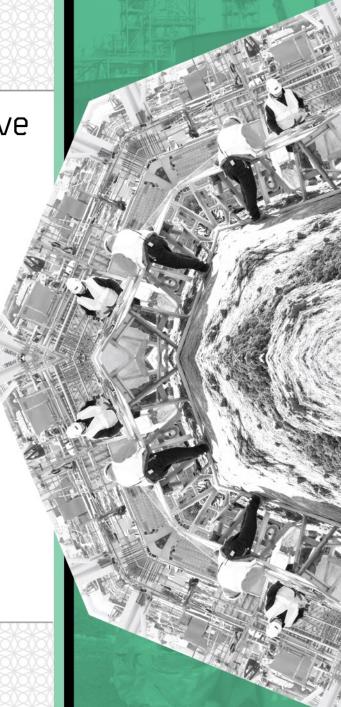
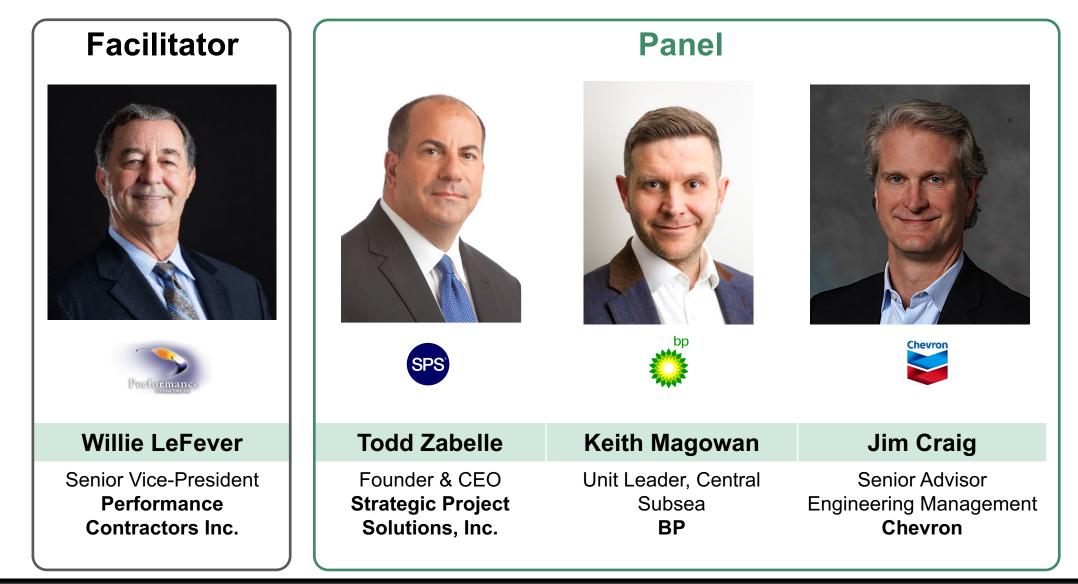
PerspECCtive

Modernizing Construction -From Construction to Production

How supply chains and project delivery are changing to leverage the benefits of industrialization and digitization







Introduction

Willie LeFever



Other Industries Have Perfected Modern Production. So, When Will Construction?

Construction Users Roundtable (CURT) "The Voice 2019"



Modern Production Thinking

Examples (BP & Chevron)

Beyond Modern Production



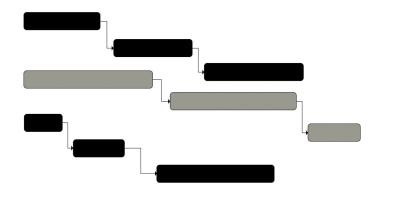
Modern Production Thinking

Todd R. Zabelle

Modern Production?

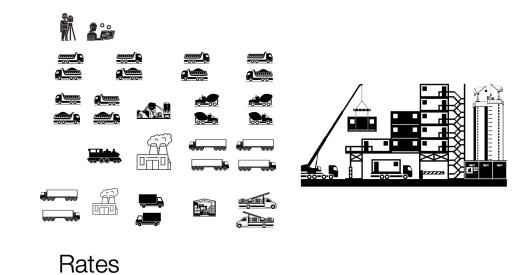


Demand (Schedule)



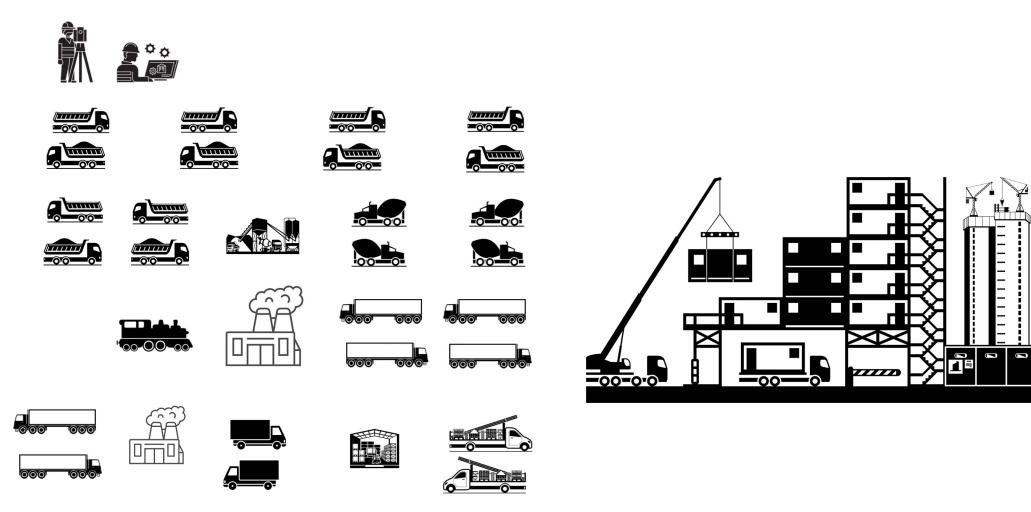
Should / Want Happen

Supply (Production System)



Dates

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Modernizing Construction - From Construction to Production

