ABSTRACT

Title of Thesis: ASSESSING CPM SCHEDULING SOFTWARE FOR THE SMALL TO MID-SIZE CONSTRUCTION FIRM.

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An analysis of the results of a regional survey and a comparison of three commonly used programs, SureTrak, Primavera Contractor, and Microsoft (MS) Project, was undertaken. Selected because of their comparable cost structure and their wide acceptance in the industry, these three programs were evaluated on the basis of the features construction managers use to manage their projects.

The results indicate that each program had many benefits. However, MS Project and Primavera Contractor both scored better than SureTrak on the overall rating. MS project also scored best in terms of ease of use. It must be noted that this study is based on a comparison of use on relatively small projects (approximately $500,000 in final value and four months duration) and that the results on larger, more complex projects might be different.

ASSESSING CPM SCHEDULING SOFTWARE FOR THE SMALL TO MID-SIZE CONSTRUCTION FIRM

by

Craig Vernon Hawkins

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Executive Summary:

Critical Path Method (CPM) scheduling is a well established method to schedule large, complex construction projects. Use of CPM by large national firms has been well documented in several studies. This paper addresses the use of CPM by smaller, regional firms with a focus on the Mid-Atlantic area. The barriers smaller firms must overcome to access the CPM features best suited to managing construction projects were reviewed by comparing three commonly used software packages: Microsoft Project, SureTrak, and Primavera Contractor. These packages were selected for their comparable single station costs and features. The schedule for an actual project was entered into each program, updated, and revised as it would be throughout a project. The features, reports and graphics desired, as determined by a survey of Mid-Atlantic contractors, were reviewed for each software package and compared.

Survey responses indicated that while the use of CPM scheduling is widespread, the extent to which available program features are used is limited. All respondents reported using CPM on at least some of their projects, while 85% indicated use on most, if not all projects. Additionally 95% reported doing the majority of the CPM work in-house with only 5% outsourcing all of the work.

Of those firms internally to creating, maintaining and managing the CPM schedule, 84% used 1 of the 3 programs reviewed and some of them used multiple programs. Although

there were numerous reasons cited by survey respondents that they consider when selecting a software package, the most frequently mentioned, ease of use, was tested based on time to complete project set-up, activity updates and logic revisions for the sample project. Based on this criterion alone, Microsoft Project was the clear choice – approximately 33% faster to set-up or revise and 20% faster to update. In practice, however, as many firms employed the use of SureTrak by Primavera as Microsoft Project, 42% each, with far fewer using Primavera's newer offering, Contractor, 5%.

Introduction:

The most important tool used by project managers in the construction industry to plan, control, and assess their projects is Critical Path Method (CPM) scheduling. Considering the state of information technology available to today's project manager, the array of CPM tools can be overwhelming. The purpose of this study is to compare and contrast some of the most commonly available systems used on smaller commercial projects.

The CPM scheduling methodology was developed by DuPont in the 1950's to assist in the control and monitoring of engineering and construction projects.[1] CPM quickly grew in popularity among larger construction firms. By 1974, over 50% of the ENR top 400 construction firms used CPM. With the introduction of personal computers and PC based software, the use of CPM scheduling continued to grow. By 1990, a second study of ENR 400 contractors reported that 93% were using CPM in some fashion with only 14% (as compared to 45% in the earlier study) seldom or non-users. The use of CPM by ENR top 400 contractors grew to over 98% by 2004. The primary use of CPM by larger firms has been for planning projects prior to start of construction. The secondary use is for periodic control of the work during construction.[2]

Although the growth in CPM use by top firms, those firms listed in ENR's top 400, is well documented, the use by the smaller regional firms that perform most of the construction in this country has not been as thoroughly researched. The survey conducted

as part of this study focused on the use of CPM by commercial builders in the Mid-Atlantic area (Washington DC Metro area to Philadelphia Metro area), with 70% of the respondents with annual volumes below $150million and therefore smaller than those listed in ENR's top 400 list

As larger firms have learned, the use of CPM results in less schedule slip (i.e. better on-time performance), less cost growth, and better overall cost performance. Additionally, the use of resource loaded schedules further improves these objectives. The benefits of CPM are such that 47.6% of owners, those firms, and individuals paying for construction, now require its use on over all of their projects.[3]

CPM implementation does not come without a cost. Its use requires a significant allocation of management time and money during construction. Setting up and monitoring a basic CPM can cost 0.5% of the work for projects over $1m and can jump to 1% and higher for smaller projects. The cost of resource planning and cost control adds an additional 0.3% of the total construction.[4] The research presented herein addresses how the Contractor can control these costs.

The Survey:

The goal of the survey was to determine the scheduling practices employed by construction contractors in the Mid-Atlantic Region. In order to accomplish this, the survey needed to be composed of concise, easy to answer questions that provided sufficient insight regarding the following:

1. How prevalent is CPM use by firms in the region.
2. What percentage of users utilized outside consultants for this work and if so, to what extent.
3. Of those who do CPM in house, who actually completes the task – scheduling department / specialist, Project Manager (PM), Superintendent, Project Engineer or Assistant Project Manager (APM), other?
4. What software is used and what role do project owners have in selection.
5. What features are used – multiple calendar, revenue loading, cost loading, manpower loading, trade and location codes, roll-up of multiple projects, hammock activities, etc.
6. How the information is shared – reports, graphics, electronic, integrated into letters and memos, etc.

In order to increase the number of firms willing to respond to the survey, the questions were designed such that the survey could be completed easily in under fifteen minutes. Accordingly, fourteen simple and multi-part questions were developed that could define

the extent of CPM use and be reliably combined and analyzed. A complete copy of the Survey is in appendix A.

Complete definititions for terms used in the survey and this paper are provided below:

Schedule Set-up – the entry of schedule data into a computer to establish the initial schedule

Schedule Update – the entry of actual start and finish dates along with percentages of completion and/or remaining durations for in-progress activities

Schedule Revision – the entry of new activities, deletion of activities, adding or deleting logic relationships

CPM Schedule Process – the process by which a firm completes the schedule set-up, schedule updates, and schedule revisions necessary to organize the schedule data needed to manage the project

Microsoft Project (MS Project) – a CPM scheduling software package sold by Microsoft, the version used is a 120 day trial edition of Project 2002

Primavera Contractor – a CPM scheduling software program specifically intended for construction contractors sold by Primavera, the version used is 5.0 Deluxe

SureTrak – a CPM scheduling software program sold by Primavera, the version used is 3.0

Work Breakdown Structure (WBS) – a hierarchical organization of the phases, sub-phases, and activities required to complete a project

Activity or Task – the smallest portion of a project which consumes resources and has a definable beginning and ending

Resource – labor, material, equipment or service consumed in the process of completing an activity

Cost – the cost to be paid by the project owner, not the contractor

Contractor – General Contractor or Construction Manager at Risk

Owner – Project Owner, Developer, Construction Manager Agency

In order to reach the target audience, several avenues were evaluated. Lists from ENR and other publications, local chapters of Associated Builders and Contractors, Inc. (ABC) and Associated General Contractors (AGC), Civil Engineering Department lists of local

universities, along with phone books and other published directories were considered. The ENR lists were considered and rejected as they contained generally larger firms, an area where CPM use has already been well researched. Other local contractor publications did not have available comparable lists. ABC and AGC were both contacted and would only provide directories to members. The author was able to get a copy of the directory for the Delaware chapter of ABC. The Civil Engineering Department at University of MD did not maintain a list and Catholic University was not inclined to share their list as it was maintained for fundraising efforts only. Finally, the author chose to use the local Blue Book of Building and Construction for the Washington DC area (including Northern Virginia and Maryland) and the book for the Eastern Pennsylvania and Delaware Area in addition to the Delaware ABC Directory. From these directories, 190 Contractor firms that advertised either web pages or e-mail addresses were selected. After researching and locating the appropriate party, surveys in the form of MS Word documents were e-mailed to each firm.

By using the commonly used word processor, MS Word, respondents could either complete the survey on their computer and return it by e-mail or print it out, complete by hand, and fax or e-mail it to the author. Slightly more than 10 % (20) responded to the questionnaire. The annual dollar volume of construction managed for the firms responding ranged from under $10,000,000 to greater than $500,000,000, with the median falling between $50,000,000 and $150,000,000. The majority of responses came from firms that described themselves as General Contractors and the balance were primarily Construction Managers.

Given the mix of both larger and smaller contractors, this survey confirmed the author's hypothesis that it is not only the large ENR 400 firms that utilize CPM to manage their projects. All respondents indicated that they used CPM scheduling at least some of the time with 45% reporting they used it all of the time and another 40% reporting they used it most of the time. In addition, 60% of the responding firms reported they did not use outside consultants to complete the CPM scheduling process and another 35% reported completing the CPM process in-house for an average of 79% of their projects. Only 5% reported always outsourcing the CPM schedule process.

The responses further indicate, that 74% of the time, the project manager is involved in the CPM schedule process and 47% of the time he/she is solely responsible for completing the CPM schedule process. The results also indicate that 32% of the time a team of individuals work on the CPM schedule process, and in only 21% of the time is there a separate schedule department or scheduling specialist fully responsible.

Many firms, 84% of respondents, used at least one of the three "entry" level software packages that the case study comparison addresses. These three software packages: Microsoft Project, SureTrak by Primavera, and Primavera Contractor all retail for around $500 per license. While the survey responses revealed that many firms use multiple programs and the single most often used program is Primavera Project Planner (P3), the simpler programs included are selected when making the new purchases. Ease of use, the single biggest reason as to why firms would use one package over another as reported by

57% of respondents, is driving this result. Those that use multiple programs do so to meet specific client needs, to accommodate the skill set of their employees, or as the size and complexity of the project allow, in that order.

The responses to the questions regarding the features firms used and the frequency they used them supported the ease of use selection as well. While most of the features reviewed were used by over 50% of the respondents, only the more complex resource features - the ability to level resources automatically while allowing resource constraints to drive a schedule and the ability to report on resource use across multiple projects - did not meet that threshold. Additionally, of those who did use those two features, they did so only rarely to sometimes.

The most commonly used features, those used by at least 75% of respondents, were the ability to keep target or baseline schedules, the ability to organize the schedule along location codes, the ability to use templates, and the ability to cost or revenue load the schedule in decreasing use order. Among those reporting to use them, the level of use for those four features all averaged between sometimes and frequently in the same decreasing order. Of the features used by less than 75% of the responding firms, there were three that were used at a higher level of frequency: trade codes, roll-up or hammock activities, and the ability to compare one schedule to another.

Only one respondent indicated that they selected the software based on the reports/graphic capabilities. This fact coupled with the reported use of the custom reports

feature by 68% of the respondents, equally strong for users of each of the three programs reviewed, indicates that each program can meet the needs of users in this regard.

One interesting finding is that the schedule reports were shared more frequently with the project owner and architect than with the subcontractors performing the work. This especially so when it came to sharing via electronic means (63% with owners as compared to 11% with the subcontractors) or sharing the actual program files (32% with the owners and 0% with subcontractors). The only time subcontractors saw the schedule more frequently than the owners was in the contract documents where it was contained 63% of the time as compared to 58% of the time in the owner-contractor contract.

The responses are summarized in Appendix B.

Case Study: **Description and Process**

In order to assess available software for use by construction firms, a case study was undertaken. In determining the software to compare, there commonly used low cost (approximately $500/license) programs, SureTrak Project Manager, Primavera Contractor, and Microsoft Project were chosen. [5]

SureTrak was also developed by Primavera and is a less powerful version of Primavera Project Planner (P3). It was developed initially around the same time as Microsoft Project to take better use of the Windows environment than P3 does with its DOS heritage. SureTrak is widely used within the construction arena, but was also marketed across the project management spectrum. Like P3, SureTrak is no longer being pushed by Primavera as evidenced by the lack of additional research and development over the past 5 years. Currently used by the author's firm, SureTrak was loaded onto the local hard drive of a Dell laptop, Program files, however, were able to be filed on any drive accessible within the firm's network.

A new affordable single user product, Primavera Contractor – specifically developed for the construction contractor, with easy collaboration to P3's replacement, Primavera 5.0 for Engineers and Constructors and Primavera's Project Management Module (formally known as Expedition), was selected as a comparable to the other two products. Primavera

Contractor 5.0 was purchased for evaluation purposes by the author's firm and was loaded onto the local hard drive of a Dell laptop with all data files kept there as well.

Microsoft Project is an extended part of the widely used Microsoft Office Suite of programs. It continues to be refined and improved by Microsoft and is marketed to the full world of project management, not just contractors. As the results of the survey revealed, Microsoft Project is used by as many firms as SureTrak. The author had access to a four month trial version of Microsoft Project 2002 and the results are based on this program.

