

Mapping ERP “Chart of Accounts” to Building Information Modeling Software Using Omniclass Coding Structures and Activity Based Costing/Management- A CONTRACTOR’S perspective

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Introduction

As the world of construction becomes increasingly automated through the use of Building Information Modeling (BIM), particularly during the early design phases, when the opportunity to find errors/omissions is high and the cost to make corrections is low, it is apparent that those responsible to execute the projects- the owners and contractors project managers, cost estimators, schedulers, document controllers, project controllers et al have not yet caught up with our architectural and engineering counterparts to ensure the work we do is consistent with, complimentary to and supportive of the use of BIM and related evolving technological advances, specifically, the use of Enterprise Resource Planning (ERP) systems.

The inherent problem with “flat file” or single dimension WBS/CBS structures lies with the fact that not all stakeholders need to see the project deliverables shown in the same way. This led to the evolution of multi-dimensional, “relational” or “object oriented” database coding structures.

The idea or concept of multi-dimensional Work Breakdown Structures (WBS) or Cost Breakdown Structures (CBS) is not new. After World War II, building construction specifications began to expand, as more advanced materials and choices became available.¹ The Construction Specifications Institute (CSI)² was founded in 1948 and began to address the organization of specifications using a numbering system like the Dewey Decimal System used by libraries. The purpose or objective of this effort was to ensure that a specification appeared once and only once in any set of contract documents, thus helping to eliminate redundancy or conflicting information in the contract documents, and thus reducing claims and disputes.

¹ Construction Specifications Institute History (n.d.) http://www.lacsi.org/index.php?option=com_content&view=article&id=52&Itemid=59

² http://en.wikipedia.org/wiki/Construction_Specifications_Institute



In 1963, CSI published a format for construction specifications, with 16 major divisions of work. These 16 divisions were built around work packages normally and customarily sub-contracted by prime contractors to specialty sub-contractors (e.g., Site work, Concrete, HVAC, Electrical) or prime contractors would supply their own workforces (e.g., general building, masonry, finishes, doors, and windows).

This need for multiple ways to sort or view work and their associated costs was reaffirmed by the Norwegian government, who, back in 1992, initiated a project to STANDARDIZE the Cost Coding structures coming from their production sharing contractors drilling for oil in the North Sea. The STANDARDIZED Cost Coding structure is known a “Norsok Z-014”³ has withstood the test of time and is still in use after 26+ years undergoing 2 revisions or updates.

In the early- to mid-1970’s, around the same period that MasterFormat was evolving within CSI, the U.S. General Services Administration (GSA), in conjunction with the U.S.-based American Institute of Architects (AIA), commissioned Hanscomb Associates, Inc. to create a standardized construction cost-coding structure, originally named ‘Mastercosts.’ The GSA and AIA renamed this ‘UniFormat, which enabled capture and summation of costs by building components. ASTM⁴ International began developing a standard for classifying building elements (1989), based on UNIFORMAT, and renamed to UNIFORMAT II.⁵

When CSI’s “Masterformat” and ASTM’s “Unifomat” were combined, this provided us with a two-dimensional sort capability used to “view” or see our project deliverables.

The OmniClass Construction Classification System (known as OmniClass or OCCS) originated around 2000 as a product of the Construction Specifications Institute. (CSI) It incorporates other extant systems currently in use as the basis of many of its Tables – MasterFormat™ for work results, UniFormat for elements, and EPIC (Electronic Product Information Cooperation) for structuring products⁶

The OmniClass Construction Classification System (OmniClass or OCCS) is a means of organizing and retrieving information specifically designed for the construction industry. OmniClass is useful for many applications for Building Information Modeling (BIM), from organizing reports and object libraries to providing a way to roll up or drill down through data to get the information that meets your needs. OmniClass draws from other extant systems in use to form the basis of its Tables

³ Norsok Z-014 (2002 version) <http://www.standard.no/pagefiles/951/z-014.pdf>

⁴ http://en.wikipedia.org/wiki/ASTM_International

⁵ Charette, R. P. *Unifomat II*, retrieved from: unifomat.com/index.php/using-unifomat-ii/building-design-management#astme1557

⁶ From “About Omniclass” (n.d.) <http://www.omniclass.org/about/>



wherever possible — MasterFormat™ for work results, UniFormat™ for elements, and EPIC (Electronic Product Information Cooperation) for products.

OmniClass is designed to provide a standardized basis for classifying information created and used by the North American architectural, engineering and construction (AEC) industry, throughout the full facility life cycle from conception to demolition or reuse, and encompassing all the different types of construction that make up the built environment. OmniClass is intended to be the means for organizing, sorting, and retrieving information and deriving relational computer applications.

OmniClass consists of 15 hierarchical tables, each of which represents a different facet of construction information. Each table can be used independently to classify information, or entries or it can be combined with entries on other tables to classify more complex subjects. This is the basis for the use of multi-dimensional Work and Cost Breakdown Structures.

OmniClass provides a basic structure of information about construction grouped into three primary categories composing the process model: construction resources, construction processes, and construction results. These are then divided into 15 suggested Tables for organizing construction information. The OmniClass Tables correspond to this arrangement of information:

- Tables 11-22 to **organize construction results**
- Tables 23, 33, 34, and 35, and to a lesser extent 36 and 41, to **organize construction resources**, and
- Tables 31 and 32 to **classify construction processes**, including the phases of construction entity life cycles.

The framework for object-oriented information implements the basic approach of ISO 12006-2, but uses entries on these tables as defining points (or characteristics) for object-oriented information organization. The 'object-oriented' approach describes the characteristics of things without imparting a grouping preference or hierarchical order.

In the object-oriented approach, the object is central, acting as a basis for characteristics or properties that describe it. An object thus described can then be grouped with similar objects using a classification arrangement like OmniClass. The framework established by ISO/PAS 12006-3 will enable computers to store and relate data in an object-oriented manner, while OmniClass Tables provide humans with a variety of viewpoints of that data and is a useful approach to establishing relationships between objects.



Having provided a brief over-view of the history and evolution of multi-dimensional (relational or object oriented) coding structures, this sets the stage for this paper which will attempt to provide answers to the following question:

- 1) Is there a way to “map” the coding structures from the Omniclass Tables to today’s ERP systems, specifically to the “Cost of Goods Sold” and “Revenue Recognition” sections?

The hypothesis being that by using Activity Based Costing at a minimum of Level 3 and preferably Level 4 of the CPM schedule⁷ that it is not only possible but relatively easy to accomplish this objective.

Definitions

Before starting, we need to ensure that everyone knows and understands the terminology used in this paper.

Enterprise resource planning (ERP)⁸ is a process by which a company (often a manufacturer) manages and integrates the important parts of its business. An ERP management information system integrates areas such as planning, purchasing, inventory, sales, marketing, finance and human resources.

Direct Cost⁹- An expense that can be traced directly to (or identified with) a specific cost center or cost object such as a department, process, product or ACTIVITY. Direct costs (such as for labor, material, fuel or power) vary with the rate of output but are uniform for each unit of production, and are usually under the control and responsibility of the department manager. As a rule, most costs are fixed in the short run and variable in the long run. Also called direct expense, on cost, variable cost, or variable expense, they are grouped under variable costs.

Indirect Costs¹⁰-Overhead not directly associated (such as office expenses, telephone expenses, R&D) with the production of goods or services. In the context of project management, there are two types, Project Indirect (Overhead) Costs and Home Office Overhead Costs.

⁷ To see more on the different levels of CPM schedule, refer to GPCCaR Module 7.1 Figure 8 <http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling>

⁸ Enterprise Resource Planning (ERP) - Investopedia <https://www.investopedia.com/terms/e/erp.asp>

⁹ Direct Cost- <http://www.businessdictionary.com/definition/direct-cost.html>

¹⁰ Indirect Costs-: <http://www.businessdictionary.com/definition/indirect-overhead-cost.html>



Activity Based Management (ABM)¹¹- Approach to management that aims to maximize the value adding activities while minimizing or eliminating non-value adding activities. The overall objective of ABM is to improve efficiencies and effectiveness of an organization in securing its markets. It draws on activity based-costing (ABC) as its major source of information and focuses on (1) reducing costs, (2) creating performance measures, (3) improving cashflow and quality and, (4) producing enhanced value products.

Activity Based Costing (ABC)¹²- Cost accounting approach concerned with matching costs with activities (called cost drivers) that cause those costs. It is a more sophisticated kind of absorption-costing and replaces labor based costing system. ABC states that (1) products consume activities, (2) it is the activities (and not the products) that consume resources, (3) activities are the cost drivers, and (4) that activities are not necessarily based on the volume of production. Instead of allocating costs to cost centers (such as manufacturing, marketing, finance), ABC allocates direct and indirect costs to activities such as processing an order, attending to a customer complaint, setting up a machine or constructing a building. A subset of activity based management (ABM), it enables management to better understand (a) how and where the firm makes a profit, (b) indicates where money is being spent and (c) which areas have the greatest potential for cost reduction. Developed by professors Robert Kaplan and Robin Cooper of Harvard University in late 1980's. Most of the basis for APPLIED ABM/ABC is based on the published work of Mr. Gary Cokins.

