

# A Standard Integrated Project Controls Model for Optimizing Organizations' Processes

By: Mohamed Hisham, **MSc, MEng, PMP, PMI-RMP, PMI-SP**  
Corporate Project Controls Manager



# About the Speaker

# About the Speaker



EXPERIENCE

16 YEARS

- Planning & Scheduling
- Cost Control
- Risk Management
- Delay Analysis
- 4D Modeling
- Automated Reporting
- PMO Standardization



## EDUCATION



Cairo University – Master of Science (MSc)

Master of Science in Construction Management. Research subject is “Application of Building Information Modeling (BIM) in Infrastructure Bridges”.



Nile University – Master of Engineering (MEng)

Master of Engineering in Construction Management. Areas of study include (not limited to): advanced planning and control, asset management, IT applications in construction, and cost management.



Cairo University – Bachelor of Science (BSc)

BSc. of Civil Engineering 2007 "Very Good; honors".



## PROFESSIONAL CERTIFICATIONS



PMP – Project Management Professional



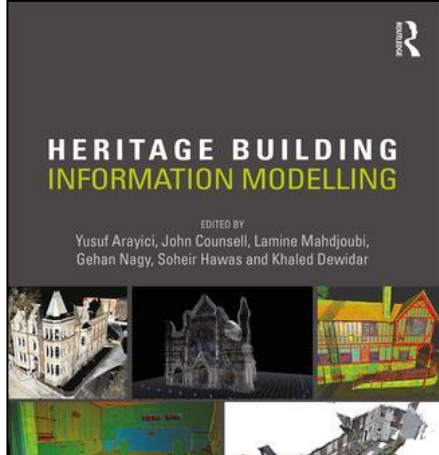
PMI-RMP – Risk Management Professional



PMI-SP – Scheduling Professional

# About the Speaker

**Publications:** <https://www.researchgate.net/profile/Mohamed-Hisham-2>



Chapter 10 | 19 pages

Planning of sustainable bridges using building information modeling

With Mohamed Marzouk, Mohamed Hisham

Hide abstract ^

This chapter presents a framework for using Bridge Information Modeling (BrIM) as an effective tool in the management of existing and heritage. Building Information Modeling (BIM) has been utilized in different applications, such as: cost estimation lean construction facility management sustainable development and construction process documentation. The proposed BrIM management system depends on developing a 3D BrIM model of the heritage or existing bridge then integrating it with the other system modules, which are the database module and the condition assessment module. Information systematized in the database must include general data about each bridge, like the description of the structure and its environment. The developed program then creates a database of the bridge components by writing the extracted information to an MS Excel file. The C# program extracts the intelligent attributes of elements from BrIM and creates a text file that can be used by the ANSYS software package.

Comparative Analysis of Bridges Construction Methods Using Bridge Information Modeling  
2019 • International Journal of 3-D Information Modeling (IJ3DIM) 7(3)

[See publication](#)

Planning of Sustainable Bridges using Building Information Modelling, Chapter: 10  
Feb 2017 • Routledge, UK, Editors: Yusuf Arayici, John Counsell, Lamine Mahdjoubi, Gehan Nagy, Soheir Hawas, Khaled Dewidar, pp.114-132

Implementing earned value management using bridge information modeling  
Jun 2014 • KSCE Journal of Civil Engineering 18(5):1302-1313

Modeling Sustainable Building Materials in Saudi Arabia  
Jun 2014 • 2014 International Conference on Computing in Civil and Building Engineering


Applications of bridge information modeling in bridges life cycle  
Mar 2014 • SMART STRUCTURES AND SYSTEMS 13(3)

A hybrid model for selecting location of mobile cranes in bridge construction projects  
Sep 2013 • The Baltic Journal of Road and Bridge Engineering 8(3):184-189

Building Information Model for Selecting Environmental Building Materials  
Jan 2013 • The Seventh International Structural Engineering and Construction Conference

Applications of Building Information Modeling in Cost Estimation of Infrastructure Bridges  
Jun 2012 • International Journal of 3-D Information Modeling, 1(2), 17-29

Bridge Information Modeling in Sustainable Bridge Management  
Jan 2012 • International Conference on Sustainable Design and Construction (ICSDC) 2011



**Mohamed Hisham** [Edit](#)

Master of Engineering · Position · Institution

Location | Website

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Research Interest Score: **151.3** +0.10



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# Contents

# Contents

1. Introduction
2. The Proposed Project Controls Model
3. Horizontal Standard Integration
4. Vertical Standard Integration
5. Standard Operating procedures (SOPs)
6. BIM - Application Programming Interface (API)
7. Summary & Conclusion

# 1. Introduction

# Purpose & Objective

- The purpose of this presentation is to present a standard integrated project controls model that can be utilized to optimize the organizations' processes
- The presented model helps to improve productivity and to enhance the efficiency of the processes
- The presented model plays a crucial role in achieving the projects' objectives in the most efficient manner



# Standardization Definition

**Standardization** describes the establishment of set of procedures and rules that people in the organization should follow to complete specific tasks



# Standardization Benefits

If the processes aren't standardized, running a complex business will be a nightmare



# Standardization Benefits



**Improves Clarity**



**Improves Productivity**



**Guarantees Quality**



**Improves Morale**



**Shortens Learning Curve**



**Reduces Conflicts**

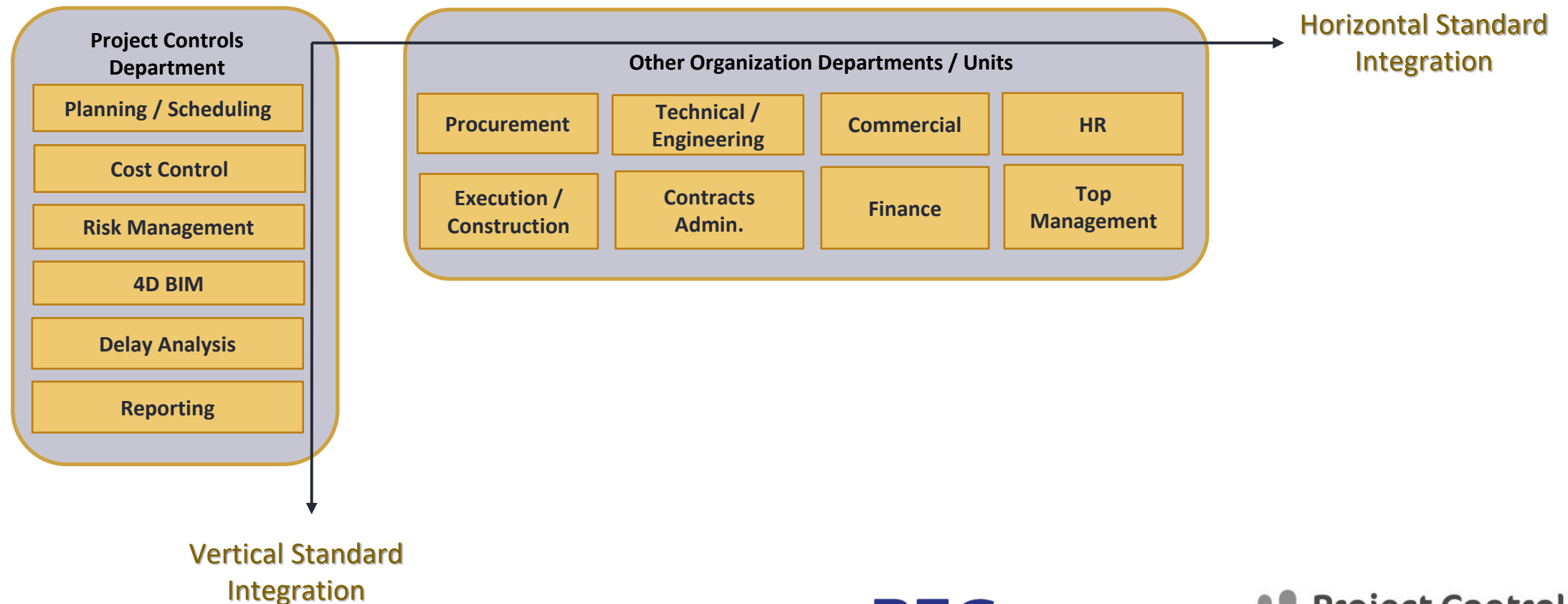
## 2. The Proposed Project Controls Model

# The Proposed Project Controls Model

The Proposed Project Controls Model Considers Standard Integration of Project Controls Processes in **2** Dimensions:

- **Horizontal** Standard Integration (between project controls dep. & other dep.)
- **Vertical** Standard Integration (in the project control dep.)

# The Proposed Project Controls Model



# 3. Horizontal Standard Integration

# Horizontal Standard Integration

Horizontal Standard Integration (Between Project Control Dep. & other Dep.)

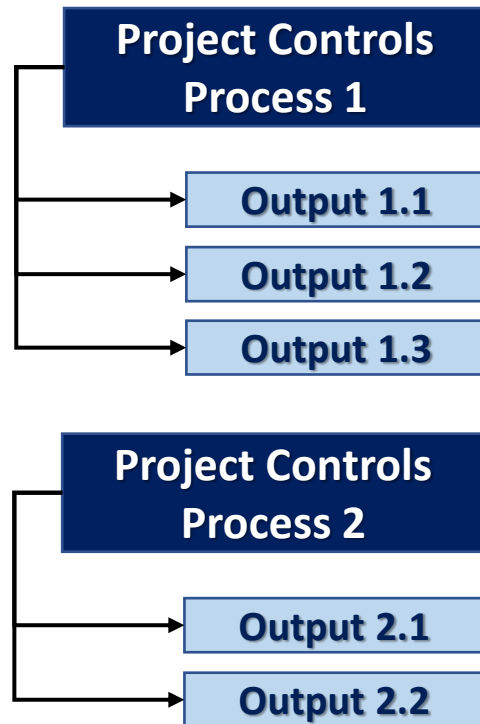
- Defining the Project Controls Departments Outputs
- Defining Other Departments Requirements
- Mapping the Project Controls Processes & Outputs with the Other Departments Requirements

*This ensures effective & smooth flow of tasks, processes, & outputs between departments & improves productivity*