To compare the capabilities and ease of use of the selected software, an actual construction project was chosen from the author's firm. This project initially entailed completion of two independent phases using a construction manager with several subcontractors to be completed over a four month period. During the course of construction there were three project schedule updates. Update 1 coincided with the full release of work and issuance of all permits. Update 2 incorporated the addition of a new phase of construction to the project. Update 3 assessed the project conditions at a point that should have been two weeks prior to substantial completion. At each update schedule activity progress was recorded by noting the start date and completion date of activities as well as the estimated remaining durations for the activities that were in progress. In addition, Update 2 and Update 3 each included revisions to the schedule, i.e. new or deleted activities and revised logic.

The actual project was completed using the scheduling software and systems of the construction manager. While the baseline schedule was the same and the updates coincided, the project manager did incorporate additional minor revisions and changes through-out to accommodate the small changes to the construction that one should expect with a renovation project. To provide consistency in the comparison of the three programs, the author chose to use only the documented changes. With his limited training and use combined with average typing skills reflecting the average scheduler on construction projects, the case study data entry was also completed by the author for consistency.

In addition to the list of features identified previously, this study compared the time required to create and maintain project schedules. Prior to any data input, the 78 activity as-planned schedule was entered into a table created using Microsoft Excel. For each activity, this table contained a unique identification number, the description, the duration, the phase/primary WBS description, the area, the responsible party/trade, the billable cost, and a list of predecessors with predecessor type (F-S was the default), and lead lag information. The project update information was also entered in a table that included start dates, finish dates, and remaining durations to be entered. These project update tables also included notes and added activity information for the schedule revisions that were required corresponding to the update period selected. A copy of each of these tables is included in appendix C.

Case Study Findings: General

Setting up the basic as-planned schedule, using one of the computer software programs reviewed, entailed taking the data developed for the table in appendix C and entering, at a minimum, the activity description, duration, and logic. Each program also required some time to enter general project information – project title, project start date, and project calendar information. Additional time was required to edit and correct the data (note: the data entry table purposely omitted several required logic ties, as would likely occur in the development of the usual project schedule). Editing was done to insure that each activity had a minimum of 1 start predecessor and 1 finish successor except for WBS Summary activities, the initial project activity (in this case: NTP), and the final project activity (in this case: Clean and Demob). This process was repeated twice for each schedule program and where possible, both as a direct entry and as part of the program wizards provided. The average times are indicated in Table 1.

Table 1 Project Basic Set-up Durations

Program	SureTrak	SureTrak	Contractor	Contractor	MS Project
Type of Entry	Direct	Wizard	Direct	Wizard	Direct
Project Set-up	2 min	2.5 min	1.5 min	4 min	1 min
Activity/Logic Set-up	41.5 min	55 min	47.5 min	62.5 min	40 min
Edit Logic	6 min	7 min	5.5 min	9 min	5 min
Total Basic Set-up	49.5 min	64.5 min	53.5 min	75.5 min	46 min

It is important to note that the wizards provided for both SureTrak and Contractor, along with the method employed by MS Project, resulted in additional information being entered during the Basic Set-up.

As the survey respondents noted, some of the more commonly used features involved including trade\responsibility, location, and cost detail in the schedule. This required codes, resources, and a work breakdown structure definition during the initial set-up. As was done with the basic set-up, this extended set-up was entered twice for each schedule program and where possible both as a direct entry and as part of the program wizards provided. The average times are indicated in Table 2.

Table 2 Extended Project Set-up Durations

Program	SureTrak	SureTrak	Contractor	Contractor	MS Project
Type of Entry	Direct	Wizard	Direct	Wizard	Direct
Basic Set-up	49.5 min	64.5 min	53.5 min	75.5 min	46 min
Define Codes/WBS	6.5 min	Incl. in Basic	15.5 min	Incl. in Basic	2 min*
Assign Codes/WBS	22 min	Incl. in Basic	29 min	Incl. in Basic	10 min*
Enter Cost Data	19.5 min	28.5 min	24.5 min	27.5 min	4 min
Total Extended Set-up	97.5 min	93 min	122.5 min	103 min	62 min

* MS Project includes WBS structure in basic set-up; these times reflect defining and assigning resources only.

With the full extended set-up, on projects of similar complexity and size as our case project, the data indicates that Wizards do save some set-up time and MS Project is one third faster as well. It is important to note that this savings is not without a cost. The WBS utilized by both wizards and MS Project is a default code sequence based on how the project is entered. Customizing this to match the direct entry system would add approximately 15 minutes to the total time for the two programs from Primavera. MS Project is not as easy to customize.

Furthermore, using either the Wizards or MS Project, the activity ID number is assigned by the software program and not by the schedule developer. On large projects this makes it much more difficult to assign additional logic ties beyond the auto link option. In MS Project this computer generated activity ID number is further complicated when activities are added at a later date as the program renumbers ID numbers to keep the sequential nature of its WBS system. While sometimes advantageous during the initial set-up, this can cause problems once there is any interaction with other programs or schedules.

In addition to building the WBS into the initial set-up, MS Project shows a significant savings in time when setting up and entering cost data. This is primarily because MS Project allows the user to enter cost data directly into a tabular view of the project while, both SureTrak and Contractor require that costs be entered through resource data entry boxes assigned to each individual activity. Although this allows for greater flexibility in the type of costs being entered, it is more than what is needed/used by most smaller

contractors and, as shown from the results in table 2, adds to the time (=costs) of setting up the project.

Project updates also require staff time. Updates generally are a multi-step process starting with the review of current project conditions. The time involved is the same for all three programs (although all three enable the user to print out reports that assist in the assembling of related information). After collecting the data from the field, an update of progress is entered into the program and invariably, followed by a revision to the logic or the addition\deletion of activities. These programs support a feature where the user can have the computer automatically update activities based on planned progress. This practice should be avoided as, despite the good intentions of the many people involved in a construction project, it is extremely rare that a schedule will be followed exactly and accepting the planned without comparing to actual the user loses the potential improvement on future scheduling tasks that this historical knowledge would provide.

All three programs reviewed allow the user to update an activity by entering actual start and finish dates and if an activity is incomplete, entering either a percent complete or a remaining duration or both. For this case study, progress updates were reported using actual dates and remaining durations to the best estimate of the Project Manager at the time of the update.[6] As is the case in many projects, there were instances where the update data was incomplete, when they occurred the subsequent update provided the corrected information. In all three programs this did not cause a problem.

Project schedule revisions were made concurrent with the second and third progress updates. These revisions added activities due to change orders, deleted activities that were not required and established constraints due to outside source impacts. All of these revisions are likely to occur in any construction project schedule.

As was done with the schedule set-up, the updates and revisions were entered twice for each schedule program. The average times are indicated in Table 3.

Table 3 Average update and revision times

Program	SureTrak	Contractor	MS Project
Update 1 (17 Activities)	7.5 min	7 min	7.5 min
Update 2 (45 Activities)	20.5 min	16.5 min	11.5 min
Update 3 (27 Activities)	10.5 min	9.5 min	8 min
Update Average/Activity	0.43 min/activity	0.37 min/activity	0.35 min/activity
Revision 2 (12 activities)	18 min	20 min	11.5 min
Revision 3 (5 activities)	2.5 min	2.5 min	2 min
Revision Average/Activity	1.21 min/activity	1.32 min/activity	0.79 min/activity

Similar to the case with the initial project set-up, MS project proved to be one-third faster than either of the Primavera programs. It must be noted, however, that cost data updates were not made in any of the programs or project updates and that inclusion of them may have changed the results.

A complete listing of case study trial data can be found in appendix D.

Case Study Findings: Feature Comparisons

This project lent itself to testing the selected software in regards to the following features:

Feature	Percent of users per survey
Target baselines	89%
Location codes	84%
Cost loading	79%
Roll-up or hammock activities	74%
Resource assignments	74%
Start-up wizards	58%
Trade codes	68%

Target Baselines:

According to the survey results, the most widely used feature is the target baseline. With this feature the scheduler can view current progress against a previously saved version of the schedule for easy graphical indication of any improvements or slippage. This feature, in some form, is included in all three programs.

With SureTrak**,** target dates can be set automatically for each activity - either all activities at once or for selected activities - as long as the schedule is not saved in the Concentric (P3) format. Additionally, target dates can be manually edited. By automating the process for select activities, the scheduler can use SureTrak to keep the original baseline for original activities and set new baselines for added or revised activities. Additionally, the scheduler using SureTrak can automatically set target dates to early or late dates. A

limitation with SureTrak is that there can only be one set of target dates and the baseline is a set of start/finish dates only with no logic retained.

With Primavera Contractor an unlimited number of target baselines can be used, thus enabling the scheduler to compare the current project against the original baseline and a later update. With Primavera Contractor the scheduler can display and compare up to three baselines against the current schedule at any one time. Primavera Contractor baselines include logic information as well and can be restored as projects on their own to update with new information. Similar to SureTrak, the program will update selected activities information automatically, though the activities need to be selected through one of the many filtering options. Additionally, with Primavera Contractor the scheduler can update select data types in baseline schedules.

One significant advantage to Primavera Contractor over the other two software packages is the built in tool, Claim Digger. This tool takes the ability to compare the current schedule to baselines one step further. That is, the user is able to compare a project to either one of its assigned baselines or to another project and to get reports of exactly what has changed instead of needing to scan a list or a graphic representation to spot it.

Using MS Project, the user can have one primary baseline and 10 additional baselines. The saved baselines retain information on nearly 20 different data items per activity, including time phased information. In addition, the program will maintain up to 10

interim plans that save only start and finish date data. Selected activities can be updated into a baseline along with adjusting summary tasks.

Location Codes:

The second most widely used function according to the survey results was Location Codes. These codes are used to enable the user to organize and filter the schedule on the basis of what part of the project site the activity occurs. This is helpful when the user wants to be able to take the schedule out on the project to review progress in any area. It also assists the owner in planning follow-up activities such as interior fit-outs by location.

The SureTrak user has three different ways to establish location codes for activities. The first, through the use Activity Codes, allows the scheduler to establish up to twenty different codes that can be used to present different views of the project. Each activity code has a name (maximum of four characters), a length (maximum of ten characters), and a description. The maximum length of all codes is sixty-four characters. The name defines the type of code, i.e. Phas for Phase, Area for Area and Resp for Responsibility. The length establish the maximum number of characters the user needs to define the available code options; for the code named Area in the case study the values of Shower, Utility Room, Hallway, Roof, and All Areas were options. The length required for this could have been one with corresponding value names of S, U, H, R, and A.

The second method available to the SureTrak user is through activity ID codes. Activity ID codes are a user defined subset of the activity ID. Once defined, they are a set length and are read from left to right. As an example, in the case study project, there could have been a one digit phase code and a one digit area code included in the activity ID so that the activity demo existing walls and slab, the first activity of work in the shower area of phase 1 could have had the code 1S001. Activity ID codes are limited by the overall limit of ten characters in the activity ID and by the need to keep room for unique activity codes and expansion.

Both activity codes and activity ID codes can be used to sort activities. With SureTrak, the user has the option of assigning a sort order within each set of values or alternatively sorting alphanumerically. Additionally, the user could use one set of outline codes to sort activities by location, but this is not recommended.[7] This method of organizing activities is similar to that used with MS Project schedules and is described below.

The user of Primavera Contractor has location coding options similar to the user of SureTrak in that an activity code can be established for this trait with a set of values. The name of the code, however, can be a maximum of twenty characters and there are an unlimited number of codes available. In addition, with Primavera Contractor both global codes and project specific codes can be maintained, so the user can create libraries of common codes and use them on all projects without having to define them project by project. Unlike with SureTrak, the Primavera Contractor user does not have the option of activity ID Codes. Additionally, sorts on non-hierarchical codes are limited to ascending

or descending alphanumerical order. The scheduler is not given the option of determining the order the codes should be sorted for different reports and graphics. Primavera Contractor codes are grouped in the software program dictionary, thus reducing the ways the reports can be used.

The MS Project program uses a different method to code activities. In lieu of separate codes, MS Project allows for up to ten different sets of custom outline codes which group activities in alternative hierarchical methods to the original WBS outline code. The user may set-up outline codes by project or select from a list of enterprise codes maintained by the computer system administrator. Once established, users can select from a predefined list or type in directly. The codes are a series of levels of different code length totaling a maximum of 254 characters. When sorting, outline codes can be used with other criteria as with activity codes and activity ID codes. The most significant difference is that unlike when using Primavera Contractor and SureTrak, these codes must be given a sort order when developed.