<https://www.linkedin.com/in/garycokins/>

Generally Accepted Accounting Principles (GAAP)¹³- Authoritative rules, practices, and conventions meant to provide both broad guidelines and detailed procedures for preparing financial statements and handling specific accounting situations. Generally accepted accounting principles (GAAP) provide objective standards for judging and comparing financial data and its presentation, and limit the directors' freedom in showing an unrealistic picture through creative accounting. An auditor must certify that the provisions of GAAP have been followed in reporting an organization's financial data in order it to be accepted by investors, lenders, and tax authorities.

Most developed countries (Canada, India, Japan, UK, US, etc.) have their own GAAP which may differ from those of others in minor or major details.

A “Contractor” (or Sub-Contractor) organization¹⁴- A business entity that “initiates, plans, executes, controls and closes” projects where the project itself is a PROFIT CENTER- that is, a

¹¹ Activity Based Management: <http://www.businessdictionary.com/definition/activity-based-management-ABM.html>

¹² Activity Based Costing: <http://www.businessdictionary.com/definition/activity-based-costing-ABC.html>

¹³ GAAP Standards: <http://www.businessdictionary.com/definition/generally-accepted-accounting-principles-GAAP.html>

¹⁴ By Author



contractor or sub-contractor is in the business of assuming the risk of being able to “initiate, plan, execute, control and close” the project in exchange for a known or committed cost, as the organizations primary business objective. This is the target audience of this paper.

An “Owner” organization¹⁵- A business, governmental or other entity that “initiates, plans, executes, controls and closes” projects where the project itself is a COST or INVESTMENT CENTER- that is, for an “OWNER” the project is an EXPENSE and the value of undertaking any project derives not from the project but from the PRODUCT the project was undertaken to create. Usually this “product” takes the form of some type of ASSET. (Financial, Human, Physical, Informational or Intangible) The model described in this paper is not appropriate for most owners.

Problem Definition

The problem is straight forward to explain. We have two generally accepted STANDARDIZED sets of coding structures, one of which has been tested and proven globally to work for the accounting sector and the other which has been tested and proven to work for the “built environment” or the architectural, engineering and construction (AEC) sectors using 4D BIM, using the Omniclass coding structure to enable exchange of data to the CPM scheduling software, and 5D BIM, using the Omniclass coding structure to enable exchange of data to the Cost Estimating software packages.

So how to get these two standard sets of codes to be able to exchange cost, resource, scheduling and other important data? The hypothesis being that using Activity Based Management and Activity Based Costing, is the simplest and most logical approach to enable data exchanges in both directions- from the 3d, 4D and 5D BIM software to the ERP systems and then back again.

¹⁵ By Author



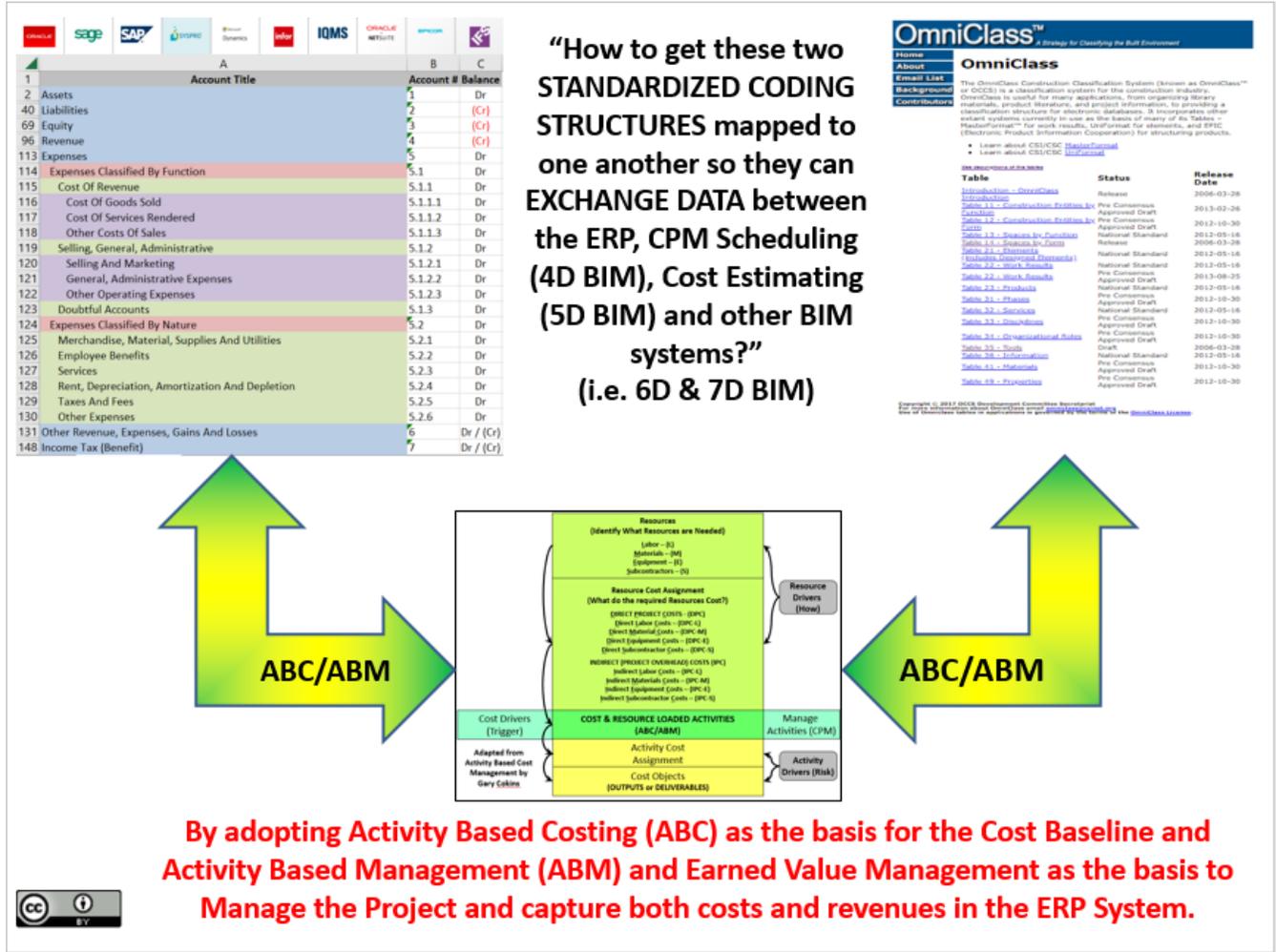


Figure 1- Graphical Illustration of the Problem

What is “Activity Based Management”?

Activity Based Management is nothing more than an alternate way to filter, sort, organize and show your cost data that makes sense to any/all stakeholders who are responsible to “initiate, plan, execute, control and/or close” projects. Explained another way, it is exactly the same cost and resource data that we find in most accounting software, but through the use of specific activity coding structures, enables us to see the information presented in a way that makes the most sense to those who have to make decisions about how the project is going to be run, or more importantly, once the project has started, what changes or “course corrections” need to be made in order to finish the project “on time, within budget, and in substantial conformance to the contractual requirements defined by the Contractual Work Breakdown Structure (CWBS).