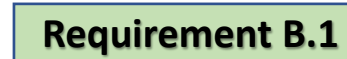
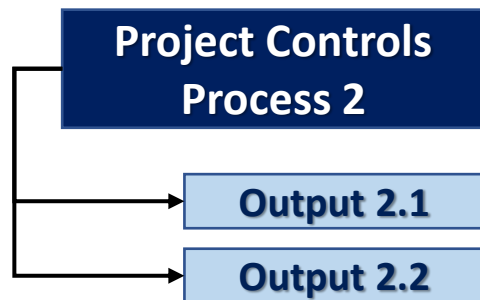
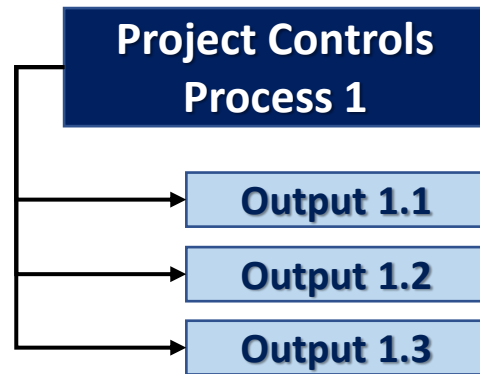
# Horizontal Standard Integration

*Define project Controls Processes & Outputs*



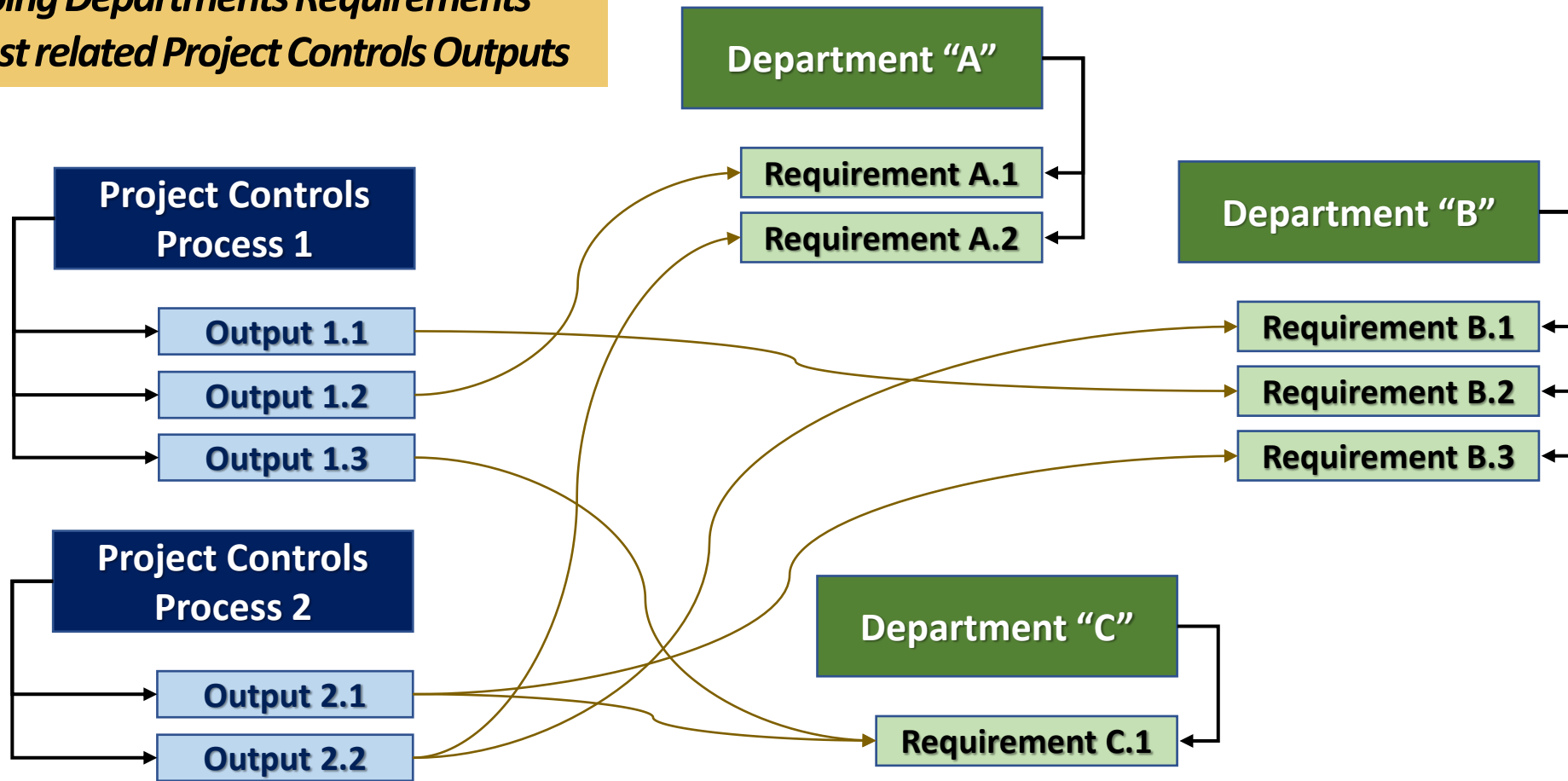
# Horizontal Standard Integration

## Define Departments Requirements



# Horizontal Standard Integration

*Mapping Departments Requirements against related Project Controls Outputs*



# Horizontal Standard Integration

## Develop Schedule Baseline

Activity D	Activity Name	Original Duration	Start	Finish
Residences		250	14-Mar-18	07-Jan-19
PHASE A		250	14-Mar-18	07-Jan-19
Zone 01		250	14-Mar-18	07-Jan-19
Civill Works		250	14-Mar-18	07-Jan-19
Substructure & Basement		76	14-Mar-18	10-Jun-18
Zone 1-1		87	11-Jun-18	27-Sep-18
Ground Floor		76	11-Jun-18	13-Sep-18
Z011.GNRL.GF.03.1075	RC Column Works	15	11-Jun-18	30-Jun-18
Z011.GNRL.GF.03.1085	Concrete Slab Works	24	01-Jul-18	28-Jul-18
Z011.GNRL.GF.02.1020	Backfilling below Slab on Grade	8	20-Aug-18	02-Sep-18
Z011.GNRL.GF.03.1070	RC slab on grade works	10	03-Sep-18	13-Sep-18
First Floor		39	29-Jul-18	16-Sep-18
Z011.GNRL.FF.03.1075	RC Column Works	15	29-Jul-18	14-Aug-18
Z011.GNRL.FF.03.1085	Concrete Slab Works	24	15-Aug-18	16-Sep-18
Roof Floor		9	17-Sep-18	27-Sep-18
Z011.GNRL.RF.03.1075	RC Column Works	4	17-Sep-18	20-Sep-18
Z011.GNRL.RF.03.1085	Concrete Slab Works	5	22-Sep-18	27-Sep-18
Zone 1-2		87	29-Sep-18	07-Jan-19
Ground Floor		76	29-Sep-18	25-Dec-18
Z012.GNRL.GF.03.1075	RC Column Works	15	29-Sep-18	15-Oct-18
Z012.GNRL.GF.03.1085	Concrete Slab Works	24	16-Oct-18	12-Nov-18
Z012.GNRL.GF.02.1020	Backfilling below Slab on Grade	8	05-Dec-18	13-Dec-18
Z012.GNRL.GF.03.1070	RC slab on grade works	10	15-Dec-18	25-Dec-18

## Execution / Construction Dep.

**Sequence of Works**

**Critical Activities / Paths**

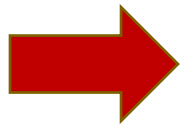
**Work Phasing Strategies**

**Resources Requirements & utilization**

# Horizontal Standard Integration

## Develop Schedule Baseline

Activity D	Activity Name	Original Duration	Start	Finish
Residences		250	14-Mar-18	07-Jan-19
PHASE A		250	14-Mar-18	07-Jan-19
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## Procurement Dep.

Procurement	19-Feb-23	23-Feb-25
Prequalification Submittals & Approvals	19-Feb-23	11-Jun-24
Civil	19-Feb-23	26-Aug-23
Concrete	19-Feb-23	05-Mar-23
Block Works	19-Jul-23	05-Aug-23
Cement Plaster	08-Aug-23	26-Aug-23
Precast Wall Cladding	20-May-23	06-Jun-23
Pre-Qualification of Precast Wall Cladding- Approval	27-May-23	06-Jun-23
Pre-Qualification of Precast Wall Cladding- Submittal	20-May-23	25-May-23
Steel Structure Works For Buildings / Perglas / Canopies	19-Jun-23	10-Jul-23
Substructure Water proofing	19-Feb-23	07-Mar-23
Waterproofing ( Wet Area - Roofing System )	19-Jul-23	06-Aug-23
Arch	19-Jun-23	11-Jun-24
MEP	01-Mar-23	21-Feb-24
External Works	16-Jul-23	04-Nov-23
Material Submittals & Approvals	06-Mar-23	04-Jul-24
Placing Order	21-Mar-23	11-Jul-24
Manufacturing and Delivery of Materials	22-Mar-23	23-Feb-25

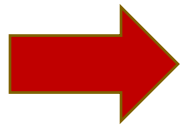
Procurement Plan

# Horizontal Standard Integration

## Develop Schedule Baseline

## HR Dep.

Activity D	Activity Name	Original Duration	Start	Finish
Residences		250	14-Mar-18	07-Jan-19
PHASE A		250	14-Mar-18	07-Jan-19
Zone 01		250	14-Mar-18	07-Jan-19
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Resource	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24
Rgh Carp.			27	45	49	98	104	89	96	97	113	99	106	100	84	45	34	20
Steel Fixer			13	26	28	72	80	71	82	88	102	79	90	102	72	50	36	21
Labor/Helper	5	6	67	123	131	234	257	210	238	427	789	1068	1047	1086	1013	1108	991	1116
Eq. Operator		5	10	18	17	19	27	15	10	56	56	54	31	43	56	20	59	
Block Mason										29	47	28	44	43	48	60	34	46
Finishing Carpenter												37	57	32	50	73	37	73
Aluminum Installer											3	16	13	12	14	17	19	19
Tiler											26	56	32	49	43	40	56	42
Granite Setter											2	9	10	9	8	24	12	20
Carpet Setter																0	0	2
Painter											49	155	133	149	152	118	167	177
HVAC Technician									1	2	3	5	7	12	8	9	10	10
Electrician						2	5	5	6	12	41	58	72	97	71	94	90	96
Precast Installer									3	42	40	27	42	24	35	44	15	46
Metals Skilled labor											0	7	8	4	8	10	9	13
Insulation worker												0	0	0	0	0	0	0
Steel Structure Installer											2	5	73	3	8	252	5	65
False Ceiling Installer											27	110	63	78	90	52	109	124
Plumber					4	5	6	6	12	14	31	48	34	47	38	45	44	58
Plasterer										50	177	127	136	181	103	144	165	120
Equipment Installer											2	17	20	15	20	18	13	23
Fire Fighting Technician									2	5	7	11	10	10	13	13	10	15
Duct-man									8	13	21	28	22	29	27	33	25	29
Concrete Mason			3	4	5	9	10	8	9	9	27	42	25	44	36	35	38	29
<b>Total</b>	<b>5</b>	<b>11</b>	<b>120</b>	<b>216</b>	<b>234</b>	<b>439</b>	<b>489</b>	<b>404</b>	<b>467</b>	<b>844</b>	<b>1565</b>	<b>2086</b>	<b>2098</b>	<b>2157</b>	<b>1984</b>	<b>2340</b>	<b>1939</b>	<b>2223</b>

