Welcome

Computer Aided Production Engineering 04 December 2019



Introduction

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	P	roject: WELLMONT-1	7 Wellmont Substation	58.0d	01-Jan-2018 A	10-Apr-2018												
		W1000	Notice to Proceed	0.0d	01-Jan-2018 A		 Notice to Proc 	eed										
-		W1010	Project Start	b0.0	03-Jan-2018 A		Project !	Start										
		W1020	Project Management	56.0d	03-Jan-2018 A	10-Apr-2018	+											
		W1030	Project Complete	0.0d		10-Apr-2018												
	-	WBS: WELLMONT-	17.1 Mobilization	10.0d	03-Jan-2018 A	18Jan-2018A			WBS	WELLMONT-17.1	Mobilization				10000 C			
		W1040	Mobilize	10.0d	03-Jan-2018 A	18-Jan-2018 A	-		Mobi	lize	1							
- 11	=	WBS: WELLMONT-	17.2 Construction	31.0d	22-Jan-2018 A	14-Mar-2018				-	1	1	1	1		1	WBS: W	/ELLMONT
	E	WBS: WELLMON	T-17.2.1 Below Grade	13.0d	22-Jan-2018 A	12-Feb-2018 A							WBS: WELL	MONT-17.2.1 Below (Grade			
		W1050	Grade Site	8.0d	22-Jan-2018 A	01-Feb-2018 A				*	Grad	le Site						
2		W1060	Set Foundation	9.0d	22-Jan-2018 A	05-Feb-2018 A				L+-		Set Foundat	on					
		W1070	Install Conduit	3.0d	05-Feb-2018 A	07-Feb-2018 A					1	- Install	Conduit					
		W1080	Dig Cable Trench	4.0d	06-Feb-2018 A	12-Feb-2018 A						4	Dig Cable Tre	nch				
		WBS: WELLMON	T-17.2.2 Above Grade	20.0d	08-Feb-2018 A	14-Mar-2018											WBS: W	/ELLMONT
8		W1090	Erect Steel Structures	8.0d	08-Feb-2018 A	21-Feb-2018 A						4		Erect St	eel Structu <mark>r</mark> es			
D.		W1100	Install Equipment	6.0d	13-Feb-2018 A	21-Feb-2018 A					1		*	Install E	quipment			
		W1110	Install Grounding	2.0d	22-Feb-2018 A	26-Feb-2018 A					1			-	Install Grou	nding	1	
6		W1120	Install Bus and Jumpers	8.0d	22-Feb-2018 A	07-Mar-2018					1			+		Instal	Bus and Jumpers	1
		W1130	Lay Control Cable	12.0d	22-Feb-2018 A	14-Mar-2018											Lay Con	trol Cable
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		W1140	Install Fence	7.0d	05-Feb-2018 A	14-Feb-2018 A						L=-	Install F	ence				
	=	WBS: WELLMONT-	17.3 Site Restoration	22.2d	13-Feb-2018 A	22-Mar-2018							-					
		W1150	Remove Equipment	5.0d	14-Mar-2018	22-Mar-2018					1						-	
		W1160	Lay Stoning	2.0d	13-Feb-2018 A	14-Feb-2018 A							Lay Sto	ning				100000
		W1170	Lay Roadway	4.0d	13-Feb-2018 A	19-Feb-2018 A							4	Lay Roadway				
	-	WBS: WELLMONT-	7.4 Project Closeout	10.0d	22-Mar-2018	10-Apr-2018												
		W1180	Substantial Completion	10.0d	22-Mar-2018	10-Apr-2018					1							1



Missing?



Advanced Work Packaging (AWP)

A construction-driven process that adopts the philosophy of "beginning with the end in mind."

The work packaging and constraint management process removes the guesswork from executing at the workface by tightly defining the scope of all work involved, and by ensuring that all things necessary for execution are in place.