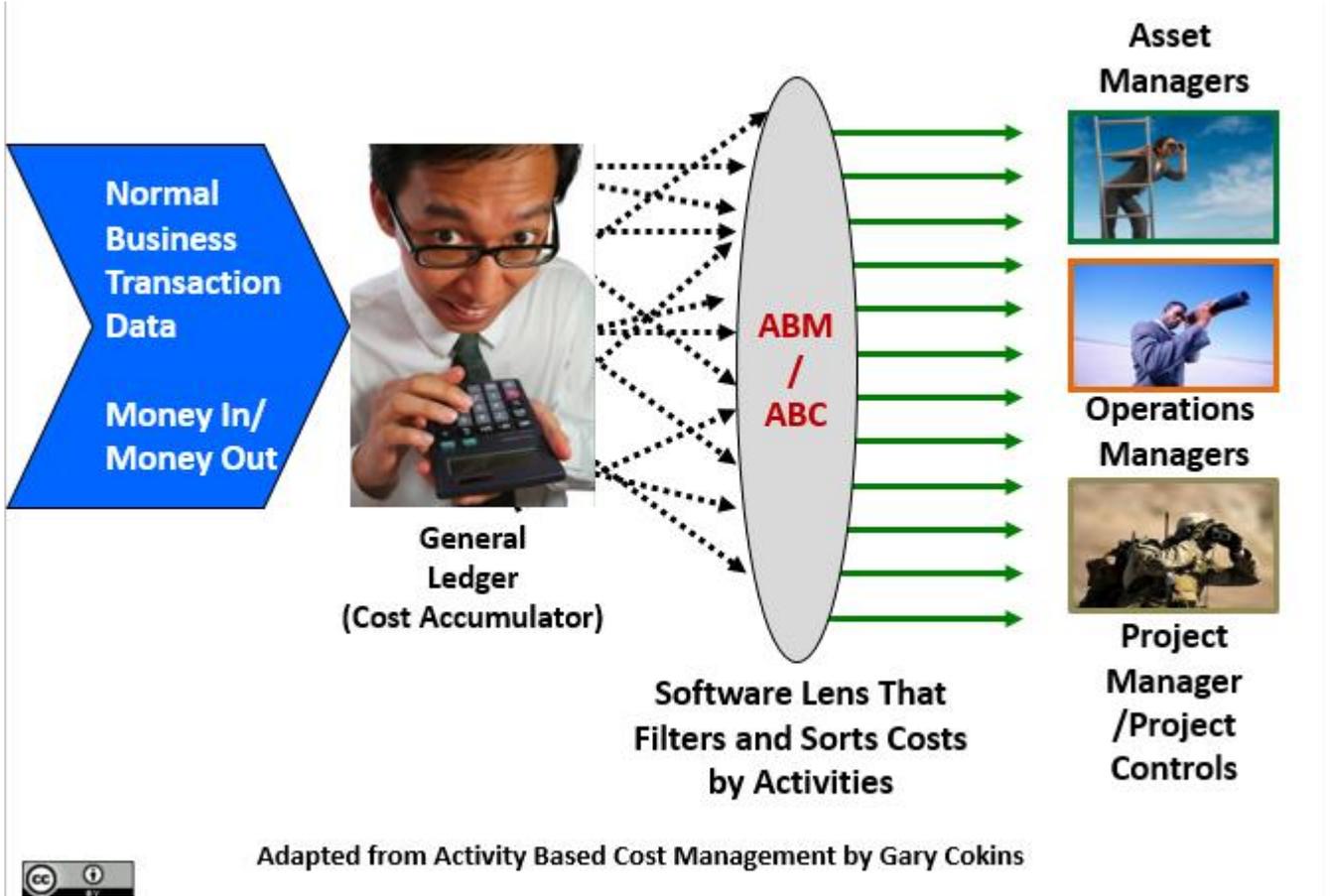


Figure 2- Graphical Illustration of the ABM/ABC System works

As we can see from Figure 2 above, Activity Based Management is NOT a separate accounting system from the one most organizations already use. All it requires are some additional fields and the associated coding structures to be able to “filter” and “sort” the cost data in a way that enables those responsible for projects to be able to make sound business decisions about their projects.

As an example, in Figure 3, we can see in Scenario 1, which is coming from the General Ledger view of what is happening, that this project is in trouble. The planned costs to date were \$41,000, and the actual charged costs to date are \$51,800 leaving us with a \$10,300 cost OVER RUN. But while we can clearly see that the project is in serious trouble running 25% over budget, what can we NOT find out from Scenario 1?

While we see that “Salaries” with a \$6,000 over-run make up close to 60% of the problem, what we do not know is WHOSE salaries is it that is blowing the budget?



Which is why we need to move to the second scenario. In Scenario 2 we can see the same values- The planned costs to date were \$41,000, and the actual charged costs to date are \$51,800 leaving us with a \$10,300 cost OVER RUN. But by being able to sort the cost information not as the accountants need to see it but as the project managers, project team and other key stakeholders need to see the problem, only by switching to the Activity Based Management view can we now use this data to make informed and rational decisions how to fix or otherwise address the problem.

From the General Ledger...

Chart of Accounts View 1

Telecom Implementation

COA CATEGORY	PLANNED	ACTUALS	VARIANCE
Salaries	\$18,000	\$24,000	\$(6,000)
Equipment	20,000	20,000	-0-
Travel Expense	2,000	4,400	(2,400)
Supplies	1,000	2,400	(1,400)
Rent	500	1,000	(500)
TOTAL	\$41,500	\$51,800	\$(10,300)

We know the bad news (we are bleeding to death financially) but what it doesn't tell us is WHERE we are bleeding...

... to the ABC Database Sort...

Activity Based View (WBS/CBS) 2

Telecom Implementation

ACTIVITIES	PLANNED	ACTUALS	VARIANCE
Survey Site	\$5,000	\$4,800	\$200
Prepare Site Design	5,000	7,500	\$(2,500)
Deliver Equipment	2,000	3,500	(1,500)
Install Antennae	6,000	6,000	-0-
Install Feeder Lines	12,000	15,000	(3,000)
Test Antennae Line System	1,500	1,500	-0-
Install BTS Cabinet	2,000	2,000	-0-
Install Power System	2,000	2,000	-0-
Commission BTS	1,000	1,000	-0-
Connect Transmission	1,000	2,500	(1,500)
Integrate BTS	1,000	1,500	(500)
Produce Site Folder	2,000	2,000	-0-
Conduct Site Assessment	1,000	2,500	(1,500)
TOTAL	\$41,500	\$51,800	\$(10,300)

... by moving to an ACTIVITY based Accounting System, we can identify sources of problems related to COST... (WHERE we are losing (or making) money)



Figure 3- Illustrating the differences between the General Ledger and Activity Based Management Views¹⁶

In this view, we can now see that installing the Feeder Lines, with a cost over-run of \$3,000 and Preparing the Site Design with a cost over-run of \$2,500, represent those activities we need to focus on to find out why the salaries or other expenses are so much higher than was originally estimated.

¹⁶ Adapted from "Implementing Activity Based Costing" n.d. IMA and Gary Cokins <https://goo.gl/t39BzG>



But this not only shows us the BAD news, but also the good. We can see from this same data that we are making money on Surveying the Site.

Brief Explanation of the GAAP Accounting “Chart of Account” Titles & Codes

In Figure 4, we are showing the typical titles and coding structures, known as the “Chart of Accounts” that accountants all over the world have largely agreed to and tend to follow.¹⁷

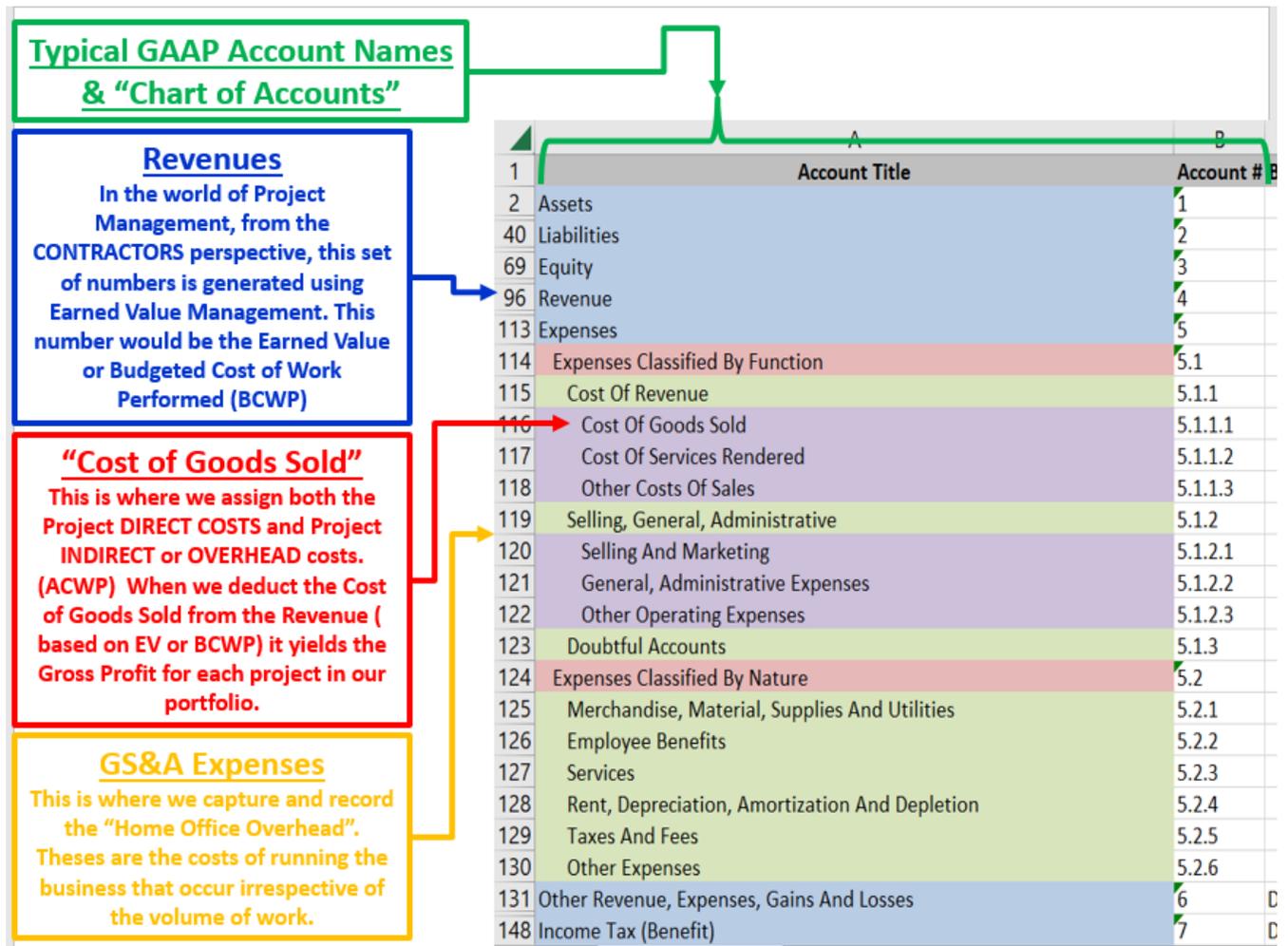


Figure 4- GAAP “Chart of Accounts” Showing Project Related Accounts¹⁸

¹⁷ For more on this topic go HERE <http://www.investinganswers.com/financial-dictionary/financial-statement-analysis/generally-accepted-accounting-principles-gaap-992>