4 Verbs

5 Levers

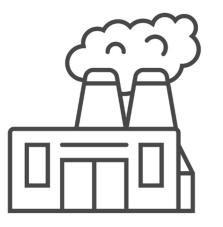
3 Curves

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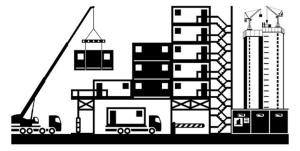


Design

Make



Transport

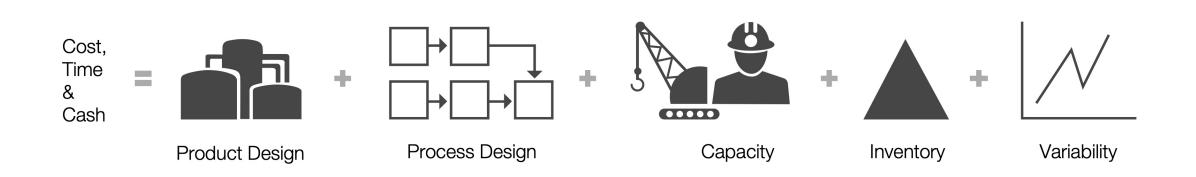


Build

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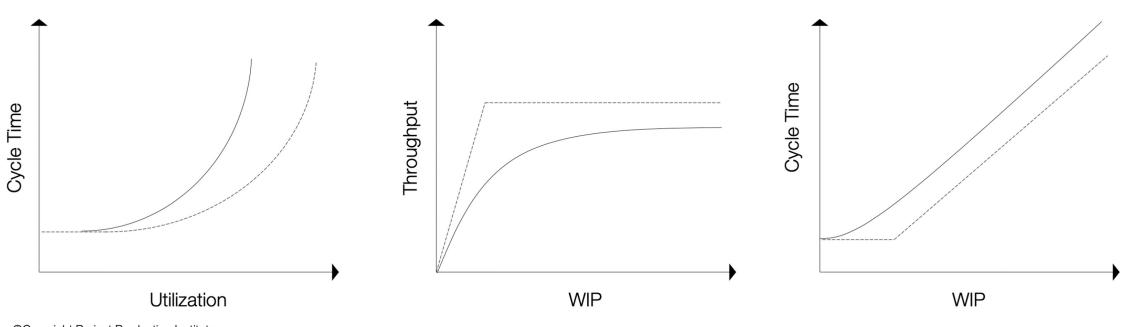
5 Levers



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3 Curves



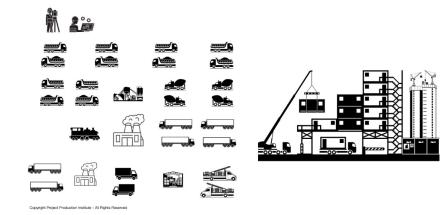
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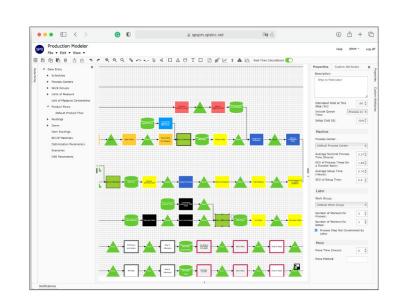


Work-in-Process = Time!

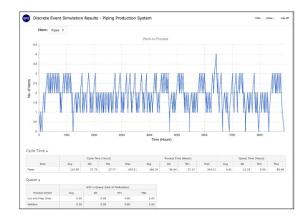


Production System Digital Twin



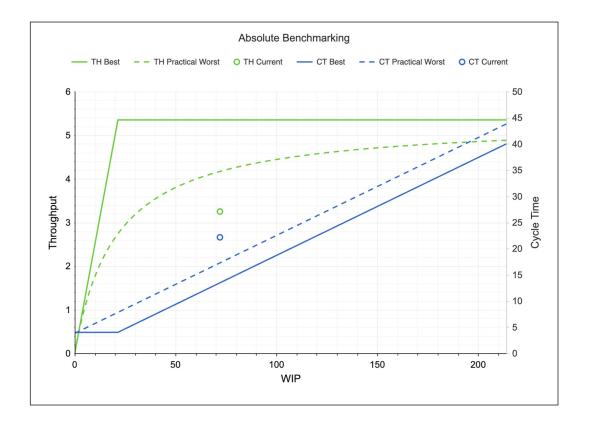


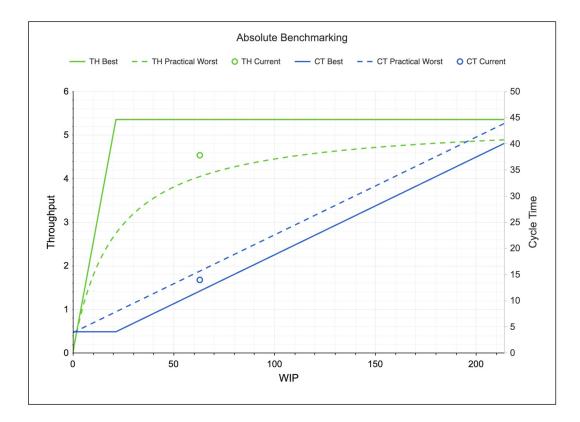




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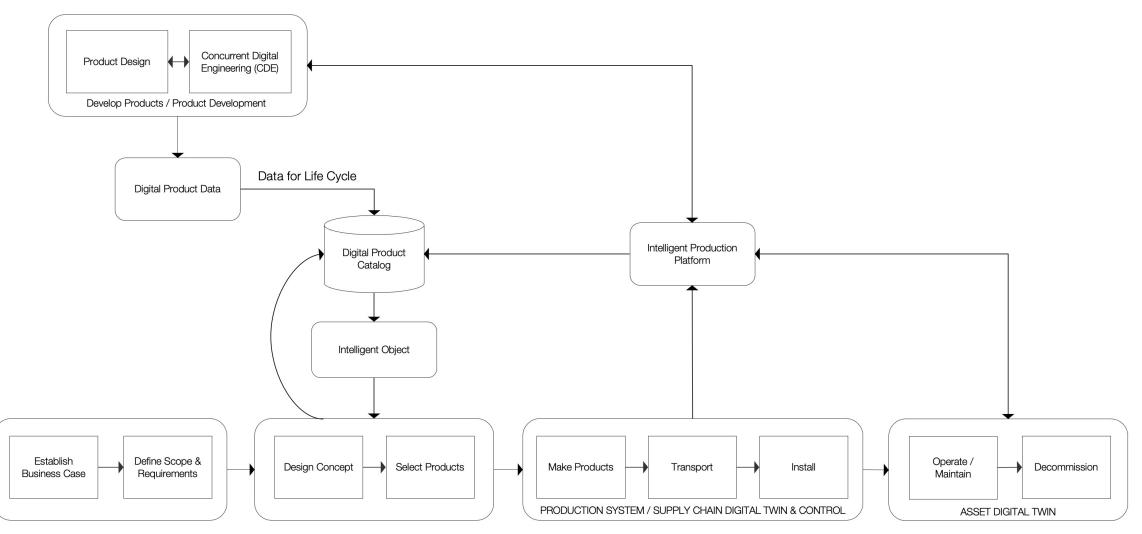