Construction Industry Institute (CII) RT272

Design something, create a schedule of what, who and when then make sure all that is needed is there



What, who and when



















Separate product design from process design Proliferation of Era 2 project controls Lack of understanding of fundamental OS



TIME	TOPIC	PRESENTER	VENUE
7:30 - 8:30	Breakfast & Registration		
8:30 - 9:00	Welcome	Ram Shenoy PhD	Plenary – Ballroom
9:00 - 9:45	Call to Action	Gary Fischer	Plenary – Ballroom
9:45 - 10:00	Break		
10:00 - 10:45	Introduction to CAPE	Todd Zabelle	Yerba Buena B
10:45 - 12:00	Digital Prototyping in Support of CAPE	Alex Kunz P.E.	Yerba Buena B
12:00 - 12:45	Lunch		Plenary – Ballroom
12:45 - 1:15	Keynote	Anil Seth	Plenary – Ballroom
1:15 - 1:30	PPI Achievement Award		Plenary – Ballroom
1:30 - 2:30	Process Design & Validation	Roberto Arbulu Craig Evans	Yerba Buena B
2:30 - 2:45	Break		
2:45 - 4:30	Process Design & Validation	Roberto Arbulu Todd Zabelle	Yerba Buena B
4:30 - 5:00	Wrap Up	Plenary – Ballroom	Plenary – Ballroom



Production Engineering

Application of engineering material science, operations science and related knowledge to define, design and optimize production operations and processes





















FIGURE 1.7

Effects of DFMA and CE on product cost at Hewlett Packard. (Adapted from Williams, R.A. *Successful Implementation of Engineering Products and Processes*. Van Nostrand, New York, 1994.)





Ability to Influence Curve adapted from Gluck & Foster HBR September 1975



Computer Aided Production Engineering (CAPE)

Application of various computer tools including 4D visualization, discrete-event simulation, etc. to define, design and optimize production processes and systems



Role of CAPE in PPM?



Production System Optimization **Production Engineering** Project Production Control







Bottleneck

Critical

Repetitive









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419	57 04 57 Dulling	Rig	Shutdown power,	lug down, and prep remaining	Drilling	Drilling	8.00Hr		2 SR/D x 7 D/Wk x				41958 41956
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419	55 04 Drilling	Rig	All equipment mo	ved.	Drilling	Drilling (Generic)	11.00Hr		2 Sft/D x 7 D/Wk x		50	960	41956 41954
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419	52 04	Rig	Set Substructure.	. drawworks and doghouses.	Drilling	Drilling	5.00Hr		2 SR/D x 7 D/Wk x				41953 41951
- 419	51 04 51 Dulling	Rig	SetPin Derrick. S	let on Rig Floor. String Up Block.	Drilling	(Generic) Drilling	8.00Hr		2 Sft/D x 7 D/Wk x				41952 41950
- 415	50 04	Rig	Robertick and	l bridle down.	Drilling	(Generic) Drilling	6.00Hr		12 H//D 2 Sft/D x 7 D/Wk x				41951 41949
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						_		41952 5	Set Substructure, d	rawworks and dogh	houses.		
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Design, control and improve







Continuous Process Improvement Feedback Loop



Machine Learning Robotic Process Automation







Option 1: If less than 1/4" shim L.S.T.





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ood supports the same dimension as the joint width to