¹⁸ Adapted from “What is GAAP” (n.d.) <http://www.accounting.com/resources/gaap/>



In the context of project management, at least from the perspective of the CONTRACTOR, the three major Sections that projects impact are:

- 1) Account Level 4- Revenues: From a PROJECT perspective, Revenues are called Earned Value or Budgeted Cost of Work Performed (BCWP) and are recognized on a project when the work is physically completed. However, from an ACCOUNTING perspective, the Revenue is not recognized until the work has been billed and the client has paid the bill. This results in time lags between the time the work has physically been completed and the time that accounting recognizes the Earned Value or BCWP as Revenue that need to be reconciled.
- 2) Account Level 5.1.1.1- Cost of Goods Sold (CoGS). Sometimes referred to as “Above the Line” costs. This includes not only the project DIRECT COSTS, such as concrete, steel, wood etc. PLUS the labor to install or fabricate the required deliverables for each activity PLUS both the small hand tools like drills and electric saws or jackhammers which are normally EXPENSED but also the large pieces of equipment like Bull Dozers, Excavators and Cranes, which, because their useful lives are normally longer than the project life, are depreciated and only the operating, maintenance and depreciated costs are charged against the project, along with the INDIRECT COSTS which cover those cost items like the Project Manager and Project Engineer’s salaries, Safety, QA/QC, On Site Trailers, Trucks, Telephone, Electricity etc. that are required for the project under the General Condition. Items that are necessary for the project but are not chargeable to any single activity.
- 3) Account Level 5.1.2- General, Sales and Administration Expenses. These items are a “cost of doing business” which accrue regardless of how many projects the company has or doesn’t have. This cost category are also known as “Home Office Overhead” or “Below the Line” costs and consists of the home office facilities, salaries and bonuses for the CEO, Secretaries, Accounting and Finance departments, Cost Estimators bidding on new work etc. This amount is normally charged against the project as a flat or pro rata percentage based on the monetary value. While this is a common practice it probably is not the most accurate way to allocate home office overhead as not all projects require the same level of home office support.

Brief Explanation of the Most Relevant and Useful Omniclass Codes for Contractors

As shown in Figure 5, there are 4 Omniclass tables which are relevant for use by the Contractors and Sub-Contractors on the site.

- 1) Table 22- Work Results. This table defines the DELIVERABLES required under or by the contract documents. This is normally known as the Contractual Work Breakdown Structure and defines what the Contractor must deliver or create to have successfully completed the project. While the WBS defines WHAT needs to be done, it is the next level deeper, the Cost and Resource Loaded CPM schedule, which tells us HOW (what is the sequence of activities or the work flow) as well as WHEN the work will be done, which is established by the early and late start and finish dates, calculated by the forward and backwards pass.
- 2) Table 23- Products. This table contains almost 7,000 “products” used in the construction process. These can be broken down into a more refined set of codes:
 - a. Products are those “commercial off the shelf” items that you can purchase at Home Depot or Ludlow’s or your local Ace Hardware store. Paints, lumber, insulation, plumbing pipes, electrical wire etc.
Fabricated Products are a somewhat unique class of product. These are NOT “commercial off the shelf” items but items that have been designed specifically for a single project and then fabricated either on or off site. Examples include laminated panels and structural beams, cabinetry, digesters, switch gear and pre-fabricated structures like pre-engineered building or communications or power transmission towers.
 - b. Consumable products. Consumables are usually commercial off the shelf products and can be expensed either as DIRECT COSTS (if they are going to stay with the project when completed) or INDIRECT COSTS if they are consumed for General Conditions activities. Examples of direct consumables include nails, screws and fasteners, caulking and other sealing compounds, joint tape, fittings, elbows and couplers. Examples of INDIRECT CONSUMABLE costs are paper for the office photocopier machine, gloves and personal safety equipment, coffee for the office coffee machine etc. What makes these a separate class is these items are not usually charged to any activity but just purchased and then consumed as required and replenished when they run low. When doing the cost estimate, these items are



usually budgeted using a percentage of the total cost or some other factored estimating model.

- c. Fixtures are a unique class of product used in construction because in many contracts, the actual fixture (i.e. lights or bathroom) are not specified but the contractor has to provide an ALLOWANCE that the owner can use to select specific lighting or bathroom fixtures at the time they are to be installed.
- d. Bulk Products. While these are primarily covered in Table 41 Materials, there are some such as Loam or Topsoil which are purchased by the truckload and may be allocated

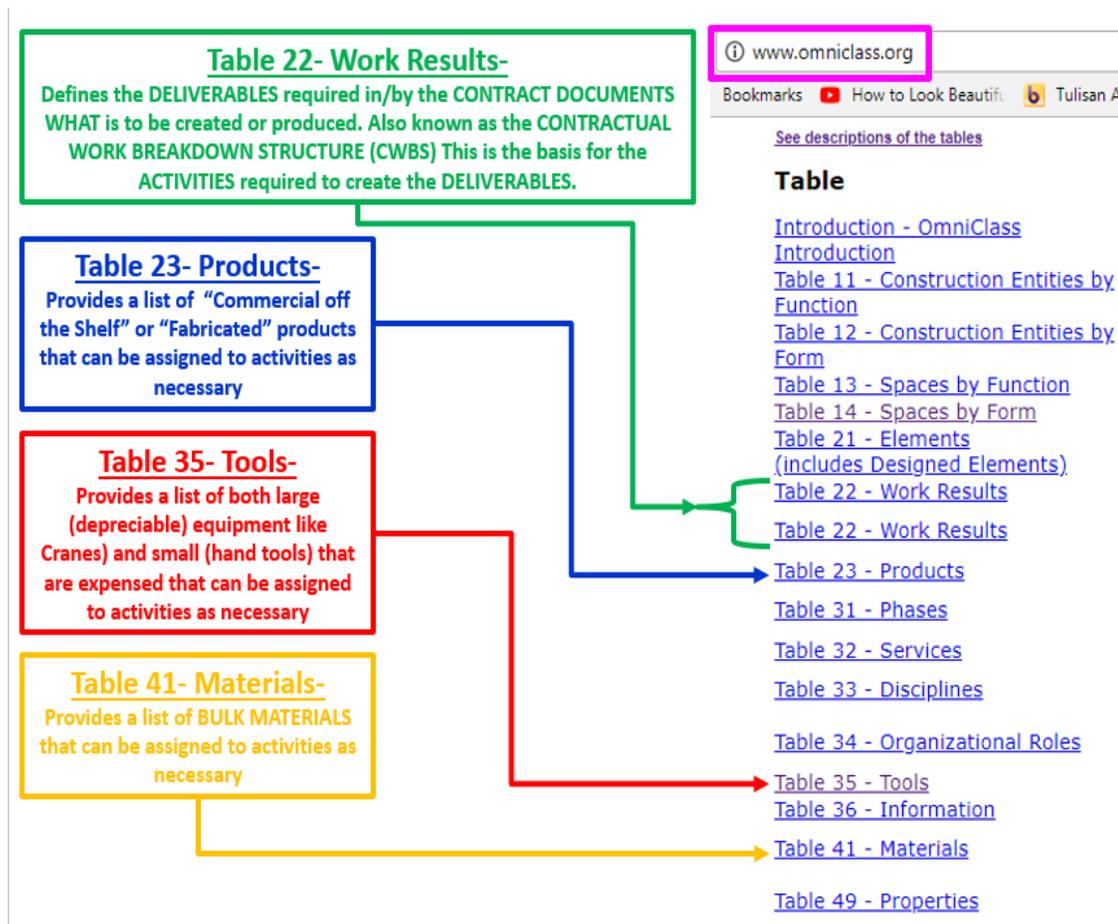


Figure 5- Showing the 15 Omniclass Tables and the 4 Used by Contractor's and Sub-Contractors¹⁹

¹⁹ Adapted from Omniclass Tables (n.d.) <http://www.omniclass.org/>



- 3) Table 35- Tools. While this table may appear to be self-explanatory, there are two types of tools to consider:
- a. Expensed Tools- these are tools like drills, electric jackhammers, circular saws, grinders and other hand tools. Normally these are charged to the project and are considered to have no residual value at the end of the project. The cost of these tools is normally included in cost of the standard crews who will be using them. Any tool, regardless of size that is LEASED or RENTED is always an EXPENSE, either Direct or Indirect
 - b. Depreciated Tools- these are tools whose useful life extends beyond any single project and that are owned by the company. (Not leased or rented) Examples of these tools are Bull Dozers, Cranes, Excavators, Large Welding machines. As the depreciation expense can have a major impact for any company who owns their own “heavy equipment” it is best to carry the depreciation as a below the line cost and have an internal lease or rental rate to the projects that includes the depreciation expense.
- 4) Table 41- Materials. This table contains a list of bulk materials, which are normally purchased by the truck, trailer, tank or rail car volumes. These would most likely be used if a contractor has set up their own concrete batch plant or asphalt plant rather than being used for most construction sites.

