Critical Path Safety Scheduling Software

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Introduction

Critical path management (CPM) software is used for project scheduling on virtually all medium-to-large construction projects. The schedule provides a basis for coordination, planning, and adjusting time frames as the work progresses. Although good scheduling has been shown to correlate with improved safety, no CPM software incorporates safety interventions or equipment into the schedule.

Most activities that promote safety and health on the jobsite are tied, in some manner, to the schedule. For example, if there is an activity in the schedule for "Install Sewer Line", the safety manager should verify delivery and availability of trench boxes or shoring materials prior to the start of this activity. By monitoring progress on the schedule, safety personnel could ensure the well being of the on-site workers and the neighboring community. Short term look-ahead schedules (usually one or two weeks) can also be generated from the master schedule, and are used by foremen and superintendents to manage the job, and to report back on progress or task completion to update the schedule.

Typically, ES&H managers do not have access or training to directly modify the schedule electronic file. Scheduling software has been a tool of the operations personnel, sometimes through a subcontracted scheduler, or the CM and there is great reluctance to "share" access to modify the schedule with ES&H personnel.

Timeline/History

1996 CPWR and colleagues at the University of Maryland College Park, and in collaboration with several members of the ASSE Construction group, proposed development of this software as part of a CPWR Intervention grant. Initial software described as "Safety CPM/Net Works". This consisted of two parts: "Safetybase" and a mock-up of "Safety/Net Integrator". SafetyBase was a database of construction hazards and check lists associated with specific Construction Specification Institute (CSI) MasterFormat cost codes. The focus was on technical safety/hazard control information. Safety/Net Integrator was intended to flag schedule items certain CSI codes associated with high risk tasks. The software developer returned to India, and left no documented source code. However, the safety professionals involved were enthusiastic supporters, and encouraged CPWR to continue the project.

1999 CPWR approached Conceptual Arts and University of Florida. It was recognized by the new team that this approach required CSI codes be manually inserted into the schedule, which was not done on many projects at the time. They proposed a process to directly flag schedule activities that need safety management attention.

2000-2004 Jeff Nelson from Conceptual Arts, and a team assembled by Jimmie Hinzie from the M.E. Rinker School of Building Construction at the University of Florida proposed a redefined project which was named "Salus/JSA" and later "SALUS CPM". Through a co-developer license with Primavera the developed a very effective software program which would insert and track safety activities into a Primavera Suretrak schedule. Although the safety professionals were enthusiastic about this innovative product, in field trials it was immediately apparent that most safety managers did not have access or authority to modify the project schedule. Because of the hours invested in creating and updating the schedule,, schedulers were very protective.

2002-2004 A new approach was devised, named "Salus Link". This worked in parallel with a Primavera P3 and Suretrak schedules, with read-only access, and regular updates from the master schedule file. It allowed safety managers their own version of the project schedule, in which they could link any electronic document or hyperlink to each schedule activity. These could be check-lists, policies, JSAs, tool box talks, slides, etc.

2006 Conceptual Arts applied for and was awarded a one year NIOSH Small Business Innovation Research (NIOSH) grant to commercialize this software product. Agreements were reached to pilot the software on projects with Bechtel, Bovis Lend Lease, and Willis Construction.

2008 Oracle Corporation purchased Primavera and terminated all third-party or external developer agreements. SBIR funds were returned and project terminated.

SALUSLINK

integrate safety into the construction planning and management process

Software Development and Maintenance Challenges

Technology transfer related to new software products, or in this case add-ons to existing commercial software, presents multiple challenges:

1. Multiple platforms, multiple operating systems, complex network access issues. As these platforms change, software must be continuously updated in order to remain functional, and users now expect automated checks for updates over the internet. Even on construction sites, access to internet, WIFI, and cell phones has become an expectation. In a rapidly changing environment, software products must also be continuously updated to remain functional. Given that most grant funding is short term, at least the cost of updates and upgrades must be covered by income from a commercial product.
2. Rapid changes in applications, in this case Primavera P3 and Suretrak, can require unexpected changes and rapid development of the product. If you take too long to develop the product, a new3 version may be needed to respond to a changing environment.
3. Usability testing is critical, and is the norm. An additional challenge faced with SalusLink was verifying needs and usability from the perspectives of various positions within an organization. The product was enthusiastically received by safety managers, who immediately recognized the value of this tool, and how it would allow them to do their work faster and better. Until late in the process, the schedulers were not considered as part of the usability testing, only to find they could block any use of the software.
4. The perceived value of the software relied in part on the work that would be saved on future projects, since many components could be used on other projects with minor modifications. This initial barrier, of entering information and collecting documents on the first use, may discourage adoption.
5. Multiple interface formats, can now require redesign of user interface for several screen sizes (cell phone, tablet, desktop), and several versions of each. This can further increase the effort and cost of usability testing and updates.
6. Recruiting actual users is a challenge in construction. Scheduling is usually contractually required on a site by the owner or construction manager, which makes adoption of change easier. To be most effective schedules must span multiple employers on a project, so individual subcontractors have little ability to influence site-wide use. There is limited research on organizational structures on multi-employer sites.

Outcomes/Conclusion

CPM scheduling software, of which Primavera remains the market leader for larger projects, still offer an opportunity for future improvements in planning and coordination of safety activities. On large multi-employer projects, which can consist of hundreds of overlapping contracts, paper- based schedules are often inadequate. Inadequate integration of safety managers into the construction design and operations teams continues to be an issue on many sites. As Building Information Management (BIM) software databases grow in popularity, these are a related opportunity for safety and health managers.

This project failure illustrates several challenges related to software development and updates, and organizational structures that can allow hoarding or restricting access to critical information (knowledge is power), and inadequate software security which is needed to increase confidence that data destroyed or changed by other employees or other employers can be readily recovered. Sharing requires trust, which can be difficult to develop on a rapidly changing multi-employer work site.

This project also illustrates the importance of understanding organizational structures and work processes, as well as technical knowledge. Safety managers and schedulers, for example, may not agree on the value of change.

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