Manpower Requirements by Trade & by Time Interval

# Horizontal Standard Integration

Project Controls Processes	Execution / Construction Dep.	Finance Department	Procurement Department	Engineering Department	Contracts Department	Commercial Department	HR Department	Top Management
<b>Develop Schedule Baseline</b>	Activities Sequence Works Phasing Strategies Resource Requirements & Utilization Critical Activities	Planned Cash-in Distribution After Applying Payment Terms	Procurement Plan	Engineering Plan	Baseline schedule as a Base for Progress Measurement and Delay Analysis	Planned Cash-in Distribution After Applying Payment Terms	Manpower Histogram by Trade	Milestone Schedule Critical Requirements
<b>Develop Cost Baseline</b>	Budget limits (Manpower-Equipment)	Planned Cash-out distribution	Budget limits (Materials)	Budget Limits (Service Providers)	Budget limits (Sub-Contracts)	Budget Limits (Service Providers)	Budget Limits (Hiring)	Cash-flow Structured Budget
<b>Monitoring &amp; Controlling</b>	KPIs Variance Analysis Productivity measures Revised budget limits	Revised Cash-flow based on current status	KPIs Variance Analysis Revised budget limits	KPIs Variance Analysis Revised budget limits	Updated schedule as a Base for Delay Analysis Revised budget limits	Identifying gaps between EV & Invoices Revised budget limits	Revised Manpower Histogram Revised budget limits	KPIs Major Variances & Recommended Actions At Completion Values
<b>4D BIM Modeling</b>	Visualizing Construction Sequence Identifying Logistics Challenges				Visualizing impact of delay events	Evaluations of Variation Orders		Visualizing Construction Sequence 4D Status (Planned VS Actual)

# Horizontal Standard Integration

Project Controls Processes	Execution / Construction Dep.	Finance Department	Procurement Department	Engineering Department	Contracts Department	Commercial Department	HR Department	Top Management
Develop Schedule Baseline	<p>Activities Sequence</p> <p>Works Phasing Strategies</p> <p>Resource Requirements &amp; Utilization</p> <p>Critical Activities</p>	Planned Cash-in Distribution After Applying Payment Terms	Procurement Plan	Engineering Plan	Baseline schedule as a Base for Progress Measurement and Delay Analysis	Planned Cash-in Distribution After Applying Payment Terms	Manpower Histogram by Trade	<p>Milestone Schedule</p> <p>Critical Requirements</p>
Develop Cost Baseline	Budget limits (Manpower-Equipment)	Planned Cash-out distribution	Budget limits (Materials)	Budget Limits (Service Providers)	Budget limits (Sub-Contracts)	Budget Limits (Service Providers)	Budget Limits (Hiring)	<p>Cash-flow</p> <p>Structured Budget</p>
Monitoring & Controlling	<p>KPIs</p> <p>Variance Analysis</p> <p>Productivity measures</p> <p>Revised budget limits</p>	Revised Cash-flow based on current status	<p>KPIs</p> <p>Variance Analysis</p> <p>Revised budget limits</p>	<p>KPIs</p> <p>Variance Analysis</p> <p>Revised budget limits</p>	<p>Updated schedule as a Base for Delay Analysis</p> <p>Revised budget limits</p>	<p>Identifying gaps between EV &amp; Invoices</p> <p>Revised budget limits</p>	<p>Revised Manpower Histogram</p> <p>Revised budget limits</p>	<p>KPIs</p> <p>Major Variances &amp; Recommended Actions</p> <p>At Completion Values</p>
4D BIM Modeling	<p>Visualizing Construction Sequence</p> <p>Identifying Logistics Challenges</p>				Visualizing impact of delay events	Evaluations of Variation Orders		<p>Visualizing Construction Sequence</p> <p>4D Status (Planned VS Actual)</p>



# Horizontal Standard Integration

Project Controls Processes	Execution / Construction Dep.	Finance Department	Procurement Department	Engineering Department	Contracts Department	Commercial Department	HR Department	Top Management
Develop Schedule Baseline	Activities Sequence Works Phasing Strategies Resource Requirements & Utilization Critical Activities	Planned Cash-in Distribution After Applying Payment Terms	Procurement Plan	Engineering Plan	Baseline schedule as a Base for Progress Measurement and Delay Analysis	Planned Cash-in Distribution After Applying Payment Terms	Manpower Histogram by Trade	Milestone Schedule Critical Requirements
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# Horizontal Standard Integration

Project Controls Processes	Execution / Construction Dep.	Finance Department	Procurement Department	Engineering Department	Contracts Department	Commercial Department	HR Department	Top Management
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<b>4D BIM Modeling</b>	Visualizing Construction Sequence Identifying Logistics Challenges				Visualizing impact of delay events	Evaluations of Variation Orders		Visualizing Construction Sequence 4D Status (Planned VS Actual)

# 4. Vertical Standard Integration

# Vertical Standard Integration

## Vertical Standard Integration (Inside Project Control Dep.)

- In the same section / unit of Project Controls Department (Planning section)

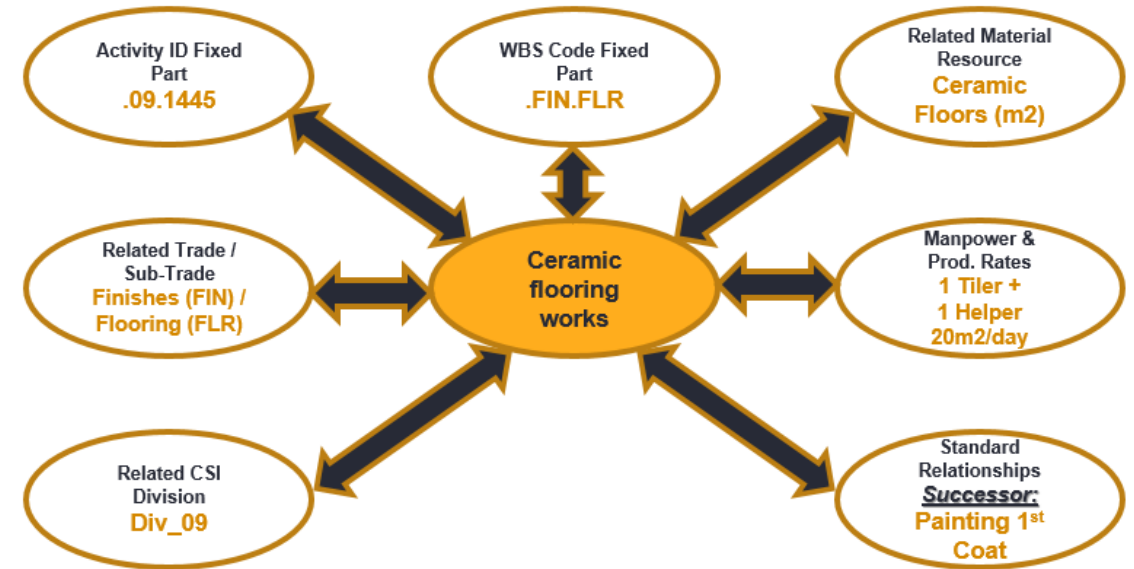
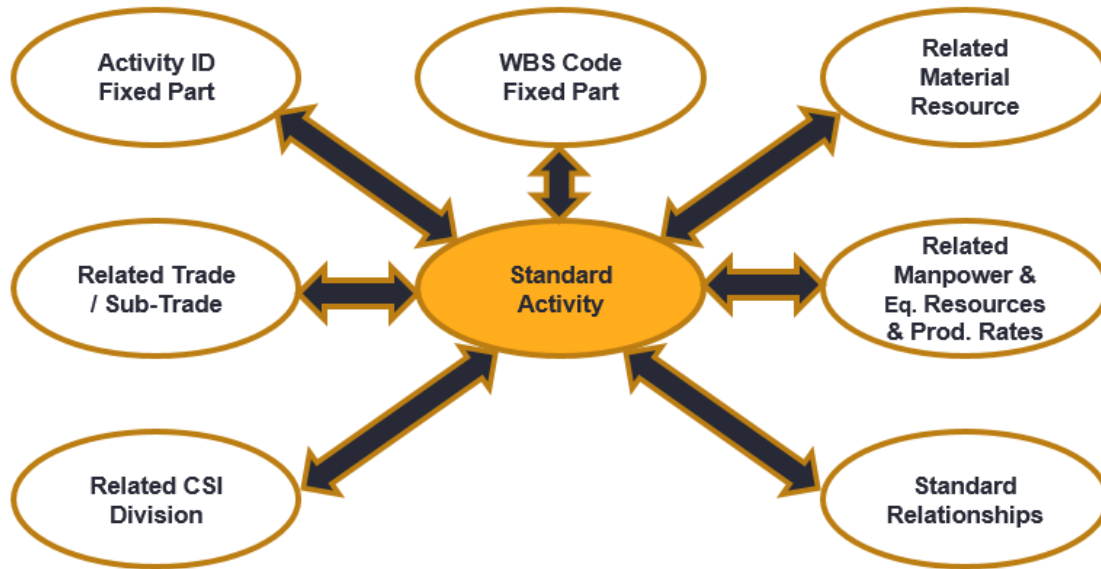
To standardize planning & scheduling processes such as schedule development

- Between sections / units of Project Controls Department (Planning & Cost Control , etc.)

To standardize criteria, workflows, etc. between the separate sections / units to improve the efficiency of project controls dep.