Cost Loading:

The third most widely used feature among survey respondents was the ability to cost load the schedule. This feature allows the schedule to be used to create progress billings, to report on earned value in addition to time, and to forecast cash flow requirements. The survey did not provide the data to determine which of these reasons drove the high level of use or if it is a combination.

With SureTrak, the user has the option of either assigning Lumpsum costs by entering directly into the resource field or having the program calculate a cost from the entry of Unit costs and Units. It is important to note that Resources can only have one unit price for an entire project. Although the program has a resource defined as Lumpsum that can be cost loaded, it will not automatically update, even when the program is set up to recalculate costs as activities are updated. This option only works when the user has set-up costs through a resource. SureTrak also does not maintain previous period cost information; only budgeted, actual to date, to complete, and at completion cost data are stored.

With Primavera Contractor, the user is required to set-up cost accounts to track both resource costs and non-resource costs. These accounts are set-up in a global (available to all projects) hierarchical structure. This structure is most beneficial when established at the initial project set-up, although it can be edited on an individual activity or resource level at a later date. Resource costs are time based and are typically related to personnel or equipment. Non-resource costs, also called expenses, are not time based, are project specific, and can be assigned to an activity to occur at the start, at the finish, or uniformly over its duration.

Entering resource costs is done during set-up of the resource. A unit cost is assigned to the resource along with the number of units of the resource per unit of time. Additionally,

the resource can be set-up with rates that are specific for different time frames as well as accounting for overtime multipliers.

Non-resource costs, expenses, are set-up and assigned to single activities and, although their costs can be entered as a budgeted number of units with a set price, the quantity of units is not dependent on how much time it takes to complete the activity. This type of cost data is best used for material and lump sum subcontractor costs.

If properly set-up, costs can be compared and sorted using cost accounts, WBS elements, by time period, and by cost category. As was shown in the case study trials, however, just getting simple lumpsum costs by activity set-up in Primavera Contractor was a significantly more time consuming process than was required using MS Project.

Like Primavera Contractor, MS Project users can define both resource costs that are time dependent and non-resource costs. In addition, MS Project users can set-up resources to have costs assigned that are per use, which can be used to account for delivery or mobilizations costs. The non-resource costs, called fixed costs by MS Project and expenses by Primavera Contractor, can be entered into MS Project through a simple spreadsheet entry. Used in the case study trial projects, this method was shown to be extremely time efficient. The process must be further augmented with individual line item edits if the uniform method of distribution is not desired and if either at start or at complete cost assignment is required. Although MS Project users do not have as many options for coding and combining resource costs or non-resource costs as users of

Primavera Contractor, MS Project users can track current scheduled costs against baseline plans both by activity and time phased.

Roll-up, Hammock, and Summary Activities:

Executive level summary needs and the ability to focus upon the role of certain sets of activities in the global context of a project requires the use of simple ways to show the overall duration for a specific group of activities. This is accomplished through the use of a summary activity, also known as a roll-up activity, a hammock activity, or as a topic activity. This feature was used by nearly three out of four firms in the survey.

SureTrak users can create summary activities in several ways. If the project is formatted with a Work Breakdown Structure, there are summary WBS activities provided for each WBS code that spans the duration of all activities with the same WBS code. These activities cannot have logic ties assigned to them. If the project is set-up with outline codes, or entered like an outline, the activity immediately above an indented group of activities will be a topic activity. Topic activities can be assigned logic ties, resources, and costs, but will take their duration from the overall duration of the activities in the immediate level under them. Topic activities cannot be created by assigning an activity type to them in the activity form. In addition to establishing a WBS or outline structure, SureTrak users can create hammock activities. Hammock activities span the incomplete portion of a series of activities starting from the earliest start to start predecessor and

completing at the latest occurring finish to finish successor. Hammock activities cannot be updated individually.

The Primavera Contractor user does not have the range of options the SureTrak user has for summary activities. The WBS summary activity spans all activities with the same code. It can have logic ties and costs, but the program will not automatically compute costs earned when the project is updated for it. The other method available is through what is called a level of effort activity type. This activity can be set-up to run concurrent with a series of activities, similar to the hammock activity type available with SureTrak, except that it can be updated with a start date. Primavera Contractor users do not have the option of an alternative outline activity.

MS Project is developed around the concept of using summary tasks. Activities are entered into the project in an outline form with the bottom level designed to roll into the next higher level as each successively higher level rolls up. In addition to combining durations, MS Project summary tasks also combine the cost of subordinate tasks with the cost of the summary task to calculate the total cost for the summary task. As discussed previously, MS Project users have up to ten custom outline code sets in addition to the initial set-up. These can be used to create alternative summary task structures.

Resource Assignments:

In all three programs, users can assign resources, with related costs and quantities to activities. Once assigned, each program can be used to create charts and graphs showing time based use of resources, either in histograms or cumulative curves of units and/or costs.

Through SureTrak, the user can define and assign multiple resources to an activity. Each resource is defined by a unique resource code of eight characters or less. The description can be up to forty characters long and the user can assign time based or lumpsum costs and revenue amounts (see previous section on cost loaded schedules). Resources are either driving or non-driving. Driving resources control the duration of an independent type activity. This is done by overriding the duration nominated in the Activity form with the duration of the longest driving resource assigned to the activity.

SureTrak users may also assign resources to calendars other than the activity calendar, thus accommodating an additional restriction on availability. This assignment does not impact the task activity type. Furthermore, resources can be leveled to established limits provided certain criteria are met. As resource leveling is one of the least used functions, as indicated by the responses to the previously discussed survey, it will not be addressed any further.

With SureTrak the user can also establish resource groups. These groups will display combined resources and costs in the resource tables or profiles, but cannot be assigned to an activity.

The actual assigning of resources with SureTrak can be accomplished in many ways. The user may add a column on the barchart display and enter resources direct into the form without cost or quantity information specified, or the user may insert a resource assignment by selecting from the insert drop down after right clicking on an activity, or by entering in the activity form detail box for resources. If a resource was not previously set-up, it may be created on the fly, but it will not have all the usual characteristics and it will take the defaults of being a driving resource able to be leveled.

The Primavera Contractor program also maintains a dictionary of resources. Unlike the dictionary stored with SureTrak data, the data stored by Primavera Contractor is maintained in a hierarchical organization which allows for easier retrieval. Additionally, resources are available across projects. Resource ID's are limited to twenty characters and resource names are limited to ninty-nine characters. More fields are available to the user to store contact information if the resource is an individual. With Primavera Contractor, the user can set-up codes for organizing reports and analysis on multiple levels. For example, if the basic resource organization is along the lines of functional task, a code could be set-up for the physical office location of the resource, allowing a scheduler to check that they have not only assigned the right type of resource, but have optimized the use of resources from a specific office. As with SureTrak, resources can be assigned their own calendars and limits. To make it easier, Primavera Contractor has a wizard developed to assist the user in the creation of new resources.

Once the resources are established, they can be assigned to an activity. This requires that the activity's window be open and the add resource pop-up window be open as well. Resources cannot be added on the fly; they have to be selected from the dictionary outline or list.

As with the other two software packages, MS Project keeps a list of resources that can be set-up with unique calendars, limits, group information, and codes. Resources can also be shared across multiple projects. Unlike with the other two software programs, MS Project users can accomplish this all in a single spreadsheet rather than multiple tabs. If desired, the multiple tabbed window of resource information can be used as an option.

Assigning resources in MS Project can be done by opening up the assign resource pop-up window and selecting the resources for each activity. The MS Project user can also assign resources through the activity information pop-up or by typing the resource name directly into the appropriate column of schedule display. Resources can be entered on the fly, but will not have all the information assigned to it unless set-up in the master project list. With MS Project, the scheduler can also select and assign resources from outside the project - from a MS Windows domain list, from an e-mail address book, or from other projects.

Start-up wizards:

As part of the case study trials, projects were set-up using the start-up wizards provided. These wizards assist the user in setting up the initial project by asking a series of questions to help organize a schedule.

SureTrak's Project KickStart Wizard guides the scheduler through the basic set-up of a project. The end result is an outline form, including a list of phases and the activities assigned to each phase. Using the wizard the scheduler can draw on other projects for activity lists as well as set-up and assign resources. The user can also choose to have the wizard link activities within phases in a sequential finish to start manner.

Once the wizard is finished, the scheduler still needs to complete the entry of information. Project overview data needs to be entered, especially start and data dates if the project does not start on the date the schedule is created. The calendar settings should be reviewed and, if necessary, defined. Activity codes and work breakdown structure coding, if used, need to be assigned. Resource limits and cost information need to be entered. The activity ID's can be edited to accommodate activity ID codes or just to make it easier to locate an activity. Most importantly, the logic relations between activities and phases need to be edited to model the project plan.

Primavera Contractor users have two Wizard options for setting up a new project. The Create a New Project Wizard will enter basic information; project name and ID, start and finish dates, and rate type defaults. This simplified method was used on the two manually entered schedule trials. The other two trial schedules created in Primavera Contractor

were done so with the Project KickStart utility that comes packaged with the program. This utility works the same as the wizard provided in SureTrak.

MS Project does not have a similar wizard, although the project guide tool bar will prompt the user to complete the steps manually. This guide takes the user through the set-up of activities, the assignment of resources, tracking of progress, and finally reporting. While the project guide tool bar does not simplify the process, it does provide the training and guidance necessary for the beginning user when working on actual schedules and not sample data.

Trade Codes

Trade codes are handled by the three programs in a manner similar to the Location codes. SureTrak and Primavera Contractor both support the use of a trade or responsibility code with code values that can be set to match the desired functional trade or actual names that can be used to sort and/or filter the schedule activities. MS Project can accommodate this through custom developed outline codes as was required to assign location codes. All three programs, however, will provide more information to the scheduler if resources are assigned in lieu of trade codes. Like trade codes, resources can be used to sort and/or filter schedule activities. Furthermore, resources can be summarized in usage profiles over time, providing information on peak work load requirements and if necessary limits can be set to avoid assigning individuals to more concurrent work than they could possibly perform.

Sharing the Schedule:

In addition to frequently used features, several other aspects of the three software packages were explored during the case study trials. The biggest single issue was the sharing of the schedule among those who need to access it.

SureTrak has the added benefit of being compatible Primavera Project Planner (P3). Although Primavera Contractor and MS Project report to be able to be exported into P3, only SureTrak allows for the scheduler to save the project as a P3 file or to open a P3 file and work in it. Similarily, Primavera Contractor can work with both Primavera e/c and Primavera's Project Management Module (formally known as Expedition).

Sharing of files created in the three packages is easiest by e-mail to another user of the program. While both MS Project and Primavera Contractor programs save project specific data as a single file, SureTrak uses multiple data files. With SureTrak, the case study required 16 files. Primavera Contractor is designed to be a stand alone application and is not intended to have common file storage shared by multiple users. MS Project and SureTrak both accommodate saving back-up files in different network drives.

As indicated previously, MS Project renumbers Activity ID's when the project is revised and activities are inserted or deleted, maintaining a sequential numbering sequence. In addition to making it difficult for the every day user to locate activities after revisions, this does not allow for easy integration with other systems that would key on the unique

activity ID's to map updated information. An alternative code needs to be set-up in MS Project to accommodate this whereas both Primavera Contractor and SureTrak maintain activity ID numbers unless manually overridden.

Furthermore, all three packages provide an extensive array of options for viewing the schedule, both on-screen and in printed reports, including: changing the layout on the screen; filtering for specific resources, codes, or other traits; and standard and custom reports.

Training:

An area for further review would include the availability and quality of training for each of the programs. A recent study of scheduling practices uncovered a serious discrepancy in the view point of the affected schedule users on the quality of the schedules produced by contractors. While 75% of contractors were satisfied with their scheduling practices, only 35% of owners and 36% of subcontractors viewed the schedules contractors prepared as of good quality.[8] In order to close this gap, training for the contractor needs to improve and a better understanding of the limitations and goals of project scheduling by end users needs to be achieved. Primavera provides training for its users in several major cities as well as through a limited network of authorized dealers and user clubs. Microsoft has far more geographic options regarding training, but with less of an emphasis on construction scheduling and more on general project management. Colleges, unfortunately, also do not have consistent standards in training and are more theoretical,

emphasizing such task as profitability analysis, resource leveling and crashing over the more common questions regarding level of detail and incorporation of project changes.[9]

Conclusion:

As indicated by the number of users and sales of each of the three programs, project managers within the industry find each of the programs capable of supporting their efforts to manage construction projects. The findings of the survey and case study also show that each program can perform the features desired most by the program users. By recapping the findings discussed previously, a choice can be made between the three based on the criteria reviewed. By assigning a score of one to the best performing program, a score of two to the next best and a score of three to the least successful program for each of the features results in un-weighted equally good scores for MS Project and Primavera Contractor. SureTraks combined score is not as good. Table 4 summarizes the results for each of the three software programs reviewed in the manner described.