What does the Matrix between the WBS and CBS look like?

The matrix formed when we match the WBS and the CBS looks no different than when we combine the WBS and the OBS to form the Work Packages or Control Accounts. The WBS (Table 22) is listed on the Y Axis and the Table 23, Products, Table 35, Tools and Table 41, Materials are shown on the X Axis, resulting in a matrix that looks like what is shown in Figure 6.

Table 22- Work Results-	Table 23- Products-	Table 35- Tools-	Table 41- Materials	Cost Estimating Database Labor
Activity ID #1000-	Omniclass Code-P	Omniclass Code-T	Omniclass Code- M	RS Means Standard Crews
Activity ID #2000	Omniclass Code-P	Omniclass Code-T	Omniclass Code- M	RS Means Standard Crews
Activity ID #3000-				
Activity ID #4000				
Activity ID #5000-				
Activity ID #6000				
Activity ID #7000-				
Activity ID #8000				
Activity ID #9000				
Activity ID #nnnnn				

Figure 6- Conceptual Illustration showing the relationship between Activities from Table 22 and Costs from Tables 23, 35 and 41 PLUS Labor coming from the Cost Estimating Database (Commercial or In-House)

Just as with the Work Package or Control Account process, (for more on this, see Guild of Project Controls Module 3.5 <http://www.planningplanet.com/guild/gpccar/creating-control-accounts>) the intersection between the Activities and the Products, Tools and Materials give us a PARTIALLY cost loaded Activity, which is essential for use in Earned Value. But what about the LABOR component? To find that information we need to look to either an in-house or commercial cost estimating database, which has adopted CSI Unifomat (Omniclass Table 21) and/or CSI Masterformat (Omniclass Table 22) as the cost estimating coding structure.

To see a more realistic explanation of this process, let us take an example to “Form, Pour and Strip” 4 25’ long, 5 KIP Cast In Place Concrete Beams, one on each of the North, East, South and West walls. This is an example of a composite estimate that can easily be applied to any repetitive process.

To explain what we are looking at in Figure 7, this data was taken from the 2018 RS Means “Facilities Construction Costs” pages 1400 and 99.



- 1) The LABOR component of the activity is based on STANDARDIZED CREWS. In this example we are using Crew C-14A, which consists of 5 Construction Workers and 1 Foreman, two pieces of equipment, one Expensed and one Depreciable.
- 2) This is the total number of people on this crew (25 people) X 8 hours per day = 200-person hours
- 3) This column provides the base pay hourly rate for a single worker.
- 4) This column shows us the extended value calculated by multiplying the # of each trades people X 8-hour day X the hourly rate for that trade giving us a DAILY cost of each trade.
- 5) In Column 5, we have the total BARE COSTS for Labor and Equipment SUMMED
- 6) While in Column 6, we have the MARKED-UP HOURLY rate as shown in Column 4, to cover the additional costs of both Project and Home Office Overhead plus a Profit.
- 7) Column 7 contains the Marked-Up hourly rate shown in Column 6 for each tradesman X 8 hour day, gives us the daily fee that the contractor has to charge if he/she expects to cover the project and home office overhead and make a profit on his/her direct or indirect labor.

#	Crew C-14A 1	Contractors Bare Costs		Including Contractors OH & P		Contractors Crew Cost Per Labor Hour	
		Hourly 3	Daily 4	Hourly 6	Daily 7	Bare Costs 9	Billing Rate Including OH & P
1	Carpenter Foreman	\$52.70	\$421.60	\$85.55	\$684.40	\$50.54	\$81.64
16	Carpenters	\$50.70	\$6,489.60	\$82.30	\$10,534.40		12
4	Rodmen	\$54.65	\$1,748.80	\$87.30	\$2,793.60		
2	Laborers	\$39.85	\$637.60	\$64.70	\$1,035.20		
1	Cement Finisher	\$47.55	\$380.40	\$75.20	\$601.60		
1	Equipment Operator	\$53.75	\$430.00	\$84.80	\$678.40		
1	Gas Engine Vibrator		\$25.60		\$28.16	10	13
1	Concrete Pump (Small)		\$881.60		\$969.76	\$4.54	\$4.99
200	Total Daily Labor Hours		\$11,015.20		\$17,325.52	\$55.08	\$86.63
2			5		8	11	14

RS Means Facilities Construction Costs 2018- Page 1400

Figure 7- RS Means Table showing how the costs of STANDARDIZED CREWS are calculated.²⁰

- 8) In Column 8, we can see the SUM of both Labor and Equipment including the Mark-Ups. This is the daily BILLING RATE for this crew the Contractor would use when creating the cost estimate.

²⁰ RS Means 2018 Facilities Cost Data <https://www.rsmeans.com/products/books/2018-cost-data-books/2018-facilities-construction-costs-book.aspx> Page 1400



- 9) Item 9 is calculated by taking the 200 total labor hours shown in Item 2, and divide it into the Total Daily BARE COST shown in 5, it tells us that the BARE COST of this crew is \$50.54 per hour.
- 10) Item 10 shows us the total BARE COSTS of ONLY the equipment ($\$25.60 + \881.60) divided by 200 crew hours (2) which gives us an hourly BARE COST for the equipment of \$4.54.
- 11) This is the sum of both labor and equipment BARE COSTS per hour worked for Column 9.
- 12) When we take the 200 total labor hours shown in 2 and divide it into the Total Daily Marked Up Costs shown in 8, it tells us that the Marked-Up BILLING RATE of this crew is \$81.64 per hour worked.
- 13) Item 13 shows us the total MARKED UP COSTS of ONLY the equipment ($\$28.16 + \969.76) divided by 200 crew hours (2) which gives us an hourly MARKED UP COST for the equipment of \$4.99.
- 14) Lastly, the value shown under 14 is the Marked-Up cost of both Labor and Equipment per crew hour worked

With single digit EBIT profit margins for most contractors, capturing this information in real time not only gives us a competitive advantage over other bidders as we are able to use today's productivity as the basis to bid tomorrow's work, more importantly, in the event of a CLAIM or DISPUTE, these records showing both per unit and per hour costs become indispensable when preparing for arbitration or litigation.



How do we INTEGRATE the Labor, Materials & Equipment into each ACTIVITY?

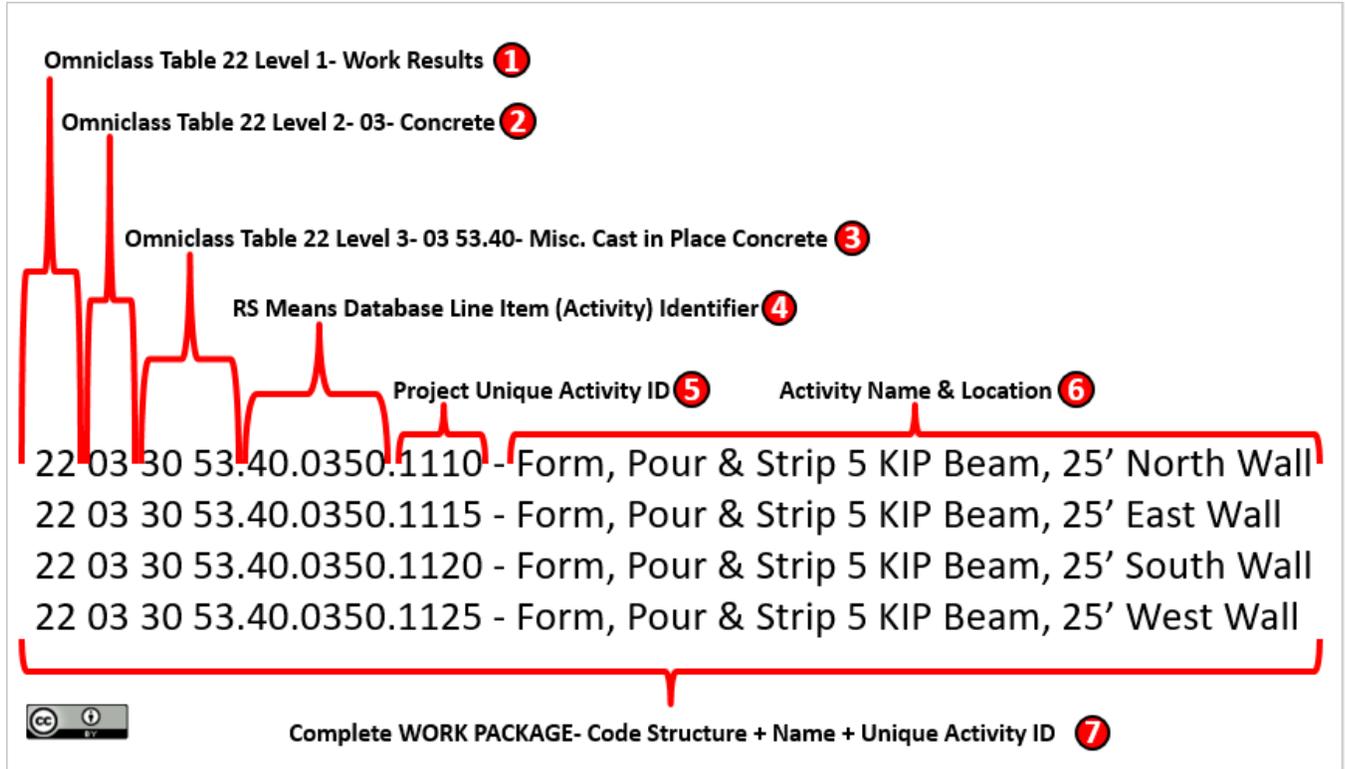


Figure 8- Explanation of the Combined/Integrated Omniclass Table 22 with the RS Means Database Codes

Before we get into any real examples, we need to fully understand the development of the Standardized Coding Structures.