Current State

Optimal Frontier

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Productization

Keith Magowan - BP

Will Subsea be the next Blockbuster?



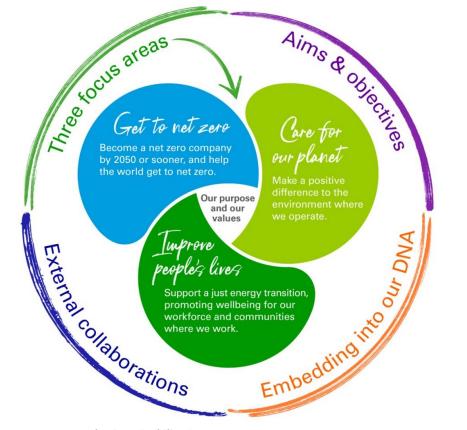


P<mark>&</mark>O



Energy Transition - From IOC to IEC





bp Sustainability Frame

The Energy Transition is real and being driven by societal pressure to protect our planet

Spend x10 the capital in renewables by 2030

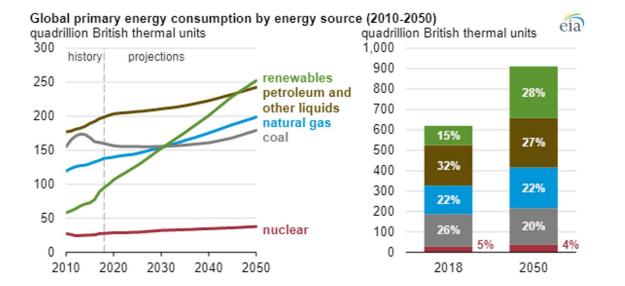
Reduce daily production by 40% by 2030 with Net Zero Carbon by 2050 ambition

Numerous governments making climate and emission reduction commitments

P<mark>&</mark>O

What does this mean for O&G?





Source: U.S. Energy Information Administration, International Energy Outlook 2019 Reference case

What is the role of O&G in the Energy Transition?

Widely recognized that O&G will continue to be a major part of the world's energy portfolio in 2050

Oil and gas production will help bp fund the energy transition

What does this mean for Subsea Projects?

If subsea projects do not radically transform, subsea will quickly become uncompetitive and will rapidly become the Blockbuster of the oil and gas industry



Subsea Vision



20% reduction in Total Cost of Ownership

Subsea production system reliability >98% Build contracts that align business goals

Improve Return on Investment

50% reduction in schedule for Define/Execute phase of subsea projects

Forecasting Accuracy

Cost accuracy within +/-2% for subsea projects minimizing time capital is employed before returns are realized





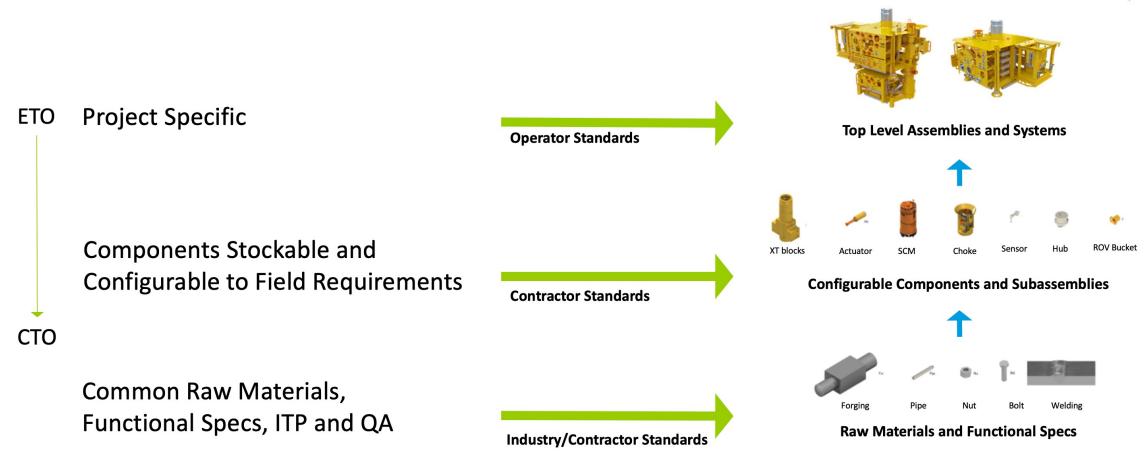


Productization From ETO to CTO

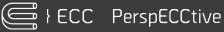








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Modernizing Construction - From Construction to Production