Table 4 – Summary feature results

Feature	SureTrak	Primavera Contractor	MS Project
Ease Of Use	2	3	1
Target Baselines	3	1	2
Location Codes	2	1	3
Cost Loading	3	2	1
Roll-up, Hammmock and Summary Activities	2	3	1
Resource Assignments	3	2	1
Wizards	2	1	3
Trade Codes	1 (tie)	1 (tie)	3
Sharing	3	2	1

The relative importance of each of the features reviewed to the construction manager will weight the selection of the best program for the firm or individual. The final selection of which program to use to manage construction should take into consideration not only the results of this study, but also the context in which the program will be used. Of primary consideration would be the current level of training of the users and the interface needs, if any, with other programs - higher level scheduling programs or project management software. Furthermore, project owner requirements could dictate the solution needed.

End Notes

1. Newitt, *Construction Scheduling: Principles and Practice*, 44

2. Garza and Kelleher, *Expanding Role of CPM*

3. Galloway, *Use of CPM Scheduling,*

4. O'Brien and Plotnik, *CPM in Construction Management,* 447-454

5. Although Primavera Project Planner (P3) is used by more contractors and is by far the most complex, at around $5,000 per license it is also 10 times the cost of the two selected programs. Additionally, P3 has been replaced by its manufacturer, Primavera, and support for the existing version is being phased out, the manufacturer is even offering free upgrades (current info as of 6/30/07 website) to users to entice them to switch.

6. After 25 + years the author has found that unless the schedule is resource/cost loaded, the remaining duration alone is far superior for forecasting the remaining schedule. Often an activity is progressed physically but because a portion was not started, the entire original duration remains. If a project is resource/cost loaded, a combination of percent complete and remaining duration will provide the best results.

7. Harris, *Planning Using Primavera,* 13-7

8. Pinnell, *Risk Assessment,*

9. Galloway, *Study of University Courses,*

Appendix A – Survey

A Survey of Schedule Practices:

Please answer the following questions in relation to your work in the Mid-Atlantic Region.

1. Name of Firm: _____

2. Your Name and Title: _____

3. Average Annual Construction Volume
- ☐ Under $10 Million
- ☐ $10 - $50 Million
- ☐ $50 - $150 Million
- ☐ $150 - $500 Million
- ☐ Greater Than $500 Million

4. How would you best describe the way your firm operates, select only one?
- ☐ GC that Self Performs some of the work
- ☐ GC that Subcontracts as much as possible
- ☐ CM at risk
- ☐ CM Agency
- ☐ Specialty Contractor
- ☐ Other _____

5. How often does your firm use Critical Path Method (CPM) Scheduling on their projects, select only one?
- ☐ All Projects
- ☐ Most Projects
- ☐ Some Projects
- ☐ Only when required by owner
- ☐ Never (if checking this box, skip balance of survey and return)

6. On those projects where CPM is used, who prepares and maintains your CPM schedules, select only one?
- ☐ In-house Personnel
- ☐ Hired Consultants
- ☐ Both; In-house _____% and Hired Consultants for the balance

7. If hired Consultants are used, why? Select all that apply.
- ☐ Project Size
- ☐ Project Complexity
- ☐ Owner Specified CPM Requirements
- ☐ In-house staff not trained
- ☐ In-house staff not available
- ☐ Costs

If you do not do any in-house CPM work, please skip the balance of the Survey and return.

8. Who is responsible for performing CPM work in-house?

- ☐ Scheduling Department
- ☐ Scheduling Specialist
- ☐ Project Manager
- ☐ Superintendent
- ☐ Project Engineer / Assistant Project Manager
- ☐ Other _____

9. What Software do you use to Create CPM Schedules, select all that apply?

- ☐ Microsoft Project, version _____
- ☐ Primavera P3, version _____
- ☐ Primavera Contractor, version _____
- ☐ Primavera Engineer/Constructor, version _____
- ☐ SureTrak, version _____
- ☐ Other _____

10. If you use more than one (1) software package, Why? Please select all that apply:

- ☐ Client requirements
- ☐ Project size or complexity
- ☐ Employee preferences
- ☐ Other _____

11. If you use only one (1) software package, how was the selection made; please select all that apply:

- ☐ Employee prior training
- ☐ Compatibility with others
- ☐ Price
- ☐ Ease of use
- ☐ Reports\graphics
- ☐ Able to handle more complex issues
- ☐ Other _____

12. In addition to basic scheduling, please advise as to how often you use the following features: (never, rarely, sometimes, frequently, always)

Feature	never	rarely	sometimes	frequently	always
Trade Codes					
Location Codes					
Multiple Calendars					
Cost and Revenue Loading					
Manpower and Resource Loading					

Feature	never	rarely	sometimes	frequently	always
Automatic Resource Leveling					
Start-up Wizards					
Templates					
Roll-up or hammock activities					
Exporting to/importing from word processor software					
Exporting to/importing from spreadsheet software					
Baseline or target schedules					
Resource Analysis across multiple projects					
Comparison reports					
Progress Spotlighting					
Custom reports					

13. How often do you typically update CPM Schedules:

- ☐ As required by Owner
- ☐ Monthly
- ☐ Weekly
- ☐ At Milestones
- ☐ Other _____

14. How are schedule requirements and updates communicated to others? Check all that apply

Item	Format	To Owner\AE	To Subs\Vendors
Base Line Schedule	Printed Report		
	Printed Graphics		
	Electronic reports\Graphics		
	Actual program files		
	Only as part of larger status\progress report		
	Reviewed at progress meetings		
	Included in Contract documentation		

Item	Format	To Owner\AE	To Subs\Vendors
Updates and Revisions	Printed Report		
	Printed Graphics		
	Electronic reports\Graphics		
	Actual program files		
	Only as part of larger status\progress report		
	Reviewed at progress meetings		

15. Would you be willing to answer additional questions during a phone interview:

☐ No

☐ Yes, I can be reached at _____. It would be best if I was called during the following hours and day(s) of the week: _____

16. If you would like a summary of the results, please provide a e-mail address below:

_____

Appendix B – Survey results – Detail w/o company and respondent names

Survey Results	# of responses	% of response		
Annual Volume of Respondent				
X<10	3	15%		
10<X<50	4	20%		
50<X<150	6	30%		
150<X<500	4	20%		
500<X	2	10%		
Type of contractor				
GC -Self Perform	9	45%		
GC Subs	5	25%		
CM Risk	3	15%		
CM Agency	2	10%		
SP Cont	0	0%		
Other	1	5%		
Frequency that CPM is employed				
All	9	45%		
Most	8	40%		
Some	3	15%		
If Required	0	0%		
Never	0	0%		
What organization is involved				
Firm	12	60%		
Consultant	1	5%		
both-% done in-house?	7	35%	avg in-house	79%
Why use a consultant	of all repondents		of those using consultants	
Size	3	15%		30%
Complexity	5	25%		50%
Spec Require	5	25%		50%
Not Trained	4	20%		40%
Not Available	7	35%		70%
Costs	0	0%		0%

Survey Results	# of responses	% of response		
Specific individuals involved:				
Sched Dept	4	21%	unassisted	16%
Sched Specialist	3	16%	unassisted	5%
PM	14	74%	unassisted	47%
Super	2	11%	unassisted	0%
PEng/APM	1	5%	unassisted	0%
Other	1	5%	unassisted	0%
Software Used?				
MS Project	8	42%		
P3	10	53%		
Primavera Contractor	1	5%		
Primavera E/C	2	11%		
SureTrak	8	42%		
Other	2	11%		
1 or more of 3 selected programs	16	84%		
why use multiple programs				
Client	5	26%	of respondents	56%
Size\Complex	3	16%	of respondents	33%
Employee	4	21%	of respondents	44%
Other	1	5%	of respondents	11%
selection criteria				
Training	3	16%	of respondents	21%
Compatibility	4	21%	of respondents	29%
Price	3	16%	of respondents	21%
Ease of Use	8	42%	of respondents	57%
Reports/Graphics	1	5%	of respondents	7%
Complexity	4	21%	of respondents	29%
other	2	11%	of respondents	14%

Survey Results

		# of responses	% of response		
features	0 = Never, 4= always	users	% used	total	Avg level
	trade	13	68%	39	3.00
	location	16	84%	38	2.38
	multi Cal	12	63%	25	2.08
	Cost/Rev Load	15	79%	30	2.00
	Manpower/resources	14	74%	27	1.93
	Auto Resource Level	5	26%	7	1.40
	Start-up wizards	11	58%	18	1.64
	Templates	15	79%	31	2.07
	Roll-up/Hammock	14	74%	33	2.36
	Exp/Imp to WP	10	53%	15	1.50
	Exp/Imp to Spreadsheet	12	63%	27	2.25
	Target\Baseline	17	89%	47	2.76
	Multi project resource	8	42%	12	1.50
	Comparisons	13	68%	30	2.31
	Spotlighting	13	68%	25	1.92
	Custom Reports	13	68%	29	2.23
frequency of updates?					
	as req'd	5	26%		
	monthly	10	53%		
	weekly	5	26%		
	milestones	2	11%		
	other	2	11%		

Survey Results	# of responses	% of response
communication tools		
Base Line Schedule provided to owners:		
Print Report	16	84%
Print Graphic	15	79%
elect rep/graph	12	63%
prog files	6	32%
in stat rept	1	5%
at mtg	17	89%
in contract doc	11	58%
Base Line Schedule provided to subcontractors:		
Print Report	13	68%
Print Graphic	14	74%
elect rep/graph	2	11%
prog files	0	0%
in stat rept	0	0%
at mtg	16	84%
in contract doc	12	63%
Updated Schedules provided to owners:		
Print Report	17	89%
Print Graphic	14	74%
elect rep/graph	12	63%
prog files	3	16%
in stat rept	1	5%
at mtg	19	100%
Updated Schedules provided to subcontractors:		
Print Report	13	68%
Print Graphic	12	63%
elect rep/graph	4	21%
prog files	0	0%
in stat rept	0	0%
at mtg	18	95%

Survey Results Firm	1	2	3	4	5	6	7	8	9	10
Annual Volume of Respondent?										
X<10	1							1		
10<X<50				1		1				
50<X<150			1				1			
150<X<500		1			1				1	
500<X										1
Type of Contractor?										
GC -Self Perform	1	1	1				1	1		
GC Subs					1	1				1
CM Risk				1					1	
CM Agency										
SP Cont										
Other										
How often is CPM Used?										
All			1		1	1			1	1
Most	1	1		1			1			
Some								1		
If Required										
Never										
Who is involved?										
Firm	1	1	1	1		1	1	1		
Consultant										
both (% done by Firm)					35%				80%	99%
Why use a consultant?										
Size of project										
Complexity					1					1
Specifications Require						1			1	1
Employees Not Trained					1				1	
In-house Staff not available									1	
Costs										
Specific individuals involved:										
Sched Dept		1	1							
Sched Specialist	1								1	
PM	1		1	1	1	1	1	1		1
Super						1				1
PEng/APM										
Other								Proj Personnel		
Software Used?										
MS Project	1						1			1
P3	1	1	1		1				1	
Primavera Contractor				1						
Primavera E/C										1
SureTrak		1			1	1	1	1	1	
Other		PPM								

Survey Results Firm	11	12	13	14	15	16	17	18	19	20
Annual Volume of Respondent?										
X<10				1						
10<X<50	1						1			
50<X<150		1			1	1		1		
150<X<500										1
500<X			1							
Type of Contractor?										
GC -Self Perform	1	1		1			1			
GC Subs					1	1				
CM Risk								1		
CM Agency			1							1
SP Cont										
Other								1 - consultant		
How often is CPM Used?										
All	1						1	1		1
Most		1	1	1	1					
Some						1			1	
If Required										
Never										
Who is involved?										
Firm			1	1	1		1		1	
Consultant	1									
both (% done by Firm)		90%				80%		90%		80%
Why use a consultant?										
Size of project		1				1		1		
Complexity	1	1				1				
Specifications Require	1							1		
Employees Not Trained		1				1				
In-house Staff not available	1	1	1			1		1		1
Costs										
Specific individuals involved:										
Sched Dept			1							1
Sched Specialist									1	
PM		1		1	1	1	1	1		
Super										
PEng/APM		1								
Other										
Software Used?										
MS Project				1	1	1	1		1	
P3		1	1			1			1	1
Primavera Contractor										
Primavera E/C										1
SureTrak			1					1		
Other		Micro Project								