# Standardizing Schedule Development

## Standard Activity Dictionary



# Standardizing Schedule Development

## Standard Activity Dictionary

Standard Activity Codes to be assigned to Standard Activity Dictionary

Standrad Code (1)		Standard Code (2)	
Trade	Trade Code	Sub-Trade	Sub Trade Code
Substructure Civil Works	CIV		
Concrete	CON		
Finishes	FIN	Flooring	FLR
Finishes	FIN	Walls & Ceiling	WAL
Finishes	FIN	Wet Areas	WET
Building General Finishing Works	EXT		
Doors & Windows	DOR		
Furniture & Equipment	FUR		
Roofing System	ROS		
Roof Finishes	FIN		
Elevator	ELV		
Substructure MEP Works	MEP		
Mechanical	MEC	Drainage	DRA
Mechanical	MEC	Water Supply	WSU
Mechanical	MEC	Fire Fighting Works	FIR
Mechanical	MEC	HVAC Works	HVC
Electrical	ELE	First Fix Works	FX1
Electrical	ELE	Second Fix Works	FX2
Electrical	ELE	Third Fix Works	FX3

Standard Code (3)	
CSI Division	CSI Division Code
General Requirements	Div_01
Site Construction	Div_02
Concrete	Div_03
Masonry	Div_04
Metals	Div_05
Wood & Plastics	Div_06
Thermal & Moisture Protection	Div_07
Doors & Windows	Div_08
Finishes	Div_09
Specialities	Div_10
Equipment	Div_11
Furnishing	Div_12
Special Construction	Div_13
Conveying Systems	Div_14
Mechanical	Div_15
Electrical	Div_16

# Standardizing Schedule Development

## Standard Activity Dictionary

### Standard Resources Dictionary

### & Rates to be assigned to

### Standard Activity Dictionary

Manpower	
Resource Name	Res. ID
Labor/Helper	LBR
Eq. Operator	EQO
Rgh Carp.	RCP
Steel Fixer	STF
Concrete Mason	COM
Precast Installer	PRI

Equipment	
Resource Name	Res. ID
Excavator	EXV
Loader	LDR
Mini-Loader	MLD
Compactor	CMP
Truck	TRU
Grader	GRD

Material	
Resource Name	Res. ID
Excavation (m3)	EXC
Anti-Termite (m2)	ANT
Backfilling (m3)	BFL
Gravel (m2)	GRV
Interlock (m3)	INL
Plain Concrete (m3)	PLC

# Standardizing Schedule Development

## Standard Activity Dictionary

Activity Name & ID Structure				Activity Codes			Resources					
Div.	Activity Name	ID Serial	Activity ID Fixed Part	CSI Division Code	Trade	Trade Code	Reference Quantity (for calculation)	Unit	Labor/Helper	Eq. Operator	Rgh. Carp.	Steel Flier
02	Excavation Works	1000	02.1000	Div_02	Substructure Civil Works	CIV	300	m3	1	4.00		
02	Anti-Termite Works	1005	02.1005	Div_02	Substructure Civil Works	CIV	225	m2	1			
02	Structure backfilling under foundation level	1010	02.1010	Div_02	Substructure Civil Works	CIV	400	m3	1	4.00		
02	Backfilling around foundation & neck columns	1015	02.1015	Div_02	Substructure Civil Works	CIV	45	m3	1	2.00		
02	Backfilling around grade beams	1020	02.1020	Div_02	Substructure Civil Works	CIV	45	m3	1	2.00		
02	Gravel layer works	1025	02.1025	Div_02	Substructure Civil Works	CIV	200	m2	1			
02	Interlock Concrete Pavers	1030	02.1030	Div_02	Building General Finishing Works	EXT	52	m2	1			
02	Agricultural Soil Works	1035	02.1035	Div_02	Building General Finishing Works	EXT	25	m3	1			
03	Plain Concrete Works	1040	03.1040	Div_03	Substructure Civil Works	CIV	7	m3	1		1.00	
03	RC Foundation Works	1045	03.1045	Div_03	Substructure Civil Works	CIV	3.00	m3	2		1.00	1.00
03	RC Raft Foundation Works	1050	03.1050	Div_03	Substructure Civil Works	CIV	40.00	m3	4		1.00	8.00

Standard Name & ID Structure

Standard Coding

Standard Rates & Resource Allocation



# Standardizing Schedule Development

## Standard Activity Dictionary

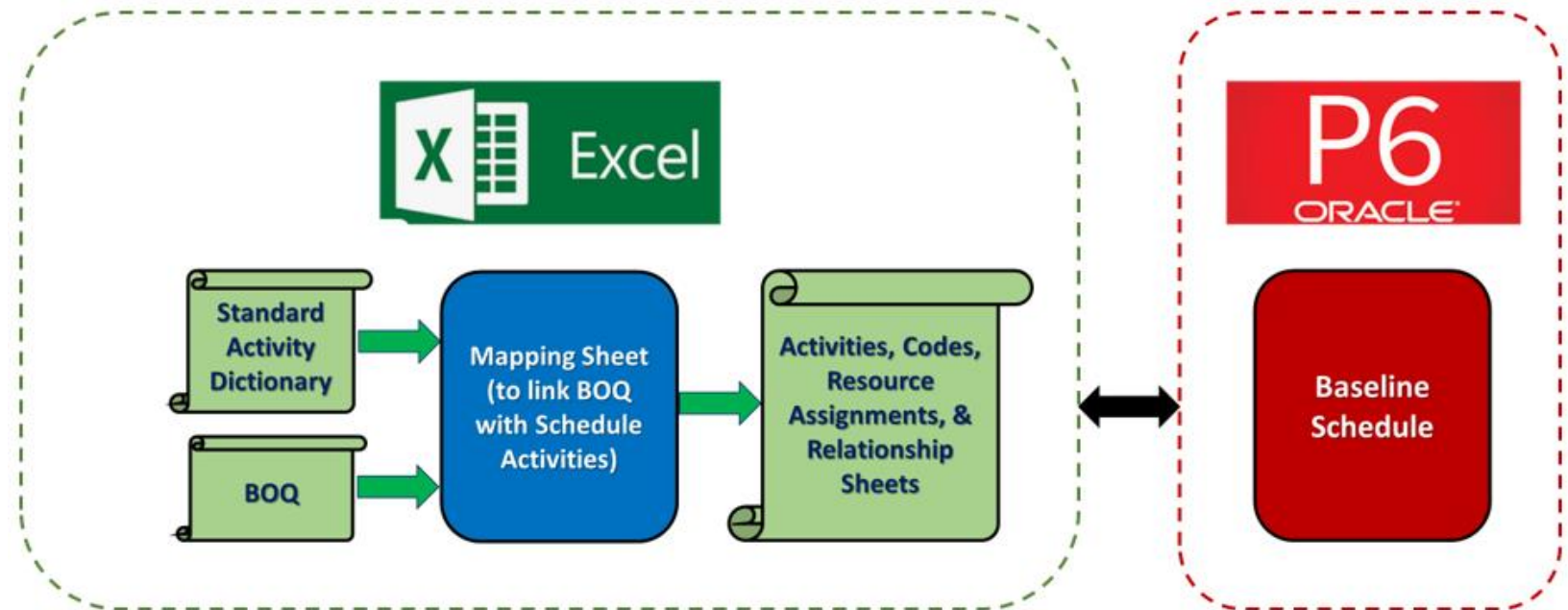
The benefits of having a Standard Activity Dictionary include:

- Reducing time & effort needed to develop the schedule
- Automating the schedule development & reduce errors
- Having standard Activity ID structure for same activity in different zones, locations
- Having standard naming of activities (no typos)
- Working easily on Enterprise level (several projects)
- Easiness of modifications and adjustments when needed
- Easiness of filtering and reporting

# Standardizing Schedule Development

## Mapping Schedule Activities with BOQ items

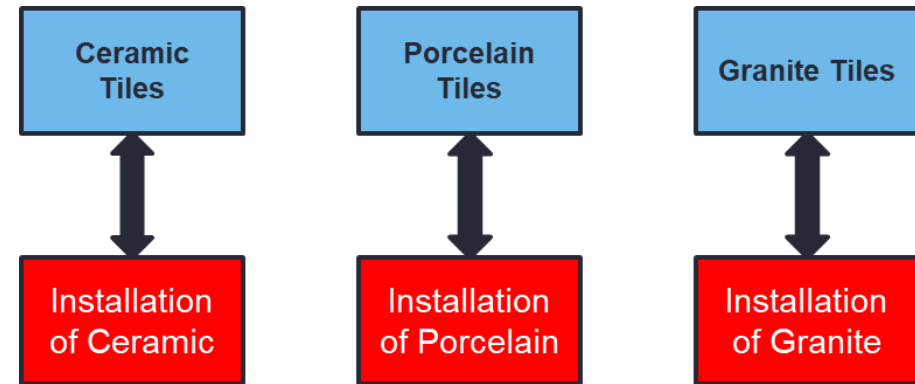
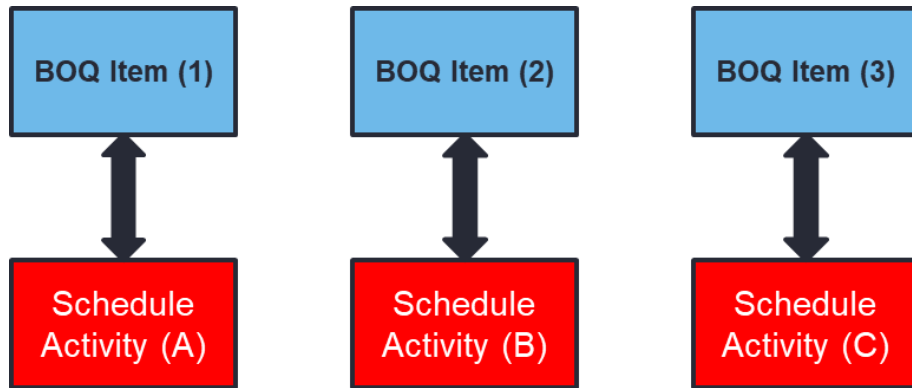
Creating Mapping sheets is concerned with the development of excel sheets which link the BOQ items with the schedule activities