BP

Functional Requirements

BP Specifications

Standardization Management

Scope of Work

Standard Product Services Catalogue Specs, Standards and Codes

Standard Product Line

Customer Demand

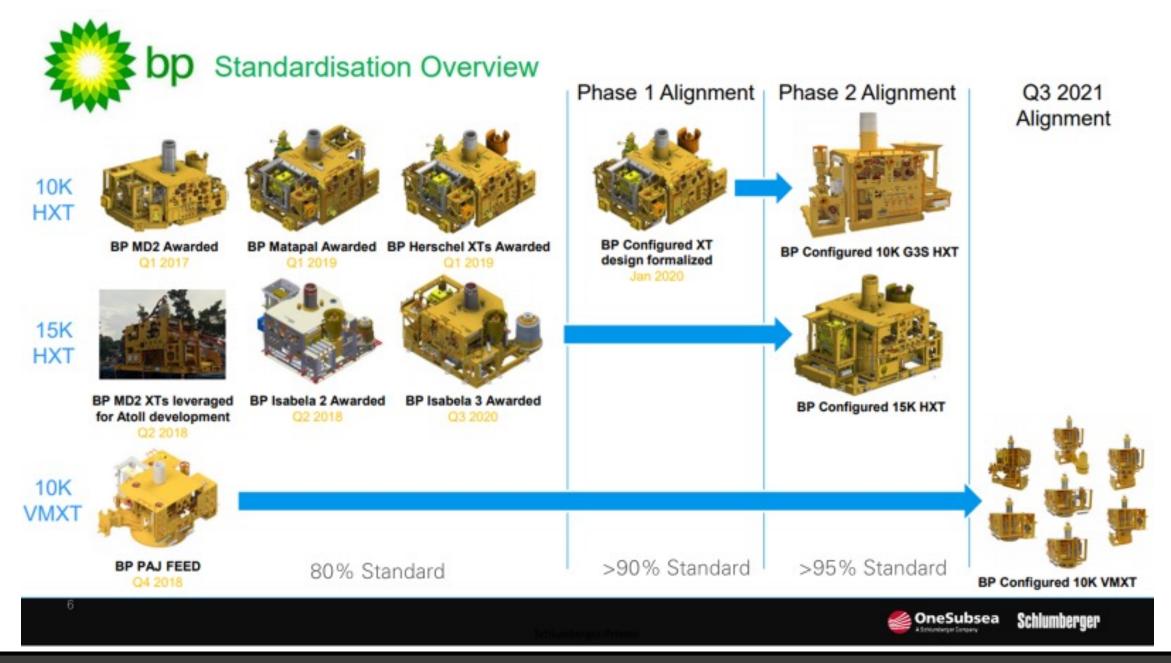
Subsea Supplier

Stocking Program (pre-investment)

Supply Chain Capacity









Modernizing Construction - From Construction to Production

Blockers



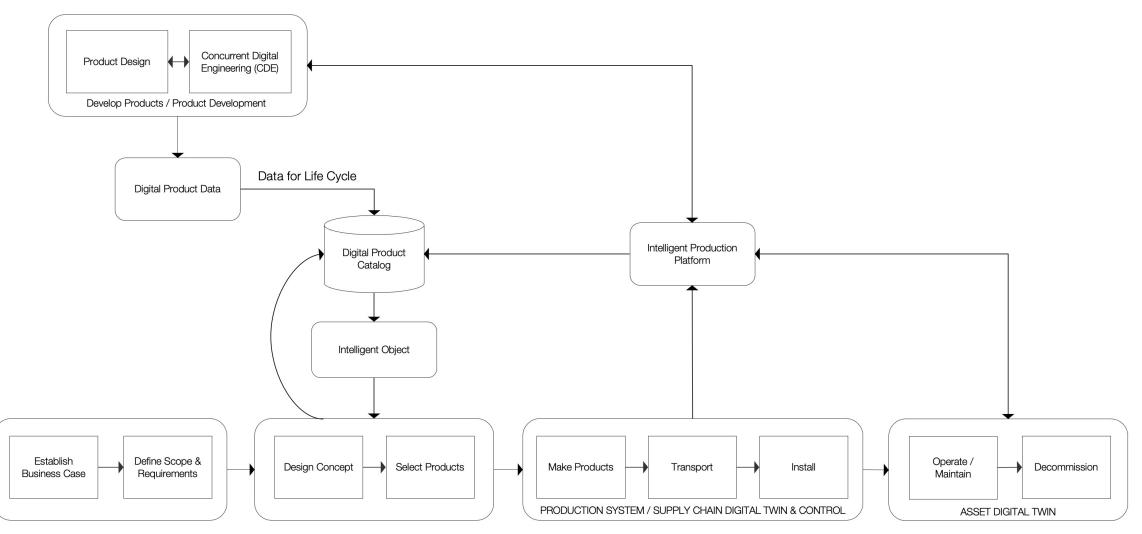
Mindset - not how we have done it previously!

Timely technology forecasting and development

Funding



Standard Work James E. Craig P.E.



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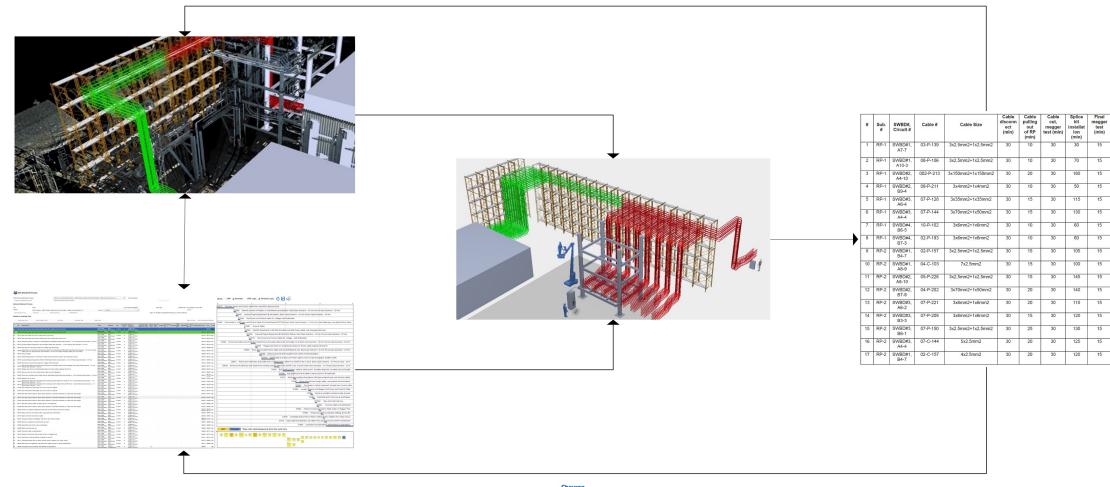


Library (BoP) of >2,000 Standard Work Processes and Growing!

