

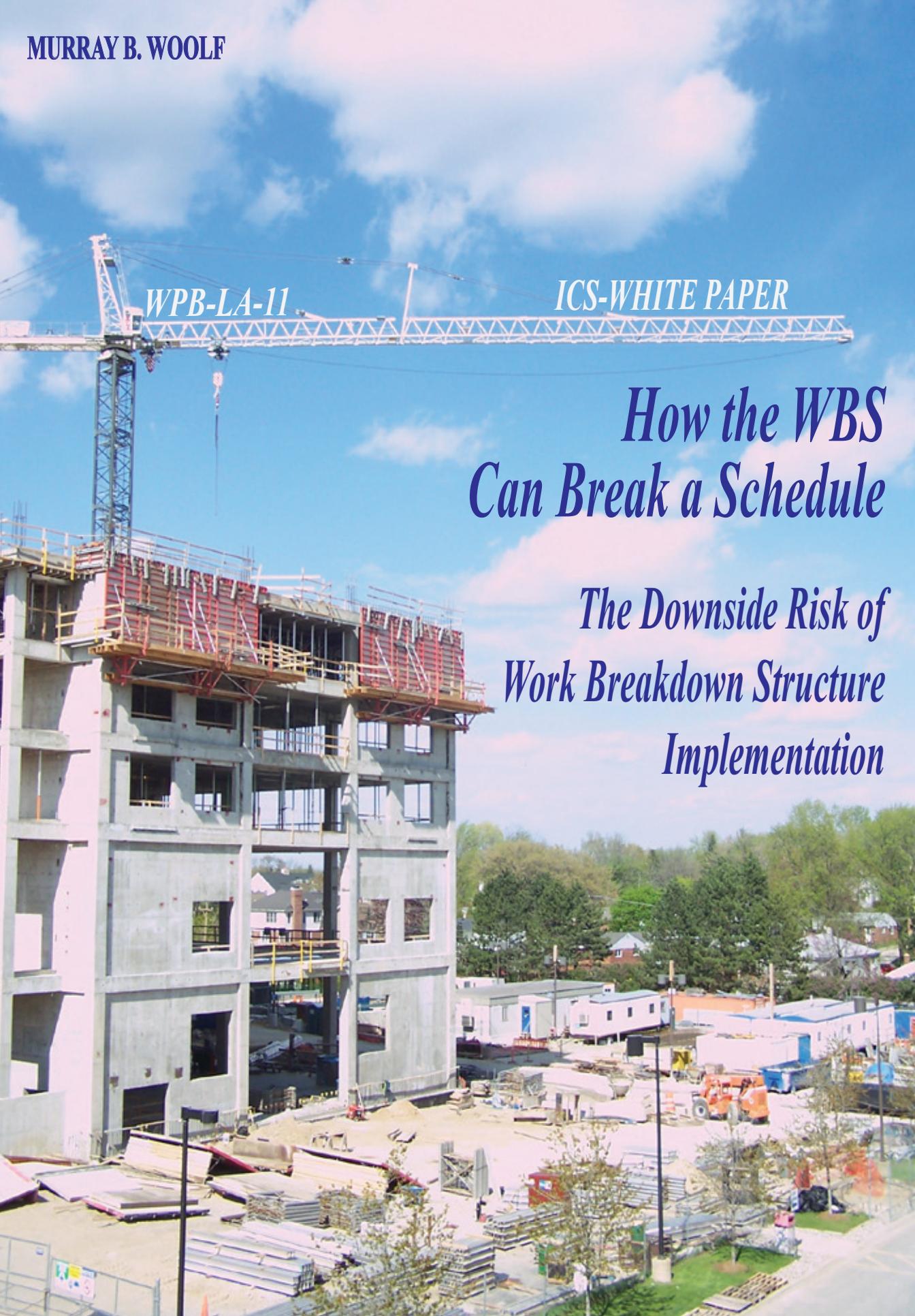
MURRAY B. WOOLF

WPB-LA-11

ICS-WHITE PAPER

How the WBS Can Break a Schedule

*The Downside Risk of
Work Breakdown Structure
Implementation*





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The Downside Risk of Work Breakdown Structure Implementation

by Murray B. Woolf

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Note: This White Paper was designed to function as a stand-alone reference document. It presumes a minimum understanding of the basics of the Critical Path Method. If you do not feel that you have this level of understanding, or if you find the content of this White Paper a little “over your head,” you would quite likely receive great benefit from reading **CPM MECHANICS**.

CPM MECHANICS is Volume 1 of the ICS-Compendium* and forms the basis for both the **DOMINANT PROJECT MANAGEMENT SERIES** and the **COGNITIVE PROJECT MANAGEMENT SERIES**. This White Paper is heavily referenced in **CPM MECHANICS**, and was written to serve as a supplement to that book. To learn more about CPM Mechanics, we encourage you to investigate it at www.CpmMechanics.com.

* The ICS-Compendium is a five-year project that began in January 2011. The primary eight volumes are scheduled for issuance in six-month increments, starting with CPM Mechanics, which is already on bookshelves. Release Dates for the other volumes are posted at the ICS-Placement website. Simply go to www.ics-placement.com.

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Note: Words appearing in **bold font** are defined in the glossary at the end of the White Paper. You may wish to consult the ICS-Dictionary for additional terms not defined in the glossary.

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Table of Contents

I:	Understanding a Work Breakdown Structure (WBS)	5
I.A:	WBS Does Not Enhance a Schedule's Temporal Functionality	5
I.B:	Work Breakdown Structure, Its Common Meaning	6
II:	What a WBS Is	7
II.A:	A WBS Decomposes Project Work Scope	8
II.B:	A WBS Provides a Detailed Breakdown	10
II.C:	A WBS is Organized Hierarchically	12
II.D:	A WBS is Product-Oriented	16
III:	How a WBS is Used	18
III.A:	WBS Created by Costs Folks, Handed to Scheduling Folks	18
III.B:	WBS Mainly Supports Non-Temporal Project Objectives	19
III.C:	WBS Can Erode a Schedule's Temporal Functionality	21
IV:	Definitions of Terms Used in this White Paper	22



ICS-Compendium: Project Management Critical Thinking



How the WBS Can Break a Schedule

The Downside Risk of Work Breakdown Structure Implementation

I: Understanding a Work Breakdown Structure (WBS)

The Work Breakdown Structure (WBS) is one of **Dominant Project Management's** most treasured inventions. One can hardly pick up a book on either Project Management or Project Time Management without being overwhelmed by this term and all of the praise heaped upon it. So popular is WBS that most leading Project Management authorities actually *require* its implementation in Project Schedule development.^[1] This White Paper seeks to dampen this unbridled enthusiasm with a splash of sober reality – about the downside risk of WBS Implementation.