Survey Results										
Firm	1	2	3	4	5	6	7	8	9	10
why use multiple programs										
Client						1				1
Size\Complex	1	1								
Employee	1								1	1
Other								Training		
selection criteria										
Training						1		1		
Compatibility							1			
Price								1		
Ease of Use					1	1	1	1		
Reports/Graphics								1		
Complexity		1				1				
other		Contr Rerom MS Project								
Which features are used and how often?			0 = Never, 4= always							
trade	3	4	4	2	0	0	0	0	3	3
location	3	0	4	2	2	0	2	1	3	3
multi Cal	2	4	3	1	0	0	0	0	2	3
Cost/Rev Load	1	3	3	0	2	3	0	1	1	1
Manpower/resources	1	3	2	0	3	0	2	1	1	1
Auto Resource Level	0	0	0	0	0	0	0	0	0	0
Start-up wizards	1	0	0	2	1	0	0	0	1	0
Templates	1	4	0	3	1	0	2	0	2	1
Roll-up/Hammock	1	2	2	0	2	3	0	0	3	2
Exp/Imp to WP	1	4	0	0	1	0	0	0	0	1
Exp/Imp to Spreadsheet	2	4	3	0	1	0	0	0	3	1
Target\Baseline	2	4	3	2	2	3	0	2	4	2
Multi project resource	0	0	1	0	0	0	0	0	1	0
Comparisons	0	3	3	1	0	0	0	0	1	3
Spotlighting	0	0	2	0	1	3	0	1	1	2
Custom Reports	2	3	4	2	0	0	0	0	1	1
frequency of updates?										
as req'd	1							1		
monthly	1		1		1			1	1	
weekly		1		1		1	1			1
milestones								1		
other		as issues require								

Survey Results Firm	11	12	13	14	15	16	17	18	19	20
why use multiple programs										
Client			1						1	1
Size\Complex						1				
Employee						1				
Other										
selection criteria										
Training							1			
Compatibility		1			1			1		
Price					1			1		
Ease of Use				1	1		1		1	
Reports/Graphics										
Complexity		1	1							
other										
Which features are used and how										
trade		1	3	4	0	4	1	2	2	3
location		4	3	2	1	0	1	2	2	3
multi Cal		2	3	1	0	0	0	1	2	1
Cost/Rev Load		3	3	2	0	0	2	1	1	3
Manpower/resources		3	3	2	1	0	0	0	1	3
Auto Resource Level		1	2	0	0	1	0	0	1	2
Start-up wizards		1	3	0	0	2	2	2	1	2
Templates		1	3	3	0	3	3	2	1	1
Roll-up/Hammock		2	4	0	0	2	4	2	1	3
Exp/Imp to WP		1	3	0	0	1	0	1	1	1
Exp/Imp to Spreadsheet		3	3	0	0	2	0	1	1	3
Target\Baseline		4	3	3	1	2	0	2	4	4
Multi project resource		3	3	0	0	1	0	1	1	1
Comparisons		2	4	2	2	3	0	1	3	2
Spotlighting		1	4	0	2	2	0	2	2	2
Custom Reports		1	4	0	2	3	0	2	2	2
frequency of updates?										
as req'd		1	1						1	
monthly		1		1		1	1	1		
weekly										
milestones					1					
other										bi-wkly

Survey Results Firm	1	2	3	4	5	6	7	8	9	10
communication tools										
Base Line Schedule provided to owners:										
Print Report	1	1	1	1	1	1	1		1	1
Print Graphic	1	1	1	1	1		1	1	1	1
elect rep/graph	1	1			1			1	1	1
prog files	1		1						1	
in stat rept									1	
at mtg	1		1	1	1	1	1	1	1	1
in contract doc				1		1		1	1	1
Base Line Schedule provided to subcontractors:										
Print Report	1	1	1	1		1	1			1
Print Graphic	1		1	1	1		1	1	1	1
elect rep/graph										
prog files										
in stat rept										
at mtg	1		1	1	1	1	1	1		1
in contract doc		1		1		1		1		1
Updated Schedules provided to owners:										
Print Report	1	1	1	1	1	1	1		1	1
Print Graphic	1	1	1	1	1		1	1	1	1
elect rep/graph	1	1	1		1				1	1
prog files									1	
in stat rept										
at mtg	1	1	1	1	1	1	1	1	1	1
Updated Schedules provided to subcontractors:										
Print Report	1	1		1		1	1			1
Print Graphic	1			1	1		1	1	1	1
elect rep/graph										
prog files										
in stat rept										
at mtg	1	1	1	1	1	1	1	1		1

Survey Results

Firm	11	12	13	14	15	16	17	18	19	20
communication tools	NO RESPONSE									
Base Line Schedule provided to ov										
Print Report		1	1	1		1		1	1	1
Print Graphic			1	1	1			1	1	1
elect rep/graph		1	1		1			1	1	1
prog files		1						1		1
in stat rept										
at mtg		1		1	1	1	1	1	1	1
in contract doc			1	1		1		1	1	1
Base Line Schedule provided to su										
Print Report			1	1		1		1	1	1
Print Graphic			1	1	1			1	1	1
elect rep/graph					1				1	
prog files										
in stat rept										
at mtg		1		1	1	1	1	1	1	1
in contract doc		1	1	1		1		1	1	1
Updated Schedules provided to ov										
Print Report		1	1	1	1	1		1	1	1
Print Graphic			1		1			1	1	1
elect rep/graph		1	1		1			1	1	1
prog files								1		1
in stat rept								1		
at mtg		1	1	1	1	1	1	1	1	1
Updated Schedules provided to su										
Print Report			1	1	1	1		1	1	1
Print Graphic			1		1			1	1	1
elect rep/graph			1		1			1	1	
prog files										
in stat rept										
at mtg		1	1	1	1	1	1	1	1	1

Survey Results										
Firm	1	2	3	4	5	6	7	8	9	10

Respondent information:	
Firm	Title
1	VP
2	Corp Scheduling Eng
3	Scheduling Manager
4	Chief Estimator
5	???
6	President
7	President
8	VP Project Management
9	Reg MGR of Project Controls
10	Dir of Scheduling
11	President
12	Marketing manager
13	VP
14	VP
15	PM
16	PM
17	Dir Of Pre-Con
18	Proj. Exec.
19	Managing Principal
20	Director of Engineering

Appendix C – Sample Project Data

Sample Project Schedule Data				
Act. ID	Description	WBS	Area	Trade
10	NTP	Admin		Owner
20	Permit Dwgs Submitted	Admin		CM
30	Permit Review	Admin		Govt
40	Permit Issued	Admin		Govt
50	SRA Doors and Frames	Admin		General
60	SRA Tile	Admin		Tile
70	SRA Paint	Admin		Paint
80	SRA Toilet Accessories	Admin		General
90	SRA Sprinkler Shop Dwgs	Admin		FireProt
100	SRA HVAC Equipment	Admin		Mech
110	SRA Water Disinfection Equip	Admin		Plumb
120	SRA Water Pumps	Admin		Plumb
130	SRA Water Heater	Admin		Plumb
140	SRA Light Fixtures	Admin		Elec
150	SRA Fire Alarm	Admin		Elec
160	F/D Tile	Admin		Tile
170	F/D Paint	Admin		Paint
180	F/D Toilet Accessories	Admin		General
190	F/D Sprinkler Components	Admin		FireProt
200	F/D HVAC Equipment	Admin		Mech
210	F/D Water Disinfection Equip	Admin		Plumb
220	F/D Water Pumps	Admin		Plumb
230	F/D Water Heater	Admin		Plumb
240	F/D Light Fixtures	Admin		Elec
250	F/D Fire Alarm	Admin		Elec
260	Set-up Field Office	All work		CM
270	Mobilize Dumpster/tools	All work		CM
280	Demo Existing walls/Slab	Phase 1	Shower	General
290	Demo Plumbing	Phase 1	Shower	Plumb
300	Demo Mechanical	Phase 1	Shower	Mech
310	Demo Electrical	Phase 1	Shower	Elec
320	Underground Plumbing	Phase 1	Shower	Plumb
330	Backfill and place slab	Phase 1	Shower	Conc
340	Frame Walls	Phase 1	Shower	General
350	Electrical Rough in	Phase 1	Shower	Elec
360	Mech Rough in	Phase 1	Shower	Mech
370	Plumbing Rough in	Phase 1	Shower	Plumb
380	Sprinkler Rough in	Phase 1	Shower	FireProt
390	M/P insulation	Phase 1	Shower	Mech
400	Wall insulation	Phase 1	Shower	General
410	Drywall	Phase 1	Shower	General
420	Caulk	Phase 1	Shower	General
430	Tape and Finish	Phase 1	Shower	General
440	Ceramic Tile walls	Phase 1	Shower	Tile
450	Paint	Phase 1	Shower	Paint

Sample Project Schedule Data			
		in Days	
Act. ID	Description	Duration	Cost
10	NTP	0	
20	Permit Dwgs Submitted	1	3500
30	Permit Review	30	
40	Permit Issued	0	
50	SRA Doors and Frames	13	
60	SRA Tile	10	
70	SRA Paint	10	
80	SRA Toilet Accessories	10	
90	SRA Sprinkler Shop Dwgs	15	
100	SRA HVAC Equipment	13	
110	SRA Water Disinfection Equip	13	
120	SRA Water Pumps	13	
130	SRA Water Heater	13	
140	SRA Light Fixtures	13	
150	SRA Fire Alarm	15	
160	F/D Tile	10	2000
170	F/D Paint	3	500
180	F/D Toilet Accessories	5	500
190	F/D Sprinkler Components	5	1500
200	F/D HVAC Equipment	5	1200
210	F/D Water Disinfection Equip	5	1800
220	F/D Water Pumps	5	3200
230	F/D Water Heater	5	2500
240	F/D Light Fixtures	8	3000
250	F/D Fire Alarm	10	800
260	Set-up Field Office	2	4000
270	Mobilize Dumpster/tools	1	6000
280	Demo Existing walls/Slab	4	12000
290	Demo Plumbing	2	2500
300	Demo Mechanical	2	2000
310	Demo Electrical	2	1000
320	Underground Plumbing	3	7300
330	Backfill and place slab	2	500
340	Frame Walls	3	9000
350	Electrical Rough in	5	4000
360	Mech Rough in	5	4200
370	Plumbing Rough in	5	9000
380	Sprinkler Rough in	3	2500
390	M/P insulation	3	1000
400	Wall insulation	2	3500
410	Drywall	2	10000
420	Caulk	1	750
430	Tape and Finish	4	4500
440	Ceramic Tile walls	5	1800
450	Paint	3	2300

Sample Project Schedule Data						
Act. ID	Description	Pred	Pred	Pred	Pred	Pred
10	NTP					
20	Permit Dwgs Submitted	10				
30	Permit Review	20				
40	Permit Issued	30				
50	SRA Doors and Frames	10	40 FF			
60	SRA Tile	10	40 FF			
70	SRA Paint	10	40 FF			
80	SRA Toilet Accessories	10	40 FF			
90	SRA Sprinkler Shop Dwgs	10	40 FF			
100	SRA HVAC Equipment	10	40 FF			
110	SRA Water Disinfection Equip	10	40 FF			
120	SRA Water Pumps	10	40 FF			
130	SRA Water Heater	10	40 FF			
140	SRA Light Fixtures	10	40 FF			
150	SRA Fire Alarm	10	40 FF			
160	F/D Tile	60				
170	F/D Paint	70				
180	F/D Toilet Accessories	80				
190	F/D Sprinkler Components	90				
200	F/D HVAC Equipment	100				
210	F/D Water Disinfection Equip	110				
220	F/D Water Pumps	120				
230	F/D Water Heater	130				
240	F/D Light Fixtures	140				
250	F/D Fire Alarm	150				
260	Set-up Field Office	40				
270	Mobilize Dumpster/tools	260				
280	Demo Existing walls/Slab	260	290 FF	300 FF	310 FF	
290	Demo Plumbing	270				
300	Demo Mechanical	270				
310	Demo Electrical	270				
320	Underground Plumbing	280				
330	Backfill and place slab	320				
340	Frame Walls	330 FS1				
350	Electrical Rough in	340				
360	Mech Rough in	340				
370	Plumbing Rough in	340				
380	Sprinkler Rough in	340 FF				
390	M/P insulation	360	370			
400	Wall insulation	350	390	380		
410	Drywall	400				
420	Caulk	410				
430	Tape and Finish	410				
440	Ceramic Tile walls	420	430			
450	Paint	420	430			

