The Job Shop Lean 2026 Conference

Proven solutions for ***every*** high-mix low-volume (HMLV) manufacturer

August 17, 2026

TIME	TOPIC
7:00 – 8:00 a.m.	• REGISTRATION • BREAKFAST
Designing a Production System for a Job Shop (and not Toyota)	
8:00 – 8:30 a.m.	(Susan Dixon and Shahrukh Irani) If We Build It, Will They Come?
Overview of this presentation: The mission of the Katy Area Economic Development Council (KAEDC) is to lead the economic development efforts of the Katy Area to recruit, retain, and expand high-quality, high-impact companies, jobs, and talent to improve the quality of life and place for Katy area residents. The Katy Area is home to many of the world's major energy companies, and a variety of compatible industry clusters aka the Energy Corridor. One of the missions of the Department of Industrial & Systems Engineering in the Cullen College of Engineering on the main campus of the University of Houston is industry outreach. **In this keynote**, the speakers will report the progress that has been made to establish an industry-university partnership that will allow Katy's small and medium-sized manufacturers to (1) hire Industrial Engineering, Mechanical Engineering and Data Science interns, (2) avail of the co-curricular programs currently offered by the ISE department ranging such as assessment of current shop operations, Senior Capstone Design projects, course projects in INDE6378 and INDE6377, etc. and (3) establish a forum for continuous exchange of ideas and experiences related to HMLV (high-mix low-volume) manufacturing. Nothing ventured, nothing gained!		
Backup	(Maher Hijazi) Know What To Borrow, How To Adapt (It) and When To Apply (It) in a Craft-Driven Signage Manufacturer Where Every Project is Different
Overview of this presentation: In industries where every order is unique, operational excellence cannot be achieved by simply importing a single methodology and hoping it fits. Custom signage manufacturing is one such environment. Each project differs in size, materials, lighting systems, mounting conditions, architectural constraints and client expectations — making it far more similar to a craft-driven fabrication shop than a traditional assembly line, let alone a job shop. **In this keynote**, operations leader Maher Hijazi shares how a large signage manufacturer successfully improved quality, speed and coordination by selectively integrating ideas from multiple operational disciplines rather than forcing one framework onto a complex environment. Drawing from real-world experience, he explains how Agile project management techniques help capture evolving customer requirements early, how digital twins and 3D modeling reduce costly design misunderstandings, and how rapid prototyping and additive manufacturing accelerate design validation. On the shop floor, Lean and Six Sigma practices help to stabilize repeatable processes such as CNC cutting, welding and finishing. The central insight is simple but powerful --- operational excellence in high-mix, project-driven environments comes not from blindly adopting a single approach (be it TOC or QRM or HMLV Lean), but from knowing what practices to borrow from the different approaches known, how to adapt each of those practices to one's specific production system, and when to apply and implement it. For leaders of job shops, fabrication businesses and engineer-to-order manufacturers, this keynote offers practical lessons on building structure without sacrificing the flexibility required when every order is a different project.		
Backup	(Shahrukh Irani) Assessing the Spectrum (and Expectations) of the High-Mix Low-Volume (HMLV) Manufacturers in Attendance
Overview of this presentation: This presentation will (1) determine the spectrum of manufacturers in attendance who are small-to-medium sized (and not an OEM like Toyota), Make-To-Order (and not Make-To-Stock like Toyota), **High**-Mix **Low**-Volume (and not **Low**-Mix **High**-Volume like Toyota), etc. and (2) learn their reason(s) for attending this one-of-a-kind conference by asking for a show of hands if their operations are experiencing "pain points" like "*Our product mix widens every year but we do not rationalize it using Value Analysis*" and "*Our factory could not handle changes in product mix and/or production volumes*". This feedback will influence the		

discussions in all the X's and O's Interactive Sessions between the speakers and conference attendees.

Relevant Information for this Presentation:

Please complete the questionnaire **Will You Benefit By Attending This Conference?** in Appendix 1.

8:30 – 9:00 a.m.	(Shahrukh Irani) To Be or Not To Be a Job Shop?

