PerspECCtive

Reinventing construction: Practical steps to improve productivity and predictability



Year: **2017** 

Date: Location: **December 13 Boca Raton, FL** 





### Agenda



### **Our moderator and panelists**



Matthew Parsons (*Moderator*) Partner, Capital Projects & Infrastructure McKinsey & Company



Glenn Ballard Director, UC Berkeley Project Production System Laboratory



Todd Zabelle President, Strategic Project Solutions



Wayne Crabtree Advisor, Chevron Capital Project Management System



David Parker CRO, Cloudleaf

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### In the United States alone, construction labor productivity has declined since 1968 in contrast to rising productivity in other sectors



### Specific action is needed within each of the seven areas identified

External forces Industry dynamics Firm-level operational factors

#### **Areas needing action**

#### Areas needing action

Regulation	<ul> <li>Regulation, processes, approvals</li> <li>Technology</li> <li>Large-scale construction</li> </ul>	Consite execution	<ul> <li>Planning and scheduling</li> <li>KPIs, performance dialogues</li> <li>Mobilization / demobilization</li> <li>Waste and variability management</li> </ul>
Contractual framework	<ul> <li>Tendering process</li> <li>Culture</li> <li>Contract structure</li> </ul>	ATA Technology	<ul> <li>Coordination, accuracy, transparency</li> <li>Advanced materials</li> <li>Automated construction processes</li> </ul>
Design, engineering processes	<ul> <li>Prefab, standardization, and modularization</li> <li>Design requirements</li> <li>Constructability</li> </ul>	Workforce	<ul> <li>Apprenticeship model</li> <li>Front-line worker training</li> <li>Culture of knowledge management</li> </ul>
Procurement and SCM	<ul> <li>Lessons learned</li> <li>Digital and AA</li> <li>Live real-time predictive practices</li> </ul>	Boost produ Achieve up t	ctivity by 50% to 40% cost savings

# Last Planner System: defining the fundamentals of planning for execution to improve workface performance

Last Planner System: five key		Master Scheduling	Set milestones, phase durations, and overlaps	
principles help anchor the design	Should	Phase	Specify handoffs and conditions of satisfaction	
of the execution process	0.000	Scheduling	between processes within phases	
	Can	Lookahead Planning	<ul> <li>Identify and remove constraints</li> <li>Breakdown tasks from processes into operations</li> </ul>	
	Will		<ul> <li>Design operations</li> </ul>	
		Commitment	<ul> <li>Make reliable promises</li> </ul>	
	Do			
		Learning	<ul> <li>Measure PPC', TMR<sup>2</sup> &amp; TA<sup>3</sup></li> <li>Use "5 Whys" to identify countermeasures</li> <li>Act to prevent reoccurrence</li> </ul>	



### **Three Eras of Project Delivery**



Focus on functional activity <u>Measure</u> progress to baseline Operations management excluded

### **CURRENT APPROACH**

Project as Production System

Apply Operations Management/Research

Eliminate variability, reduce inventory

Evolution of project delivery to a *discipline* focused around a production system



Workers won't work but will soldier

Bar Chart, Time and motion studies, ...

Separate planning and doing

# **Project Production Management: apply operations sciences to the construction context**





STRATEGIC PROJECT SOLUTIONS

# Gorgon Trains: demonstrating real world impact through effective project production management

### Train 1 performance (no production control)

Work not calibrated to demand \$4B+ logistics costs Un-sequenced material delivery Work started but not completed Non-progressable work Tie up of capital Higher indirect/direct labor ratio More HES incidents Construction not sequenced with Systems Completion

**\$280M** in surplus material (2017)



# And achieving success beyond the typical learning curve

Train 1 📕 Train 2 📕

Train 3

### Duration to RFSU



 Production Control enabled Gorgon to achieve a 29% time reduction from Train 1 to Train 2, more than 2x the improvement seen in the historically best-performing Project 3

# Sensor networks: supply chain visibility and variance optimization in complex capital projects



- New innovative low-energy sensor networks
- Real time visibility into operations

- Analyzing inventory and work flow processes
   Improving precision and optimization strategies to assess variance
- Ubiquitous communications to support enterprise scale

### **Questions?**

# BACKUP



# Why construction matters: Construction related spending accounts for 13% of the global GDP



### **Topics for discussion**

- How have principles of lean manufacturing and production control been applied in the construction industry since 1990? What have been the results?
- What are the key differences between conventional project management and project production control? What are impediments to innovation?
- What can be learned of the benefit of project production control from the Gorgon project?
- What role can technology play in managing variability and inventory?



