

Work Breakdown Structure

In the mid-1990s, several task forces and peer reviews recommended that the California Department of Transportation (Caltrans) establish and implement modern project management processes and tools to improve the Department's capital project delivery. In 1994, Caltrans issued the first version of the Department's Capital Outlay Support (COS) Standard Work Breakdown Structure (WBS). The WBS defines capital project work content in terms of 491 discreet products and activities (or deliverables) involved in a state highway project. Caltrans then assessed the knowledge and skills necessary to achieve them. Based on activities identified in the WBS and the Department's Strategic Plan, Caltrans then initiated the Long-Term Training Plan for Capital Projects, a blueprint for ensuring its 11,000+ capital projects employees can accomplish the 491 WBS deliverables.

In 1998, the California Department of Transportation (Caltrans) adopted a new Strategic Plan that mandated improved project management accountability. Caltrans sought advice from several organizations, including private sector firms Fluor Daniel and Bechtel, the U.S. Corps of Engineers, local agencies, the Arizona Department of Transportation, and the Consulting Engineers and Land Surveyors of California. It also convened internal peer reviews to evaluate processes and recommend improvements. One outside organization was Oracle Corporation, which presented a workshop on the Oracle Custom Development Model. The Model is a productivity tool that identifies activities or tasks within a specific job and defines the necessary skills, tools, and knowledge to perform them. The Model identifies roles necessary to produce each deliverable. The Model intrigued Caltrans officials who decided to adapt the Oracle Model as a statewide standard for planning and managing capital highway projects.

Caltrans issued the first version of the Capital Outlay Support (COS) Work Breakdown Structure (WBS) in 1994. There have been five updates, the most recent in 2000. The WBS, along with the Resource Breakdown Structure (RBS), and the Organizational Breakdown Structure (OBS) provide a complete system for planning and controlling project work content, cost, schedule, and quality.

The Language Challenge

In the initial stage, Caltrans convened a task force of technical experts from its seven functional areas involved in capital projects—construction, design, engineering services, environmental, project management, right-of-way, and traffic operations. The task force challenge was to build a project management system based on the Oracle Model. Quite simply, the task force members' job was to analyze each phase of a project and specify work content in terms of products and activities.

The WBS is an 8-level hierarchical grouping of activities that provides for a progressively detailed definition of work elements for all levels of review, including staff, functional manager, project manager, or program manager.



WBS Levels

The WBS facilitates summary reporting for each Caltrans capital project. The WBS contains eight levels, each succeeding level further classifying the work into separate components. Each level represents a summary of the work below it and provides the basis for reporting that is as detailed as needed.

Level 0—Caltrans Level represents all work that the legislature charges Caltrans to perform.

Level 1—District Level, 12 components correspond to scheduled work performed throughout all 12 Caltrans Districts. A 2-digit charge number designates the charge district—the organizational unit that receives resources to perform the work.

Level 2—Program Level separates work by major program. Currently, this applies only to the Capital Project Program (transportation/highway projects) and the Transportation Planning Program. The time reporting system does not represent this level separately.

Level 3—Project Level represents work scheduled for an individual capital project. A 6-digit field (called EA, or expenditure authorization) identifies each capital project. EA is used in time reporting.

Level 4—Summary Task Level breaks a capital project into a maximum of 10 summary tasks. While some projects may not need all 10 tasks, no capital project can have more than 10. Although similar to the concept of project “phases,” these major project tasks do not equate to project phases.

Level 5—Major Task Level is a breakout of summary tasks and represents the minimum level of detail required to plan, schedule, and manage capital projects.

Levels 6, 7, and 8—Task and Activity Levels contain task and activities when Level 5, Major Tasks, does not contain sufficient detail to plan, schedule, and manage the work. Because some Level 6 activities do not need further breakdown to Level 7, not all activities have a Level 7, and not all Level 7 activities have a Level 8.

As task force members worked, they soon realized that their biggest problem was agreeing on common nomenclature to describe each step. The lack of agreed-to language was a major impediment to monitoring projects and planning resources because there was no way to compare the process with the plan.