PACIFIC CONTRACTING STEP NO. DESCRIPTION TIME PER ACTIVITY DISMANTEL CRATE BEFORE PREDRILLING PREDRILL HOLES ON GALVANIZED RETAINER (10 LENGTH) 3 MINS STRIKE LINE FOR TOP OF L.S.T. ON CONCRETE DECK 1 DONE MARK HOLES FOR L.S.T. ONTO CONCRETE DECK 2 DONE PREDRILLING 3/8" DIA. X 4-1/2" HOLES FOR L.S.T. INTO DECK з PREDRILL RETAINER AND ATTACH JIG 4 MINS 38 SEC TAPE TADPOLE GASKET TO BACKSIDE OF L.S.T.. GUY 3 INSTALLS 4 EXPANSION ANCHORS AND SPLICE LINE-UP PIECE. 5 SLIDE LATERAL SLIDE GARRIER ASSEMBLY INTO LATERAL SLIDE TRACK 6 MINS 10 SEC 6 SLIDE 5/16" X 1" BOLTS INTO SLIDE CARRIER ASSEMBLY 5mins REALIGN BOLTS IN SLIDE CARRIER ASSEMBLY 2 MINS DROP FIRE BARRIER INTO JOINT AND ALIGN BOLTS WITH GALVANIZED 2 MINS 48 SEC 7 RETAINED 8 BOLT MAIN FIRE BARRIER ASSEMBLY TO SLIDE CARRIER ASSEMBLY Predrill 3/8" dia. x $3 \cdot 3/4$ " holes through fire barrier into 31 MINS 01 SEC 9 CONCRETE DECK ANCHOR AND FASTEN 10 REMOVE WOOD SUPPORTS FROM MAIN FIRE BARRIER ASSEMBLY 6 MIN 18 SEC CAULK THE JOINT BETWEEN THE FIRE BARRIER 14 MIN 57 SEC 11 INSTALL TOP HEAT SHIELD TO GALVANIZED RETAINER 7 MINS 50 SEC 12 LODSELY ATTACH EPDM TO PARAPET WALL 13 INSTALL ALUMINUM CURB RETAINER OVER EPDM ONTO PARAPET WALL 14 ATTACH TURNBAR ASSEMBLY TO ALUMINUM CURB RETAINER 15 FASTEN SPLICE COVERS TO ROOF COVER PLATE



Digital Prototype Computer Aided Production Engineering 04 December 2019



- Current state approach vs Data-driven (Print drawings vs. Program robots)
- 2. Requirements: How to organize the data (use cases, product structure)
- 3. Product Data Management (Catalogs, reuse, taxonomies)
- 4. Interfaces & Precision



What does a program catalog look like



There's no time - get it built



VW MQB platform used as basis for up to sixty vehicle designs



What does a program catalog look like





VOLKSWAGEN


What does design data look like





What does design data look like





What does design data look like

(i) Total Number of Components in 10M_EXPANSION_LOOP: 152

Parts: Part Components: Unique Part Files: Unique Part Configurations: Number Of Bodies:	
Subassemblies: Subassembly Components: Unique Subassembly Configurations: Unique Subassembly Files:	
Components: Resolved Documents: Number Of Top Level Components: Resolved Components: Lightweight Components: Suppressed Components: Hidden Components: Virtual Components: Envelope Components:	
Assembly Maximum Depth: Number Of Total Evaluated Mates: Top Level Mates: Flexible Subassembly Mates:	



10M EXPANSION LOOP PRODUCT ENCYCLOPEDIA

















Cover Type 4 (Mass: 9,105.7 kg) (Volume: 3.79 m³)

Pipe-Support Plate

(Mass: 154.2 kg) (Volume: 0.02 m^3)





Box Type 4 (Mass: 17,865.48 kg) (Volume: 3.47 m³)



Pipe Support (Mass: 241.19 kg) (Volume: 0.03 m³)



Take the data to NC



NC manufacture

NC assemble



Or additive





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Task3 PUSH BLOCK 2 Provintity2 Alert On 1:	s deixyNEAR_ACTUATOR_2 = Charge 3.00in 3s 4.95s 7.95s			
Task4 RETRACT 2 Task3 Task End 0.5 Task5 ACCEL TIRES Task3 Alert On 11	s delay REAR_ACTUATOR_2 = Change -3.00n 2s 2 8.45s 10.45s s delay 22) = change 1440deg/s 1s 2 11.32s10.26s			
Taski END Task End 2	s delay and Motion Analysis 3 12.28s 12.28s			
Click here to add				

Event-based motion



What are the use-cases for the data How do we get to it What is the product architecture How do we evaluate it

















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Product Data Management

Expose the WIP

Just enough version control

Managed re-use



Product Data Management

Versi



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PROJECT PRODUCTION INSTITUTE

Product Data Management

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Level 2

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Lunch

Computer Aided Production Engineering 04 December 2019



Process Design

Computer Aided Production Engineering 04 December 2019









OIL PIPELINE EXPANSION LOOPS

93 loops





3,300 Precast Boxes

~ 8 Tons Each

Product Design

Product Design (2D Drawings)

Digital Prototype

Box Type 3

Precast boxes

Box Type 4

Use of precast boxes for loop assembly

How are you planning to build it?