# Standardizing Schedule Development

## Relationships between Schedule Activities & BOQ Items

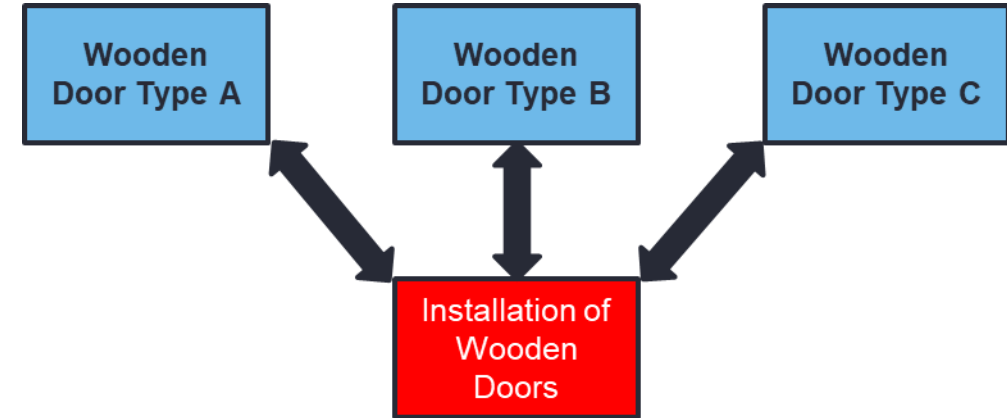
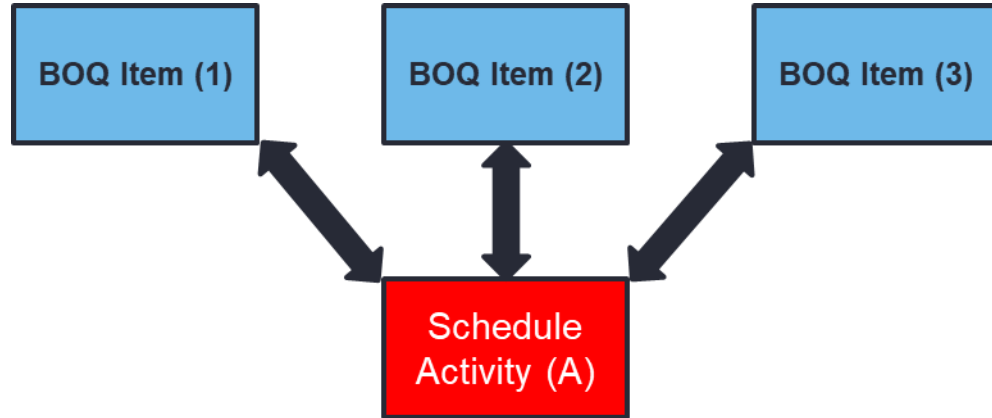
### One to One



# Standardizing Schedule Development

## Relationships between Schedule Activities & BOQ Items

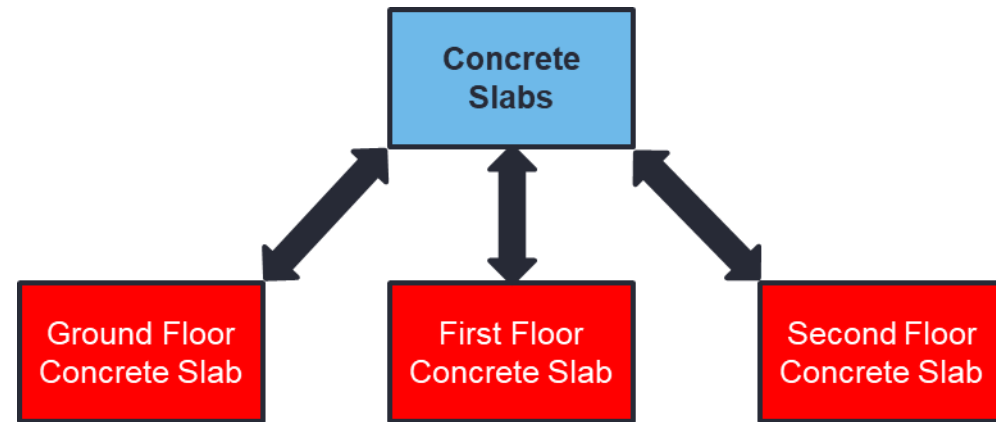
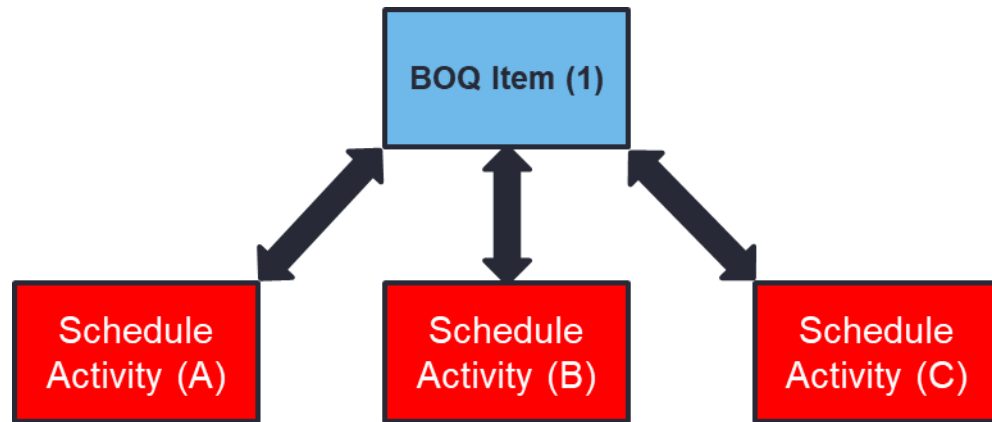
### One to Many



# Standardizing Schedule Development

## Relationships between Schedule Activities & BOQ Items

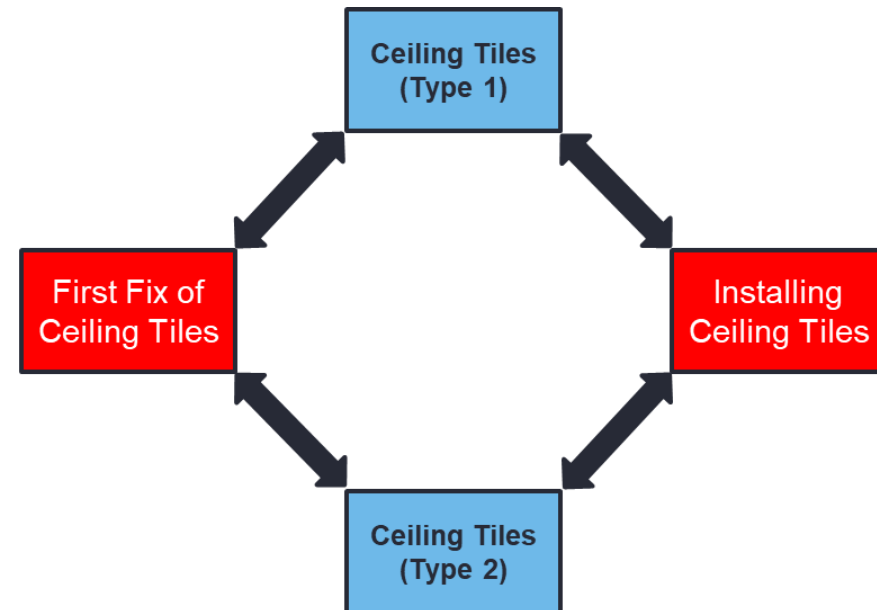
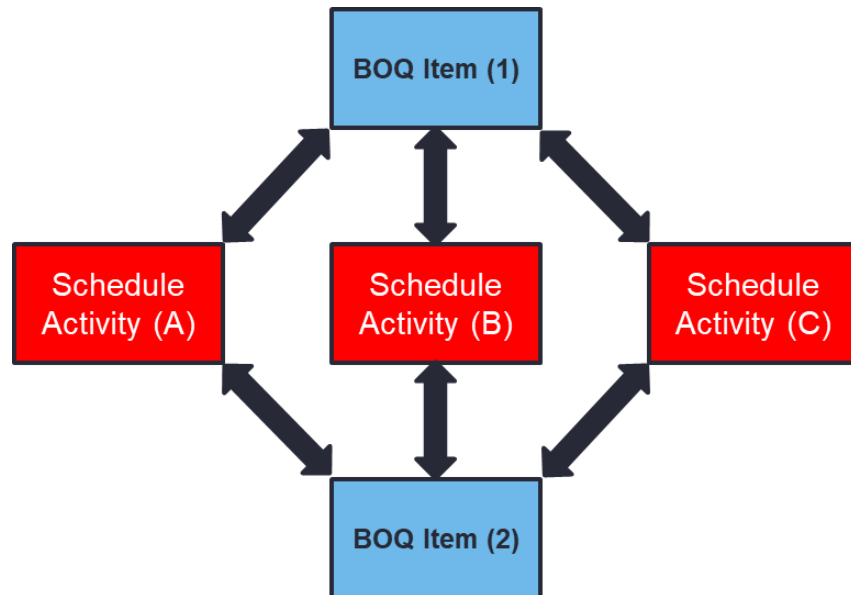
### Many to One



# Standardizing Schedule Development

## Relationships between Schedule Activities & BOQ Items

### Many to Many



# Standardizing Schedule Development

## Mapping Sheet

Item Description	Unit	Quantity	Unit Rate	Price	Division	Building Code	Floor Level	Activity ID	WBS Code	Activity Name	Q Weight	Cost Weight	Activity Quantity	Activity Cost	Labor/Helper	Eq. Operator	Rgn. Carp.	Steel Fixer
أعمال الحفر والردم للأساسات. أعمال الحفر: الحفر في جميع أنواع التربة بما في ذلك الطبقات الصخرية والصلبة من منسوب سطح الأرض الطعمية حتى منسوب التأسيس ويشتمل على دعابات الأضلاع الترابية المؤقتة وزحج المياه وأي أعمال تحت منسوب المياه الأرضية ومعالجة منسوب التأسيس حسب توصيات تقرير التربة والمخططات كما يتحمل كل مواد الحفر خارج الموقع للترديد المعتمدة طبقاً لتعليمات المهندس المشرف.	3م	495	16	7920	DIV_02	B01	SS	B01SS.02.1000	P01B01SS.CIV	Excavation Works	100%	100%	495	7,920	13.20	52.80		
أعمال الردم: الردم بكرة معتمدة تم اختيارها من مواد تواج الحفر وأل تم توريدها من خارج الموقع حسب توصيات الترخيص ثرية الموقع وتخصيص الموافقة المهندس وذلك لتعويض المناسيب الساق وحول الأساسات وأعمال طبقات الأرضية على طبقات معتمدة أعمال الدك والأحجار لكل طبقة وما شابه ذلك من أعمال وذلك طبقاً للتوصيات الفنية.	3م	529	23	12167	DIV_02	B01	SS	B01SS.02.1015	P01B01SS.CIV	Backfilling around foundation & neck column	100%	100%	529	12,167	94.04	188.09		

BOQ Data

Activity ID, Name, WBS Code, Activity Codes

Cost & Quantity

Manpower & Equipment

# Standardizing Schedule Development

## Mapping Schedule Activities with BOQ items

### The benefits of having mapping sheets:

- Realistic representation of scope of work (ensure that all activities are within the project scope)
- Accurate allocation and assignment of cost and quantities (cost and quantity are assigned to the activity considering defined weights)
- Accurate manpower and equipment assignment (the quantity assigned to the activity is used to calculate the required man-hours for execution when integrated with the standard productivity rates)