Edit Standard Process			Edit Standard Process			
			Edit Existing Standard Process Off-Line: (1915) X3U Cutover - 090V Power Cable and Cento Contra Area Standard Process Contra Area Standard Process Contra Area Standard Process	I Cable - Heta Level (Scenario 1) To Sort By Name		Show: 🗆 LRM 👩 Forecast 👘 LRM Logic 👩 Forecast Logic 👩 🔚 🍊
Existing Standard Process:	Off-Line: (1857) KSU Cutover - 690V Power Cable and Control Cable - Meta Level		Create a New Bandard Process Duplicate Detected Standard Process Selected Standard Process			
ate a New Standard Process	Filter Expand All Collapse A	1	ID 1915	Is currently available:	Dece: No Created At: 11/10/2020 9:02:20 AM	37677 Pull New Power and Control cable from new RP to Splicing Point
cted Standard Process	Off-Line: (1862) G5_PL_MC_TOD	-	Name: KSU Cutover - 880V Power Cable and Control Cable - Meta Level (Scenario 1)	Group: 0. CAPE	(30000 - CONTRACT OF CONTRACT.	37685 Identify position of feeder on switchboard at substation Best Case Scenario - 15 min Worse Case Scenario - 30 min
scied Standard Process	··· (1863) CNST_Control_&_Power_3GP_Main_Instrument_Cable		Put Process On-Site IP History Version Summary SP Parameters		Note: To modify the Standard Process, it must be off-line.	37686 Lockout/Tagout Equipment @ sub-station Best Case Scenario - 15 min Worse Case Scenario - 30 min
1857		Created At: 10/6/2020 2:11:39 PM	Details for selected Task			37689 Test Power and Control cable for voltage with Multimeter
e: KSU Cutover - 690V Power Cab	··· (1864) CNST_Control_&_Power_3GP_Main_Lighting_and_Power_Distribuion_Cables	Update	New Attach Point New Constraint, Task Edit Task Duplicate Task	Defete Task	Examt to Excel. Edit Using Network Manager	37681 Disconnect or Cut Power and Control cable from Switchboard (MCC)& Dress Best Case Scenario - 10 min for small cable (per one cable) Worse Ca
Process On-Line SP History Versio	··· (1865) CNST_Control_&_Power_LV_and_Control_Cables	cess, it must be off-line.	10 Description	Team Member Dur Warkdays Default Perecast St. Only Calendar Based on U	rt Attach System Sealint Step Terrip Permits Pack TQP/EQ PO Joint Unidentified Pred Succ Docs M Point Type ID	37687 Ground Cable
ilis for selected Task	(1866) CNST_Control_&_Power_Control_and_Protection_cables		a v 36721 Pull new Power and Control Cable from RP to splice point (1st 10m)	KSU CARE KSU Demonstration Electrician 1.00Hr X D/Wk x 8 Hr/D	38720 Ma	27684 Identify Equipment in the field to make sure that Power cable is de-energized at Load
	··· (1868) CNST_Control & Power_3GP_Main_HFT_Control and Protection_cables		a 38720 Pull new Power and Control Cable from RP to splice point (2nd 10m)	NSU CAPE KSU 1.04Hr X 1.5Hr/D x 5 Demonstration Electrician 1.04Hr X 1.5Hr/D x 5 NSU CAPE KSU 1.04Hr X 1.5Hr/D x 5	38721 38719 No	37683 Lockout/Tagout Equipment @ Plant HOA Station Best Case Scenario - 15 min Worse Case Scenario - 30 min
New Attach Point New Constraint Task	(1869) CNST_Control_8_Power_3GP_Main_Termination_LV_and_Control_cables	Export to Excel Edit Using Network Manager	B 38719 Pull new Cable from RP to splice point (3rd 10m) B 38718 Pull new Power and Cable from RP to splice point (4th 10m)	Demonstration Electrician Lower DJ/Wk x 8 Hr/D KSU CAPE KSU	38720 38718 No 38719 38702 No	37678 Test Power and Control cable for voltage with Multimeter
			36710 Full new Power and Control Cable from IV to spice point (wh tom) 36702 Identify position of feeder on switchboard at substation Best Case Scenario - 15 min Worse Case Scenario - 30		39719 39702 Ba 39719 39702 Na	
ID Description	··· (1871) Pipe Spool Installation	Permits Pack TQP/EQ PO Joint Unidentified Pred Succ Docs	III 38703 Ladiout/Tapout Equipment () sub-station Best Case Scenario - 15 min Worse Case Scenario - 30 min	Demonstration Electrician D/Wk x 8 Hr/D KSU CAPE KSU 0.50Hr X 1 SR/D x 5 Demonstration Operations	38702 38706 No.	37682 Disconnect cable wires from terminal block and insulate cable ends. Reinstate cover Best Case Scenario - 15 min Worse Case Scenario - 60 min
	(1872) CNST_Control_&_Power_3GP_Main_10kV_Cable_Termination	NO	III _ 38706 Test Power and Control cable for voltage with Multimeter	KSU CAPE KSU 0.50Hr X 1.5ft/D x 5 Demonstration Electrician 0.50Hr X D/Wk x 8 Hr/D	38703 38698 No.	37690 Megger test (from LV Switchboard Side) for Power cable integrity IR and PI
37677 Pull New Power and Control cable from new RP t	··· (1873) CNST_Control_&_Power_3GP_Main_GTG_110kV_Cable_Termination	37685 No	B 36696 Disconnect or Cut Power and Control cable from Switchboard (MCC)s Dress Best Case Scenario - 10 min for a cable (per one cable) Worse Case Scenario - 60 min for larger diameter cable (per one cable)	Demonstration Electrician U/WK x 6 HV/D	38706 38704 No	37680 Dress and insulate Power cable ends at Switchboard side Best Case Scenario - 5 min Worse Case Scenario - 30 min
