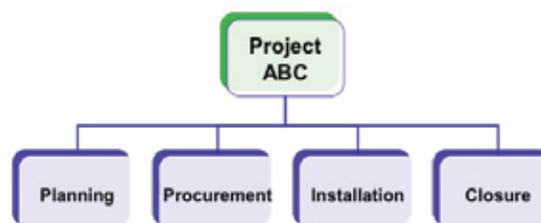


How to Manage Your Job Using Work Breakdown Structure

BY DR. PERRY DANESHGARI AND DR. HEATHER MOORE

Construction productivity has historically lagged other industries in productivity, which until it is correctly measured, it cannot be improved. The method of measurement has alienated the labor, and as a result, the outcome is data that is not useful. By measuring productivity changes during construction at the task, project, and industry levels, issues can be resolved early enough to reduce waste and minimize errors. To enable accurate feedback from the source, construction companies have to learn to develop and use the work breakdown structure (WBS) process. To build a correct WBS, all the stakeholders in the process of construction project management have to be involved at the beginning of the process. A correctly built WBS is the road map for the project and will allow early identification of risks and issues, enabling timely corrective actions.

Figure 1: Four phases of Work Breakdown Structure for a project



CREATING A PROPER WBS

The key to WBS is in each of the three words, as follows:

- **Work:** identify the activities that need to be done, regardless of when, who, and how much
- **Breakdown:** break down the project from its top level deliverables into finer and finer increments

- **Structure:** a hierarchical view that depicts how everything in the project is accounted for, and ensures no work is left out

Every electrical project will have four major phases to the WBS (Figure 1):

- Pre-job Planning
- Buying the job (Procurement)
- Installation
- Closure

Pre-Job Planning. Figure 2 depicts the suggested activities that could be included in the planning phase of the WBS. The activities in this phase are common activities that occur on most jobs. The process of procurement also begins in this phase. It is at this stage that all the activities related to how the job will be built has to be identified, packages and quantities created, prefabrication separated, and expectations from the vendors clearly specified. For instance, what material will be needed, when, where, and how should be created at this step or at least a place holder for it should be planned on the project schedule.

Procurement. Procurement planning needs to happen in the earliest phases. Purchasing is not the same as procurement; construction purchasing primarily deals with buying the material for the job. Procurement, on the other hand, is responsible for all the activities related to the material, tools, and equipment needed. Material procurement planning at the onset of the job is one the most critical part of the planning. All the issues regarding the following have to be planned for and tracked as part of the overall project's electrical scheduled plan:

- Vendor information
- Commodity items
- Long lead time items
- Order times and frequencies
- Onsite delivery
- Delivery times
- Gang boxes
- Returns
- Change orders
- Milestones
- Pre-fabrication
- Cut-Sheets
- As-built

See Figure 3 for sample procurement plan.

Installation. In the installation phase of the WBS, the job will be broken down into high-level phases of the work and detail-level tasks. One example of various activities that need to be considered as part of the installation phase of WBS on a job is shown in Figure 4. Naturally,