# Standardizing Schedule Development

## Mapping Schedule Activities with BOQ items

### The benefits of having mapping sheets (Cont.):

- Easy and auto adjustments and modifications to the schedule parameters (when the quantities or the rates are revised, the related assignments are modified)
- Integration with cost control & invoices (by rolling up data to BOQ level or control level, CPI can be calculated and also the unbilled amounts can be defined)
- Dealing with large amount of data / activities easily and in systematic manner (following specific procedures and clear sheets)

# Standardizing Schedule Development

## Generated files for P6 Import

### Activities & Codes

Act ID	Activity Name	WBS Code	Original Duration	Division	Building	Floor	Trade	Sub-trade
B01.SS.02.1000	Excavation Works	P01.B01.SS.CIV	8	DIV_02	B01	SS	CIV	
B01.SS.02.1015	Backfilling around foundation & neck columns	P01.B01.SS.CIV	12	DIV_02	B01	SS	CIV	
B01.SS.02.1025	Gravel layer works	P01.B01.SS.CIV	2	DIV_02	B01	SS	CIV	
B01.SS.02.1005	Anti-Termite Works	P01.B01.SS.CIV	1	DIV_02	B01	SS	CIV	
B01.SS.03.1040	Plain Concrete Works	P01.B01.SS.CIV	8	DIV_03	B01	SS	CIV	
B01.SS.03.1065	PC under slab on grade	P01.B01.SS.CIV	4	DIV_03	B01	SS	CIV	
B01.SS.03.1045	RC Foundation Works	P01.B01.SS.CIV	16	DIV_03	B01	SS	CIV	
B01.SS.03.1060	Grade Beams Works	P01.B01.SS.CIV	12	DIV_03	B01	SS	CIV	
B01.SS.03.1055	RC Column Necks & Walls	P01.B01.SS.CIV	12	DIV_03	B01	SS	CIV	
B01.GF.03.1075	RC Column Works	P01.B01.GF.CON	16	DIV_03	B01	GF	CON	
B01.FF.03.1075	RC Column Works	P01.B01.FF.CON	16	DIV_03	B01	FF	CON	
B01.RF.03.1075	RC Column Works	P01.B01.RF.CON	16	DIV_03	B01	RF	CON	
B01.SS.03.1160	RC of Entrance Stair	P01.B01.SS.CIV	6	DIV_03	B01	SS	CIV	
B01.SS.03.1070	RC slab on grade works	P01.B01.SS.CIV	12	DIV_03	B01	SS	CIV	
B01.GF.03.1085	Concrete Slab Works	P01.B01.GF.CON	20	DIV_03	B01	GF	CON	
B01.FF.03.1085	Concrete Slab Works	P01.B01.FF.CON	20	DIV_03	B01	FF	CON	
B01.RF.03.1085	Concrete Slab Works	P01.B01.RF.CON	20	DIV_03	B01	RF	CON	
B01.GF.03.1155	Lintels Works (precast)	P01.B01.GF.FIN.WAL	4	DIV_03	B01	GF	FIN	WAL
B01.FF.03.1155	Lintels Works (precast)	P01.B01.FF.FIN.WAL	4	DIV_03	B01	FF	FIN	WAL

### Resource Assignment

Act ID	Resource ID	Budgeted Unit
B01.SS.02.1000	LBR	13.20
B01.SS.02.1000	EQO	52.80
B01.SS.02.1000	EXV	13.20
B01.SS.02.1000	LDR	13.20
B01.SS.02.1000	TRU	26.40
B01.SS.02.1015	LBR	94.04
B01.SS.02.1015	EQO	188.09
B01.SS.02.1015	MLD	94.04
B01.SS.02.1015	TRU	94.04
B01.SS.02.1025	LBR	36.80
B01.SS.02.1005	LBR	38.44
B01.SS.03.1040	LBR	46.86
B01.SS.03.1040	RCP	46.86
B01.SS.03.1040	COM	4.69

### Relationships

Pred ID (Stt)	Pred Name	Succ ID (Stt)	Succ Name	Rel Typ	Lag	Pred ID	Succ ID	Pred Check	Succ Check
02.1000	Excavation Works	02.1005	Anti-Termite Works	FS	0	B01.SS.02.1000	B01.SS.02.1005	B01.SS.02.1000	B01.SS.02.1005
02.1015	Backfilling around foundation & neck columns	03.1060	Grade Beams Works	FS	0	B01.SS.02.1015	B01.SS.03.1060	B01.SS.02.1015	B01.SS.03.1060
02.1025	Gravel layer works	07.1305	Polyethylene Sheets Works below slab on grade	FS	0	B01.SS.02.1025	B01.SS.07.1305	B01.SS.02.1025	B01.SS.07.1305
03.1040	Plain Concrete Works	03.1045	RC Footing Works	FS	0	B01.SS.03.1040	B01.SS.03.1045	B01.SS.03.1040	B01.SS.03.1045
03.1045	RC Footing Works	03.1055	RC Column Necks & Walls	FS	0	B01.SS.03.1045	B01.SS.03.1055	B01.SS.03.1045	B01.SS.03.1055
03.1055	RC Column Necks & Walls	07.1310	Waterproofing for foundations & column necks	FS	0	B01.SS.03.1055	B01.SS.07.1310	B01.SS.03.1055	B01.SS.07.1310
03.1055	RC Column Necks & Walls	16.2220	Earthing system-cables from RC elements to outside building	SS	2	B01.SS.03.1055	B01.SS.16.2220	B01.SS.03.1055	B01.SS.16.2220
03.1060	Grade Beams Works	15.1705	MEP Sleeves in Grade Beams	SS	2	B01.SS.03.1060	B01.SS.15.1705	B01.SS.03.1060	B01.SS.15.1705
03.1065	PC under slab on grade	03.1070	RC slab on grade works	FS	0	B01.SS.03.1065	B01.SS.03.1070	B01.SS.03.1065	B01.SS.03.1070
07.1310	Polyethylene Sheets Works below slab on grade	03.1065	PC under slab on grade	FS	0	B01.SS.07.1310	B01.SS.03.1065	B01.SS.07.1310	B01.SS.03.1065
07.1310	Waterproofing for foundations & column necks	02.1015	Backfilling around foundation & neck columns	FS	0	B01.SS.07.1310	B01.SS.02.1015	B01.SS.07.1310	B01.SS.02.1015
16.2220	Earthing system-cables from RC elements to outside building	07.1310	Waterproofing for foundations & column necks	FS	0	B01.SS.16.2220	B01.SS.07.1310	B01.SS.16.2220	B01.SS.07.1310
02.1005	Anti-Termite Works	03.1040	Plain Concrete Works	FS	0	B01.SS.02.1005	B01.SS.03.1040	B01.SS.02.1005	B01.SS.03.1040
03.1060	Grade Beams Works	15.1715	MEP works under slab on Grade	FS	0	B01.SS.03.1060	B01.SS.15.1715	B01.SS.03.1060	B01.SS.15.1715
15.1715	MEP works under slab on Grade	02.1025	Gravel layer works	FS	0	B01.SS.15.1715	B01.SS.02.1025	B01.SS.15.1715	B01.SS.02.1025
03.1070	RC slab on grade works	03.1160	RC of Entrance Stair	FS	0	B01.SS.03.1070	B01.SS.03.1160	B01.SS.03.1070	B01.SS.03.1160
15.1705	MEP Sleeves in Grade Beams	15.1715	MEP works under slab on Grade	FS	0	B01.SS.15.1705	B01.SS.15.1715	B01.SS.15.1705	B01.SS.15.1715
03.1075	RC Column Works	03.1085	Concrete Slab Works	FS	0	B01.GF.03.1075	B01.GF.03.1085	B01.GF.03.1075	B01.GF.03.1085

# Standardizing Schedule Development

## Resource Loaded Schedule Assigned with Codes

Projects Activities

Layout: Classic Schedule Layout Filter: All Activities

Activity ID	Activity Name	Original Duration	Start	Finish	Budgeted Total Cost	CSI Division	Building	Floor	Trade
<b>P01</b>		370	06-Nov-20	10-Nov-21	\$3,579,473.00				
<b>B01</b>		370	06-Nov-20	10-Nov-21	\$3,579,473.00				
<b>Sub-Structure</b>		109	06-Nov-20	22-Feb-21	\$572,628.00				
<b>Substructure Civil Works</b>		109	06-Nov-20	22-Feb-21	\$553,130.00				
B01.SS.02.1000	Excavation Works	8	06-Nov-20	13-Nov-20	\$7,920.00	DIV_02	B01	SS	CIV
B01.SS.02.1005	Anti-Termite Works	1	14-Nov-20	14-Nov-20	\$10,810.00	DIV_02	B01	SS	CIV
B01.SS.03.1040	Plain Concrete Works	8	15-Nov-20	22-Nov-20	\$19,844.00	DIV_03	B01	SS	CIV
B01.SS.03.1045	RC Foundation Works	16	23-Nov-20	08-Dec-20	\$198,720.00	DIV_03	B01	SS	CIV
B01.SS.03.1055	RC Column Necks & Walls	12	09-Dec-20	20-Dec-20	\$14,264.00	DIV_03	B01	SS	CIV
B01.SS.07.1310	Waterproofing for foundations & column necks	4	21-Dec-20	24-Dec-20	\$23,120.00	DIV_07	B01	SS	CIV
B01.SS.02.1015	Backfilling around foundation & neck columns	12	25-Dec-20	05-Jan-21	\$12,167.00	DIV_02	B01	SS	CIV
B01.SS.03.1060	Grade Beams Works	12	06-Jan-21	17-Jan-21	\$82,018.00	DIV_03	B01	SS	CIV
B01.SS.02.1025	Gravel layer works	2	26-Jan-21	27-Jan-21	\$11,960.00	DIV_02	B01	SS	CIV
B01.SS.07.1305	Polyethelene Sheets Works below slab on grade	4	28-Jan-21	31-Jan-21	\$9,200.00	DIV_07	B01	SS	CIV
B01.SS.03.1065	PC under slab on grade	4	01-Feb-21	04-Feb-21	\$22,264.00	DIV_03	B01	SS	CIV
B01.SS.03.1070	RC slab on grade works	12	05-Feb-21	16-Feb-21	\$131,928.00	DIV_03	B01	SS	CIV

2021

Nov Dec Jan Feb Mar Apr May Jun Jul A

22-Feb-21, Sub-Structure

22-Feb-21, Substructure Civil Works

- Excavation Works
- Anti-Termite Works
- Plain Concrete Works
- RC Foundation Works
- RC Column Necks & Walls
- Waterproofing for foundations & column necks
- Backfilling around foundation & neck columns
- Grade Beams Works
- Gravel layer works
- Polyethelene Sheets Works below slab on grade
- PC under slab on grade
- RC slab on grade works