I.A: WBS Does Not Enhance a Schedule's Temporal Functionality

The main point of this White Paper is that WBS Implementation does very little to actually improve a Schedule's ability to function as an effective *temporal* tool. In fact, all too often, when Schedule Implementation rules get out of hand, its imposition into the Schedule (and Schedule Development processes) can actually weaken the Schedule as a Project Time Management tool.

None of this is to say that the WBS Concept is without merit. Quite to the contrary, WBS Implementation is not only a great way, but possibly the only practical way, to correlate the Project Schedule with other (non-temporal) Project Controls functions. On Projects where *temporal* outcomes are of lesser (or even equal) importance to Project Stakeholders than are *non-temporal* outcomes, the ICS-Compendium recommends WBS Implementation (albeit, a carefully managed and controlled implementation).

1 Some authorities go as far as to classify Schedules without as WBS as ... invalid or unacceptable.



But the ICS-Compendium is all about Construction Project Time Management, and thus our skewed perspective is unabashedly oriented toward what is best from a temporal perspective. Viewed through this lens, we are deeply bothered when we encounter standards, best practices, or recommended practices that boldly *mandate* the use of WBS in *all* Project Schedules, no matter how the Project Schedule will ultimately be used. This White Paper seeks to inform the reader about the downside risk of Work Breakdown Structure Implementation.

I.B: Work Breakdown Structure, Its Common Meaning

So what *is* a Work Breakdown Structure? Well, just like virtually every other term that comprises the **Project Time Management** lexicon, there is anything but consensus as to what this term means.

Here are a few popular definitions, from the amalgamation of which we may glean a sense of what the term means. With permission from and thanks to **MAXWIDEMAN.COM**:

- ☛ **WBS:** A task-oriented detailed breakdown, which defines the work packages and tasks at a level above that defined in the networks and schedules. The WBS initiates the development of the Organizational Breakdown Structure (OBS), and the Cost Breakdown Structure (CBS). It also provides the foundation for determining Earned Value and activity networks.
- ☛ **WBS:** A product-oriented family tree of elements that completely organizes, defines and graphically displays the components, software, services and data to be produced, as well as the work to be done, to achieve the specified project outcome.
- ☛ **WBS:** A basic project diagram that documents and describes all the work that must be done to complete the project. The WBS forms the basis for costing, scheduling, and work responsibility.
- ☛ **WBS:** A product-oriented ‘family tree’ of project components which organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of a project component. Project components may be either products or services, and ‘intermediate’ or ‘final’.
- ☛ **WBS:** Activities required to complete a project, arranged in a hierarchical structure.
- ☛ **WBS:** A family tree, usually product-oriented, that organizes, defines, and graphically displays the hardware, software, services, and other work tasks necessary to accomplish the project objectives.
- ☛ **WBS:** A way in which a project may be divided by level into discrete groups for programming, cost planning and control purposes. The WBS is a tool for defining the hierarchical breakdown of work required to deliver the products of a project.



Major categories are broken down into smaller components. These are sub-divided until the lowest required level of detail is established. The lowest units of the WBS become the activities in a project. The WBS defines the total work to be undertaken on the project and provides a structure for all project control systems.

- ☛ **WBS:** A task-oriented ‘family tree’ of activities which organizes, defines and graphically displays the total work to be accomplished in order to achieve the final objectives of a project. Each descending level represents an increasingly detailed definition of the project objective. It is a system for subdividing a project into manageable work packages, components or elements to provide a common framework for scope/cost/schedule communications, allocation of responsibility, monitoring and management.
- ☛ **WBS:** A tool for defining the hierarchical breakdown and work in a project. It is developed by identifying the highest level of work in the project. These major categories are broken down into smaller components. The subdivision continues until the lowest required level of detail is established. These end units of the WBS become the project activities. Once implemented, the WBS facilitates summary reporting at a variety of levels.

Taking the above definitions cumulatively, let us try to identify the most salient attributes of a WBS. These can be subdivided into *What It Is* and *How It Is Used*:

What a WBS Is

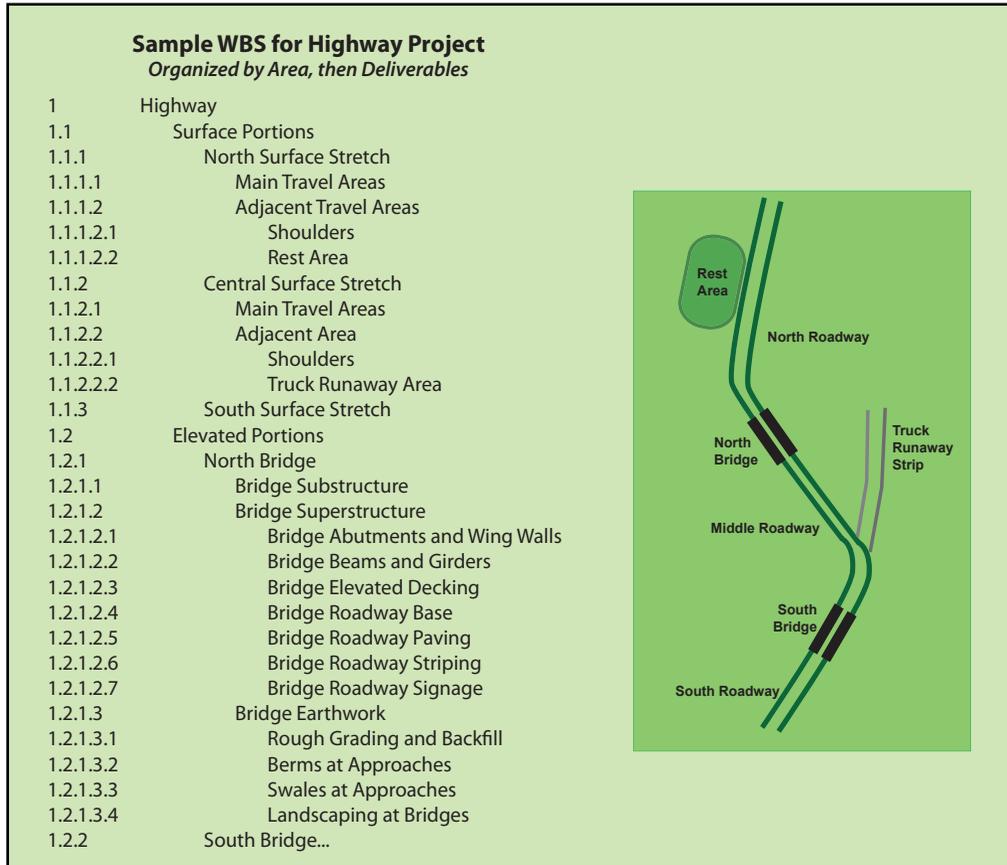
- A Decomposition of Project Work Scope
- A Detailed Breakdown
- An Organized Hierarchically (“family tree” or outline fashion)
- Product-Oriented (Task-Oriented less frequently cited)

How a WBS Is Used

- To Create a Project Schedule
- To Support Other Project Control Systems (e.g., costing, Earned Value)

II: What a WBS Is

A Work Breakdown Structure is an outline of the entire Work Scope of a Project. It is developed by systematically decomposing the Scope in terms of the components of the final Project's main product, each such decomposed component viewed as a more specific Deliverable.



F001: WBS for a Road Project (Sorted by Area, then Deliverables)

II.A: A WBS Decomposes Project Work Scope

For example, and please follow along with **Figure F001**, suppose that we are tasked with a Project that involves the construction of a two-mile stretch of new highway. Suppose that some of the roadway will rest on solid ground (**SURFACE PORTIONS**), but in two other places bridges are required to pass over country roads that cross below (**ELEVATED PORTIONS**). There also will be a **REST AREA** and a **TRUCK RUNAWAY STRIP**.

- We begin our WBS formation by naming the ultimate Deliverable, the Project itself, which we will call **HIGHWAY ADDITION**. We give the Deliverable the WBS code of **1**.
- Next, we divide this all-inclusive Deliverable into the next largest, logical grouping of Deliverables. Of course this is a judgment call, and the actual breakdown of the WBS depends ultimately on the preferences of the Project Team that is crafting



it, but should in every case take into consideration how the Schedule will be used. In the case of **Figure F001** the decision was to divide first and foremost by **SURFACE PORTIONS** and **ELEVATED PORTIONS**.

☞ But, and this is an important point, they could have taken a different tack. They might have approached the decomposition of Scope any number of different ways. For example, they could have divided the Work along the lines of Trade Contractors (responsible parties).

At the end of this White Paper you will find **Figure F002**, which offers an *Alternate WBS* for this same **HIGHWAY PROJECT**. Notice how very differently the two WBS structures looks. Now try to imagine how each of these two completely different WBS structures would align with the infrastructure and intentions of the Project Schedule, as a model of Project Execution Strategy.

A question to ask yourself is this, *“Does an effective Project Schedule naturally subdivide the Work by Deliverables, then Area ... or Areas, then Deliverables — or perhaps by some other set of variables?”* A good Project Schedule is organized to support the objectives of the Schedule as established by the Project Team. And this may differ from one Project to the next.

That having been said, our experience has been that most construction personnel think first about Location and second about (not Deliverables, but) the Trades. And so, neither WBS structure shown in this White Paper would be especially compatible with how the typical Project Schedule is naturally subdivided.

- ☞ **Figure F001** breaks the Work down by Location, then Deliverable. But this is not how Project Executions Teams typically think about the Work. They do not build toward Deliverables, per se. Instead, they build toward the completion of Work “chunks,” defined by Area and then Trade.
- ☞ **Figure F002** breaks the Work down by Trade and then Area but this, too, is awkward for the Project Execution Team. The Trades work together; they collaborate. A WBS tends to dissect the Project Scope into odd and unfamiliar (some might even say, useless) subcomponents.
- ☞ While either WBS might be valuable for Project Cost Management purposes, each does little for Project Time Management. Instead, and as will be discussed below, it often forces the Activities of the Project Schedule to be delineated in ways that do not easily blend with Project Execution Strategy thinking.



ICS-Compendium: Project Management Critical Thinking

But let us continue with our example (**Figure F001**), which subdivides the Work by Areas (first) and then Deliverables (second):