Figure 2: Sample breakdown of planning phase

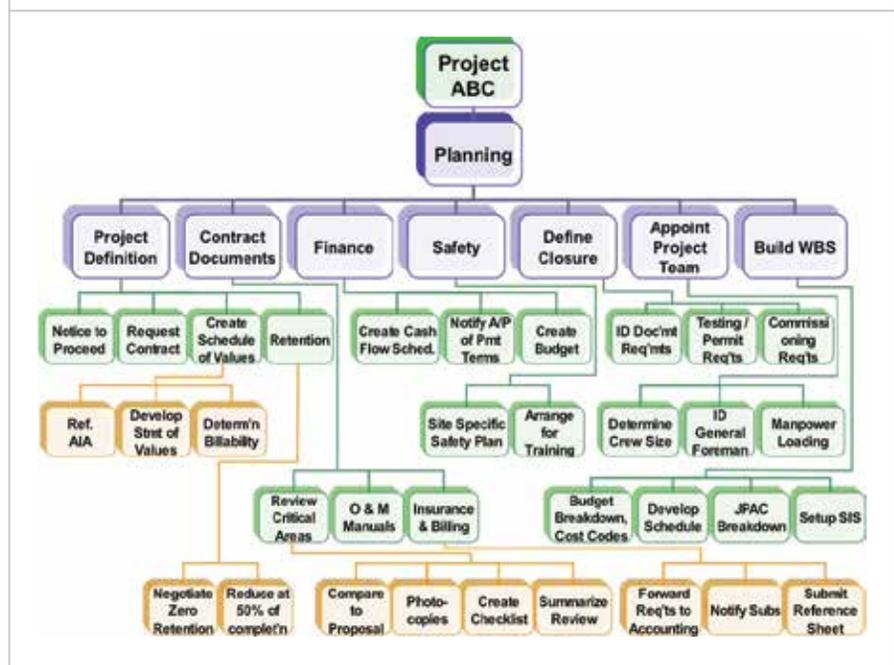
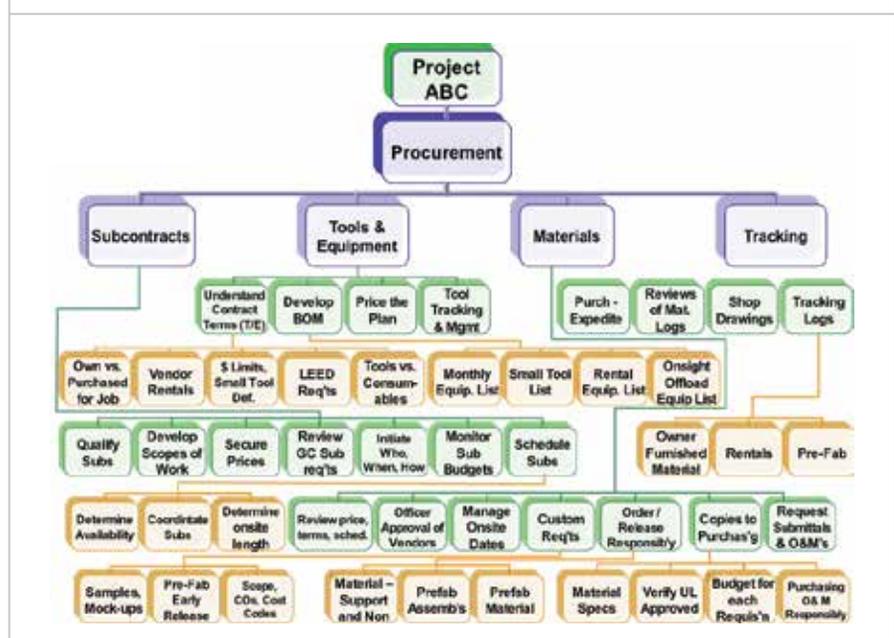


Figure 3: Sample breakdown of procurement phase



depending on the type of job, this portion of the WBS can vary substantially. For example, an industrial job may have a different installation breakdown than a commercial job, and even within the commercial category, a hospital may have a different break down than a jail.

The installation WBS is a subset of the job-related deliverables listed in Figure 4 that directly describes the onsite work. It should be developed based on the work it will take to fulfill the contractual obligations. Regardless of how the

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Figure 4: Sample breakdown of installation phase