37685 Identify position of feeder on switchboard at sub	(1874) CNST_Control_&_Power_3GP_Main_GTG_Cable_Termination_Link_Box	37677 37686 No	B 38704 Ground Cable S8704 Ground Cable S8705 Identify Equipment in the field to make sure that Power cable is de-energized at Load	Demonstration Electrician 0.10Hr X D/Wk x 8 Hr/D KSU CAPE KSU 1.5P/D x 5	38558 38701 No 38704 38700 No	37688 Remove ground and insulate Power cable end at Substation
37686 Lockout/Tagout Equipment @ sub-station Best C		37685 37689 No	36700 Lockeut/Tapout Equipment & Rant HOA Station Best Case Scenario - 15 min Werse Case Scenario - 30 min	Demonstration Electrician 0.50HV X D/WK × 8 HV/D NSU CARE KSU 0.50Hr X 1.5H/D × 5 Demonstration 0.50Hr X D/WK × 8 HV/D	38701 38605 No	37679 Spike cable to make sure Power cable is not live (de-energized) WORST CASE
37689 Test Power and Control cable for voltage with Mu	(1875) CNST_Control_&_Power_Utility_Installation_Grounding_Cable_Termination_Link_Box	37686 37681 No	III 38595 Test Power and Control cable for voltage with Multimeter	KSU CAPE KSU 0.50Hr X 1 SR/D x 5 Demonstration Electrician 0.50Hr X DWK x 8 Hr/D	38700 38699 Na	38643 Removal of cable ties and cleats from existing power cable from old RP to tie-in point. Base Case Scenario - 2 H Worse case - 2,5 H
37681 Disconnect or Cut Power and Control cable from	··· (1878) CNST_Control_&_Power_Utility_Cable_Termination_Transformer		Disconnect cable wires from terminal block and insulate cable ends. Reinstate cover Best Case Scenario - 15 m Worse Case Scenario - 60 min		38695 38207 Na	38640 Removal of cable ties and cleats from existing control cable from old RP to tie -in point Best Case Scenario - 1 H Worst Case Scenario - 1,5 H
37681 Disconnect or Cut Power and Control Cable from cable (per one cable) Worse Case Scenario - 60	(1879) CNST_Control_&_Power_3GP_Utility_Installation_Auxiliary_Cables_between_Transfoermers	37689 37687 <u>No</u>	38707 Megger test (from LV Switchboard Side) for Power cable integrity IR and PC	KSU CAPE KSU 0.52Hr X 15H/D x 5 Demonstration Electrician 0.52Hr X 15H/D x 5 KSU CAPE KSU 0.52Hr 15H/D x 5	38689 38705 <u>bb</u>	37691 Pull existing Power cable to splice point. Duration depends on cable size and lengt
37687 Ground Cable	(1880) CNST Control & Power 3GP Utility Installation Bus Duct	37681 37684 No	III = 38705 Remove ground and insulate Power cable end at Substation III = 38997 Dress and insulate Power cable ends at Switchboard side Best Case Scenario - 5 min Worse Case Scenario - 3	Demonstration Electrician 0.5000 A D/Wk x 8 Hr/D KNU CAPE KNU 1 NR/D x 5	38707 38607 bia 38703 38715 No.	37696 Pull existing Control cable to splice point or JB (optional)
37684 Identify Equipment in the field to make sure that		37687 37683 No	a C 2020 blevily Te-In Park	Press Demonstration Electrician 0.30Hr X D/Wk × 8 Hr/D NSU CARE KSU 0.30Hr X 15H/D × 5 Demonstration Electrician 0.30Hr X D/Wk × 8 Hr/D	39993 42030 Hu 39697 42221 No	37675 Perform Insulation Resistance (IR) test on New Power and Control Cables
	··· Off-Line: (1881) Bio-treatment Monitoring - Weekly 2nd Round		m 42223 Removal of cable ties and cleats from existing power cable from old RP to tie -in point Best Case Scenario - 1 1 Workt Case Scenario - 1,5 H		42030 42222 No	37692 Splice old and new Power cable using splice kit instruction
37683 Lockout/Tagout Equipment @ Plant HOA Station	··· Off-Line: (1882) Bio-treatment Monitoring - Monthly with no Hay	37684 37678 <u>No</u>	38715 Removal of cable ties and cleats from existing central cable from old RP to tie -in point Best Case Scenario - 1 Worst Case Scenario - 1,5 H	4 KSU CAPE KSU Demonstration Electrician 1.00Hr X 1.5R/D x 5 D/Wk x 8 Hr/D	38667 42033 No	37697 Terminate or Splice (optional) old and new Control cat
37678 Test Power and Control cable for voltage with Mu	··· Off-Line: (1883) Bio-Treatment Monitoring (Weekly Round 1 and 2)	37683 37682 <u>No</u>	m - 42222 Cut and Remove Old Cable from Tie-In Point to Old RP	NSU CAPE KSU 1.0000 X 158/D x 5 Demonstration Electrician 1.0000 X DVMX x 8 HV/D NSU CAPE KSU 1.58/D x 5	42221 38708 No	37666 Visually Ipspect and Megger Test Power and Control Cable
37682 Disconnect cable wires from terminal block and i Worse Case Scenario - 60 min	(1887) CNST Control & Power 3GP Utility Installation Cable Rack	37678 37690 No	= 42033 Cut and Remove Old Cable from Tie-In Paint to Old RP = 38708 Pull New Power cable to salide paint (Kettion 1) Duration depends on cable size and length	Demonstration Electrician 1.00Hr X D/Ws x 8 Hr/D KSU CAPE KSU a serve a 1.55/D x 5	38715 38713 No. 42222 42031 No.	37664 Remove insulation and terminate at Load