- ❑ **Level 1:** The WBS commences with **HIGHWAY ADDITION** as the highest level WBS Element (numbered **1.**).
- ❑ **Level 2:** The **SURFACE PORTIONS (1.1)** would be considered a second-level Deliverable, just as would be the **ELEVATED PORTIONS (1.2)**.
- ❑ **Level 3:** We would next decompose the **SURFACE PORTIONS** Deliverable into yet smaller Deliverables. From the diagram, we see that there are three separate stretches of surface-level highway, separated by two bridges. We will number and title the three, third-level Deliverables as follows: **NORTH SURFACE STRETCH (1.1.1)**, **Middle Surface Stretch (1.1.2)**, and **SOUTH SURFACE STRETCH (1.1.3)**.
- ❑ **Level 4:** We then decompose the **NORTH SURFACE STRETCH** into the next level of Deliverables, two categories: **MAIN TRAVEL AREAS (1.1.1.1)** and **ADJACENT AREAS (1.1.1.2)**.
- ❑ **Level 5:** To further our example, we next subdivide the **ADJACENT AREAS** into two distinct Deliverables, **SHOULDERS (1.1.1.2.1)** and **REST AREA (1.1.1.2.2)**.
- ❑ **Level 6:** While our example does not go further, we would surely subdivide the **REST AREA** into different Deliverables, such as **RESTROOM STRUCTURE (1.1.1.2.2.1)**, **PICNIC AREA (1.1.1.2.2.2)**, and **LANDSCAPING (1.1.1.2.2.3)** – for we are still a long way from getting down to executable Activities in a Schedule, aren't we?
- ❑ **Level 7:** We would next divide the **PICNIC AREA** into **PICNIC SHELTER (1.1.1.2.2.2.1)**, **DOG WALK (1.1.1.2.2.2.2)**, and **NATURE TRAIL (1.1.1.2.2.2.3)**. Likewise, we would decompose **RESTROOM STRUCTURE** into **FOUNDATIONS (1.1.1.2.2.1.1)**, **WALLS (1.1.1.2.2.1.2)**, **ROOF (1.1.1.2.2.1.3)**, and **INTERIOR WORK (1.1.1.2.2.1.4)**.
- ❑ **Level 8:** We might further subdivide **INTERIOR WORK** (on the **RESTROOM STRUCTURE**) into **ROUGH-IN WORK (1.1.1.2.2.1.4.1)** and **FINISH WORK (1.1.1.2.2.1.4.2)**.
- ❑ **Level 9:** In turn, **FINISH WORK** might further subdivide into **FLOOR FINISHES (1.1.1.2.2.1.4.2.1)**, **WALL FINISHES (1.1.1.2.2.1.4.2.2)**, **CEILING FINISHES (1.1.1.2.2.1.4.2.3)**, and something known in the Construction Industry as **FURNITURE, FIXTURES, AND EQUIPMENT (1.1.1.2.2.1.4.2.4)**. This would include items like toilets, sinks, mirrors, trash cans, and so forth.

II.B: A WBS Provides a Detailed Breakdown

You should now have a fairly good idea of how a WBS works, and how it is created by further and further decomposing the initial Deliverable into smaller and smaller



components of that Deliverable. The goal is to create an unbroken link between the whole and its most minute parts, which should ultimately align with Schedule Activities.

In another part of the **ICS-Compendium** we talk about the strong influence of Sir Isaac Newton on Project Management, but nowhere is that influence more apparent than with the concept of a Work Breakdown Structure. Newton championed the notion that the composition and function of an entity is best understood by an examination of its constituent parts. To his credit, it is widely believed that the Industrial Revolution was made possible, in no small way, by this *parts-make-up-the-whole* philosophy.

In particular, it helped guide formulation of a new management approach that effectively said “*to manage the whole, simply manage the parts.*” And so, companies were reorganized into functional silos, and each was given its own management layer. Those functional units were then further subdivided into operational teams and so forth. To force and capture accountability, these operational groups were additionally designated as Cost Centers, or Profit Centers.

☞ The typically automobile dealership is an excellent example of this management approach in action. A customer drives onto the lot with a beat-up old car, proposed as a trade-in. The New Car Department tries to sell the customer on a sleek, shiny model year vehicle. Meanwhile, the customer's car is channeled to the Used Car Department, for them to examine the vehicle and establish a trade-in value.

In turn, the Used Car Department sends the vehicle to the Body Shop, which prepares an estimate of what it would cost to elevate the vehicle to minimum standards for sale on the lot as a Used Car. But the Body Shop needs to get pricing from the Parts Department, which will provide the parts and supplies needed to perform the necessary repairs and improvements. The Parts Department consults the latest Pricing Tables just issued by the Finance Department. And so it goes.

Making matters worse, much worse, for the customer is that each Department is a separate Cost/Profit Center, and so each Department marks up its services in order to generate revenue in excess of costs. The Parts Department buys parts from a local supplier and then marks up those prices before “selling” the parts to the Body Shop. The Body Shop estimates its labor and part costs, and then marks up these items in order to yield its “profit.” This price (for repairing/improving the used car) is treated as a “cost” by the Used Car Department, which then tacks on a “reasonable profit” as it arrives at a trade-in value. The



New Car Department reduces the trade-in value, in order to provide a margin on the sale of the new car.

It is clear that, in this example, the customer comes out on the short end of the stick. Viewed at the Department level, everything seems reasonable. But from the customer's perspective, it just looks like the Dealership has exponentially enriched itself, with mark-up compounded upon mark-up. And as we shall soon see, this *compounding* effect can be found in the typical WB application.

When modern **Project Management** was still in its academic womb, the notion of Command-and-Control (a Newtonian offshoot) as a management philosophy was already a cultural cornerstone of both Government and military organizations. All that was left was for the formal institution of Project Management to simply join these two dynamic forces: Command-and-Control and Work Decomposition. The result was the management approach that permeates virtually every Dominant Project Management text.

Think about it: The very idea of Project Controls is based on the idea that if you can control the various individual areas of concern of the Project Manager, then you will necessarily control the Project itself, and insure its successful outcome. That is precisely why Project Management is divided into “knowledge areas” (silos). The thinking is that Project Management boils down to Cost Management, Time Management, Procurement Management, Quality Management, and so forth. And supporting each of these areas of management focus are corresponding control systems, such as Cost Control, Quality Control, Schedule Control, and on.

And, just like any good old fractal, the further down the rabbit hole you venture, the more you see the same pattern of Command-and-Control, further evidence that dear Sir Isaac’s influence lives on. In the Project Schedule, the overall Project Scope is subdivided into smaller and smaller expressions of the ultimate Deliverable, all the way down to the smallest Action taken as part of the Project's overall execution. The WBS is the tool of choice for driving the systematic breakdown of Work Scope into its smallest possible subcomponents.

II.C: A WBS is Organized Hierarchically

Next, we observe that a WBS is very structured; hierarchical, to be specific. You probably made your own observation that the numbering system can become quite unwieldy as you get further and further into the minutia of the Project Schedule. But WBS numbering is not the main problem with the hierarchical approach of WBS, as we see it.