0		3		6	9		12		15	18		21	24	27	30
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What we got

Rebar & Formwork

Bottom Coating

Process output = Precast ready for transport =

Fabricate & Assemble Rebar Cage





Process time per cage: 2 hours 58.6 min.



Aggregated Steps	Detailed Process Steps	Tools / Equipment	# of Workers per Step	Process Time (min.)	Amount of Work Per Cage	Process Time Per Cage	Worker Minutes Per Cage
	Move Stock Bar to Cutoff (1 bar = 3 cut pieces)		2	0.43	28 bars	12.0	24.0
1. Cut Rebar	Measure, Cut and Place on the Ground	Positioning Gage Stand, Rebar Shear	2	0.20	Amount of Work Per Cage Proce Time F Cage 28 bars 12.0 86 cuts 17.2 14 6.4 82 37.7 1 11.5 2 6.8 86 23.2 256 64.0	17.2	34.4
0. Rend Deber	Move Stock To Bender (6 Pieces at a time)		2	0.46	14	6.4	12.8
2. Deno Rebar	Measure, Bend and Place on the Ground	Tape Measure, Rebar Bender	# of Workers per Step Process Time (min.) Amount of Work Per Cage Process Time Per Cage 2 0.43 28 bars 12.0 1 2 0.20 86 cuts 17.2 ar 2 0.46 14 6.4 sure, der 2 0.46 82 37.7 3 11.30 1 11.3 sure, der 4 3.42 2 6.8 2 0.27 86 23.2 Nire 2 0.25 256 64.0 TOTAL 178.6	37.7	75.4		
Aggregated Steps D 1. Cut Rebar N 2. Bend Rebar N 4 3. Assemble Cage G 7 7 (2	Move Rebar to Assembly Position		3	11.30	1	11.3	33.9
	Measure, Layout and Mark (Bottom grid + 1 side times 2)	Tape Measure, Paint Pen	4	3.42	2	6.8	27.2
	Get Rebar and Position		2	0.27	86	23.2	46.4
	Tie Rebar (256 ties per cage)	Hand Tie-Wire Twist Tool	2 (1 Tie, 1 Hold)	0.25	256	64.0	128
				-	TOTAL	178.6	382.1

Rebar cutting operation requires excessive bending and lifting movements (ergonomics) for two workers

Less than optimal rebar surplus observed - no material optimization effort

Automatic Rebar Bending Machine is not tooled for all forms of geometry, so machine capacity utilization is almost zero

Rebar position placement for assembly operation (high repetition) not gaged

Rebar tying tool is antiquated and can be further optimized







Rebar position placement not gaged

Current Rebar Tying Tool





Better tooling



Place Concrete & Strop Forms



Place concrete



Apply bitumen coating



Unbolt form / take exterior sides off



Strip form and load to trailer

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Aggregated Steps	Detailed Process Steps	Tools / Equipment	# of Workers per Step	Process Time (min.)	Amount of Work Per Box	Process Time Per Box (min.)	Worker Minutes Per Box
1. Place Concrete	Move Truck to Position		6	1.21	1	1.2	7.2
	Pour and Vibrate Concrete	Shovel, Concrete Vibrator	5	13.6	1	13.6	68.0
	Screed and Finish Top	Straight Edge	2	62	1	6.2	12.4
2. Cure	Cure		0	2 Days	1	2 Days	0
3. Apply Bitumen to Box Bottom	Roll On Bitumen Coating	Roller	1	28.4	1	28.4	28.4
4. Strip Form	Remove Bolt	Box End Wrench, Breaker Bar	1	.78	112	87.4	87.4
	Rig Rack to Box	Lifting Rack	2	3.0	1	3.0	6.0
	Lift Box from Form, move to trailer & Decouple	Lifting Rack, Crane	4: 3 ground, 1 operator	64	1	6.4	25.6
					TOTAL	146.2 *	235.0



Formwork sides being manually placed, which required six workers plus being an operation exposed to safety risks. Better to use crane and the Lift Hooks provided (if so, crane utilization levels must be checked)

Safer work at height procedures needs to be observed during concrete placement operations (e.g., no straddling forms, use rolling platform, etc.)