37690 Megger test (from LV Switchboard Side) for Pow		37682 37680 No	42031 Pull New Power cable to splice point (Section 2) Duration depends on cable size and length	VSUCARE VSU 158/0 v 5	38708 40097 No	376 <u>63</u> Assemble and Crimp Lug at switchgear
			40302 Full New Power cable to splice point (Section 2) Duration depends on cable size and length	Demonstration Electrician 0.50Hr X D/Wk × 8 Hr/D KSU CAPE KSU 0.50Hr X 1.5N/D × 5 Demonstration Electrician 0.50Hr X 1.5N/D × 5	42031 40099 No	
37680 Dress and insulate Power cable ends at Switchbo	··· Off-Line: (1898) Copy of MCBU Bio-Remediation Sampling Phase	37690 37688 <u>No</u>		Demonstration Electrician D/Wk x 6 HV/D NSU CAPE KSU 1.56Hr X 1.5HVD x 5 Demonstration Electrician D/Wk x 6 HV/D	42033 38692 50	.37662 Tape and heat seal lug
37688 Remove ground and insulate Power cable end at	··· Off-Line: (1911) CNST-3GP-MOA: Cable installation (Meta LVL)	37679, 37680 38640, No	40096 Pull New Power cable to splice point (Section 4) Duration depends on cable size and length	KSU CAPE KSU 0.50% X 1.5%/D x 5 Demonstration Electrician 0.50% X DyWk x 8 Hr/D	40097 38692 No	.37661 Connect Cable to Switchboard
	- (1918) Biotreatment monitoring V2	38643	38692 Perform Insulation Resistance (IR) test on New Power and Control Cables	NSU CAPE KSU 0.504 X 158/0 × 5 Demonstration Electrician 0.5044 X 158/0 × 5 NSU CAPE KSU 3.0444 X 158/0 × 5	38713, 38709, <u>10</u> 40098 38714	37693 Perform Continuity Test by Multi meter or Megger Test
37679 Spike cable to make sure Power cable is not live		37688 38640, No 38643	26709 Splice old and new Power cable using splice kit instructions	Demonstration Electrician D/Wk x 8 Hr/D	38692 38691 No 38692 38691 No	37695 Check and verify protection settings at new Ri
38643 Removal of cable ties and cleats from existing pr Worse case - 2,5 M		37679, 37691 No 37688 37691 No	38 3714 Splice old and new Control cable 38591 Visually Inspect and Megger Test Rower and Control Cable	KSU CAPE KSU 1.0cHv X 1.9cHv X<	38692 38693 No. 38724 38693 No.	37694 Complete Bump Test on Notor (Check motor rotation (for motor only)
and an Removal of cable ties and cleats from existing co	··· (1920) Install Extract Grilles and Diffusers	37679, 37607, 11	II 20090 Remove insulation and terminate at Lead	Demonstration Electrician DrWk x 8 HV/D KSU CAPE KSU 0.55Hr X 158/D x 5 Demonstration Electrician DrWk x 8 HV/D	39714 39691 39669 biz	37676 Seal, label and abandon old cable from splicing point to old RP switchboard
Worst Case Scenario - 1,5 H	··· (1922) Install HVAC Duct Spools Test Points	57000	39669 Assemble and Drimp Lug at switchgear	KSU CAPE KSU 0.56Hr X 1 SP/D x 5 Demonstration Electrician 0.56Hr X D/Wk x 8 Hr/D	38660 38688 No	37660 Complete Documentation and Release to Operation
37691 Pull existing Power cable to splice point Duration	··· (1923) Paint Floor Under Equipment	38643 37675 No.	I 38688 Tape and heat seal lug	KSU CAPE KSU 0.50Hr X 158/D x 5 Demonstration Electrician 0.50Hr X 158/D x 5 D/Wk x 8 Hr/D KSU CAPE KSU 0.50Hr X 158/D x 5	38689 38687 <u>No</u>	LRM Forecast Tasks with solid background drive the cycle time
37696 Pull existing Control cable to splice point or JB (c	··· Off-Line: (1924) Install Piping Penetration Frame	38640 37675 No	m 38687 Connect Gable to Switchboard m 38710 Reduce Postbook Test to Mode and a set of the State	Demonstration Electrician 0.9449 A D/Wk x 8 Hr/D	38668 38710 No 1 38687 38712 No	
37675 Perform Insulation Resistance (IR) test on New F		37691, 37692, No 37696 37697 No	38710 Perform Continuity Test by Multi meter or Megger Test 38712 Check and verify protection settings at new RP	Demonstration Electrician 0.50Hr A D/We x 8 Hr/D	39687 38712 Mg 38710 38711 No	드 등 등 등 등 등 등 등 등 등 등 등 등 등 등 등 등 등 등 등
	··· (1926) Install Gas Extinguishing Piping System	37696 37697	30712 Creck did Very protocoli Sectory and the Ro 30712 Camplete Bump Test on Motor (Check mater rotation (for motor only))	Demonstration Electrician 0.5689 X D/Wk × 8 Hr/D NSU CARE XSU 0.3689 X 158/D × 5 Demonstration Electrician 0.3689 X D/Wk × 8 Hr/D	38712 38693 No.	
37692 Splice old and new Power cable using splice kit is	(1927) Paint of Gas Extinguishing Piping System Weld Joints			KSU CAPE KSU 0.50Hr X 1.58/D x 5 Demonstration Electrician 0.50Hr X 1.58/D x 5	38711 38686 <u>No</u>	
37697 Terminate or Splice (optional) old and new Contr		37675 37666 <u>No</u>	III 38586 Complete Documentation and Release to Operations	KSU CAPE Darina Demonstration Zhakasheva 1.00D X 1.58/D x 5 D/Wk x 8 Hr/D	X 39593 No.	

