade contractors	415,423	342,379,444	3,446,169	101,891,679

N=Comparable data not available D=Withheld to avoid disclosure

APPENDIX G

RAW DATA

PROLOG MANAGER UN WEIGHTED PROJECT MATRIX

	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Project 7	Project 8	Project 9	Project 10
	Military College	State University	Student Activities Center	University of W GA	Nueroscience Research Center	Large Office Complex	Surgical Suite Renovation	Museum	10 Floor Office Building	Student Dormitory
Original Budget	\$ 931,820.00	\$ 33,275,210.00	\$ 13,387,992.00	\$ 23,093,077.00	\$ 7,055,001.00	\$ 243,173,362.00	\$ 16,751,070.00	\$ 19,863,833.00	\$ 104,949,986.00	\$ 31,495,321.00
Projected Budget	\$ 931,820.00	\$ 32,736,483.00	\$ 13,907,811.00	\$ 25,369,184.00	\$ 6,962,034.00	\$ 245,909,716.00	\$ 17,816,439.00	\$ 19,957,054.00	\$ 109,901,597.00	\$ 39,523,909.00
Committed Cost	\$ 568,436.00	\$ 28,002,339.00	\$ 13,851,160.00	\$ 25,653,560.00	\$ 6,830,513.00	\$ 228,037,719.00	\$ 15,692,323.00	\$ 25,806,580.00	\$ 110,554,635.00	\$ 38,715,746.00
Outstanding Change Issues	\$ -	\$ 521,760.00	\$ (324,710.00)	\$ 37,114.00	\$ 59,054.00	\$ 10,621,113.00	\$ 509,301.00	\$ 421,736.00	\$ 80,756.00	\$ (11.00)
Uncommitted Cost	\$ 363,384.00	\$ 5,209,237.00	\$ 369,381.00	\$ 10,938.00	\$ 72,467.00	\$ 8,245,586.00	\$ 1,614,815.00	\$ 229,317.00	\$ 12,319.00	\$ 500.00
Total Cost	\$ 931,820.00	\$ 33,733,336.00	\$ 13,895,831.00	\$ 25,701,612.00	\$ 6,962,034.00	\$ 246,904,418.00	\$ 17,816,439.00	\$ 26,457,633.00	\$ 110,647,710.00	\$ 38,716,235.00
Prolog Modules										
Cost Module	3	5	5	5	5	4	5	4	4	4
Authorization Request	0	1	1	1	1	1	1	0	0	0
Contract Invoices	1	1	0	0	0	0	0	0	0	0
Cost Events	1	1	1	1	1	1	1	1	1	1
General Invoices	0	0	1	1	1	0	1	1	1	1
Prime Contract Change Orders	0	1	1	1	1	1	1	1	1	1
Subcontract Change Orders	1	1	1	1	1	1	1	1	1	1
Docs Module	5	7	5	5	4	7	5	6	6	4
Conversation Log	0	0	0	0	0	0	0	0	0	0
Drawing Packages	0	1	0	0	0	1	0	0	0	0
Drawings & Specifications Log	1	1	0	0	0	1	1	1	0	0
Hotlist	0	0	0	0	0	0	0	0	0	0
Issues	0	0	0	0	0	0	0	1	1	0
Meeting Minutes	0	1	1	1	0	1	0	0	1	0
Request for Information	1	1	1	1	1	1	1	1	1	1
Submittal Package	1	1	1	1	1	1	1	1	1	1
Submittal Register	1	1	1	1	1	1	1	1	1	1
Submittal Transmittal	1	1	1	1	1	1	1	1	1	1
Field Admin	0	1	1	0	2	1	0	2	0	0
Daily Details	0	0	0	0	1	0	0	1	0	0
Daily Work Journal	0	1	1	0	1	0	0	1	0	0
Notices to Comply	0	0	0	0	0	1	0	0	0	0
Reports	1	1	1	1	1	1	1	1	1	1
	9	14	12	11	12	13	11	13	11	9
20 # of modules used/Total # of modules	0.45	0.7	0.6	0.55	0.6	0.65	0.55	0.65	0.55	0.45
Projected cost/Actual Cost <1.00	1.00	0.97	1.00	0.99	1	0.995971307	1	0.754302322	0.99325686	1.020861378