- 1) This refers to Omniclass Table 22 which is Work Results. This is the basis for the Standardized WBS.
- 2) This is Level 1 of Omniclass Table 22 WBS. 03 is always Concrete.
- 3) This is Level 2 of Omniclass Table 22 WBS. 03 30 is always Cast in Place Concrete
- 4) This is Level 3 of the Omniclass Table22 WBS. 03 30 53 is always Miscellaneous Cast in Place Concrete
- 5) This is Level 4 of the WBS that marks the END of Omniclass Table 22 and indicates where the commercial or in-house coding structure takes over going to a greater level of detail. Level 4 is unique to RS Means. Level 4- 03 30 53.40 is always Concrete in Place



- 6) This is Level 5 of the WBS 03 30 53.40.350 is always Form Pour & Strip 5 KIP Beams, 25". By adding in the Unique Activity ID we can now go even one level deeper, Level 6 where we can differentiate between the identical beams for each of the 4 walls- N, S, E and W.
- 7) This indicates a complete WORK PACKAGE consisting of 4 identical activities, located in different parts of the structure.

If we take the same breakdown structure shown above and now add real numbers to the example this is what it looks like-

03 Concrete 1										
03 30 Cast in Place Concrete 2										
03 30 53 Miscellaneous Cast in Place Concrete 3										
03 30 53.40 Concrete in Place 4										
0.0010 0.0020 0.0050	Including Forms (4 uses), reinforcing steel, concrete placement and finishing, unless otherwise indicated.	Crew Type	Daily Output per Unit	Labor Hours per Unit	Unit of Measure	Material Costs	Labor Costs	Equip-ment Costs	Total Costs per Unit	Total Price/Unit Including OH&P
0.0300	Beams- 5 kip per lineal foot, 10' long spans	C14-A	15.62	12.8	Cubic Yard (CY)	\$340.00	\$645.00	\$58.00	\$1,043	\$1,475
0.0350	Beams- 5 kip per lineal foot, 25' long spans	"	18.55	10.78	CY	\$355.00	\$545.00	\$49.00	\$949	\$1,325

5 **6** **7** **8** **9** **10** **11** **12** **13** **14**

Source- RS Means Facilities Construction Costs 2018- Page 99

Figure 9- RS Means Table showing how to calculate the Cost of each of the 4 activities.²¹

To explain what is shown in Figure 8, below is a brief explanation of each column and number used in the cost estimate.

- 1) This is Level 1 of Omniclass Table 22 WBS. 03 is always Concrete.
- 2) This is Level 2 of Omniclass Table 22 WBS. 03 30 is always Cast in Place Concrete
- 3) This is Level 3 of the Omniclass Table 22 WBS. 03 30 53 is always Miscellaneous Cast in Place Concrete
- 4) This is Level 4 showing the Omniclass Table 22 Codes plus the RS Means Line Items. 03 30 53.40 is always Concrete in Place
- 5) This is Level 5 showing the combination of Omniclass Table 22 PLUS the RS Means Line Item 03 30 53.40.350 is always Form Pour & Strip 5 KIP Beams, 25". By adding in the Unique

²¹ RS Means 2018 Facilities Cost Data <https://www.rsmeans.com/products/books/2018-cost-data-books/2018-facilities-construction-costs-book.aspx> Page 99



Activity ID we can now go one level deeper, Level 6 where we can differentiate between the identical beams for each of the 4 walls- N, S, E and W.

- 6) STANDARDIZED Crew C-14A (see Figure 7 to see what this Crew is comprised of)
- 7) Daily Output (average) that Crew C-14A produces for this type of activity per Cubic Yard of Concrete.
- 8) Average number of crew-hours per cubic yard of concrete for this type of activity.
(Productivity)
- 9) Unit of Measure- In this case, Cubic Yards of Concrete in place including the forming, placement of reinforcing steel, placing and finishing of the concrete and stripping of the forms.
- 10) Direct Material Costs per Unit of Measure (CY)
- 11) Direct Labor Costs per Unit of Measure (CY)
- 12) Direct Equipment Costs per Unit of Measure (CY)
- 13) Summation of the Direct Material, Labor and Equipment costs
- 14) Marked-Up costs of the Direct Costs for Material, Labor and Equipment, including Project and Home Office Indirect (Overhead) costs and Profit.



What does this cost data look like using Activity Based Costing (ABC)?

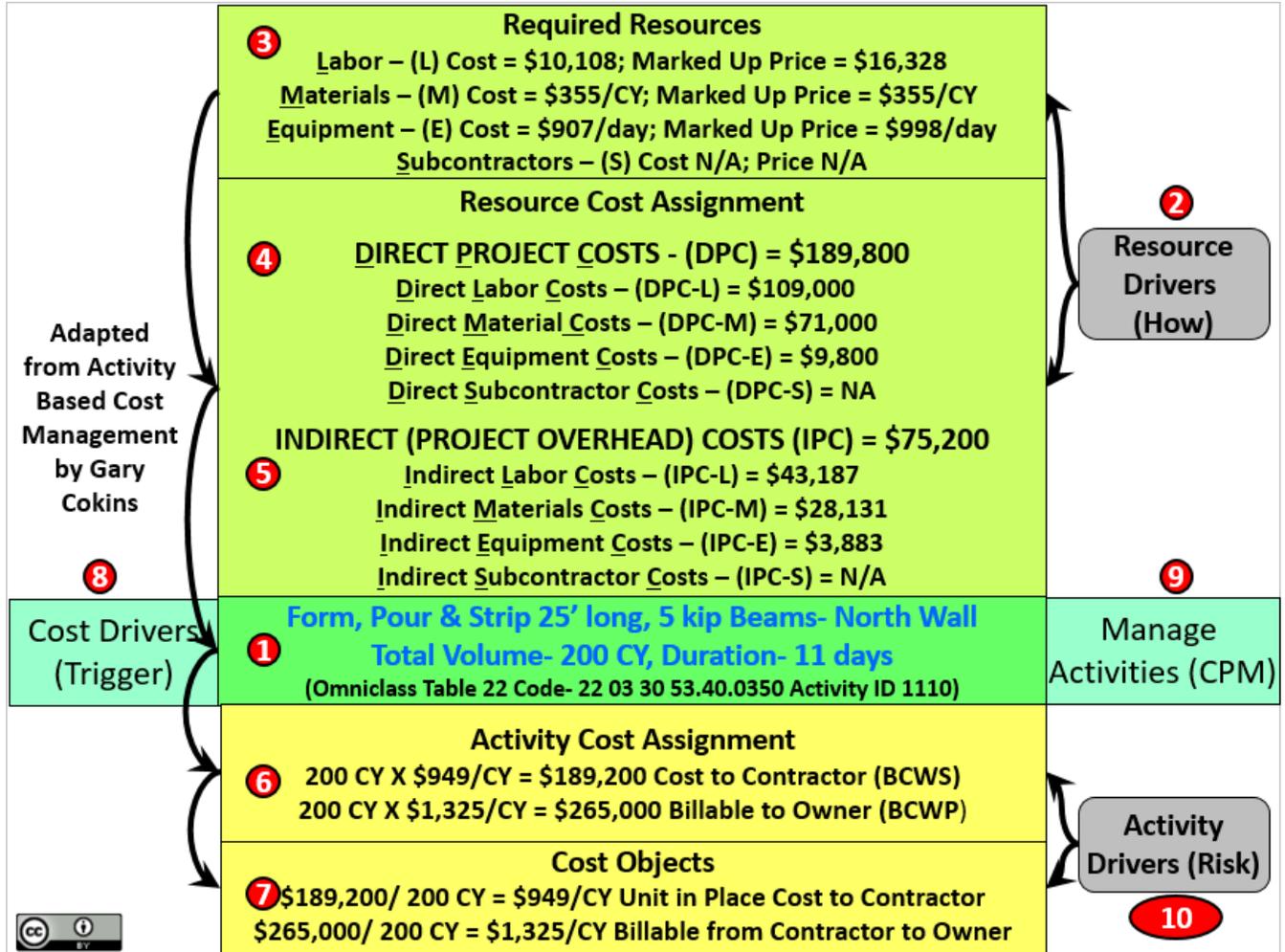


Figure 10- Adapting the Information from the Cost Estimating Database into Activity Based Costing Format²²

When we convert the information contained in the Cost Estimating Database (in this example, using the cost data from RS Means as shown in Figures 7 and 9 above) into the Activity Based Costing format, this is what it looks like:

²² Adapted from "Implementing Activity Based Costing" (n.d.) IMA and Gary Cokins <https://goo.gl/t39BzG> plus RS Means 2018 Facilities Construction Costs <https://www.rsmeans.com/products/books/2018-cost-data-books/2018-facilities-construction-costs-book.aspx> Page 99