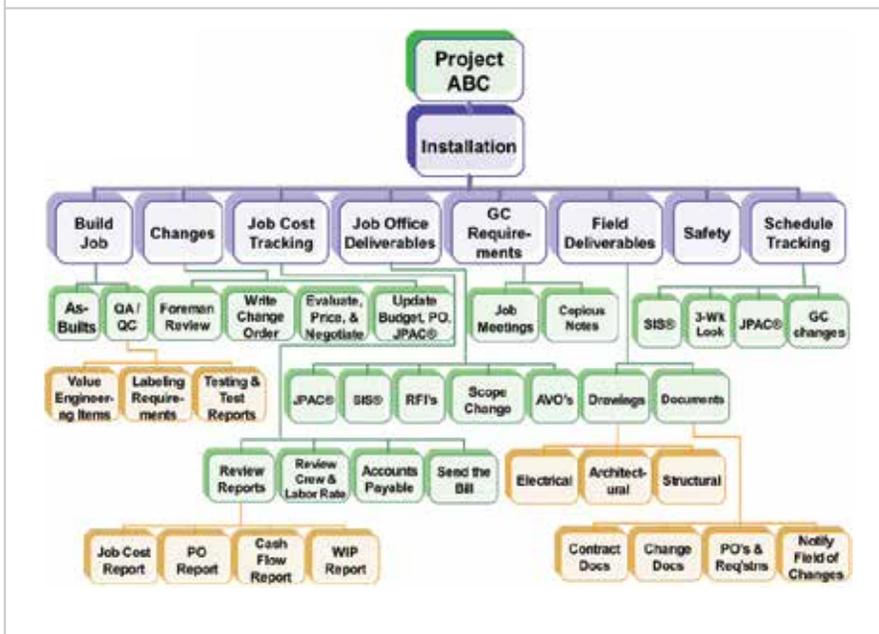
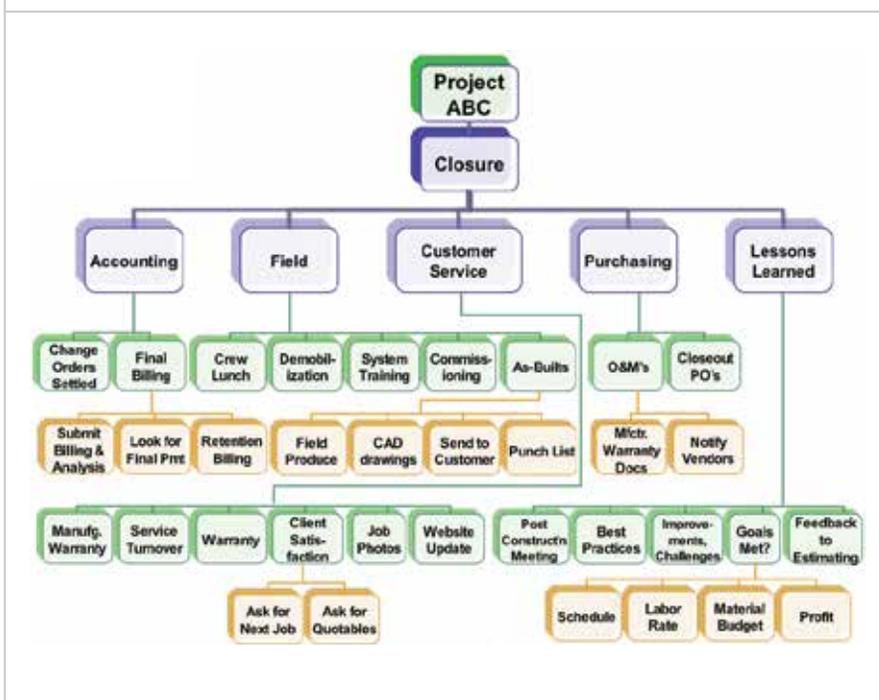


Figure 5: Sample breakdown of closure phase



estimator conceived of the project, the installation WBS needs to reflect the work. To accomplish an accurate reflection of the work, the installation WBS needs to involve the field leader(s) who will be involved in building the job. They can use

a top-down or a bottom-up approach. In a top-down approach, the field leader would start with the overall project at the top of the structure and then break into finer and finer elements. For instance, he or she could break down the overall project into

phases, then phases into systems, and then systems into tasks required to complete them. The level of detail in the breakdown stops when the work can be identified and measured in roughly one week increments.

A bottom-up approach is often easier the first time someone builds a WBS. In this approach, the field leader(s) would start brainstorming various tasks to be done on a smaller segment of the work. For instance, the rough-in would contain layout, boxing, branch rough-in, and wire or cable. Then additional segments are broken down similarly. Eventually, groups of tasks by area or system crystallize, and the different tasks and activities can be rearranged to show the “hierarchical” view of a WBS as shown in Figure 4.

The best outcome of this process is that the work as conceived by the builder will now be transferred from tacit to explicit, and planning for how the work will occur including when it will happen, where it will happen, and who will do it can now all be attached to an accurate reflection of the work.

Job Closure. The most neglected portion of construction jobs in terms of planning is the closure. The majority of jobs in the closing phases will have lost their active workforce, and even the project manager might have moved on to the new job or estimate. Even though the steps in this phase of the project planning are most common among all projects, many contractors lack a standard check list for job completion. A sample WBS for the closure phase of the project plan depicted in Figure 5.