The biggest problem is that an Activity can only be assigned to one WBS code. Take



another look at **Figure F001**, and try to figure out what WBS value you would assign to a single Activity called **STRIPE HIGHWAY**. This is the field Action where a road painting crew proceeds down the finished highway and applies a steady stripe of white paint along each shoulder of the road, and a parallel strip of broken yellow paint down the center of the road.

Do you really think that this *one* work crew with their *one* striping machine will subdivide their Scope into five separate Activities just to accommodate a WBS Structure, such as: **STRIPE PAVEMENT- SOUTH SURFACE AREA**, **STRIPE PAVEMENT-SOUTH BRIDGE AREA**, **STRIPE PAVEMENT-MIDDLE SURFACE AREA**, **STRIPE PAVEMENT-NORTH BRIDGE AREA**, and **STRIPE PAVEMENT-NORTH SURFACE AREA**?

The same question could be asked about road signage? With only one or two signs every quarter-mile, would we really create five separate **INSTALL SIGNAGE** Activities to correspond to the different geographic areas of the Work, each with an Activity Duration of, at most, **one day**?

We are not making a mountain out of a molehill. Remember our Schedule Reporting Mantra, found in the ICS-Dictionary:

🔊 Schedule Reporting Mantra: The Project Schedule should provide each Project Team member with all the information needed to do his or her job — no more, no less. And the information should always be in a form that is relevant, meaningful, timely, and accurate.

Are we really able to achieve this standard if we take what would have sufficed as a *single* Activity and break it into *five* separate Activities — which, in all reality, will most probably be performed together as one continuous effort anyway? You have seen those massive lane-wide road paving machines, that inch their way down a highway. Do you really think that the machine would come to a halt, each time it moves from the physical area represented by one WBS-delimited Activity to the physical area represented by the next WBS-delimited Activity?

This **HIGHWAY PROJECT** example is too simple to support a full appreciation for just how much of a problem WBS can create when it forces Activities to be classified against only *one* WBS Element. So let's consider a more complex example.

Imagine a **HEALTHCARE PROJECT** entailing construction of a new, four-story patient tower. The first floor might have common facilities such as a lobby, cafeteria, gift shop, chapel, and so forth. But the upper three floors would each contain rows of patient rooms that line either side of four corridors that branch from the central elevator lobby. Thus there



ICS-Compendium: Project Management Critical Thinking

would be a **NORTH WING**, **EAST WING**, **SOUTH WING**, and **WEST WING** for all four floors. [We will focus our analysis on just the three upper patient floors.]

Let's think about some of the basic Activities that would be involved in building out the interiors of those three upper floors, and whether the Activities would be associated with an entire floor, a single wing, or perhaps even a vertical alignment.

❑ Likely Rough-In Activities

- **LAYOUT FLOOR** (per wing)
- **ERECT WALL FRAMING** (per wing)
- **ROUGH-IN IN-WALL UTILITIES** (per wing)
- **ROUGH-IN OVERHEAD UTILITIES** (per wing)
- **PULL AND TERMINATE ELECTRICAL WIRING** (per floor and system)
- **INSTALL STAND PIPE IN MECHANICAL CHASE** (vertical, transcending floors)

❑ Likely Finish Activities

- **HANG DRYWALL** (per wing)
- **TAPE AND SAND DRYWALL** (per wing)
- **PAINT WALLS/APPLY WALL COVERINGS** (per wing)
- **INSTALL CEILING FINISHES** (per wing)
- **TEST & BALANCE HVAC** (per mechanical zone)
- **TEST MECHANICAL AND ELECTRICAL SYSTEMS** (per system)
- **INSTALL FURNITURE FIXTURES AND EQUIPMENT** (per floor)
- **CLEAN-UP** (per wing)
- **PUNCH LIST ARCHITECTURAL** (per floor)
- **PUNCH LIST MECHANICAL/ELECTRICAL** (per system)

What we see from this list is that:

- ❑ **Spatially-Oriented Activities:** Some Activities can be, and typically are, broken down by their *physical* location. We call these Spatially-Oriented Activities. Along the horizontal plane, for instance:
 - Some Activities could be associated with just one wing of a floor (e.g., we might assign **LOCATION** Activity Code values such as **1NO**, **1SO**, **1EA**, **1WE**, **2NO**, **2SO**, **2EA**, **2WE**, **2NO**, **2SO**, **2EA**, **2WE**, etc.), while...
 - For some other Activities it would make no sense whatsoever to subdivide by *wing*, and so these would be more general: by *floor*.
 - Most Spatially-Oriented Activities would probably be aligned along the horizontal plane. But some other Activities could only be *vertically* oriented (e.g., elevators, stairs, mechanical chases, exterior wall finishes).



- ❑ **Systems-Oriented Activities:** Still other Activities could not be Spatially-Oriented at all. One category meeting this condition is what **Project Facilitators**^[2] call Systems-Oriented Activities. A good example would be a very common Activity among Electrical Contractors, called **PULLING WIRE**. Let's think about this for a moment.

Providing electrical service to a patient room from a central circuit panel involves these logical steps:

1. **Install Conduit:** Electrical conduit is a piping in which the electrical wire will stretch from the source of power (circuit panel) at one end, to the point of use (power outlet in a patient room) at the other end. Conduit installation can be spatially-oriented – such as rooms, or wings of a floor, or to an entire floor.
2. **Pull Wire:** Once the conduit has been installed across the entire distance, between the source of power and the point of use in a continuous length of pipe, the electrician will pull copper wire through the conduit from one end to the other. Obviously, it does not make sense to orient this Activity spatially!

☞ How else, though, would we orient the **PULL WIRE** Activities, of which there might be a dozen or more such Activities? Would it make sense to break them down by system, such as **PULL COMMUNICATION WIRE**, **PULL LIGHTING WIRE**, or **PULL FIRE ALARM WIRE**? What if, as a matter of practicality, all three copper wires would be pulled at the same time, using one single effort?