- 1) Activity Name and Unique ID- As the name implies, Activity Based Costing (ABC) and ultimately, Activity Based Management (ABM) everything starts with the Activity. In this example, from the Bill of Materials (BoM) or Bill of Quantities (BoQ), we know that this activity requires 200 Cubic Yards (CY) of concrete. Dividing the 200 CY by the PRODUCTIVITY of 18.55 CY per day for Crew C-14A, indicates that this activity will take 10.78 days, rounded to 11 days duration. This is an AVERAGE or P50 value meaning it does not have any risk contingency or buffer built in. (For more information on this topic, reference Guild of Project Controls Compendium and Reference, Modules 7 <http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling> and 8 <http://www.planningplanet.com/guild/gpccar/introduction-to-managing-cost-estimating-budgeting> .
- 2) Resource Drivers- This tells us what we need for resources to execute this activity and how we are going to do it.
- 3) In this case, it is Labor, (Crew C-14A), Materials (From either Omniclass Table 23 or 41) and Equipment (From Omniclass Table 35)
- 4) We now break the costs into more detailed categories, whether they are DIRECT costs or PROJECT or HOME OFFICE INDIRECT or OVERHEAD costs. This is the level of detail that is necessary for the ERP systems to properly and appropriately categorize the costs using the GAAP Chart of Accounts for tax accounting and financial reporting purposes.
- 5) We now break the costs into more detailed categories, whether they are DIRECT costs or PROJECT or HOME OFFICE INDIRECT or OVERHEAD costs. This is the level of detail that is necessary for the ERP systems to properly and appropriately categorize the costs using the GAAP Chart of Accounts for tax accounting and financial reporting purposes.
- 6) By multiplying the estimated quantities from the BoM/BoQ X the DIRECT costs yield the CONTRACTORS COSTS. This is the number provided to the Project Manager that he/she is expected to meet or beat. When using Earned Value Management, performance against this target is measured by Schedule Variance (SV), Cost Variance (CV), Cost Performance Index (CPI) and Schedule Performance Index (SPI) (For more on this topic, reference Guild of Project Controls Compendium and Reference, Module 9 <http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-progress>)
- 7) Once the work has started, by capturing then dividing the ACTUAL UNITS IN PLACE into the ACTUAL COSTS of WORK PERFORMED (Actual Units/ACWP) provides the CONTRACTOR with the means to continuously update the cost estimating database, using todays productivity and cost data as the basis to bid tomorrows work.
- 8) From the contractor’s perspective, the “Trigger” to each activity is either the start or completion of the predecessor activity, depending on the logic chosen.
- 9) One of the most important tenets of project management from the CONTRACTORS perspective is “You cannot manage a project by managing the money”. To effectively



manage any project, manage the WORK FLOW (the activities) and using ABC/ABM, the “money will follow the work” (both on the cost and the revenue side of the equation)

10) Lastly, the risks from the CONTRACTORS perspective is that his/her Actual Cost of Work Performed (ACWP) is HIGHER than what was estimated and/or that the PRODUCTIVITY was lower, resulting in the activity taking longer than planned and/or costing more than was estimated. However, by managing both in real time, it is possible to know well in advance of potential problems, thus enabling the project manager to make appropriate corrective or remedial actions.

Connecting the Dots on Capturing & Exchanging Cost and Revenue Data

As the purpose of this paper was to explain and demonstrate HOW the STANDARDIZED Codes of Accounts from Omniclass could be mapped to the STANDARDIZED Chart of Accounts recommended by GAAP, Figures 10 and 11 have been created to illustrate exactly how this happens using Activity Based Costing (ABC) and Activity Based Management (ABM) as the “Integrator” or “go between”.

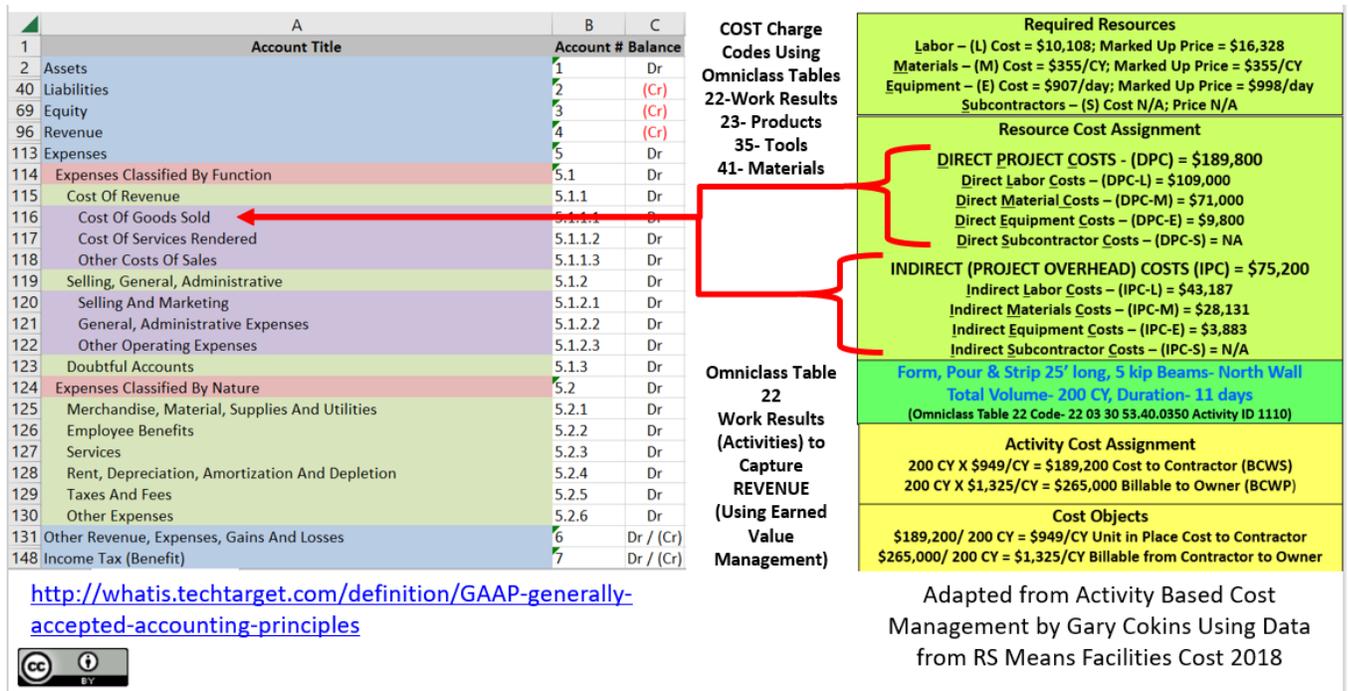


Figure 11- Illustrating how using ABC/ABM can tie the Omniclass Coding Structure to the GAAP Coding Structure²³

²³ Adapted from “Implementing Activity Based Costing” n.d. IMA and Gary Cokins <https://goo.gl/t39BzG> and from “What is GAAP” (n.d.) <http://www.accounting.com/resources/gaap/>



Figure 10 shows very clearly how, using ABC/ABM which was based on the Omniclass Tables 22-Work Results, matrixed against Tables 23, Products, Table 35, Equipment and Table 41 Materials, can aggregate and categorize the costs in a way which is readily transferable to the GAAP coding structure.

In Figure 10, we can see how on the PROJECT DIRECT and INDIRECT cost side, the values would be exported into the Cost of Goods Sold (CoGS) accounts for each project. As nearly all projects are also required to carry some percentage of HOME OFFICE OVERHEAD costs, to address this requirement consistent with ABC/ABM, one or more activities called “Home Office Overhead” should be created and those costs loaded into the project not on a pro-rata or percentage basis as is commonly done now, but as a separate standalone activity (or activities). By isolating the HOME OFFICE OVERHEAD from the Project Direct/Indirect costs, enables the contractor to manage the HOME OFFICE OVERHEAD costs as aggressively as they try to manage the project DIRECT and INDIRECT PROJECT COSTS.

Obviously enough, the data from the Home Office Overhead costs would not be expensed under the heading of “Cost of Goods Sold” but under the heading of the “below the line” costs, General, Sales and Administrative costs.

As an example, the Cost Estimators/Quantity Surveyors responsible for preparing a bid are normally based in the home office. If a bid is submitted and the project is won, then their time preparing that bid would be appropriately charged against the project as a “Cost of Goods Sold” (GAAP 5.1.1.1). However, for all the projects that are bid and LOST, the time spent preparing those bids would be charged against GAAP 5.1.2.1 “Selling and Marketing” expense.

On the REVENUE side, Figure 11 illustrates how the data generated by using Earned Value Management, once billed to the client and paid for, will accrue to GAAP account 4.1.1.1, by renaming “Products” as “Projects”.