Allan Kosup, Caltrans Deputy Director for Engineering A, San Diego, served on the task force. He recalls, “It was clear when we

talked about what it would take to deliver a project, one manager’s definition of 60 percent was completely different than another’s. The process required that we establish a common nomenclature so that we could accurately compare the process with the plan.”

In addition to the terminology issue, task force members realized how few individuals understood the entire process involved in delivering a project. Therefore,

the task force frequently invited technical experts in specific functional areas, such as property appraisal or hydraulic design, to fill the knowledge gaps related to those skills and abilities.

The result of the task force work is an 8-level hierarchical grouping of activities (see WBS Levels) that provides a manageable way of looking at project management and providing a system for planning and controlling capital projects. The WBS is a bottom-up approach in that each level is described more completely by the level below it. Therefore, the WBS provides for a progressively detailed definition of work elements for all levels of review, including staff, functional manager, project manager, or program manager. It also expedites summary reporting at a variety of levels.

At the conclusion of developing the system, the Department updated its charging system to include the WBS, which allows employees to charge to the same activities that managers plan. It follows the adage: Plan the work, work the plan.

How the WBS Works

At its most fundamental level, the WBS is a time planning and logging tool. By classifying project elements into a product-oriented grouping that organizes and defines the total scope of the project, the WBS lets staff charge time spent on capital projects to the actual task they perform. Proper time charging gives managers a tool to track the actual cost of projects, review the project status, and allocate resources.

Bob Bazargan, Branch Chief, Project Program Management Support for District 12, finds the WBS to be a great management tool. “The WBS makes project management much easier. Different project functions manage at

different levels,” he says. “The WBS provides us with a template for deciding which projects are managed at what levels. Planning requires detail, while managing looks at higher levels.”

For example, Bob Bazargan says that environmental staff usually manages at the lowest possible level, while design staff focuses on midlevels. Construction managers usually concentrate on the highest level because they don’t control that phase, the contractor does. But when I work with construction managers, they don’t just look at high-level activity; they have to look at all activities.”

Yes, engineering contractors working on Caltrans projects must understand and use the WBS.

The WBS is Good . . .

The biggest difference for Caltrans managers is that they now use the WBS as a basis for work plans. WBS provides a uniform tool that helps managers use the real critical path method (CPM) to plan construction projects. However, the WBS by itself is not the solution. Managers also use the RMS, essentially bringing a business planning perspective to developing and maintaining accurate work plans. Together, the WBS and RBS systems help managers track the status of the work plan. As Allan Kosup comments, “Tracking the status of a work plan is vital to good project and resource management. Before the WBS and RBS, managers often couldn’t tell whether a work plan was 6 weeks or 6 months old.”

Additionally, new tracking software automatically updates project status every week and queries managers monthly about project status.

Work plans use the WBS and RBS as building blocks, the basis for the capital program’s annual

resource requests to the legislature. This has added credibility to the process. The WBS also helps Caltrans respond to legislative requests. For example, the legislature might want to know what a 10 percent cut in the capital budget would mean for highway construction projects. Managers use work plans to demonstrate which projects will or won’t be built. That same information also helps Caltrans make the case for additional project funding.

. . . And Promises to Get Better

The WBS has totally revamped Caltrans capital project planning and management processes, but like all systems, it has flaws. As noted, at its most fundamental level, the WBS is a time planning and logging tool. Nigel Blampied, Chief, Office of Project Management Process Improvement, managed the WBS development process and coordinated the task force work. He continues to lead the annual update process.

Nigel Blampied considers WBS a good system, but not a perfect system. He observes that most problems relate to Caltrans’ information system, which doesn’t allow planning and time-keeping systems to communicate. New software scheduled to come online in 2002 should correct that problem. The new system will include self-populated time sheets tied to the WBS, which essentially tell employees what jobs they should be doing.

There is also confusion about how detailed some WBS levels should be, and employees still charge time to the wrong level. With WBS, activities are ‘nested’ in the process, which can be confusing to track accurately, especially on large projects that involve multiple structures or phases.

The Skill Development Plan

Most Caltrans officials cite two important benefits from the WBS. First, the WBS provides a common language for planning and monitoring capital projects. Second, the WBS identified 491 deliverables potentially necessary to complete a project and the roles necessary to perform them.