3. **Terminate Wire:** This is where the ends of the wire, having been pulled, are attached to the circuit panel on one end, and to a power outlet on the other end. While the latter Activity might make sense to be Spatially-Oriented, the circuit panel terminations may make more sense to be included in a Systems-Oriented set of Activities (e.g., a Subnetwork entitled Major Mechanical and Electrical Installations).

The point we are trying to make is that it is very unlikely that all of the Activities in a Construction Project Schedule will align with just *one* orientation schema. Going back to our **HIGHWAY PROJECT** example, most of the Scope of Work was stretched out across space, and so a Spatially-Oriented WBS might make sense for *most* of the Activities (which is how the WBS in **Figure F001** is structured). But we did spot a few Activities that might not conveniently subdivide by area, remember? **LANDSCAPING? PAVING? LANE STRIPING? SIGNAGE?**

The heart of the problem we are discussing is in deciding the underlying “rule of thumb” to use for defining Deliverables when building a WBS. Remember that while

2 A Project Facilitator is the label used in Cognitive Project Management to refer to what is known as a Planner/Scheduler in Dominant Project Management circles.



a WBS organizes Activities hierarchically, there are no hard-and-fast rules as to *how* the decomposed Deliverables should be oriented. This is truly a function of personal preference.

But – and this is the kicker – whatever schema or context you initially choose, it must be applied *consistently* throughout the entire WBS. If we were following a *physical* schema, then an Activity such as **INSTALL IN-WALL CONDUIT, 2ND FLOOR WEST** would be part of a **WALL STRUCTURE, 2ND FLOOR** WBS sub-element. And the **WALL STRUCTURE, 2ND FLOOR** WBS sub-element would be part of the **2ND FLOOR, WEST WING ARCHITECTURE** WBS Element, and so forth.

By comparison, if we were following a *systems* schema, then that same **INSTALL IN-WALL CONDUIT, 2ND FLOOR WEST** Activity would be part of a **LIGHTING SYSTEM** WBS sub-element, and **LIGHTING SYSTEM** would be part of an **ELECTRICAL SERVICES** WBS Element.

When you consider that a single Activity can only have one WBS code assigned to it, which *one* would *you* choose for WBS classification? If it is included as a component of one larger Deliverable, then it would not be included in the composition of another larger Deliverable, right? If **INSTALL IN-WALL CONDUIT, 2ND FLOOR WEST** is included as part of the **LIGHTING SYSTEM** Deliverable, then it would not appear in a Listing of Activities associated with the **WALL STRUCTURE, 2ND FLOOR** WBS Element. Or, vice versa.

II.D: A WBS is Product-Oriented

The last observation we make from the definitions of WBS cited on page 6 is that a WBS is *Product-Oriented*. Now in certain industries, Projects are definitely Product-Oriented; one might even say, extremely so. Software Development is one such industry.

The Project boils down to creating a new software program that provides certain functionality. As a practical matter, the entire program is written by numerous Software Engineers (called programmers), each of whom writes a different component of the overall program. Because these component pieces must ultimately fit together to form one cohesive, functioning whole, it makes sense that the data *output* of one programmer's coding will constitute the data *input* for another programmer's coding.

Each of these sections of source code constitutes an easily-recognizable Deliverable, and these Deliverables tend to sew together like squares of fabric in a patchwork quilt; where one drops off another picks up. This sounds a lot like roadway work, or utility pipeline work found in the Construction Industry.

Another problem with associating WBS Elements with Product-Oriented Deliverables is that not all Actions on a Construction Project necessarily lead to Deliverables—without, that is, greatly stretching the meaning of the term, *deliverable*.

For instance, consider these three standard Activities that represent the process of getting a needed piece of equipment to site:



- PREPARE AND SUBMIT ESCALATOR SHOP DRAWINGS
- REVIEW AND APPROVE ESCALATOR SHOP DRAWINGS
- FABRICATE AND DELIVER ESCALATOR

It is easy to spot the Deliverable in the first Activity; the Contractor assembles the required information and produces **SHOP DRAWINGS**, this being the *deliverable*. But then the Owner or its agent (Architect, Engineer, Construction Manager) reviews the submittal and either approves or rejects it. Here is where the stretching takes place. The *response* from the Owner (acceptance or rejection) is usually little more than a sheet of paper. Is this what you would consider to be a *deliverable*?

Proponents of WBS are probably wincing as they read this entire White Paper, and the last few paragraphs in particular. They would likely argue that we have taken the WBS Element too low, down to the Activity level. They would suggest that the Deliverable is simply the **ESCALATOR**, and that all three of the cited Activities would be coded to the same WBS Element, the one that describes the **ESCALATOR**.

“Fair enough,” we respond. So let’s agree that the lowest WBS level could be, and quite often is, always more general than the Level of Detail of the Activities that are collectively assigned to that single, common WBS Element. But, if this is so, then what do you do about an Activity that can be associated with *more than one* Deliverable?

In a typical processing plant, many different systems work together as a cohesive whole. In an automobile manufacturing plant, try to picture the miles of conveyor belts, ventilation systems, electrical systems, paint ovens, chemical bath tanks, the hundreds of robots with their articulated arms, and so forth. All of these systems must work together like gears in a Swiss watch.

A Project Schedule for a process plant usually captures three different stages of construction operations.

- Installation Stage:** The first is the Installation Stage, in which the Schedule's Activities are normally Spatially-Oriented.
- Systems Stage:** In the Systems Stage, Activities switch over to a Systems-Oriented and model the steps involved in integrating the previously-constructed physical pieces into a cohesive system.
- Integration and Testing Stage:** At last there is the Integration and Testing Stage, where all of the systems are integrated with one another.

How would you design a WBS Structure for a single Schedule that at one stage is Spatially-Oriented, at another stage is Systems-Oriented, and at a third and final stage is Process-Oriented?



☞ Notice our choice of the word, “process.” In that third phase, the vast majority of the construction work (including *intra*-system functional testing) has been completed. Now the tedious process of making certain that all of the systems work with one another begins. What would you consider to be the Deliverable during this third stage of the Schedule? Can you really identify *one*?