Sample Project Schedule Data				
Act. ID	Description	WBS	Area	Trade
460	Ceramic Tile Floor	Phase 1	Shower	Tile
470	Ceiling Grid	Phase 1	Shower	General
480	Light Fixtures	Phase 1	Shower	Elec
490	HVAC distribution and controls	Phase 1	Shower	Mech
500	Plumbing Fixtures	Phase 1	Shower	Plumb
510	Toilet Partitions	Phase 1	Shower	General
520	Ceiling Tile	Phase 1	Shower	General
530	Doors and Hardware	Phase 1	Shower	General
540	VCT Floor	Phase 1	Shower	Floor
550	Toilet Accessories	Phase 1	Shower	General
560	Mech Trim	Phase 1	Shower	Mech
570	Elect Trim	Phase 1	Shower	Elec
580	Sprinkler Trim	Phase 1	Shower	FireProt
590	Demo Utility Room	Phase 2	Utility Room	General
600	Form and Place Concrete Pads	Phase 2	Utility Room	Conc
610	Set Hot Water Heaters	Phase 2	Utility Room	Plumb
620	Install Flue and Vents	Phase 2	Utility Room	Mech
630	Set Pumps	Phase 2	Utility Room	Plumb
640	Pipe Connections	Phase 2	Utility Room	Plumb
650	Elect Connections	Phase 2	Utility Room	Elec
660	Gas Piping and Tap	Phase 2	Utility Room	Plumb
670	Controls	Phase 2	Utility Room	Mech
680	Start Up HWH/Pumps	Phase 2	Utility Room	Plumb
690	Paint/Clean-up Utility Room	Phase 2	Utility Room	Paint
700	Install Mains in Hallways	Phase 2	Hallway	Plumb
710	Connect to Room piping	Phase 2	Hallway	Plumb
720	Clean and restore Hallways	Phase 2	Hallway	General
730	Permit Inspections	All work		Govt
740	Punchlist	All work		CM
750	Substantial Comnpletion	All work		Owner
760	Clean and Demob	All work		CM
770	Construction Management	All work		CM
780	Contingency/Misc/Fee	All work		CM

Sample Project Schedule Data			
		in Days	
Act. ID	Description	Duration	Cost
460	Ceramic Tile Floor	3	1000
470	Ceiling Grid	2	1500
480	Light Fixtures	2	2000
490	HVAC distribution and controls	1	3500
500	Plumbing Fixtures	4	6000
510	Toilet Partitions	2	1000
520	Ceiling Tile	1	1500
530	Doors and Hardware	1	1500
540	VCT Floor	1	1450
550	Toilet Accessories	2	500
560	Mech Trim	1	1000
570	Elect Trim	1	1000
580	Sprinkler Trim	1	1340
590	Demo Utility Room	4	5000
600	Form and Place Concrete Pads	2	1250
610	Set Hot Water Heaters	1	1000
620	Install Flue and Vents	2	2500
630	Set Pumps	3	1500
640	Pipe Connections	3	8000
650	Elect Connections	2	1500
660	Gas Piping and Tap	2	10000
670	Controls	2	5000
680	Start Up HWH/Pumps	1	1200
690	Paint/Clean-up Utility Room	2	1000
700	Install Mains in Hallways	20	20000
710	Connect to Room piping	15	25000
720	Clean and restore Hallways	5	15000
730	Permit Inspections	4	
740	Punchlist	3	8000
750	Substantial Comnpletion	0	
760	Clean and Demob	3	2000
770	Construction Management	Hammock	55540
780	Contingency/Misc/Fee	Hammock	61330
		total	356460
		Contract	356460

Sample Project Schedule Data						
Act. ID	Description	Pred	Pred	Pred	Pred	Pred
460	Ceramic Tile Floor	440				
470	Ceiling Grid	450	460 FF1			
480	Light Fixtures	470				
490	HVAC distribution and controls	470				
500	Plumbing Fixtures	460	450			
510	Toilet Partitions	500				
520	Ceiling Tile	480	490			
530	Doors and Hardware	510				
540	VCT Floor	520				
550	Toilet Accessories	500				
560	Mech Trim	520				
570	Elect Trim	530				
580	Sprinkler Trim	520				
590	Demo Utility Room	280				
600	Form and Place Concrete Pads	590				
610	Set Hot Water Heaters	600				
620	Install Flue and Vents	610				
630	Set Pumps	620				
640	Pipe Connections	630				
650	Elect Connections	640				
660	Gas Piping and Tap	650				
670	Controls	660				
680	Start Up HWH/Pumps	670				
690	Paint/Clean-up Utility Room	680				
700	Install Mains in Hallways	290				
710	Connect to Room piping	700	680			
720	Clean and restore Hallways	710				
730	Permit Inspections	540,	550,	560,	570,	580, 720
740	Punchlist	690	730			
750	Substantial Comnpletion	740				
760	Clean and Demob	750	770	780		
770	Construction Management	10				
780	Contingency/Misc/Fee	10				

Sample Project Schedule Data								
Baseline Edits								
					in Days			
Act. ID	Description	WBS	Area	Trade	Duration	Cost	Pred	Pred
New								
155	F/D Doors/Frames	Admin		General	10		50	
Added Predecessor only								
350	Electrical Rough In						250	
380	Sprinkler Rough-In						190	
440	Ceramic Tile Walls						160	
450	Paint						170	
480	Light Fixtures						240	
490	HVAC Distribution						200	
530	Doors and hardware						155	
550	Toilet Accessories						180	
610	Set HW Heaters						230	
630	Set Pumps						210	220

Sample Project Schedule Data					
Update 1: Project Start - 10/6/06					
					in Days
Act. ID	Description	WBS	Area	Trade	Duration
10	NTP	Admin		Owner	0
20	Permit Dwgs Submitted	Admin		CM	1
30	Permit Review	Admin		Govt	30
40	Permit Issued	Admin		Govt	0
50	SRA Doors and Frames	Admin		General	13
60	SRA Tile	Admin		Tile	10
70	SRA Paint	Admin		Paint	10
80	SRA Toilet Accessories	Admin		General	10
90	SRA Sprinkler Shop Dwgs	Admin		FireProt	15
100	SRA HVAC Equipment	Admin		Mech	13
110	SRA Water Disinfection Equip	Admin		Plumb	13
120	SRA Water Pumps	Admin		Plumb	13
130	SRA Water Heater	Admin		Plumb	13
140	SRA Light Fixtures	Admin		Elec	13
150	SRA Fire Alarm	Admin		Elec	15
160	F/D Tile	Admin		Tile	10
170	F/D Paint	Admin		Paint	3
180	F/D Toilet Accessories	Admin		General	5
190	F/D Sprinkler Components	Admin		FireProt	5
200	F/D HVAC Equipment	Admin		Mech	5
210	F/D Water Disinfection Equip	Admin		Plumb	5
220	F/D Water Pumps	Admin		Plumb	5
230	F/D Water Heater	Admin		Plumb	5
240	F/D Light Fixtures	Admin		Elec	8
250	F/D Fire Alarm	Admin		Elec	10
260	Set-up Field Office	All work		CM	2
270	Mobilize Dumpster/tools	All work		CM	1
280	Demo Existing walls/Slab	Phase 1	Shower	General	4
290	Demo Plumbing	Phase 1	Shower	Plumb	2
300	Demo Mechanical	Phase 1	Shower	Mech	2
310	Demo Electrical	Phase 1	Shower	Elec	2
320	Underground Plumbing	Phase 1	Shower	Plumb	3
330	Backfill and place slab	Phase 1	Shower	Conc	2
340	Frame Walls	Phase 1	Shower	General	3
350	Electrical Rough in	Phase 1	Shower	Elec	5
360	Mech Rough in	Phase 1	Shower	Mech	5
370	Plumbing Rough in	Phase 1	Shower	Plumb	5
380	Sprinkler Rough in	Phase 1	Shower	FireProt	3
390	M/P insulation	Phase 1	Shower	Mech	3
400	Wall insulation	Phase 1	Shower	General	2
410	Drywall	Phase 1	Shower	General	2
420	Caulk	Phase 1	Shower	General	1

Sample Project Schedule Data				
Update 1: Project Start - 10/6/06				
Act. ID	Description	Start	Finish	Rem Dur
10	NTP	8/1/2006		
20	Permit Dwgs Submitted	8/1/2006	8/9/2006	
30	Permit Review	8/10/2006	10/4/2006	
40	Permit Issued		10/4/2006	
50	SRA Doors and Frames	10/3/2006		12
60	SRA Tile	8/31/2006		5
70	SRA Paint	9/22/2006		5
80	SRA Toilet Accessories	10/3/2006		9
90	SRA Sprinkler Shop Dwgs	9/21/2006	10/6/2006	
100	SRA HVAC Equipment	10/5/2006		13
110	SRA Water Disinfection Equip	10/5/2006		13
120	SRA Water Pumps	10/6/2006		13
130	SRA Water Heater	10/5/2006		13
140	SRA Light Fixtures	9/14/2006	10/6/2006	
150	SRA Fire Alarm	10/5/2006		15
160	F/D Tile			
170	F/D Paint			
180	F/D Toilet Accessories			
190	F/D Sprinkler Components			
200	F/D HVAC Equipment			
210	F/D Water Disinfection Equip			
220	F/D Water Pumps			
230	F/D Water Heater			
240	F/D Light Fixtures			
250	F/D Fire Alarm			
260	Set-up Field Office	10/6/2006		2
270	Mobilize Dumpster/tools	10/6/2006	10/6/2006	
280	Demo Existing walls/Slab			
290	Demo Plumbing			
300	Demo Mechanical			
310	Demo Electrical			
320	Underground Plumbing			
330	Backfill and place slab			
340	Frame Walls			
350	Electrical Rough in			
360	Mech Rough in			
370	Plumbing Rough in			
380	Sprinkler Rough in			
390	M/P insulation			
400	Wall insulation			
410	Drywall			
420	Caulk			

Sample Project Schedule Data					
Update 1: Project Start - 10/6/06					
					in Days
Act. ID	Description	WBS	Area	Trade	Duration
430	Tape and Finish	Phase 1	Shower	General	4
440	Ceramic Tile walls	Phase 1	Shower	Tile	5
450	Paint	Phase 1	Shower	Paint	3
460	Ceramic Tile Floor	Phase 1	Shower	Tile	3
470	Ceiling Grid	Phase 1	Shower	General	2
480	Light Fixtures	Phase 1	Shower	Elec	2
490	HVAC distribution and controls	Phase 1	Shower	Mech	1
500	Plumbing Fixtures	Phase 1	Shower	Plumb	4
510	Toilet Partitions	Phase 1	Shower	General	2
520	Ceiling Tile	Phase 1	Shower	General	1
530	Doors and Hardware	Phase 1	Shower	General	1
540	VCT Floor	Phase 1	Shower	Floor	1
550	Toilet Accessories	Phase 1	Shower	General	2
560	Mech Trim	Phase 1	Shower	Mech	1
570	Elect Trim	Phase 1	Shower	Elec	1
580	Sprinkler Trim	Phase 1	Shower	FireProt	1
590	Demo Utility Room	Phase 2	Utility Roor	General	4
600	Form and Place Concrete Pads	Phase 2	Utility Roor	Conc	2
610	Set Hot Water Heaters	Phase 2	Utility Roor	Plumb	1
620	Install Flue and Vents	Phase 2	Utility Roor	Mech	2
630	Set Pumps	Phase 2	Utility Roor	Plumb	3
640	Pipe Connections	Phase 2	Utility Roor	Plumb	3
650	Elect Connections	Phase 2	Utility Roor	Elec	2
660	Gas Piping and Tap	Phase 2	Utility Roor	Plumb	2
670	Controls	Phase 2	Utility Roor	Mech	2
680	Start Up HWH/Pumps	Phase 2	Utility Roor	Plumb	1
690	Paint/Clean-up Utility Room	Phase 2	Utility Roor	Paint	2
700	Install Mains in Hallways	Phase 2	Hallway	Plumb	20
710	Connect to Room piping	Phase 2	Hallway	Plumb	15
720	Clean and restore Hallways	Phase 2	Hallway	General	5
730	Permit Inspections	All work		Govt	4
740	Punchlist	All work		CM	3
750	Substantial Comnpletion	All work		Owner	0
760	Clean and Demob	All work		CM	3
770	Construction Management	All work		CM	Hammock
780	Contingency/Misc/Fee	All work		CM	Hammock
					total
					Contract