The term role actually derives from the theater and the fact that actors play many roles throughout their careers. Similarly, a Caltrans employee may play different roles within a single civil service classification. For example, 40 percent of the capital projects workforce is classified in the civil service classification for Transportation Engineer, Civil. Yet, these employees play at least 28 different roles on state highway projects, including resident engineer, design project engineer, transportation engineer—noise, structures designer, materials inspector, inspections engineer, task manager, and traffic engineer.

This second benefit is the skill development plan for Caltrans capital project employees. The Capital Project Skill Development Plan originated with Caltrans’ 1998 Strategic Plan and is modeled after the Oracle Corporation’s Custom Development Plan. Caltrans used a four-phase approach to develop the plan. Before the WBS identified specific skills and tools, the Caltrans training program essentially responded to priorities of Caltrans managers.

Identify Needs

Caltrans’ WBS identification of 491 deliverables helped Caltrans redefine and refocus training that supports those deliverables. Again, Caltrans’ Nigel Blampied assembled and managed a task force of Subject Matter Experts to

Benefits of a Standard WBS

- Consistent information needed to manage a statewide workforce.
- More effective communication relative to project-level work throughout the Department.
- Ease of data transfer, such as sharing project templates between and within districts.
- Reduced culture shock when employees transfer to different locations and work assignments.

specify the 'roles' that employees play in producing the particular deliverable.

Quantify Needs

Teams from Caltrans' seven functional areas then developed estimates of the number of current employees who play each role and the degree to which they needed training in the knowledge, tools, and skill areas. They further divided each estimate into those employees who urgently needed specific training and those having a moderate need.

Plan to Meet Needs

Next, the task force performed a gap analysis to compare the needed knowledge and skills with the actual workforce capabilities. Task force members identified specific classes to teach the required knowledge and skills. Caltrans then conducted a weeklong, off-site workshop, where officials worked closely with adult education consultants to identify the roles, knowledge, tools, and skills for each deliverable. They then designed the classes needed to support them. Each course design listed title, learning outcomes, WBS deliverables, types of employees needing each course, and estimated audience size. By focusing on roles rather than job classification, Caltrans used a bottom-up approach that enabled the task force to specifically describe the skills necessary for each role.

The group designed 579 courses to support the 491 deliverables. Of those, 337 courses were already available, and 242 needed to be developed. Additionally, the task force prepared cost estimates to develop and implement each course.

Implementation

The fourth step was bringing the training package to the employees. Caltrans used a systematic approach to improve training to complement the WBS, and the effort paid tremendous dividends. Once program managers approved and prioritized the courses for each functional area, they developed a funding plan for FY 2000-2001. The plan identified high-priority training needs based on currently available courses and those to be developed. At the behest of Governor Gray Davis, the California Legislature committed \$15.1 million to Capital Project skill development for each of years from 2000 to 2003.

This last step culminated in the Long-Term Plan for Capital Projects, which became the basis for Caltrans' Capital Project Skill Development Plan. Terry Murphy is Office Chief for Caltrans Capital Skill Development, the unit responsible for developing and coordinating training. According to Terry Murphy, "Nigel Blampied and his task force did the upfront work that made our job much easier than it might have been. By developing the WBS system and the Skill Development Plan that supports it, Caltrans created a plan for us to follow."

The range of courses available through the program covers the gamut of a 2-hour course on Engineering Service Center Outreach to the 8-week Bridge Design Academy. Caltrans also uses a blended approach to training, incorporating Internet- and computer-based training, classroom sessions, and self-study. Classes are taught by Caltrans staff, contract trainers, and vendor-generated materials.

According to Caltrans' Nigel Blampied, "The Skill Development Plan affirms a training program that says, 'If you want to work here, you must have these skills for this kind of project.' The WBS has revolutionized the way we do business. It has strengthened our belief in the system, and it commits us to preparing our workforce to meet Caltrans' responsibility to the traveling public."

The Capital Project Program is currently the only Caltrans program using the WBS, but the Department is exploring additional use of the process.

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