Use impact guns for formwork bolt up instead of wrench and breaker bar





Product Design – Corner Box



Final Corner Box







Loading / Offloading





Connect frame to box



Load box on truck



Transport to flipper and load box on flipper



Raise box 90 degrees



Lower box 90 degrees



Load flipped box on truck







Lift and flip (8 steps)

28% cycle time reduction42% labor time reduction











Install – 4 boxes

Aggregated Steps	Detailed Process Steps	Tools / Equipment	# of Workers per Action	Total Minutes Per Step	Total Worker Minutes Per Step
1. Prep Install Site (in parallel)	Position crane	Crane	2	25	50
	Position T1 truck	Truck	2	3	6
	Supply support equipment	Slings, hook tool, Lift frame, Spacer blocks, Ladder, Tag Lines	1	10	10
2. Unload T1 Truck	Hook, lift, place, unhook T1 box	Crane Truck, Lift Frame, Ladder, Tag Lines	6	6.4	38.4
2. Prep Install Site	Position T3/T2 truck	Truck	2	3	6
	Hook, lift, place with dowels, unhook first T2 box	Crane Truck, Lift Frame, Ladder, Tag Lines	6	17.8	106.8
4. Unload T2/T3 Truck	Hook, lift, place, unhook second T2 box	Crane Truck, Lift Frame, Ladder, Tag Lines	6	11.6	69.6
	Hook, lift, place, unhook T3 box	Crane Truck, Lift Frame, Ladder, Tag Lines	6	11.5	69.0
			TOTAL	88.3	355.8





Lift Frame



Light Lift Frame & Slings





Product Design – Blinding Concrete



Blinding Concrete - Field





Hand tool to position dowels



Move dowel into position between boxes















Bill of Material (BOM)

Bill of Process (BOP)



4D Visualizations



Construction Process



Equipment Use (Space / Time Conflict)



Break

Computer Aided Production Engineering 04 December 2019



Process Design

Computer Aided Production Engineering 04 December 2019





Large Scale & Global Deployment of EV Infrastructure







Deploy a site in one day



Construction

Manufacturing

Software





Wall Mount



Pole Mount



Field Studies & Product Analysis (v0)

Process Design Optimization & Product Analysis (V0 bracket)

First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (V1)

First Run Study / Proof of Concept LDSC - Denmark



Field Studies & Product Analysis (v1)

Process Design Optimization & Product Analysis (V1 bracket)

First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (v2)

First Run Study / Proof of Concept LDSC - Denmark






























Wall mounted CS



CSA1A00 :MAIN UNIT

Main unit - wired and closed. Attached: 2 main spacers + 2 screw plates

Screws 2 X M8x40 socket head screw



Screws

1

CSA4B00 : WM SHELL

WM Shell

Cable:

WM Shell Top terminal bracket Cables Attached: Top terminal bracket with 2 X M5 nuts. Inside WM bracket WM base bracket Cable gland and cap 1 X yellow with one ending and one cable shoe 3/8" 40cm Grounding Screws Screws: 4X ½" UNC hex screws 4X ½" Flat washer PIP 00 00 8X M8x20 flat head screws 88 Grounding 4X 3/8" Flat washer 2X 3/8" Spring washer 2X 3/8" Hex nut WM bracket Cable gland + cap WM base bracket 3 C

CSA3A00 : COVER

FCT top cover Inside 2 X FCT Rosette assembly

Screws: 4 X M3x8 screws 2 X M3x6 Torx security screw







CSA5A00 : WM PLASTIC





Metal label Screws

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5.





2.

6.

-Drill 4 leveled holes -Insert 4 dibels -insert the electricity wires throw the tube. The length of the wires extending from the end: -Blue + 2 Brown - 50 cm - with ending. -Yeliow - 35 cm - with cable shoe 3/8"

•Attach the WM base bracket to the wall with 4 X M10 screws.



3.

7.

•Cut the cable gland to the right size. •Insert the cables and the tube throw it. •Insert the cable gland and the cap to the WM base Bracket.



4.

8.