Sample Project Schedule Data				
Update 1: Project Start - 10/6/06				
Act. ID	Description	Start	Finish	Rem Dur
430	Tape and Finish			
440	Ceramic Tile walls			
450	Paint			
460	Ceramic Tile Floor			
470	Ceiling Grid			
480	Light Fixtures			
490	HVAC distribution and controls			
500	Plumbing Fixtures			
510	Toilet Partitions			
520	Ceiling Tile			
530	Doors and Hardware			
540	VCT Floor			
550	Toilet Accessories			
560	Mech Trim			
570	Elect Trim			
580	Sprinkler Trim			
590	Demo Utility Room			
600	Form and Place Concrete Pads			
610	Set Hot Water Heaters			
620	Install Flue and Vents			
630	Set Pumps			
640	Pipe Connections			
650	Elect Connections			
660	Gas Piping and Tap			
670	Controls			
680	Start Up HWH/Pumps			
690	Paint/Clean-up Utility Room			
700	Install Mains in Hallways			
710	Connect to Room piping			
720	Clean and restore Hallways			
730	Permit Inspections			
740	Punchlist			
750	Substantial Comnpletion			
760	Clean and Demob			
770	Construction Management			
780	Contingency/Misc/Fee			

Sample Project Schedule Data					
Update 2 - Roof Replacement Added and started - 12/1/06					
					in Days
Act. ID	Description	WBS	Area	Trade	Duration
10	NTP	Admin		Owner	0
20	Permit Dwgs Submitted	Admin		CM	1
30	Permit Review	Admin		Govt	30
40	Permit Issued	Admin		Govt	0
50	SRA Doors and Frames	Admin		General	13
60	SRA Tile	Admin		Tile	10
70	SRA Paint	Admin		Paint	10
80	SRA Toilet Accessories	Admin		General	10
90	SRA Sprinkler Shop Dwgs	Admin		FireProt	15
100	SRA HVAC Equipment	Admin		Mech	13
110	SRA Water Disinfection Equip	Admin		Plumb	13
120	SRA Water Pumps	Admin		Plumb	13
130	SRA Water Heater	Admin		Plumb	13
140	SRA Light Fixtures	Admin		Elec	13
150	SRA Fire Alarm	Admin		Elec	15
160	F/D Tile	Admin		Tile	10
170	F/D Paint	Admin		Paint	3
180	F/D Toilet Accessories	Admin		General	5
190	F/D Sprinkler Components	Admin		FireProt	5
200	F/D HVAC Equipment	Admin		Mech	5
210	F/D Water Disinfection Equip	Admin		Plumb	5
220	F/D Water Pumps	Admin		Plumb	5
230	F/D Water Heater	Admin		Plumb	5
240	F/D Light Fixtures	Admin		Elec	8
250	F/D Fire Alarm	Admin		Elec	10
260	Set-up Field Office	All work		CM	2
270	Mobilize Dumpster/tools	All work		CM	1
280	Demo Existing walls/Slab	Phase 1	Shower	General	4
290	Demo Plumbing	Phase 1	Shower	Plumb	2
300	Demo Mechanical	Phase 1	Shower	Mech	2
310	Demo Electrical	Phase 1	Shower	Elec	2
320	Underground Plumbing	Phase 1	Shower	Plumb	3
330	Backfill and place slab	Phase 1	Shower	Conc	2
340	Frame Walls	Phase 1	Shower	General	3
350	Electrical Rough in	Phase 1	Shower	Elec	5
360	Mech Rough in	Phase 1	Shower	Mech	5
370	Plumbing Rough in	Phase 1	Shower	Plumb	5
380	Sprinkler Rough in	Phase 1	Shower	FireProt	3
390	M/P insulation	Phase 1	Shower	Mech	3
400	Wall insulation	Phase 1	Shower	General	2
410	Drywall	Phase 1	Shower	General	2
420	Caulk	Phase 1	Shower	General	1

Sample Project Schedule Data				
Update 2 - Roof Replacement Added and start				
Act. ID	Description	Start	Finish	Rem Dur
10	NTP	A	A	
20	Permit Dwgs Submitted	A	A	
30	Permit Review	A	A	
40	Permit Issued	A	A	
50	SRA Doors and Frames	A	10/31/2006	
60	SRA Tile	A	10/17/2006	
70	SRA Paint	A	10/17/2006	
80	SRA Toilet Accessories	A		3
90	SRA Sprinkler Shop Dwgs	A	A	
100	SRA HVAC Equipment	A		3
110	SRA Water Disinfection Equip	A		3
120	SRA Water Pumps	A	10/16/2006	
130	SRA Water Heater	A	10/16/2006	
140	SRA Light Fixtures	A	A	
150	SRA Fire Alarm	A		3
160	F/D Tile	10/18/2006	11/28/2006	
170	F/D Paint	10/18/2006	12/1/2006	
180	F/D Toilet Accessories			
190	F/D Sprinkler Components	10/7/2006	11/8/2006	
200	F/D HVAC Equipment	11/27/2006	11/28/2006	
210	F/D Water Disinfection Equip			
220	F/D Water Pumps	10/17/2006	10/25/2006	
230	F/D Water Heater	10/17/2006	10/25/2006	
240	F/D Light Fixtures	10/7/2006	12/1/2006	
250	F/D Fire Alarm	12/1/2006	12/1/2006	
260	Set-up Field Office	A	10/9/2006	
270	Mobilize Dumpster/tools	A	A	
280	Demo Existing walls/Slab	10/10/2006	10/18/2006	
290	Demo Plumbing	10/10/2006	10/12/2006	
300	Demo Mechanical	10/17/2006	10/18/2006	
310	Demo Electrical	10/10/2006	10/17/2006	
320	Underground Plumbing	10/23/2006	10/26/2006	
330	Backfill and place slab	10/30/2006	10/31/2006	
340	Frame Walls	10/18/2006	10/19/2006	
350	Electrical Rough in	10/27/2006	10/31/2006	
360	Mech Rough in	11/2/2006	11/6/2006	
370	Plumbing Rough in	10/27/2006	11/6/2006	
380	Sprinkler Rough in	10/30/2006	10/31/2006	
390	M/P insulation	11/6/2006	11/9/2006	
400	Wall insulation	11/9/2006	11/10/2006	
410	Drywall	11/13/2006	11/15/2006	
420	Caulk	11/28/2006	11/28/2006	

Sample Project Schedule Data					
Update 2 - Roof Replacement Added and started - 12/1/06					
					in Days
Act. ID	Description	WBS	Area	Trade	Duration
430	Tape and Finish	Phase 1	Shower	General	4
440	Ceramic Tile walls	Phase 1	Shower	Tile	5
450	Paint	Phase 1	Shower	Paint	3
460	Ceramic Tile Floor	Phase 1	Shower	Tile	3
470	Ceiling Grid	Phase 1	Shower	General	2
480	Light Fixtures	Phase 1	Shower	Elec	2
490	HVAC distribution and controls	Phase 1	Shower	Mech	1
500	Plumbing Fixtures	Phase 1	Shower	Plumb	4
510	Toilet Partitions	Phase 1	Shower	General	2
520	Ceiling Tile	Phase 1	Shower	General	1
530	Doors and Hardware	Phase 1	Shower	General	1
540	VCT Floor	Phase 1	Shower	Floor	1
550	Toilet Accessories	Phase 1	Shower	General	2
560	Mech Trim	Phase 1	Shower	Mech	1
570	Elect Trim	Phase 1	Shower	Elec	1
580	Sprinkler Trim	Phase 1	Shower	FireProt	1
590	Demo Utility Room	Phase 2	Utility Roor	General	4
600	Form and Place Concrete Pads	Phase 2	Utility Roor	Conc	2
610	Set Hot Water Heaters	Phase 2	Utility Roor	Plumb	1
620	Install Flue and Vents	Phase 2	Utility Roor	Mech	2
630	Set Pumps	Phase 2	Utility Roor	Plumb	3
640	Pipe Connections	Phase 2	Utility Roor	Plumb	3
650	Elect Connections	Phase 2	Utility Roor	Elec	2
660	Gas Piping and Tap	Phase 2	Utility Roor	Plumb	2
670	Controls	Phase 2	Utility Roor	Mech	2
680	Start Up HWH/Pumps	Phase 2	Utility Roor	Plumb	1
690	Paint/Clean-up Utility Room	Phase 2	Utility Roor	Paint	2
700	Install Mains in Hallways	Phase 2	Hallway	Plumb	20
710	Connect to Room piping	Phase 2	Hallway	Plumb	15
	Add new activity - suspend for 1 week due to State inspection				
720	Clean and restore Hallways	Phase 2	Hallway	General	5
730	Permit Inspections	All work		Govt	4
740	Punchlist	All work		CM	3
750	Substantial Comnpletion	All work		Owner	0
760	Clean and Demob	All work		CM	3
770	Construction Management	All work		CM	Hammock
780	Contingency/Misc/Fee	All work		CM	Hammock

Sample Project Schedule Data				
Update 2 - Roof Replacement Added and start				
Act. ID	Description	Start	Finish	Rem Dur
430	Tape and Finish	11/15/2006	11/27/2006	
440	Ceramic Tile walls	11/22/2006	11/27/2006	
450	Paint			
460	Ceramic Tile Floor	11/22/2006		2
470	Ceiling Grid			
480	Light Fixtures			
490	HVAC distribution and controls			
500	Plumbing Fixtures			
510	Toilet Partitions			
520	Ceiling Tile			
530	Doors and Hardware			
540	VCT Floor			
550	Toilet Accessories			
560	Mech Trim			
570	Elect Trim			
580	Sprinkler Trim			
590	Demo Utility Room	10/23/2006	10/26/2006	
600	Form and Place Concrete Pads	10/31/2006	10/31/2006	
610	Set Hot Water Heaters	11/3/2006	11/6/2006	
620	Install Flue and Vents	11/13/2006	11/14/2006	
630	Set Pumps	11/15/2006	11/17/2006	
640	Pipe Connections	11/20/2006	11/22/2006	
650	Elect Connections	11/27/2006	11/28/2006	
660	Gas Piping and Tap			
670	Controls			
680	Start Up HWH/Pumps			
690	Paint/Clean-up Utility Room			
700	Install Mains in Hallways	10/10/2006	11/15/2006	
710	Connect to Room piping	11/14/2006		9
	Add new activity - suspend for 1 week due to State inspection			
720	Clean and restore Hallways			
730	Permit Inspections			
740	Punchlist			
750	Substantial Comnpletion			
760	Clean and Demob			
770	Construction Management			
780	Contingency/Misc/Fee			

Sample Project Schedule Data					
Update 2 - Roof Replacement Added and started - 12/1/06					
					in Days
Act. ID	Description	WBS	Area	Trade	Duration
Add new activities - Roof Replacement					
	Negotiate/Approve Roof CO	Phase 3	Roof	CM	10
	SRA Roof materials	Phase 3	Roof	CM	2
	Delivery Roof Materials	Phase 3	Roof	Roofer	10
	Masonry Repairs	Phase 3	Roof	Mason	5
	Shingle Replacement	Phase 3	Roof	Roofer	25
	Flat Roof Replacement	Phase 3	Roof	Roofer	10
	Elect. Work in Attic	Phase 3	Roof	Elec	5
	New Fans	Phase 3	Roof	Mech	5
	Insulation Repairs	Phase 3	Roof	General	5
	Clean and Demob roof	Phase 3	Roof	CM	2

Sample Project Schedule Data				
Update 2 - Roof Replacement Added and start				
Act. ID	Description	Start	Finish	Rem Dur
Add new activities - Roof Replacement				
	Negotiate/Approve Roof CO	11/1/2006	11/13/2006	
	SRA Roof materials	11/2/2006	11/13/2006	
	Delivery Roof Materials	11/16/2006		5
	Masonry Repairs			
	Shingle Replacement			
	Flat Roof Replacement			
	Elect. Work in Attic			
	New Fans			
	Insulation Repairs			
	Clean and Demob roof			