General Status Resources Codes Relationships Notebook Steps Feedback WPs & Docs Risks Expenses Summary

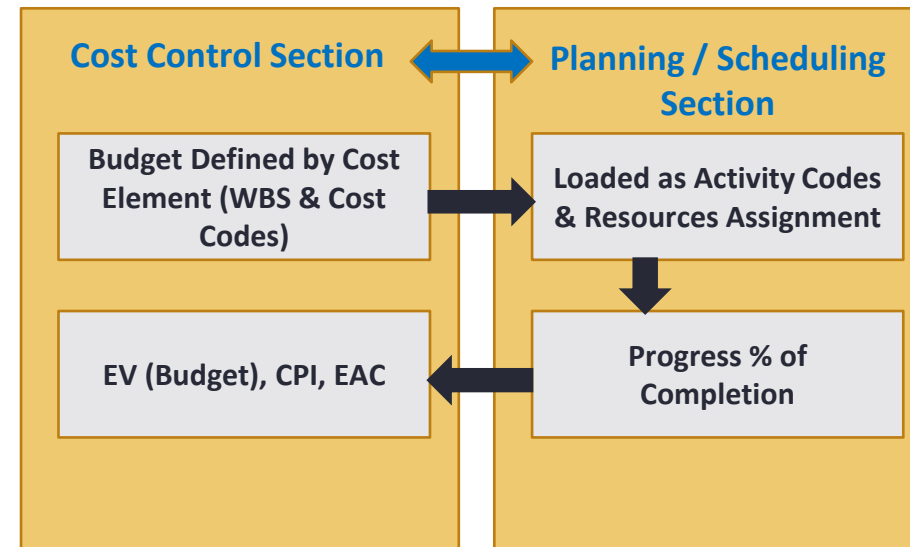
Activity B01.SS.03.1045 RC Foundation Works

Resource ID Name	Resource Name	Resource Type	Budgeted Units
LBR.Labor/Helper	Labor/Helper	Labor	640
RCP.Rgh Carp.	Rgh Carp.	Labor	320
STF.Steel Fixer	Steel Fixer	Labor	320
COM.Concrete Mason	Concrete Mason	Labor	32
PRE.PRICE	PRICE	Material	198720
RC1.Reinforced Concrete (m3)	Reinforced Concrete (m3)	Material	120

# Vertical Standard Integration

## Between Planning & Cost Control Sections / Units

This ensures having accurate reporting & calculations of Earned Value, Cost Performance Index, & Estimate At Completion



Defining the Common Level of Control

# Vertical Standard Integration

## Between Planning & Cost Control Sections / Units

- Use Activity Codes when the relation between the cost elements and the schedule activities is one to one
- Use Resource Assignments when the relation between the cost elements and the schedule activities is many to one

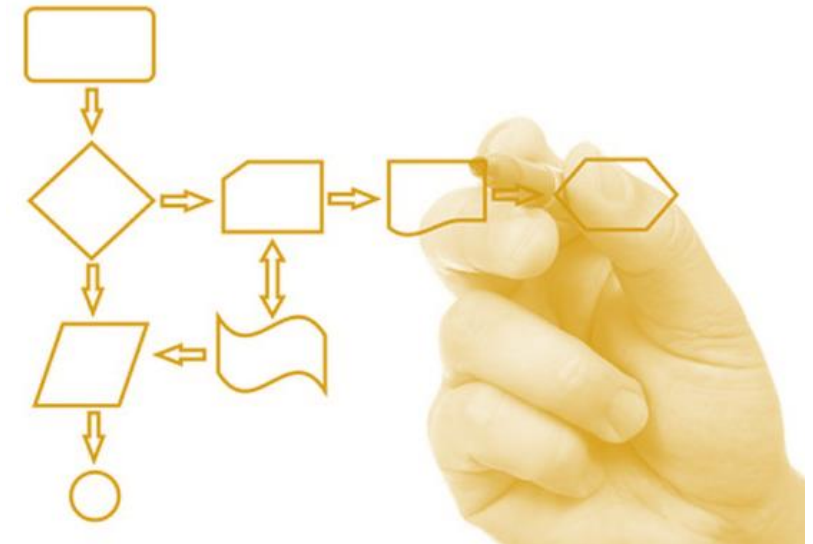
Layout: Activity Resource Assignments				Display			
Activity ID	Activity Name	Budgeted Cost	Earned Value	Remaining Early Cost	2016		
					Nov	Dec	Jan
<b>Total</b>		166,213,663	8,373,369		3,172,252	2,989,119	4,889,210
<b>Site 029</b>		10,136,094	1,343,603		233,650	341,876	704,656
<b>Division 02</b>		1,607,012	884,386		6,187	6,541	296
Division 02 - Materials		199,016	65			4,135	
Division 02 - LABOUR		42,053	0			827	
Division 02 - SERVICES		1,345,953	884,321		6,187	1,579	296
Division 02 - MISCELLANEOUS		19,990	0				
<b>Division 03</b>		1,385,555	431,773		212,583	113,558	36,483
Division 03 - Materials		1,138,723	348,246		169,803	89,288	13,726
Division 03 - LABOUR		180,470	78,871		41,148	14,294	3,322
Division 03 - SERVICES		38,950	0			8,929	19,282
Division 03 - MISCELLANEOUS		27,413	4,657		1,632	1,048	152
<b>Division 04</b>		220,871	0			169,541	37,179
Division 04 - Materials		130,055	0			100,397	22,011
Division 04 - LABOUR		52,976	0			40,334	8,848
Division 04 - MISCELLANEOUS		37,840	0			28,810	6,320
<b>Division 05</b>		85,283	0				709
Division 05 - SERVICES		85,283	0				709
<b>Division 06</b>		1,479	0				
Division 06 - SERVICES		1,479	0				
<b>Division 07</b>		129,117	8,460		222	31,512	60,149
Division 07 - Materials		36,092	4,794		126	126	23,146
Division 07 - LABOUR		3,643	2,256		59	59	806
Division 07 - SERVICES		76,916	0			31,290	28,012
Division 07 - MISCELLANEOUS		12,466	1,410		37	37	8,185

# 5. Standard Operating Procedures (SOPs)

# Standard Operating Procedures (SOPs)

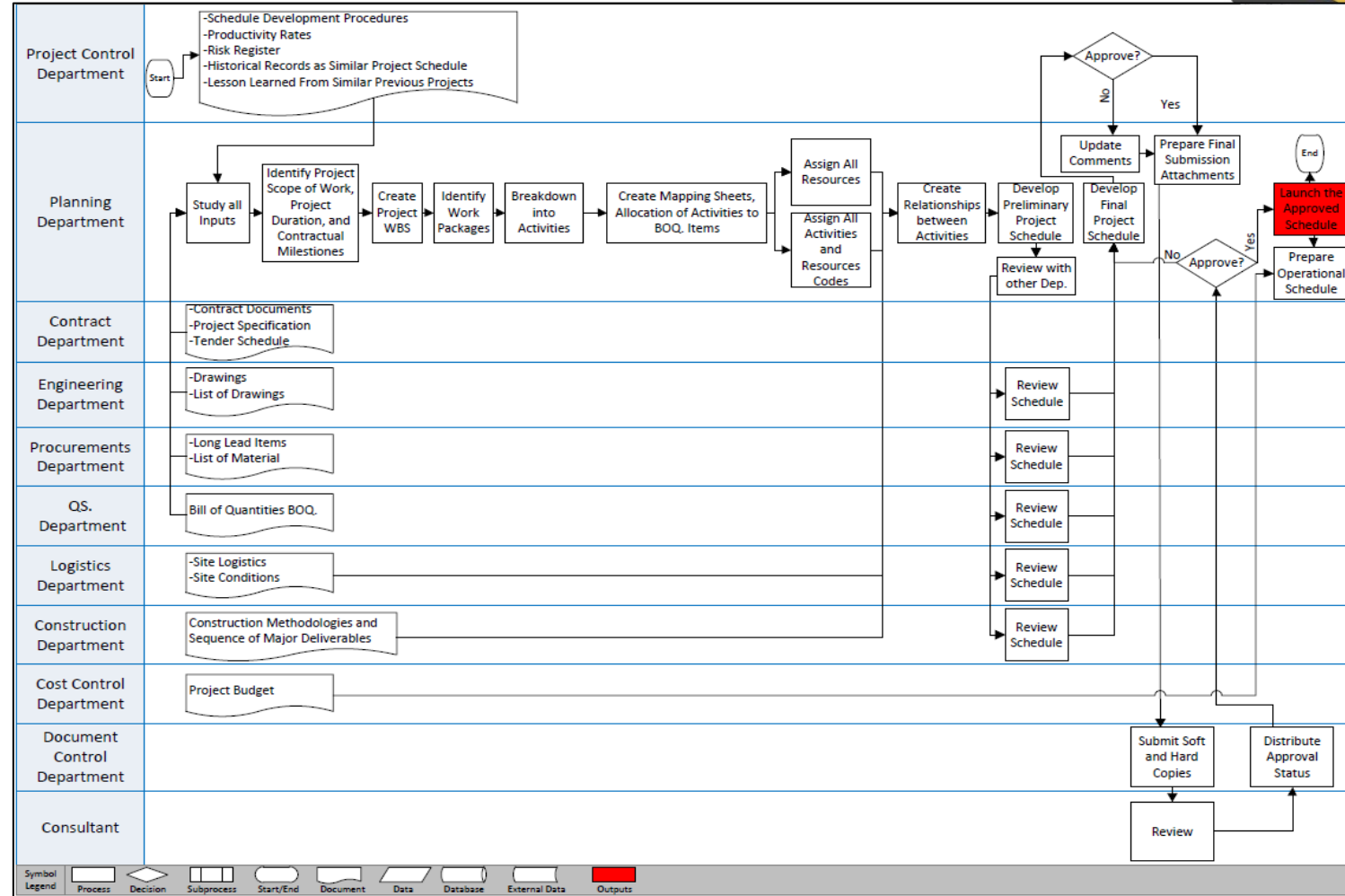
## Definition & Function

- A procedure specific to operation that describes the activities necessary to complete tasks in accordance with industry regulations, or even just your own standards
- A document that provides step-by-step instructions on how to perform a particular business activity
- It is better to be represented by Flow-Charts