 Attach the WM bracket to the WM base bracket throw the glands with 8 X M10 screws.
 Take out the cables throw the WM bracket top.



Place the WM plastic lid
 Slide the WM plastic throw the glands
 Attach with 2 X M4 Torx screws.

5.

9.



Stick the metal label in place

10.

6.



•Flip upside down the top terminal bracket. •Reattach the top terminal bracket with 2 M5 hex nuts.



•Place the shell on the bracket, the terminal block should be in front. •Take out the cables throw the WM shell •Attach the WM shell with 4 X ½" screws and flat washers.

grounding screw

•Attach the grounding cables to the grounding screw inside the shell with the grounding nuts. •Attach the yellow, blue and brown cables to the right side of the terminal bracket



 Insert the Main unit – the cables should face the front.
 Attach with 2X M8 screws
 Attach the main unit cables to the terminal block.
 Turn on all the switches



-Slide in the top cover – avoid interference with the micro switch wires while sliding.
-Loosen the 4 screws that attach the socket.
-Push upwards the socket till the screw holes on the cover aligns with the holes on the socket plate.
-Tighten the 4 screws that attach the socket.
-Tighten the 4 screws in bath sides.



 Insert the rosettes on both sides attach with 2 X M3 Torx security screw.







CSA1A00 :MAIN UNIT

Main unit - wired and closed. Attached: 2 main spacers + 2 screw plates

Screws 2 X M8x40 socket head screw



Screws

1

CSA2A00 : PM SHELL

PM Shell

Cables:

2X M5x6 screw

PM Metal label

PM Shell Top terminal bracket Cables Attached: Top terminal bracket with 2 X M5 nuts. Terminal block in a separate package 2 X brown + 1 X blue with ending - 50 cm. 1 X yellow with an ending and a cable shoe 3/8" - 40 cm 1 X Canadian fastener Terminal block Screws: 8X ½" UNC hex nuts 4X ½" Flat washer Grounding 4X 3/8" Flat washer 2X 3/8" Spring washer 2X 3/8" Hex nut Canadian fastener B 62 Screw cups Metal label Screws Grounding 00 æ 00 80



FCT top cover Inside 2 X FCT Rosette assembly

Screws: 4 X M3x8 screws 2 X M3x6 Torx security screw











L















5.



2.

6.



•Screw in 4X ½" Hex nuts •Place the leveling tool •Level the 4 nuts and remove the tool.



-Attach the terminal block to the concrete base with 2 X M5 screws. -Connect the infrastructure cables to the terminal block -Connect 2 X brown, 1 X blue cables. -Connect the Canadian fastener to the grounding cables" (only in case of continues grounding).



3.

7.

•Flip upside down the top terminal bracket. •Reattach the top terminal bracket with 2 M5 hex nuts. •Place the shell on the concrete. •Attach the PM shell with 4 X ½" nuts and flat washers.



4.



•Attach the grounding cables to the grounding screw inside the shell with the grounding nuts. •Attach the yellow, blue and brown cables to the right side of the terminal bracket





Car parking



 Insert the Main unit – the cables should face the front.
 Attach with 2X M8 screws
 Attach the main unit cables to the terminal block.
 Turn on all the switches





8.



Slide in the top cover – avoid interference with the micro switch wires while sliding.
 Loosen the 4 screws that attach the socket.
 Push upwards the socket till the screw holes on the cover aligns with the holes on the socket plate.
 Tighten the 4 screws that attach the socket.
 Attach the cover with 2XMs screws on both sides.

 Insert the rosettes on both sides attach with 2 X M3 Torx security screw.



Field Studies & Product Analysis (v1)

Process Design Optimization & Product Analysis (V1 bracket)

First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (v2)

First Run Study / Proof of Concept LDSC - Denmark









Remove stiffener plate. This will allow for sliding CSU pre-assembly over junction box and efficient electrical connections.

Is stiffener plated needed? Does not the walls of the junction box act as stiffener once bracket is attached and fastener tightened to specified torque? If stiffener plate is needed – can it be placed across diagonal cut-out?.

