III: How a WBS is Used

The message to be taken from the previous subsection is that development of a WBS Structure that is compatible with the content and alignment of Schedule Activities is often a quite daunting challenge. Unfortunately, way too frequently not enough thought is given to WBS creation – and the negative effects are not felt until well into the Project. At this point, changes to the underlying WBS could be extremely costly, time-consuming, disruptive, and maybe even impractical.

III.A: WBS Created by Costs Folks, Handed to Scheduling Folks

For this reason, Cognitive Project Management recommends that the WBS Structure be established by the Project Team at the time the Project Schedule is being developed. We wish to note that this recommendation stands in direct contrast to current Dominant Project Management best practices, which has the WBS created *prior to* Schedule Development and – worse – by the Cost Management personnel.^[3] Said more directly, the Project Facilitator has the WBS handed to her, as a *mandatory* structure that *must* be utilized and she is told to “*make it work!*”

With all of the technical challenges to creating one WBS coding schema that will work for all of the different types of Activities (and different types of Deliverables), one has to wonder whether it is even worth the struggle. The answer depends on what one gets from an effective Work Breakdown Structure.

To know whether a WBS is effective, we must first understand what *effect* we are hoping for! What is a WBS meant to help us do? How is a WBS used, in practice? To answer these questions, let’s go back to those definitions, and pull out the statements that describe how a WBS is used. In doing this, we must be diligent in distinguishing statements that describe what a WBS is, from those that explain how a WBS is used:

3 We say “worse,” because quite often Costing personnel are not especially familiar with Scheduling variables, or sympathetic to the agreed-upon objectives that have been established for the Schedule itself. As a result, when Costing and Scheduling objectives are in conflict with one another, the Costing interests all too often end up trumping the Scheduling interests. The Schedule, as a Project Time Management tool, is weakened.



What a WBS Is

- A task-oriented 'family tree' of activities which organizes, defines and graphically displays the total work to be accomplished in order to achieve the final objectives of a project
- A tool for defining the hierarchical breakdown of work required to deliver the products of a project.
- A way in which a project may be divided by level into discrete groups...

How a WBS is Used

- Defines the work packages ...
- ... for programming, cost planning and control purposes
- Initiates the development of the Organizational Breakdown Structure (OBS), and the Cost Breakdown Structure (CBS).
- Provides the foundation for determining Earned Value and activity networks.
- Forms the basis for costing, scheduling, and work responsibility
- Provides a structure for all Project Control systems.
- Provides a common framework for scope/cost/schedule communications, allocation of responsibility, monitoring and management.

III.B: WBS Mainly Supports Non-Temporal Project Objectives

Taken collectively, these definitions reveal that a WBS is mainly used to support other Project Management processes and only secondarily to support Project Time Management objectives. Now this statement may draw fire from WBS advocates, but the basis of our contention can be found in the answer to two simple questions:

- Can a competent Project Schedule be developed and maintained without inclusion of a formal WBS? (In other words, do we really *need* a WBS altogether?)
- Alternatively, can the other Project Management systems (identified in the above summary) be effectively accomplished without reference to the Project Schedule?

 If you ask WBS advocates how a WBS is important to the development or use of a Project Schedule, they will almost always cite its value in ensuring that the complete Scope of the Project is fully captured by the Project Schedule. This, then, is the main reason for using a WBS for *Project Time Management purposes*, according to its supporters: to ensure that all Work Scope is captured.



ICS-Compendium: Project Management Critical Thinking

- ❑ While we agree that a WBS *can* be used toward this end, we wholeheartedly disagree that it is the *only way* to make certain that the Project Scope is fully addressed in the Schedule. Various other methods are available to the Project Facilitator, and an open-minded and fair WBS advocate would be quick to acknowledge that other methods exist that are every bit as good.
 - For instance, virtually all contracts require and often contain some type of Chart of Accounts, which subdivides the Project Scope into budgetary buckets. Comparing Schedule content against this list is one way to insure that all Scope has been captured.
 - Another very effective approach is to compare each Specifications Section to the Project Schedule in order to ensure that the Scope is all covered. Unfortunately, the WBS extremists have been successful in rewriting Project Management standards to where they now identify WBS as a required element of a Schedule, going as far as to insist that without a WBS, a Project Schedule is simply incomplete.

Now, what about those other Project Management uses?

- ❑ Organizational Breakdown Structure (OBS)
- ❑ Cost Breakdown Structure (CBS)
- ❑ Earned Value Management System (EVMS)
- ❑ Project Control Systems (PCS)
- ❑ Scope Management

Are any of these other Project Management concerns – all admittedly important to the ultimate success of the Project – *essential* elements of a Project Schedule? Must a Schedule include Earned Value variables? Must a Schedule even include Project *Cost* information? Must Schedule Activities necessarily be associated with those responsible for performing them?

Cognitive Project Management reminds us that the ultimate goal of Project Time Management is to assist the Project Team in addressing its primary Project Execution concerns: *Coordination, Collaboration, and Communication*.

The Project Schedule is the essential tool that makes it possible for hundreds of players to perform thousands of Actions in such a way that they work together (Collaboration) in an orchestrated (Coordination) and mutually-beneficial (Communication) manner.