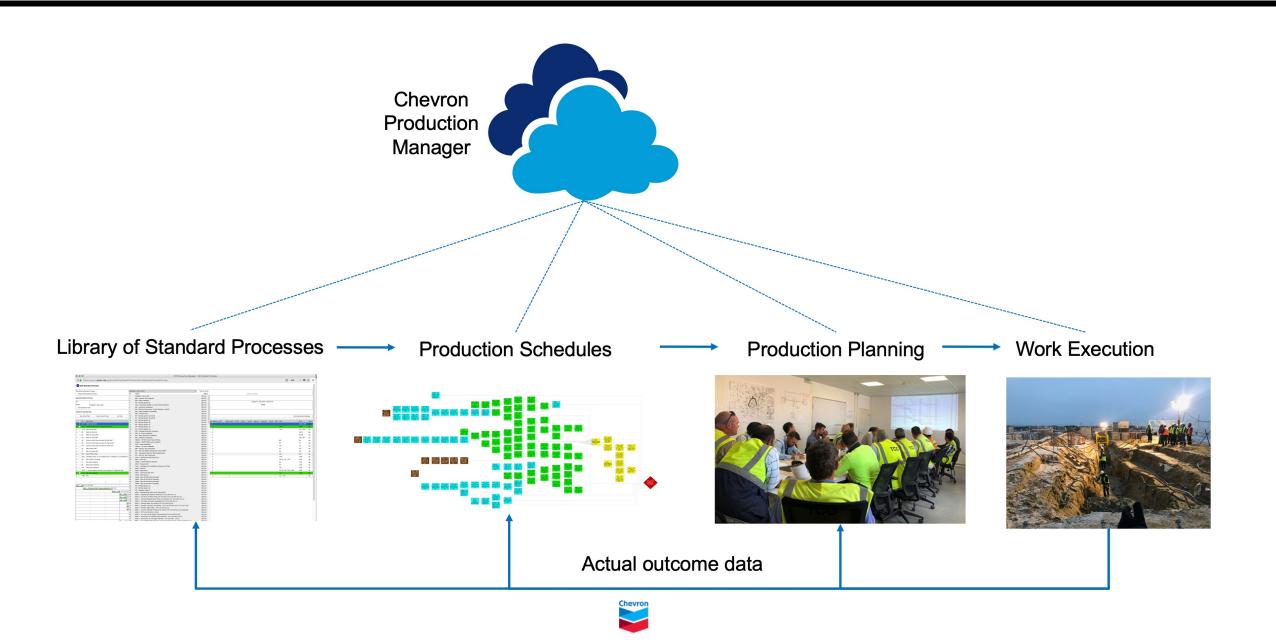


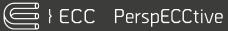
Simultaneous Design of Product & Process

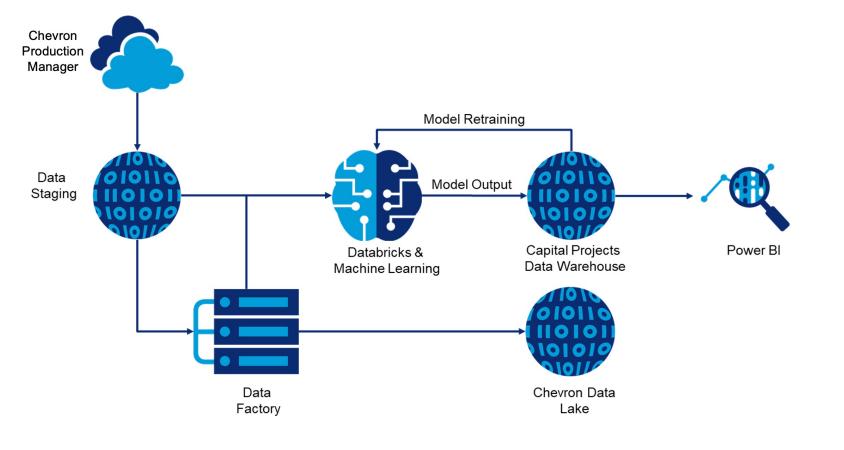












We own the data

Execution performance data is now digitally curated and ingested into the Chevron data lake four times daily

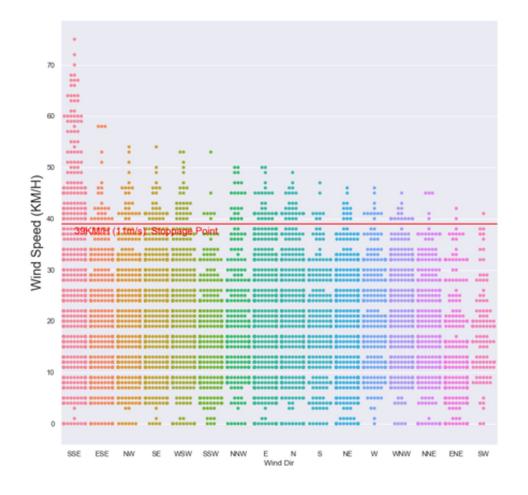
Data Lake keeps growing

- 350,000 tasks - 10,000,000 hours

- 32,000 reasons tasks were not completed







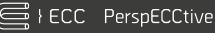
Current Artificial Intelligence application

Weather Impact: Identifies the potential impact of wind to planned construction tasks in next 24hrs based on historical and forecast data

Task Completion Forecast: Predict early/ on-time/ late using an extreme gradient boosting algorithm

Dewatering Truck Optimization: Allocates capacity, identifies optimal timing, routing and sequence over multiple geographic locations







Planned Artificial Intelligence application

Automated Analytics Correlation: Identify relationships between analytics that we are not yet aware exist

Benchmarking, estimating and scheduling norms utilizing machine learning

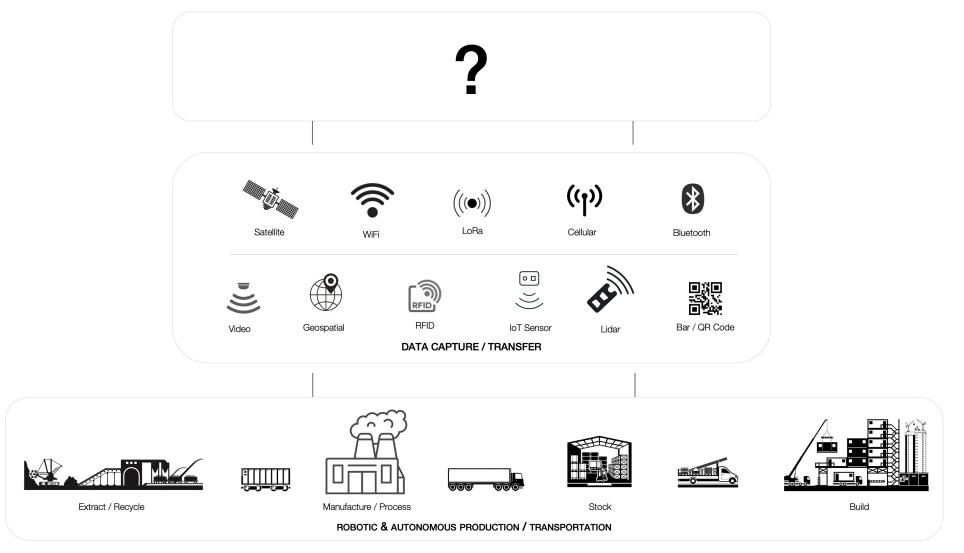
And what's in the basement – What we can't talk about!





Beyond Modern Production

Todd R. Zabelle



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Panel Discussion

Willie LeFever