Sample Project Schedule Data					
Update 3 - 1/16/07					
					in Days
Act. ID	Description	WBS	Area	Trade	Duration
10	NTP	Admin		Owner	0
20	Permit Dwgs Submitted	Admin		CM	1
30	Permit Review	Admin		Govt	30
40	Permit Issued	Admin		Govt	0
50	SRA Doors and Frames	Admin		General	13
60	SRA Tile	Admin		Tile	10
70	SRA Paint	Admin		Paint	10
80	SRA Toilet Accessories	Admin		General	10
90	SRA Sprinkler Shop Dwgs	Admin		FireProt	15
100	SRA HVAC Equipment	Admin		Mech	13
110	SRA Water Disinfection Equip	Admin		Plumb	13
120	SRA Water Pumps	Admin		Plumb	13
130	SRA Water Heater	Admin		Plumb	13
140	SRA Light Fixtures	Admin		Elec	13
150	SRA Fire Alarm	Admin		Elec	15
160	F/D Tile	Admin		Tile	10
170	F/D Paint	Admin		Paint	3
180	F/D Toilet Accessories	Admin		General	5
190	F/D Sprinkler Components	Admin		FireProt	5
200	F/D HVAC Equipment	Admin		Mech	5
210	F/D Water Disinfection Equip	Admin		Plumb	5
220	F/D Water Pumps	Admin		Plumb	5
230	F/D Water Heater	Admin		Plumb	5
240	F/D Light Fixtures	Admin		Elec	8
250	F/D Fire Alarm	Admin		Elec	10
260	Set-up Field Office	All work		CM	2
270	Mobilize Dumpster/tools	All work		CM	1
280	Demo Existing walls/Slab	Phase 1	Shower	General	4
290	Demo Plumbing	Phase 1	Shower	Plumb	2
300	Demo Mechanical	Phase 1	Shower	Mech	2
310	Demo Electrical	Phase 1	Shower	Elec	2
320	Underground Plumbing	Phase 1	Shower	Plumb	3
330	Backfill and place slab	Phase 1	Shower	Conc	2
340	Frame Walls	Phase 1	Shower	General	3
350	Electrical Rough in	Phase 1	Shower	Elec	5
360	Mech Rough in	Phase 1	Shower	Mech	5
370	Plumbing Rough in	Phase 1	Shower	Plumb	5
380	Sprinkler Rough in	Phase 1	Shower	FireProt	3
390	M/P insulation	Phase 1	Shower	Mech	3
400	Wall insulation	Phase 1	Shower	General	2
410	Drywall	Phase 1	Shower	General	2
420	Caulk	Phase 1	Shower	General	1

Sample Project Schedule Data				
Update 3 - 1/16/07				
Act. ID	Description	Start	Finish	Rem Dur
10	NTP	A	A	
20	Permit Dwgs Submitted	A	A	
30	Permit Review	A	A	
40	Permit Issued	A	A	
50	SRA Doors and Frames	A	A	
60	SRA Tile	A	A	
70	SRA Paint	A	A	
80	SRA Toilet Accessories	A	11/17/2006	
90	SRA Sprinkler Shop Dwgs	A	A	
100	SRA HVAC Equipment	A	11/22/2006	
110	SRA Water Disinfection Equip	A	Activity Deleted	
120	SRA Water Pumps	A	A	
130	SRA Water Heater	A	A	
140	SRA Light Fixtures	A	A	
150	SRA Fire Alarm	A	Activity Deleted	
160	F/D Tile	A	A	
170	F/D Paint	A	A	
180	F/D Toilet Accessories		Activity Deleted	
190	F/D Sprinkler Components	A	A	
200	F/D HVAC Equipment	A	A	
210	F/D Water Disinfection Equip		Activity Deleted	
220	F/D Water Pumps	A	A	
230	F/D Water Heater	A	A	
240	F/D Light Fixtures	A	A	
250	F/D Fire Alarm	A	A	
260	Set-up Field Office	A	A	
270	Mobilize Dumpster/tools	A	A	
280	Demo Existing walls/Slab	A	A	
290	Demo Plumbing	A	A	
300	Demo Mechanical	A	A	
310	Demo Electrical	A	A	
320	Underground Plumbing	A	A	
330	Backfill and place slab	A	A	
340	Frame Walls	A	A	
350	Electrical Rough in	A	A	
360	Mech Rough in	A	A	
370	Plumbing Rough in	A	A	
380	Sprinkler Rough in	A	A	
390	M/P insulation	A	A	
400	Wall insulation	A	A	
410	Drywall	A	A	
420	Caulk	A	A	

Sample Project Schedule Data					
Update 3 - 1/16/07					
					in Days
Act. ID	Description	WBS	Area	Trade	Duration
430	Tape and Finish	Phase 1	Shower	General	4
440	Ceramic Tile walls	Phase 1	Shower	Tile	5
450	Paint	Phase 1	Shower	Paint	3
460	Ceramic Tile Floor	Phase 1	Shower	Tile	3
470	Ceiling Grid	Phase 1	Shower	General	2
480	Light Fixtures	Phase 1	Shower	Elec	2
490	HVAC distribution and controls	Phase 1	Shower	Mech	1
500	Plumbing Fixtures	Phase 1	Shower	Plumb	4
510	Toilet Partitions	Phase 1	Shower	General	2
520	Ceiling Tile	Phase 1	Shower	General	1
530	Doors and Hardware	Phase 1	Shower	General	1
540	VCT Floor	Phase 1	Shower	Floor	1
550	Toilet Accessories	Phase 1	Shower	General	2
560	Mech Trim	Phase 1	Shower	Mech	1
570	Elect Trim	Phase 1	Shower	Elec	1
580	Sprinkler Trim	Phase 1	Shower	FireProt	1
590	Demo Utility Room	Phase 2	Utility Roor	General	4
600	Form and Place Concrete Pads	Phase 2	Utility Roor	Conc	2
610	Set Hot Water Heaters	Phase 2	Utility Roor	Plumb	1
620	Install Flue and Vents	Phase 2	Utility Roor	Mech	2
630	Set Pumps	Phase 2	Utility Roor	Plumb	3
640	Pipe Connections	Phase 2	Utility Roor	Plumb	3
650	Elect Connections	Phase 2	Utility Roor	Elec	2
660	Gas Piping and Tap	Phase 2	Utility Roor	Plumb	2
670	Controls	Phase 2	Utility Roor	Mech	2
680	Start Up HWH/Pumps	Phase 2	Utility Roor	Plumb	1
690	Paint/Clean-up Utility Room	Phase 2	Utility Roor	Paint	2
700	Install Mains in Hallways	Phase 2	Hallway	Plumb	20
710	Connect to Room piping	Phase 2	Hallway	Plumb	15
720	Clean and restore Hallways	Phase 2	Hallway	General	5
730	Permit Inspections	All work		Govt	4
740	Punchlist	All work		CM	3
750	Substantial Comnpletion	All work		Owner	0
760	Clean and Demob	All work		CM	3
770	Construction Management	All work		CM	Hammock
780	Contingency/Misc/Fee	All work		CM	Hammock

Sample Project Schedule Data				
Update 3 - 1/16/07				
Act. ID	Description	Start	Finish	Rem Dur
430	Tape and Finish	A	A	
440	Ceramic Tile walls	A	A	
450	Paint	12/11/2006	12/15/2006	
460	Ceramic Tile Floor	A	11/28/2006	
470	Ceiling Grid	12/12/2006	12/13/2006	
480	Light Fixtures	12/14/2006	12/15/2006	
490	HVAC distribution and controls	12/15/2006	12/15/2006	
500	Plumbing Fixtures	12/15/2006	12/18/2006	
510	Toilet Partitions	12/13/2006	12/13/2006	
520	Ceiling Tile	12/14/2006	12/14/2006	
530	Doors and Hardware	12/26/2006	12/27/2006	
540	VCT Floor	12/14/2006	12/15/2006	
550	Toilet Accessories	12/19/2006	12/19/2006	
560	Mech Trim	12/13/2006	12/13/2006	
570	Elect Trim	12/14/2006	12/15/2006	
580	Sprinkler Trim	12/14/2006	12/15/2006	
590	Demo Utility Room	A	A	
600	Form and Place Concrete Pads	A	A	
610	Set Hot Water Heaters	A	A	
620	Install Flue and Vents	A	A	
630	Set Pumps	A	A	
640	Pipe Connections	A	A	
650	Elect Connections	A	A	
660	Gas Piping and Tap	12/18/2006	12/18/2006	
670	Controls	12/18/2006	12/18/2006	
680	Start Up HWH/Pumps	12/18/2006	12/18/2006	
690	Paint/Clean-up Utility Room			
700	Install Mains in Hallways	A	A	
710	Connect to Room piping	A		1
720	Clean and restore Hallways			
730	Permit Inspections	set date constraint 1/22/07		
740	Punchlist			
750	Substantial Comnpletion			
760	Clean and Demob			
770	Construction Management			
780	Contingency/Misc/Fee			

Sample Project Schedule Data					
Update 3 - 1/16/07					
					in Days
Act. ID	Description	WBS	Area	Trade	Duration
Roof Replacement Activities					
	Negotiate/Approve Roof CO	Phase 3	Roof	CM	10
	SRA Roof materials	Phase 3	Roof	CM	2
	Delivery Roof Materials	Phase 3	Roof	Roofer	10
	Masonry Repairs	Phase 3	Roof	Mason	5
	Shingle Replacement	Phase 3	Roof	Roofer	25
	Flat Roof Replacement	Phase 3	Roof	Roofer	10
	Elect. Work in Attic	Phase 3	Roof	Elec	5
	New Fans	Phase 3	Roof	Mech	5
	Insulation Repairs	Phase 3	Roof	General	5
	Clean and Demob roof	Phase 3	Roof	CM	2

Sample Project Schedule Data				
Update 3 - 1/16/07				
Act. ID	Description	Start	Finish	Rem Dur
Roof Replacement Activities				
	Negotiate/Approve Roof CO	A	A	
	SRA Roof materials	A	A	
	Delivery Roof Materials	A	12/8/2006	
	Masonry Repairs	12/8/2006	12/27/2006	
	Shingle Replacement	12/11/2006	12/29/2006	
	Flat Roof Replacement	12/20/2006		1
	Elect. Work in Attic	1/3/2007		1
	New Fans	12/29/2006		1
	Insulation Repairs	1/12/2007		4
	Clean and Demob roof			

Appendix D – Summary of Case Study trial data

Case Study Results

Activity	SureTrak			
	Direct		Wizard	
(all times in minutes)	Try 1	Try 3	Try 5	Try 6
Activity and Logic Set-up	40	43	26	58
Adjust Wizard Logic			26	incl above
Define Codes	3	6	by wiz	by wiz
Define WBS	4	incl above	by wiz	by wiz
Adjust WBS			15	accepted default
Add Codes and WBS				
Assign Codes/WBS	24	20	by wiz	by wiz
Enter Cost Data	17	22	31	26
Set-up Project	2	2	3	2
Edit Logic	6	6	6	8
Total Set-up	96	99	107	94
Update 1	7	8		
per activity (17)	0.41	0.47		
Update 2	21	20		
per activity (45)	0.47	0.44		
Revision 2	18	18		
per activity (12)	1.50	1.50		
Update 3	10	11		
per activity (27)	0.37	0.41		
Revision 3	3	2		
per activity (5)	0.60	0.40		
Update avg/activity (89)	0.43	0.44		
Revision avg/activity (17)	1.24	1.18		

Case Study Results

Activity	Contractor			
	Direct		Wizard	
(all times in minutes)	Try 2	Try 4	Try 7	Try 8
Activity and Logic Set-up	47	48	70	28
Adjust Wizard Logic			incl above	27
Define Codes	7	15	by wiz	by wiz
Define WBS	4	5	by wiz	by wiz
Adjust WBS			accepted default	accepted default
Add Codes and WBS				
Assign Codes/WBS	19	37	by wiz	by wiz
Enter Cost Data	20	29	32	23
Set-up Project	2	1	2	6
Edit Logic	5	6	7	11
Total Set-up	104	141	111	95
Update 1	8	6		
per activity (17)	0.47	0.35		
Update 2	15	18		
per activity (45)	0.33	0.40		
Revision 2	24	16		
per activity (12)	2.00	1.33		
Update 3	11	8		
per activity (27)	0.41	0.30		
Revision 3	3	2		
per activity (5)	0.60	0.40		
Update avg/activity (89)	0.38	0.36		
Revision avg/activity (17)	1.59	1.06		

Case Study Results

Activity	MS Project	
(all times in minutes)	Trial 9	Trail 10
Activity and Logic Set-up	24	39
Adjust Wizard Logic		
Define Codes	2	2
Define WBS		
Adjust WBS	17	incl
Add Codes and WBS	9	11
Assign Codes/WBS		
Enter Cost Data	4	4
Set-up Project		
Edit Logic	6	5
Total Set-up	62	61
Update 1	10	5
per activity (17)	0.59	0.29
Update 2	13	10
per activity (45)	0.29	0.22
Revision 2	13	10
per activity (12)	1.08	0.83
Update 3	8	8
per activity (27)	0.30	0.30
Revision 3	2	2
per activity (5)	0.40	0.40
Update avg/activity (89)	0.35	0.26
Revision avg/activity (17)	0.88	0.71

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