Overview of this presentation: The numerous radical differences between an OEM like Toyota and any job shop are what separate Lean and Job Shop Lean. Each of Toyota's assembly facilities is a **low**-mix **high**-volume manufacturing facility. So, it only needs to be Focused ***and*** Efficient. In contrast, any job shop is a **high**-mix **low**-volume manufacturing facility. So, it needs to be Focused ***and*** Efficient ***and*** Flexible ***and*** Agile. What does any job shop have to do to achieve these four capabilities? This presentation will introduce .Job Shop Lean, a manufacturing strategy based upon the Principles of Lean, which helps any job shop to systematically scope all of its functions (business plans, operational capabilities, workforce skills, production planning and shop scheduling, supplier relationships, etc.) to be Focused ***and*** Efficient ***and*** Flexible ***and*** Agile.

Relevant Information for this Presentation:

1. (**Read_Me**) Principles of Lean
2. (**Listen_To_Me**) Why the Toyota Production System is Unsuitable for Job Shops
3. (**Listen_To_Me**) Overview of Lean Manufacturing
4. (**Listen_To_Me**) Essential Foundation for Job Shop Lean

9:00 – 9:30 a.m.	(Shahrukh Irani) Job Shop Lean Tools that Will Improve ***Any*** Job Shop

Overview of this presentation: The standard Lean toolkit contains simplistic manual tools that will not help any job shop to turn around orders faster, cut operating costs through waste elimination and reduce operational complexity caused by unplanned proliferation in their product mix. This presentation will discuss an expanded Lean toolkit developed for high-mix low-volume manufacturing. Please send an email to ShahrukhIrani1023@yahoo.com if you would like to receive **The Job Shop Lean Guidebook for High-Mix Low-Volume (HMLV) Manufacturers** prior to the conference.

Relevant Information for this Presentation:

1. (**Read_Me**) 10 Lean Manufacturing Ideas for Job Shops

9:30 – 10:00 a.m.	(Shahrukh Irani) Job Shop Lean Success Story: Superior Completion Services

Overview of this presentation: This presentation will describe a successful implementation of Job Shop Lean in the machine shop of Superior Completion Services.

Relevant Information for this Presentation:

1. (**Read_Me**) In a Machine Shop, The Labor of Lean is Data-Driven
2. (**Listen_To_Me**) A Viable Approach to Cellular Manufacturing for High-Mix Low-Volume Manufacturers
3. (**Listen_To_Me**) Job Shop Lean: Lean in High-Mix Low-Volume Production

10:00 – 10:15 a.m.	• BREAK • NETWORKING

X's and O's Interactive Session

10:15 a.m. – Noon	(Shahrukh Irani) Assess the Current State of Your Job Shop Right Now!

Overview of this session: This session will allow each attendee to assess the Current State of their job shop using the Job Shop Lean Assessment Tool (JSLAT). The JSLAT is a questionnaire that consists of several sets of questions to assess the Current State of key aspects of a job shop's operations such as Product Mix, Factory Layout, Production Planning and Scheduling, Management Involvement, Employee Engagement, etc. Each question requires only a Yes/No response. The format of the session will be as follows: (1) A question will be announced, (2) Attendees will check either the Yes or No box for it on their copy of the JSLAT, (3) The ideal/desired answer (Yes or No) for that question will be provided with supporting justification and (4) If any member of the audience seeks further elaboration regarding that question, it will be provided **not just** by the speaker **but also by** knowledgeable members of the audience.

Relevant Information for this Presentation:

Is Job Shop Lean Right For You? (**Read_Me**) All that you need to get started is to download the JSLAT (Job Shop Lean Assessment Tool), complete it and return it to ShahrukhIrani1023@yahoo.com to get back a pro bono no-strings-attached (FREE!) diagnostic report within a week.