APPENDIX H

RAW DATA

PROLOG MANAGER WEIGHTED PROJECT MATRIX

	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Project 7	Project 8	Project 9	Project 10
	Military College	State University	Student Activities Center	University of W GA	Nueroscience Research Center	Large Office Complex	Surgical Suite Renovation	Museum	10 Floor Office Building	Student Dormitory
Original Budget	\$ 931,820.00	\$ 33,275,210.00	\$ 13,387,992.00	\$ 23,093,077.00	\$ 7,055,001.00	\$ 243,173,362.00	\$ 16,751,070.00	\$ 19,863,833.00	\$ 104,949,986.00	\$ 31,495,321.00
Projected Budget	\$ 931,820.00	\$ 32,736,483.00	\$ 13,907,811.00	\$ 25,369,184.00	\$ 6,962,034.00	\$ 245,909,716.00	\$ 17,816,439.00	\$ 19,957,054.00	\$ 109,901,597.00	\$ 39,523,909.00
Committed Cost	\$ 568,436.00	\$ 28,002,339.00	\$ 13,851,160.00	\$ 25,653,560.00	\$ 6,830,513.00	\$ 228,037,719.00	\$ 15,692,323.00	\$ 25,806,580.00	\$ 110,554,635.00	\$ 38,715,746.00
Oustanding Change Issues	\$ -	\$ 521,760.00	\$ (324,710.00)	\$ 37,114.00	\$ 59,054.00	\$ 10,621,113.00	\$ 509,301.00	\$ 421,736.00	\$ 80,756.00	\$ (11.00)
Uncommitted Cost	\$ 363,384.00	\$ 5,209,237.00	\$ 369,381.00	\$ 10,938.00	\$ 72,467.00	\$ 8,245,586.00	\$ 1,614,815.00	\$ 229,317.00	\$ 12,319.00	\$ 500.00
Total Cost	\$ 931,820.00	\$ 33,733,336.00	\$ 13,895,831.00	\$ 25,701,612.00	\$ 6,962,034.00	\$ 246,904,418.00	\$ 17,816,439.00	\$ 26,457,633.00	\$ 110,647,710.00	\$ 38,716,235.00
Prolog Modules										
Cost Module	15	25	25	25	25	20	25	20	20	20
5 Authorization Request	0	5	5	5	5	5	5	0	0	0
5 Contract Invoices	5	5	5	5	5	0	5	5	5	5
5 Cost Events	5	5	5	5	5	5	5	5	5	5
5 Prime Contract Change Orders	0	5	5	5	5	5	5	5	5	5
5 Subcontract Change Orders	5	5	5	5	5	5	5	5	5	5
Docs Module	20	26	20	20	16	26	20	21	21	16
1 Conversation Log	0	0	0	0	0	0	0	0	0	0
2 Drawing Packages	0	2	0	0	0	2	0	0	0	0
4 Drawings & Specifications Log	4	4	0	0	0	4	4	4	0	0
1 Hotlist	0	0	0	0	0	0	0	0	0	0
1 Issues	0	0	0	0	0	0	0	1	1	0
4 Meeting Minutes	0	4	4	4	0	4	0	0	4	0
5 Request for Information	5	5	5	5	5	5	5	5	5	5
5 Submittal Package	5	5	5	5	5	5	5	5	5	5
5 Submittal Register	5	5	5	5	5	5	5	5	5	5
1 Submittal Transmittal	1	1	1	1	1	1	1	1	1	1
29										
Field Admin	0	5	5	0	10	5	0	10	0	0
5 Daily Details	0	0	0	0	5	0	0	5	0	0
5 Daily Work Journal	0	5	5	0	5	0	0	5	0	0
5 Notices to Comply	0	0	0	0	0	5	0	0	0	0
Reports	1	1	1	1	1	1	1	1	1	1
	36	57	51	46	52	52	46	52	42	37
#modules used/total # of modules										
69 available=1.0	0.52173913	0.826086957	0.739130435	0.666666667	0.753623188	0.753623188	0.666666667	0.753623188	0.608695652	0.536231884
Actual Cost/Projected>1.00	1.00	1.03	1.00	1.01	1.00	1.00	1.00	0.75	1.01	0.98