# Standard Operating Procedures (SOPs)

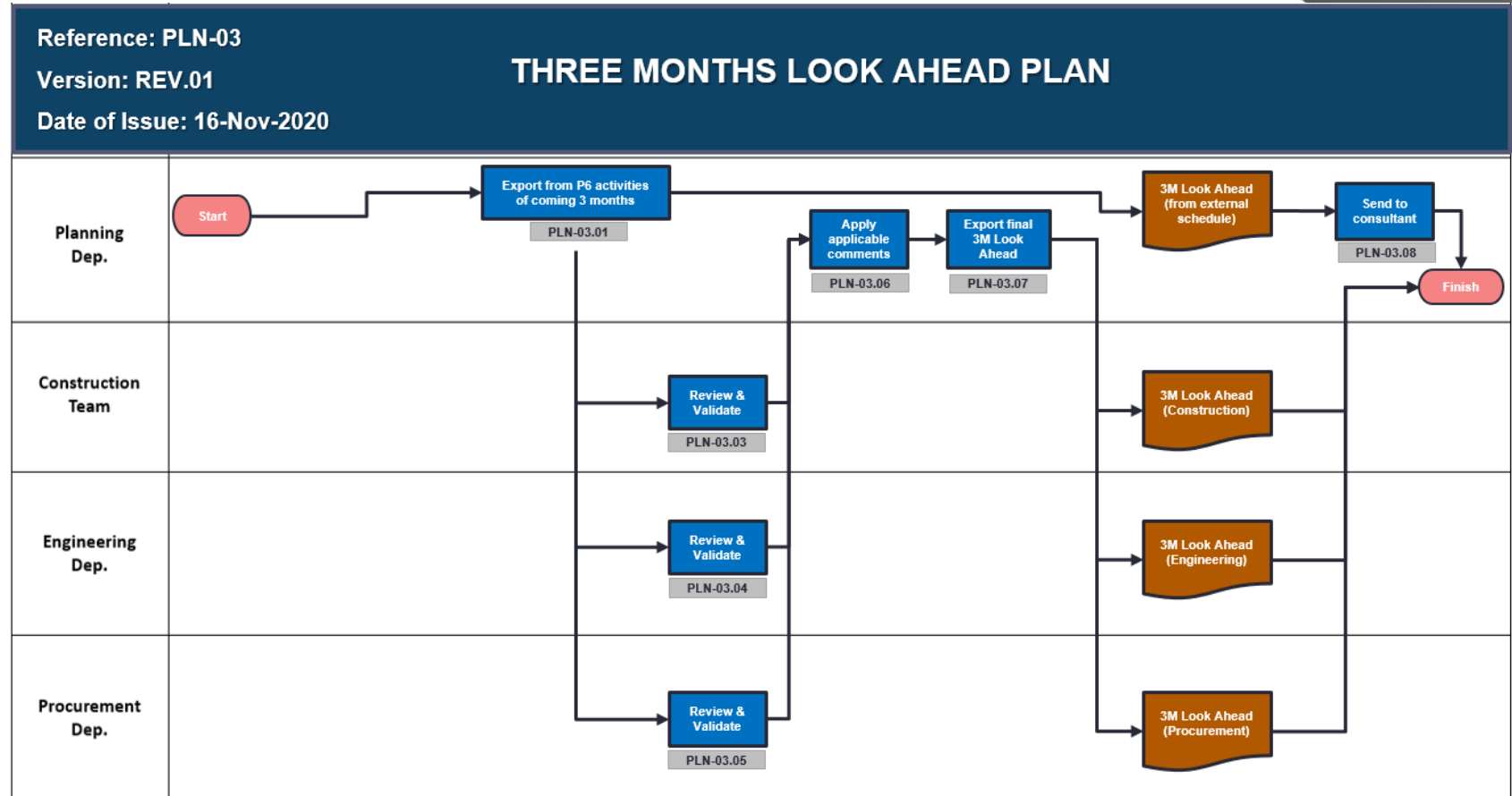
The presented Horizontal & Vertical Integrations can be presented in Standard Operating Procedures (SOPs)





# Standard Operating Procedures (SOPs)

The presented Horizontal & Vertical Integrations can be presented in Standard Operating Procedures (SOPs)

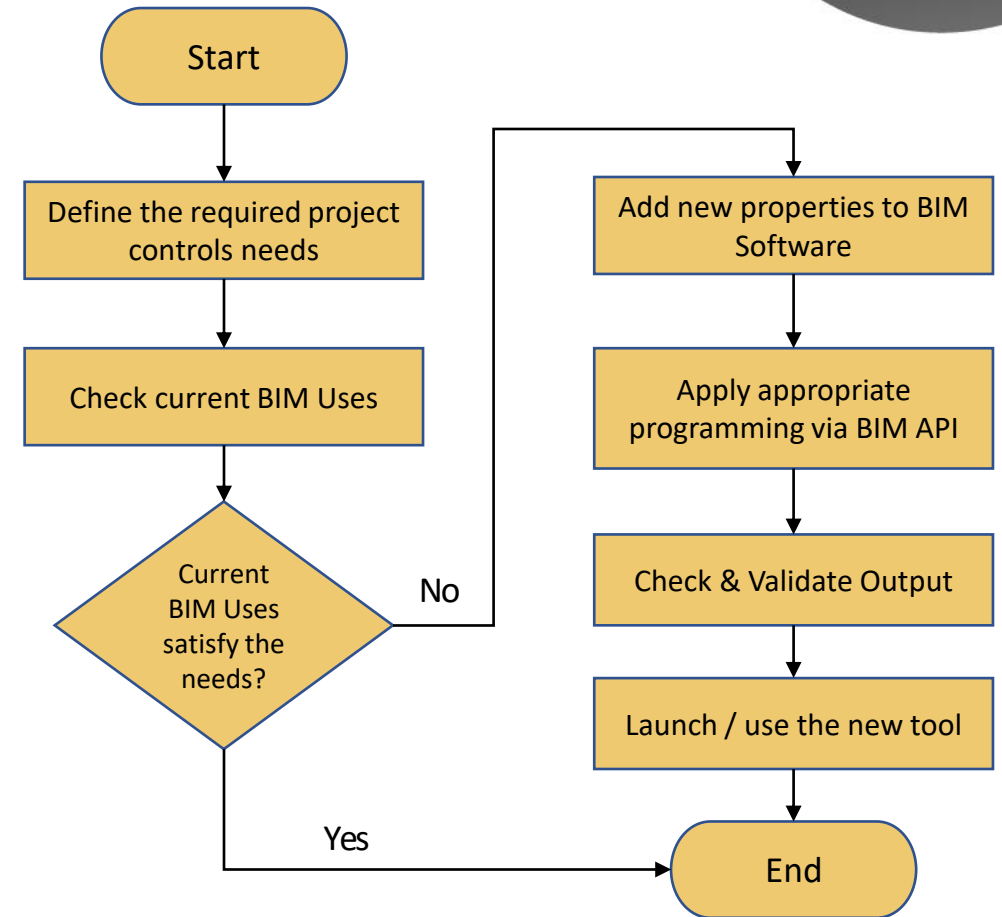


# 6. BIM – Application Programming Interface (API)

# BIM – Application Programming Interface (API)

## Role of BIM API

- BIM API is proposed to enhance the function of the standard integrated project controls model
- It expands current BIM uses by adding more properties, features, and applying customized operations via programming languages to achieve the required project controls functions

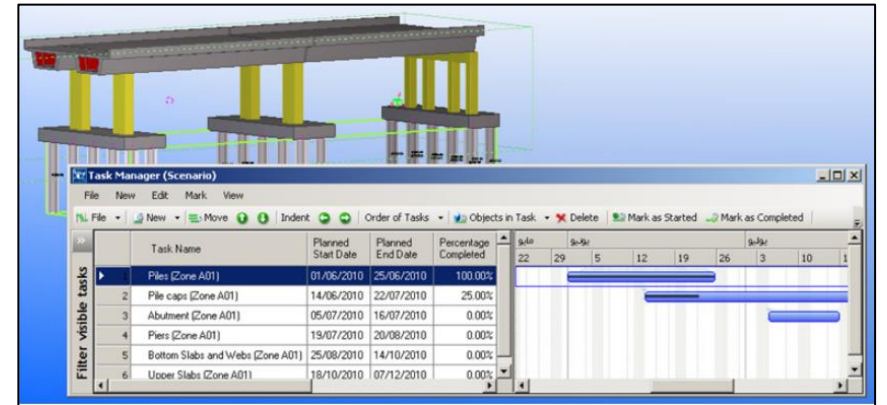


# BIM – Application Programming Interface (API)

Utilizing BIM API for Automated  
 Earned Value Calculations &  
 Analysis using C# Programming  
 Language

```

using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;
using Tekla.Structures.Model;
using TSM = Tekla.Structures.Model;
using TSG = Tekla.Structures.Geometry3d;
namespace Database_and_inpection
{
    public partial class Form1 : Form
    {
        TSM.Model model1 = null;
        public Form1()
        {
            InitializeComponent();
        }
        private void Form1_Load(object sender, EventArgs e)
        {
            model1 = new Model();
            if (!model1.GetConnectionStatus())
    
```



Day Month Year  
 Current Date 20 06 2010

Earned Value Calculations (Task Level)

Earned Value Calculations (Element Level)

ok

ID	Name	Zone	Work Type (Pack.)	Contractor	Control Account	BCWS	% Comp.	BCWP
7613	Piles (Zone A01)	A01	SUB01	C11	A01-SUB01-C11	332	100	332
9264	Pile caps (Zone A01)	A01	SUB02	C05	A01-SUB02-C05	181	25	101

Control Account	BCWS	BCWP	ACWP	CV	SV	Budget Status	Schedule Status
A01-SUB01-C11	332	332	345	-13	0	Over Budget	On Schedule
A01-SUB02-C05	181	101	90	11	-80	Under Budget	Behind Schedule
A01-SUB03-C05	0	0	0	0	0		
A01-SUP01-C02	0	0	0	0	0		

# 7. Summary & Conclusion

# Summary & Conclusion

- This presentation presents a standard integrated project controls model that demonstrates the interaction between project controls department functions and the functions of other departments in the organization in order to optimize the organizations' processes.
- The standardization is presented in two dimensions, which are: horizontal standardization, and vertical standardization. The horizontal standardization focuses on the interaction of project controls functions with other departments, while the vertical standardization focuses on standardizing the processes vertically in the project controls department.

# Summary & Conclusion

- The vertical standardization of the schedule development is presented in details with practical implementation to demonstrate the benefit of standardization in the integrated model. An example of integration between planning and cost control sections is also presented.
- Expanding the uses of Building Information Modeling (BIM) via Application Programming Interface (API) is also presented to enhance the function of the integrated model with more advanced techniques.

***Development & utilization of a standard integrated project controls model will improve the efficiency of the organizations' processes***



**THANK YOU**