2.1 Pre-Assembly Strategy - No Drop















Pre-Assembly Strategy (Initial Phase)





•Sorew in 4X.10" Hex ruls «Place the leveling tool 4.avel the 4 ruls and remove the tool.



-inset in 4 screw caps on the 4 corners with "Clean the label cavity on the concrete. «Stick the label orienting to the car parking.







8

Affaich the grounding cables to the grounding screw inside the shell with the grounding nulls. Affaich the yellow, blue and brown cables to the right side of the terminal bracket.

- event avoid teachersce with the micro switch when shifting. Cooles the 4 somes that attack the socket. What is preaded the socket til the socket holes on the cover aligns with the holes on the socket plate. "Tighten the 4 somes that attach the socket, kitach the cover and you'd." Insert the rosettes on both sides attach with 2 X M3 Torx security screw.































Field Studies & Product Analysis (v1)

Process Design Optimization & Product Analysis (V1 bracket)

First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (v2)

First Run Study / Proof of Concept LDSC - Denmark

































Availability of proper PPE (goggles were provided to Mr. Sprinkler technician)



Opportunity to define a better protection solution for modules to avoid physical damage



Provide a working platform for assembly of modules (ergonomics and safety)



Train technicians on proper use of tools and postures



Need to define a better solution for the use of terminals inside junction boxes (use of wire connectors may be easier and faster)



When installed, plastic cover pushes terminal inside junction box



Better refuse disposal – use of carts



Opportunity to train local technicians on proper loading and off-loading signals (demonstrated here)



Define standard packaging procedures and materials



Select quality materials

Room for Improvement

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Use of Carts for Transportation of Tools and Small Materials Use of Proper Tool Belts for better access to tools and small materials



Use of Proper Garbage Containers



Garbage cart can be placed

underneath working area



Carts can provide a working platform if especially designed



Are three bolts required when attaching support extensions?



Charge Spot Bracket Lateral Screws Damaged during Installation



Opportunity to use better / faster tools for assembly of terminals



Time spent doing detailed engineering on Site involving technicians



Better solution definition for conduits (white conduit was painted blue at the request of the property manager) – how does it affect the company brand?

Room for Improvement



Field Studies & Product Analysis (v1)

Process Design Optimization & Product Analysis (V1 bracket)

First Run Study / Proof of Concept - Israel

Process Design Optimization & Product DfX Optimization (v2)

First Run Study / Proof of Concept LDSC - Denmark





Site Engineering Survey through Laser Scanning



Detailed Engineering through PLM



Fabrication at LDSC



Module Assembly at LDSC



Kitting at LDSC



Site Installation of Modules & Individual Infrastructure Components





















Assemble WM Bracket Unit

Assemble "J" Drop Configuration



Assemble Switchboard Modules





Assemble Circuit Modules (e.g., Trays, Conductors, etc.)








Defining LDSC Layout

Implementing Work Stations

Implementing Enabling Systems & Tools (LCD screen for Viewing PLM Packages)



Educating Team in Project Specifics



Getting Ready for Shop Floor Operations



Training on Infrastructure Details





Offload Kits from Truck & Place in Designated Area

Layout

Install 'J' Drop Modules



Install Switchboard Module

Install Circuit Modules





Scan Site

Register Point Clouds

Develop 3D Model of Existing Site Conditions









Assemble Base, Leveling Bracket & Terminal Block

Connect Fast Connector to Base Assembly Assemble Circuit Modules

















Kitting at LDSC

LDSC Dispatch & Load Truck





Barricade & Excavate Site

Offload Kits and Place into Designated Area on Site



Install Switchboard





Install Circuit Modules

Install PM Unit









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"Like playing a car-wreck video in slow motion: You can watch every stroke of bad luck, bad timing and bad blood reduce a once-thrilling idea to dust."

David Pogue, Yahoo Finance



THE BILLION-DOLLAR CRASH OF THE STARTUP THAT TOOK ON BIG AUTO,

BIG OIL AND THE WORLD





Wrap Up

Computer Aided Production Engineering 04 December 2019



BACK UP SLIDES



Concurrent Digital Engineering for Capital Projects

Todd R. Zabelle, Alex G. Kunz, Ben Amaba PhD P.E. and James E. Craig P.E. / 🖻 DOWNLOAD ARTICLE

Abstract

Ongoing analysis of efficiency in construction compared to other industries indicates construction continues to fall further behind. There are several reasons for this, but one that is most prevalent is the difference in approach to design and engineering between advanced industries such as aerospace, automotive, etc. and the construction industry.