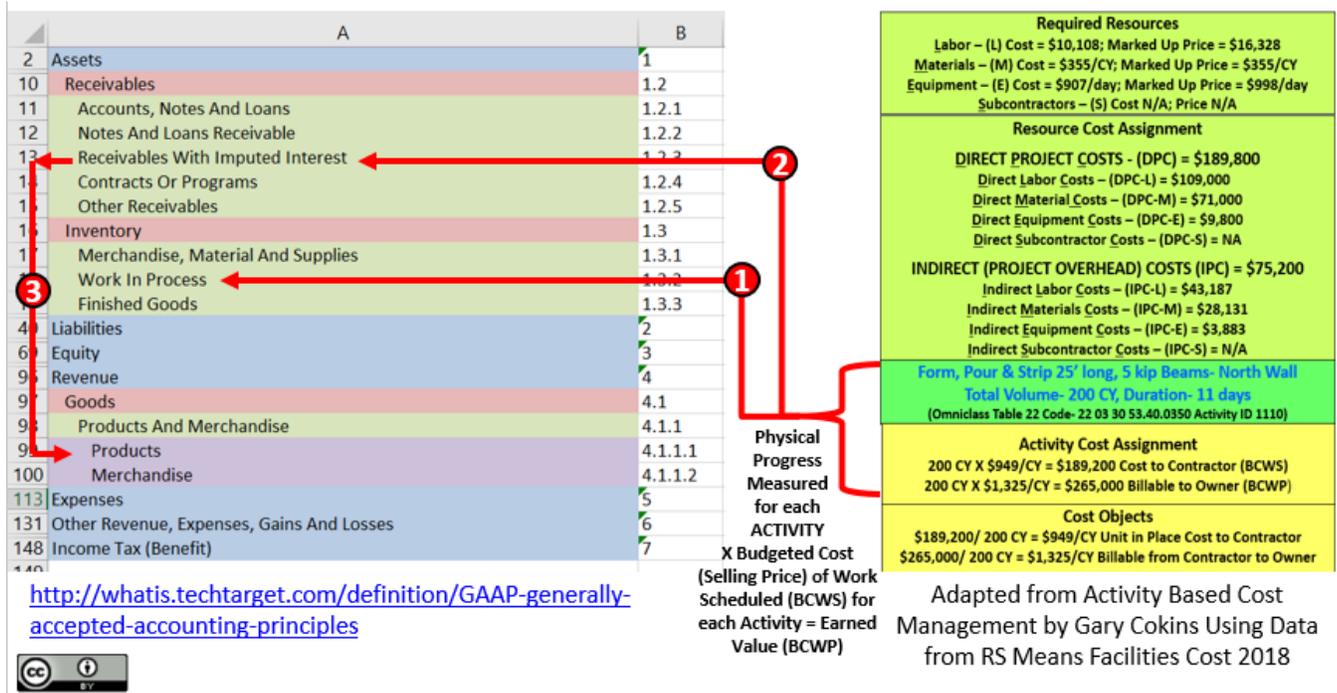


Figure 12- Showing how the Revenue Generated Using Earned Value Management flows into the ERP Software²⁴

There are 3 steps in using Activity Based Management combined with Earned Value to capture real time status on any project for entry into the ERP Accounting Module.

- 1) For work that has been PHYSICALLY COMPLETED but has NOT yet been BILLED is recorded as “Work in Progress” (GAAP Chart of Accounts #1.3.2) At the end of the month or other agreed to milestones or time frames, the accumulated Earned Value (BCWP) is transferred from Work in Progress to Accounts Payable. To learn the various methods to measure physical progress see Guild of Project Controls Module 9.3.3.1- <http://www.planningplanet.com/guild/gpccar/capturing-progress-updating-schedule>
- 2) Once the accumulated Earned Value (BCWP) of the work in place has been billed to the client, then it moves from Work in Progress to Accounts Receivable (GAAP #1.2.3)
- 3) As soon as the bill (based on the accumulated Earned Value from each activity) has been paid by the client, the payment is recorded as revenue against each project. (GAAP 4.1.1.1) To find a template showing how to bill using Activities Based Management, see the Guild of

²⁴ Adapted from “Implementing Activity Based Costing” n.d. IMA and Gary Cokins <https://goo.gl/t39BzG> and from “What is GAAP” (n.d.) <http://www.accounting.com/resources/gaap/>



Project Controls, Module 9.3 Figure 23

<http://www.planningplanet.com/guild/gpccar/capturing-progress-updating-schedule>

Worth noting is that if “advanced payments” or “earnest money” is paid by the owner to the contractor upon signing the contract (which is a common practice in the Middle East and Asia) that deposit would be recorded as a “prepaid” account receivable (negative balance for that account) and be offset either with the first actual progress billing based on physical progress (EVM) or amortized over more than one billing. Also, worth nothing is, consistent with earned value as being a “pay for performance” model, advance payments are not a “best tested and proven” practice, any more than giving your pet a “doggy biscuit” BEFORE they perform the trick would be. Earned value is based on “PROMPT” payment for work done in substantial conformance to the technical requirements and in fulfillment of the contractual terms and conditions- the “shall” clauses in the contract.

Conclusion, Recommendations and Follow Up Actions

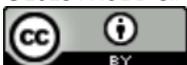
In the Introduction to this paper, the purpose of this paper was identified to answer the following question:

- 1) Is there a way to “map” the coding structures from the Omniclass Tables to today’s ERP systems, specifically to the “Cost of Goods Sold” and “Revenue Recognition” sections?

And the hypothesis was that by using Activity Based Costing at a minimum of Level 3 and preferably Level 4 of the CPM schedule that it is not only possible but relatively easy to accomplish this objective.

Based on the explanations above showing WHAT to do and HOW to do it, the use of Activity Based Costing combined with Activity Based Management serves as a relatively simple yet reliable way to enable data exchanges in both directions between the Activities from Table 22, having been cost and resource loaded using Tables 23, 35 and 41 combined with data from an in house or commercial database, through the Activities into the appropriate General Ledger accounts. Going in the other direction, the Actual Costs for Labor, Materials and Equipment, flow from the ERP system back into the Cost Estimating System, ensuring that when a bid is submitted, it is using the most recent cost and productivity information.

As a disclaimer, while this system has been used by the author for over 40 years and has proven to work based on his first-hand experiences as a general contractor, where his own money is on the line if the project “succeeds” or “fails”, **“past performance is no guarantee of future results”**.

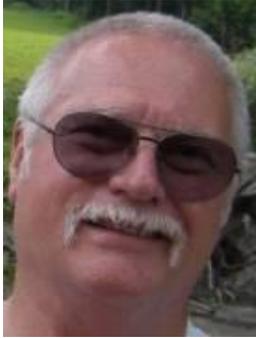


For those wishing to adopt/adapt this system for their organization, the author HIGHLY RECOMMENDS that you do so on a PILOT PROJECT rather than trying to “roll it out” top to bottom” across the entire organization before testing to see if the system works with your specific ERP, Cost Estimating and CPM Scheduling software packages. “God (or the devil if you prefer) lies in the details” and you can almost be guaranteed that some customization may be required to get the systems to accurately, reliably and precisely exchange data. Or to paraphrase the disclaimers used in the reality TV shows ““This process was developed by trained professionals,” “Do not attempt this on your own.”

For more detailed information on how to use this system, the Author urges you to subscribe to the ~650 page Guild of Project Controls Compendium and Reference (GPCCaR) <http://www.planningplanet.com/guild/GPCCAR-modules> Access if free of charge, however it does require that those wishing to gain access fill in a profile (which is also free of charge) but will take you 10 – 15 minutes of your time.



About the Author



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For 25+ years, he has been providing Project Management training and consulting throughout South and Eastern Asia, the Middle East and Europe. He is also active in the Global Project Management Community, serving as an Advocate for and on behalf of the global practitioner. He does so by playing an active professional role in the Association for the Advancement of Cost Engineering International, (AACE); Construction Specifications Institute (CSI) and the Construction Management Association of America, (CMAA). He previously served on the Board of Directors of the American Society for the Advancement of Project Management (asapm) <http://www.asapm.org/> and served previously as the Chair of the Certification Board of the Green Project Management organization. <http://www.greenprojectmanagement.org/> He is active as a regional leader and a compensated consultant to the Planning Planet's Guild of Project Controls. <http://www.planningplanet.com/guild>

He has spent 18 of the last 45 years working on large, highly complex international projects, including such prestigious projects as the Alyeska Pipeline and the Distant Early Warning Site (DEW Line) upgrades in Alaska. Most recently, he worked as a Senior Project Cost and Scheduling Consultant for Caltex Minas Field in Sumatra and Project Manager for the Taman Rasuna Apartment Complex for Bakrie Brothers in Jakarta. His current client list includes AT&T, Ericsson, Nokia, Lucent, General Motors, Siemens, Chevron, Conoco-Philips, BP, Dames and Moore, SNC Lavalin, Freeport McMoran, Petronas, Pertamina, UN Projects Office, World Bank Institute and many other Fortune 500 companies and NGO organizations.

Dr. Giammalvo holds an undergraduate degree in Construction Management, a Master of Science in Project Management through the George Washington University and a PhD in Project and Program Management through the Institute Superieur De Gestion Industrielle (ISGI) and Ecole Superieure De Commerce De Lille (ESC-Lille- now SKEMA School of Management) under the supervision of Dr. Christophe Bredillet, CCE, IPMA A Level. "Dr. PDG" can be contacted at pauldgphd@gmail.com.