UNDERSTANDING THE ELEMENTS TO MONITOR

Risk cannot be controlled; it has to be mitigated and managed. To mitigate and manage risk, it has to be made visible. To make risk visible, it has to be categorized and measured. Risk in construction projects is introduced through the large number of degrees of freedom. To reduce the degrees of freedom, the construction projects have to be broken down using WBS for segregation and externalization

of work[®]. The degrees of freedom of unknowns and potentially unknowable can be listed and categorized at the beginning of the job. Variable elements such as: labor, change orders, overtime, schedule, estimate, and material handling can be better monitored and managed by identifying what, where, when, who, and how the tasks of the projects can be performed. Figure 6 is depicting a sample of the work management matrix cubical. The what, where, when, who, and how can be better managed if the tasks are in a better controlled environment such as:

- Prefabrication
- Vendor managed inventory
- Manufacturers' packaging

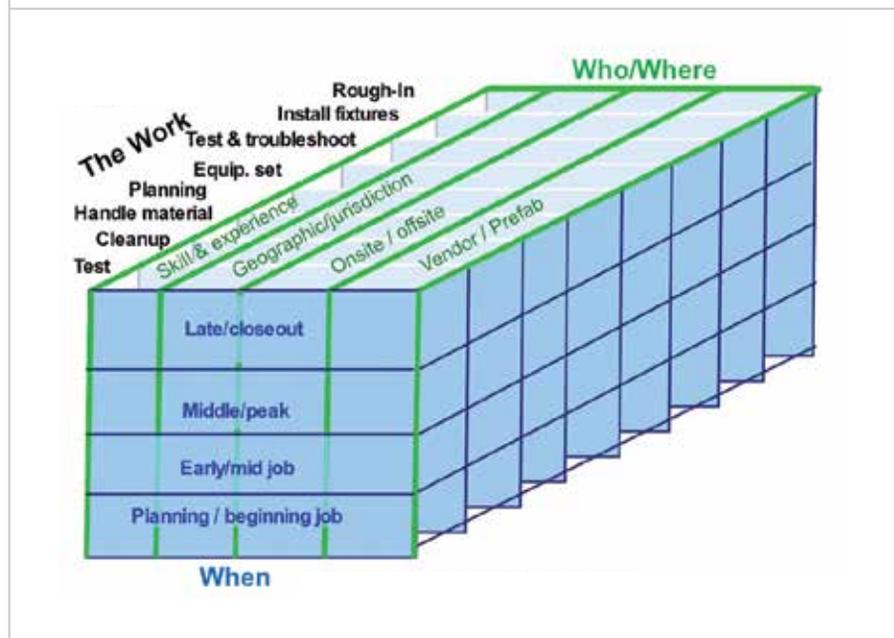
Using WBS will also allow the contractor to decide what items have to happen on the jobsite only and plan to reduce the activities dedicated to the jobsite by finding better solutions for them.

HOW TO START USING WBS

Once the work is on paper and used for planning how it can be best delivered to reduce risk, the WBS can also be used for setting a baseline against which productivity can be measured. According to ASTM Standard Practice E2691 on Job Productivity Measurement, a productivity reference point is established by setting a baseline labor hour budget (BLHB). This BLHB can be established on the individual WBS tasks (at the bottom-most level of the structure). Naturally those can be summed to compare to the estimate, which gives early-on insight as to how the job is being conceived differently from estimate to field operations. As long as the discrepancy is within 10 percent of the estimated hours, and as long as the discrepancy is explainable, the WBS and its associated BLHB will be used for tracking.

On an ongoing basis (typically weekly), the field leader(s) report on the observed percent completion of the work associated with the WBS. This measurement is done based on their observation which should take into account the difficulty of installation and energy required to

Figure 6: Dimensions of Work



complete a task, which is often not linear or related to the hours spent or quantity installed. The completion of tasks are rolled up to provide completion of overall cost codes (6-15 common codes across projects are recommended in E2691), and this completion is compared against hours spent to forecast deviation from expected productivity by cost code and overall on the job.

In conclusion, work breakdown structure is one of, if not the, most important tools for success on a project. By translating the tacit wealth of knowledge that the field has into explicit knowledge used for planning the job, the job can be planned thoroughly and in a manner that reduces risk and allows for ongoing tracking. Any other approach which uses a top-down control to measure or dictate how the work will be done is doomed to fail. All aspects of the work including installation, pre-job planning, procurement, and closure must be thought of up front and planned for with involvement of those that are going to actually do the work.

Dr. Perry Daneshgari is the President / CEO of MCA Inc. MCA Inc is a research and implementation company that focuses on implementing process and product

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Dr. Daneshgari and Dr. Moore's education session "How to

Manage Your Job Using Work Breakdown Structure" will take place Friday, October 24 at 3:30 p.m. (EDT) and their session "Industrialization/Globalization/Breaking Through" will be Saturday, October 25 at 10:00 a.m. (EDT) at the 57th Annual IEC National Convention & Electric Expo in Baltimore, Maryland. For more information, visit www.ieci.org.