### **Matt Parsons**

Partner, McKinsey & Company



- MBA, University of Pennsylvania's Wharton School, Palmer Scholar
- Control Systems Engineer from United States Naval Academy
- Matt is a Partner in McKinsey's Philadelphia Office who leads the Americas Capital Productivity and Infrastructure Practices
- Matt has extensive experience in the Global Energy and Materials Sector, including Electric Power and Natural Gas, Oil and Gas, Chemicals, and Basic Materials

#### **Broader Practice Leadership**

- Leader and convener of the Americas Capital Projects and Infrastructure Practices
- Formerly led and convened McKinsey's Nuclear Power Service Line

#### **Capital Productivity experience**

- Has support project recoveries with multiple owners, operators, and EPC firms on distressed large projects ranging in investment level from \$300M to \$20B
- Led a comprehensive capital projects and engineering transformation for a leading global chemicals manufacturer, who spends \$2B a year in capital across a range of projects and business units
- Supporting the development and implementation of a corrective action plan related to the major cost and schedule overrun of a reactor plant new build – the TVA WBN2 project
- Developed a contracting strategy for a European JV seeking to develop a technologically-complex, major offshore natural gas deposit
- Supported the precommissioning, commissioning and ramp-up planning for a \$10B iron ore mine in South America
- Coordinated the systematic de-risking of two multi-billion dollar materials mines in remote geographies confronted with substantial cost and schedule overruns or development challenges
- Conducted due diligence on several EPC firms and guiding the award process and follow-on terms and conditions negotiation for the EPC contract for a \$6B project
- Led confirmatory due diligence for a major Energy and Oil & Gas acquisition in the EPC space
  - Helped devise a go to market, development, and execution strategy for an engineering services firm in the nuclear power space
- Led a regulatory risk improvement effort related to utility sector investment in carbon capture and sequestration technologies for fossil generation plants, including technological, commodity, and infrastructure risk assessment

#### **Prior Experience**

- Spent ten years in the Nuclear Navy, where he held various responsibilities related to the construction, operations, and maintenance of nuclear powered submarines, including three years forward deployed in Guam as the plant manager of a 165MW reactor plant on USS San Francisco
- Spent two years in the Pentagon on the Chief of Naval Operations Staff in the Planning, Programming, and Budgeting office where he coordinated \$13B of annual capital investment in naval shipbuilding

## **Glenn Ballard**

Director, Project Production Systems Laboratory at University of California, Berkeley



- PhD Civil Engineering, University of Birmingham, U.K.
- MBA, Holy Names College
- Founding member of the International Group of Lean Construction (IGLC)
- Co-Founder and Member of the Lean Construction Institute

- Glenn is currently Director of the Project Production Systems Laboratory at UC Berkeley while also serving as an Adjunct Professor at the Norwegian National Technological University
- His research interests include:
- Design of project production systems: adapting lean production theory from manufacturing to construction management
- · Contracting strategies, relational contracting, negative and positive incentives
- Design management: target costing and set based design
- Production control systems analysis, from design through construction, and from execution strategies to production unit work planning, with emphasis on material and information flows
- Construction work methods design and improvement, including the application of traditional industrial engineering techniques and mimeomotion, employee participation in the development of work methods, the use of techniques such as decoupling through buffers, and the practice of First Run Studies
- In 1933, Glenn co-founded with Lauri Koskela of VTT, Findland, the International Group of Lean Construction (IGLC), which is an association of like-minded thinkers from industry and academia, dedicated to the development and application of production management concepts and techniques in the construction industry
- IGLC holds annual conferences to share research ideas and findings, with conferences having taken place in Australia, Brazil, Chile, Denmark, Finland, Israel, Norway, Peru, Singapore, Taiwan, the United Kingdom, and the United States
- In 1997, Glenn was one of the four equity partners in the Lean Construction along with Todd Zabelle, Gregory Howell P.E. and Iris Tommelein PhD (LCI was made a not for profit in 2000)

## Todd R. Zabelle

Founder & CEO, Strategic Project Solutions Inc.