REFERENCES

1.1 WEB REFERENCES

US Census Bureau-1997 Economic Census: Bridge Between NAICS and SIC.
(<http://www.census.gov/epcd/ec97brdg/INDXSIC2.HTM#C> (Accessed March 22, 2009))

Medicare.gov – Medicare Eligibility Tool. <http://www.medicare.gov/MedicareEligibility>
(Accessed March 22, 2009)

<http://www.specialtypub.com/constructech/techsurvey> (Accessed March 22, 2009)

http://www.projectteam.com/PrologManager_2008.pdf (Accessed March 22, 2009)

http://www.lavc.edu/propa/minutes_pdf/FMP1.12.06.pdf (Accessed March 22, 2009)

<http://www.pssgroup.com/PDF/PrologSampleReports.pdf> (Accessed March 22, 2009)

<http://www.pcigrp.com/pdf/Q&D.pdf>. (Accessed March 22, 2009)

<http://74.125.47.132/search?q=cache:QcFKNQwHzQJ:www.pcigrp.com/pdf/Q%26D.pdf+court+cases+prolog+manager&hl=en&ct=clnk&cd=3&gl=us> (Accessed March 22, 2009)

<http://cityroom.blogs.nytimes.com/2008/03/20/city-inspector-is-charged-in-crane-case/?pagemode=print> (Accessed March 22, 2009)

<http://www.osha.gov/pls/oshaweb/owadisp.showdocument?ptable=STANDARDS&pid=1076> (Accessed March 22, 2009)

<http://proquest.umi.com/pqdweb?did=1440531421&sid=7&Fmt=3&clientId=30287&RQT=309&VName=PQD>

<http://proquest.umi.com/pqdweb?did=585502272&sid=7&Fmt=3&clientId=30287&RQT=309&VName=PQD>

<http://proquest.umi.com/pqdweb?did=56841605&sid=7&Fmt=3&clientId=30287&VName=PQD>

REFERENCES

1.2 GENERAL REFERENCES

1. Construction Project Management Software From Meridian Named as Constructech Top Products :Constructech Magazine Names Prolog and Proliance Software as Top Products for 2008. (18 March). *PR Newswire*,1. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 1447691451).
2. Heather Hatfield (2007, July). New Software Tools Aim to Manage Document Flow. *New York Construction*, 54(13), 51. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 1305122781).
3. Moss & Associates Executes Complex Projects and Increases Sales by Standardizing on Prolog; Growing Florida Construction Management Firm Will Use Leading Project Management Software to Manage \$1B in Backlog Work. (9 May). *PR Newswire*,1 Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 1049268131).
4. Project Management Software. (2006, March). *EC & M*, 105(3), C8-C9. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 1011254501).
5. Industry Leaders Select Prolog(R) Software as Corporate Standard for Construction Project Management. (8 February). *PR Newswire*,1. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 983435561).
6. Meridian Systems Launches Enhanced Prolog at Annual User Conference. (13 September). *PR Newswire*,1. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 895229651).
7. Skanska USA Selects Meridian Project Systems as Project Management Software Standard. (15 September). *PR Newswire*,1. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 405145531).
8. Meridian Project Systems Named One of the Nation's Fastest-Growing Companies By Inc Magazine. (11 October). *PR Newswire*,1. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 84018654).

9. PROFESSIONAL PROJECT MANAGEMENT TOOL CONSOLIDATES DOCUMENTS. (2003, June). *Online Product News*, 22(6), 1 Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 338077501).
10. Kenneth Rizzo (1998, July). Tight deadlines need good project oversight Continuous monitoring essential for success. *Business Courier: Vol. 15, Issue: 10*, 28. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 32044267).
11. Two pros find a shortcut. (1994, August). *ENR*, 233(6), 36. Retrieved February 11, 2009, from ABI/INFORM Complete database. (Document ID: 14964).