As is explained elsewhere in the ICS-Compendium, a review of Project Time Management's 50-year history shows that it was not long after the invention of the



Sample WBS for Highway Project <i>Organized by Trade, Deliverable, Area</i>			
1	Highway	1.3	Structural Steel Subcontractor
1.1	Earthwork Subcontractor	1.3.1	Bridge Metal Decking
1.1.1	Rough Grading and Backfill	1.3.2	Bridge Steel Beams
1.1.2	Berms and Swales	1.4	Paving Subcontractor
1.1.3	Rip Rap	1.4.1	Paving
1.1.4	Road Subbase (aggregate)	1.4.1.1	Bridge Areas
1.2	Concrete Subcontractor	1.4.1.1.1	North Bridge
1.2.1	Foundations	1.4.1.1.2	South Bridge
1.2.1.1	Caissons	1.4.1.2	Surface Areas
1.2.1.1.1	North Bridge	1.4.1.2.1	North Surface Area
1.2.1.1.2	South Bridge	1.4.1.2.1.1	Main Roadway
1.2.1.2	Piers	1.4.1.2.1.2	Adjacent Areas
1.2.1.2.1	North Bridge	1.4.1.2.1.2.1	On/Off Ramps
1.2.1.2.2	South Bridge	1.4.1.2.1.2.2	Rest Area
1.2.1.3	Grade Beams	1.4.1.2.2	Central Surface Area
1.2.1.3.1	North Bridge	1.4.1.2.2.1	Main Roadway
1.2.1.3.2	South Bridge	1.4.1.2.2.2	Adjacent Areas
1.2.2	Structure	1.4.1.2.2.2.1	On/Off Ramps
1.2.2.1	Precast Beams	1.4.1.2.2.2.2	Rest Area
1.2.2.1.1	North Bridge	1.4.1.2.3	South Surface Area
1.2.2.1.2	South Bridge	1.4.2	Striping
1.2.2.2	Abutment and Wing Walls	1.5	Signage Subcontractor
1.2.2.2.1	North Bridge	1.6	Electrical
1.2.2.2.2	South Bridge	1.7	Mechanical
1.2.2.3	Guard (Barrier) Walls		
1.2.2.3.1	North Bridge		
1.2.2.3.2	South Bridge		

F002: Alternate WBS for a Road Project (Sorted by Trade, then Deliverables, then Areas)

Network-Based Project Schedule that other Project Management interests began to recognize the immense value of a consolidated database of Activities that represented the entirety of the Project.

Before very long at all, these other interests were *requesting* that Schedule developers incorporate certain additional information in the Schedule in order to support their respective functions. Today, fifty years later, the influence of these other interests is so great that quite often the tail is now wagging the dog. These informational elements needed by these other Project Management entities are no longer being *requested*; they are being *demande*d.

III.C: WBS Can Erode a Schedule's Temporal Functionality

Cognitive Project Management is certain that many of the informational elements mentioned in the previous paragraph are not truly *essential* to achievement of the primary



ICS-Compendium: Project Management Critical Thinking

objectives of Project Time Management. In fact, they may actually be impediments!

The inclusion of these other elements – the ones that we insist are not really necessary for Project Time Management purposes – can actually weaken, encumber, or even debilitate the Project Schedule as a potent Project Time Management tool. WBS is a prime example of an informational element that, managed responsibly, can exist within a Project Schedule without diminishing its temporal functionality — but which, not carefully managed, can yield unwanted and unintended negative effects.

The core point we are trying to make is that no matter how else the Project Schedule is used, we must never let it lose its ability to perform as an effective Project Time Management Tool.

IV: Definitions of Terms Used in this White Paper

The following definitions, for technical or unusual terms used in this White Paper, are excerpted from the ICS-Dictionary. You may wish to consult the ICS-Dictionary for additional terms not defined in the following glossary.

- ☛ **Cognitive Project Management:** The ICS-Compendium advocates Cognitive Project Management as a superior alternative, designed specifically for Construction Project Management as practiced in North America. Conversely, the ICS-Compendium uses the term Dominant Project Management to refer to the broadest grouping of contemporary literature, dogma, standards, best practices, and other formal writings and teachings on Project Management topics. In a word, Dominant Project Management refers to today's “conventional wisdom” on Project Management topics.
- ☛ **Dominant Project Management:** The term Dominant Project Management is used throughout the ICS-Compendium to refer to the broadest grouping of contemporary literature, dogma, standards, best practices, and other formal writings and teachings on Project Management topics. In a word, Dominant Project Management refers to today's “conventional wisdom” on Project Management topics. In contrast, the ICS-Compendium advocates Cognitive Project Management as a superior alternative, designed specifically for Construction Project Management as practiced in North America.
- ☛ **ICS-Compendium:** A ten-volume set of books that provide a comprehensive treatment of Project Time Management for the Construction Industry. The first four volumes, further designated as the Dominant Project Management Series, fully discuss Project Time Management as currently practiced in Construction Project Management. The next four volumes, dubbed the Cognitive Project Management



Series, comprehensively explain the innovations in and improvements to Project Time Management as offered by Cognitive Project Management. The final two volumes contain general reference information, including the ICS-Dictionary, and ground-breaking ICS-White Papers.

- ☛ **Project Administration:** One of four Project Management Domains within the Cognitive Project Management model, Project Administration provides the capacity for Project Execution, by supplying the necessary resources and operating conditions.
- ☛ **Project Coordination:** One of four Project Management Domains within the Cognitive Project Management model, Project Coordination is poised at the top of the Cognitive Project Management F.A.C.E. Diamond, where it provides a vital integration function by acting as a liaison between and among External and Internal Project Participants.
- ☛ **Project Execution:** One of four Project Management Domains within the Cognitive Project Management model, Project Execution is where the rubber meets the road. This is the Project Management Domain where the work of the Project is performed. The Project Executor is Cognitive Project Management's title for the role more commonly known as General Superintendent.
- ☛ **Project Facilitation:** One of four Project Management Domains within the Cognitive Project Management model, Project Facilitation provides information and logistic guidance, and is dedicated to facilitating achievement of Project Coordination, Project Administration and Project Execution objectives.
- ☛ **Project Management:** The term Project Management has two distinct, yet interdependent meanings. As a discrete business entity, Project Management refers to a functional organization of specially-trained Project Team members who are tasked with achievement of a Project's predefined Success Criteria. As an operational system, Project Management involves Technologies and Methodologies that are best suited to achieve Ideological objectives and address Ecological constraints. Project Management can be understood by its Operational Divisions as well as its Areas of Primary Attention.
- ☛ **Project Time Management:** The central component of effective Project Management. A basic tenet of Cognitive Project Management is that effective Project Execution simply cannot be achieved without the correspondingly effective use of Time by the Project Execution Team. Project Time Management requires the development, maintenance, and use of products and services especially designed for this purpose.