 Todd has 30+ years experience in delivering complex and critical capital projects

- In addition to being the Founder & CEO of SPS, Todd founded Pacific Contracting, an equity partner in the Lean Construction Institute (LCI) as well as the Project Production Institute (PPI)
- Over the past 20+ years, Todd has authored numerous papers on optimizing engineering, fabrication and construction

- Prior to establishing SPS, Todd founded Pacific Contracting. Established in 1993, Pacific Contracting was recognized in the mid 90's for its use of various innovations including Lean Construction and Virtual Design & Construction. In July 1998, these efforts were acknowledged in the UK Government's Re-Thinking Construction report aka the Egan report.
- In 1997, Todd was one of the four equity partners in the Lean Construction along with H. Glenn Ballard, Gregory Howell P.E. and Iris Tommelein PhD (LCI was made a not for profit in 2000).
- With widespread interest in the processes and technologies referenced in the Rethinking Construction Report, coupled with making LCI a not for profit, Todd launched Strategic Project Solutions, Inc. Since that time, SPS has enabled global leading owners and operators to effectively delivery complex and critical energy, industrial and civil infrastructure projects through the implementation of its Project Production Control (PPC) solutions.
- SPS has been instrumental in numerous successful projects including Heathrow Terminal 5, Channel Tunnel Rail Link 105 and Gorgon Trains 2 & 3 to name a few. SPS continues to be the recognized global leader in PPC solutions.
- To further propagate the understanding and application of the Project as Production System (PPS) framework along with the associated Project Production Management (PPM) body of knowledge, Todd created the Project Production Institute in 2013. Today, PPI works to gain understanding around the current "gap" in current project delivery practices through creating clarity and building capability around the effective application of PPM.

# Wayne Crabtree

Continuous Improvement Advisor, Chevron Capital Project Management System



- Wayne has 30+ years of experience in project management and organizational development within the industrial and manufacturing business sector
- Wayne is a Chevron Certified Lean Sigma Black Belt and has an MBA with an emphasis in Six Sigma

- Prior to his current position at Chevron, Wayne owned and operated businesses specializing in civil / structural construction and environmental remediation. During this time he was engaged in the successive waves of Total Quality Management, Value Engineering, Continuous Improvement, ISO 9001, Team Empowerment, and Lean Sigma. These methodologies were successfully applied to his own businesses and helped shape Wayne's own understanding of broader applications within other corporate settings.
- Wayne is currently focused on the integration of the theory and principles of Project Production Management into the Chevron Project Delivery Model. This effort supports Chevron's increased interest to be more in control of the design and execution of work on their Major Capital Projects.
- Wayne's responsibilities include CPMS Knowledge Management, CPMS Continuous Learning System, and the development and application of continuous improvement methodologies on Major Capital Projects.

## **David Parker**

CRO, Cloudleaf



 David was educated in the United Kingdom and holds an MBA in Business Studies from Wolverhampton University

- David is the Chief Revenue Officer at Cloudleaf responsible for all aspects of sales pipeline creation, revenue generation and sales strategy. He is an experienced IT professional with an extensive background in business development, operational excellence and sales management, covering both business and technical areas.
- David has held various senior executive positions throughout his career across major industries that include Industrial Manufacturing, Oil & Gas, Distribution, Financial Services, CPG, Retail, Telecommunications and Academic institutions.
- Prior to joining Cloudleaf in 2017, David was the North American executive for the Internet of Things practice working within the IBM Watson Global Business Services business unit where he led the demand generation for services engagement and building strategic roadmaps with customers and partners.
- In early 2000, David joined the senior executive management team of Aleri, as a founder, to drive forward its Complex Event
  Processing product into fresh new markets domestically and later moved to New York to help grow the company over a ten period, until
  such time that Aleri was acquired by Sybase, and subsequently SAP in 2010, where he held the role of Senior Global Vice President of
  Big Data and Internet of Things (IOT).
- During 1990- 2000 David held leadership positions at several banking institutions in the Financial Services industry before transitioning into management consultancy.