Over the past several decades, advanced industries have used different processes, methods and tools to design and engineer their products. With the advent of ever-increasing computer power and network speed, artificial intelligence (AI), machine learning (ML), robotic process automation (RPA) and enormous data complexes fed by sensors, new and more effective ways to design and engineer will emerge, no doubt reshaping design and engineering as we know it today.

In this paper, the Project Production Institute (PPI) proposes an alternative approach for design and engineering of capital assets. PPI proposes Concurrent Digital Engineering as the framework forward.

Keywords: Operations Science; Concurrent Digital Engineering; Artificial Intelligence; Machine Learning; Automation

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2.0 Findings

Findings

Initial conclusions are that the pre-assembly strategy offers Better Place significant health & safety, quality, time and cost benefit for installation of charge spot assemblies for wall mount installations.

Opportunities for Further Optimization

- The benefits of a pre-assembly strategy requires that various investments be made including a robust process of site evaluation, survey, engineering, deployment of a logistics center, and specialized equipment for the transport of pre-assembled modules.
- Local code requirements will need to be identified and modifications agreed prior to commencing work in a specific market (e.g. type of conduit required)
- The current charge spot unit requires some modification to the current design. Specifically the wall mount concept (base bracket), the wiring and the packaging will need to be rationalized.
- Cable tray appears to be lower <u>cost</u> but this needs further analysis. The total installed and life cycle cost of conduit may be less than that of mesh tray.
- A standard catalog should be set-up to allow engineers to pull and place components in a PDM system enabling automated BOM generation.





better place



































Wall Mount Floating Charge Spot Unit V1 – Installation Process Map





Charge Spot Unit V1 – Installation Process Analysis



Document Title:	Document Number
Global Infrastructure Deployment Team	
Sheet Title:	Revision / Date





Wall Mount Floating Charge Spot Unit V1 – Questions



Do we need to secure the FT water cover and the FT to the bracket before placing the bracket on the wall? – it seems the nuts needs to be placed from the back of the bracket rather than the FT just screw from the front



Per our understanding of the proposed standard, all EVSEs (CSUs) must be suitable for outdoor installation. Does this slot in the bottom of the WM CSU where the cable enters the bracket provide adequate protection of the conductors and other electrical components from the elements (driven rain, splashed water, snow from build up melting, snow removal equipment, irrigation, etc.)?



What holds the nuts in place?

Other Questions:

How are the CSUs going to be packaged?



Document Title:	Document Number:
Global Infrastructure Deployment Team	
Sheet Title:	Revision / Date:



FLEET SEWER POSESSION



Remove crash deck Install temporary steel supports Install 7 sections of Orthotropic deck Earth and Bond Orthotropic Deck Install 2 Plate Girders (65 & 105 Ton) Install 5 M-Beams (30 Ton each)

51 Hours to Execute Work







Build Digital Prototype







2D Drawings

Digital Prototype









	7		
973 Prepare	crane foundations		
	957 Lifting plan sig	ned off	
	966 Receive delivery of plate	girder	
	967 Ensure sufficient access		
	975 Prepare temporary work	s for plate girder stability	
	977 Ensure bearing dowel ho	les are cleared and clean	
	956 Setup of	crane	
	969 Setout fo	r Plate Girder Position	
	972	lace and level shims for bearings	
		955 Lift plate girder into locati	on
		965 As-built plate gir	ders location
		964 5	Shutter for grouting of bearings
		.95	4 Notify Sandbergs for grouting
			953 Grout bearings
			963 Fix end restraints to plate girder
			962 Connect Restraints to adjacent M-E
			960 Strike shutter for bearing grout
			961 Begin M-Beam Topping Şlat











4D Visualization: Product + Production Process







Completed 14 hours faster



TRAIN UNDERGROUND TUNNEL































CAPE using Immerse Virtual Reality






