Noon – 1:00 p.m.	• LUNCH

	• NETWORKING

Keys to Successful Management and Growth of a Job Shop

1:00 – 1:30 p.m.	(Todd Chretien) Leading a (Job Shop) Lean Transformation of a CNC Machine Shop

Overview of this presentation: The presentation will elaborate on the leadership of Todd Chretien who was the Director of Manufacturing at Superior Completion Services for the 18 months it took to implement Job Shop Lean in their CNC machine shop. He served as the visible leader of the company's Lean transformation, working directly on the shop floor to guide and support all changes. He engaged machinists and supervisors in ongoing discussions about layout changes, workflow redesign, and scheduling practices, reinforcing why the shift toward data-driven flow was necessary. Rather than delegating the effort, he partnered closely with the consultant, their in-house IE intern and Industrial Engineering students, reviewing proposed cell designs and ensuring shop floor realities were considered before implementation. By building trust, encouraging input from experienced personnel, and committing time and resources to sustain the initiative, he led the cultural shift required to embed data-driven decision-making into daily operations.

1:30 – 2:00 p.m.	(Jyot Bawa) Change Management in a Lower Mid-Market Aerospace and Defense Manufacturing Job Shop

Overview of this presentation: L. A. Gauge Company is a family-owned and led aerospace and defense manufacturer specializing in ultra-precision machining of exotic materials and electro-optics. The presenter, who is the President and co-owner of the company, will present a candid case study on how a family-owned and led job shop professionalized its management team. He will discuss leadership decisions, structural changes and cultural resistance encountered during a significant management transition. Additional topics of discussion are executive discipline, accountability and long-term strategic clarity that repositioned the company for scalable growth.

2:00 – 2:30 p.m.	(Ryan McAuley) Enabling Growth in a High-Mix, Low-Volume Precision Machine Shop

Overview of this presentation: This presentation will discuss how Job Shop Lean is enabling the growth of a high-mix, low-volume precision machine shop by having it utilize only one performance metric to drive all management decisions and actions --- THROUGHPUT. Specific examples of practices that we have implemented at ODAT Machine will be presented.

2:30 – 2:45 p.m.	• BREAK • NETWORKING
2:45 – 3:15 p.m.	(Lance Thrailkill) Leveraging AI and Automation to Maximize ROI on Capex Investments in a Custom Fabrication Shop

Overview of this presentation: This presentation will tell the story of All Metals Fabricating, a three-generation company with more than 70 years in business, and its evolution from a small sheet metal shop into a technology-forward custom fabrication operation. Grounded in the realities of a high-mix, low-volume job shop environment, the session will explore how the company has strategically leveraged AI and automation — not as buzzwords, but as practical tools — to drive growth, improve throughput, and maximize ROI on major equipment investments. The speaker, who is their current CEO, will show real-world applications including machine monitoring systems that expose hidden downtime, digital scheduling tools that replace tribal knowledge with data-driven prioritization, automated quoting platforms that compress lead times, and employee performance dashboards that align shop-floor execution with business objectives. Most importantly, the speaker will candidly share what worked, what failed, and what the next phase of digital transformation looks like — a grounded roadmap for job shops seeking to modernize without losing the craftsmanship and culture that built their success.

Relevant Information for this Presentation:

(**Read_Me**) 2026 Outlook: What We Expect for Our Shop and the Manufacturing Industry

3:15 – 3:45 p.m.	(Neville Divecha) Voices from the Shop Floor: A 360° View of a Machine Shop's Successful Partnership between the Top Floor and the Shop Floor

Overview of this presentation: This presentation examines how a machine shop improved manufacturability, reduced setup times, and strengthened on-time delivery by formally integrating shop-floor machinists into quoting, tooling strategy, and fixture design decisions. We will demonstrate how early operator input on tolerances, material behavior, work holding methods, and tool selection prevented costly rework, shortened first-article cycles, and improved real-world cycle times beyond what CAM simulations predicted. The presentation will highlight practical mechanisms — design-for-manufacturability reviews, standardized tooling libraries, modular fixturing, and structured feedback loops between programmers, engineers, and machinists — that turned tribal knowledge

into institutional capability. Attendees will gain a repeatable framework for aligning engineering intent with machining reality in high-mix, low-volume environments.

3:45 – 4:15 p.m.	(Dan Oliver) Who Said Company Turnarounds Are Easy?

Overview of this presentation: This presentation will offer a raw and practical look at what it truly takes to restore performance, accountability, and momentum inside a manufacturing organization. Turning around a struggling operation is rarely neat, quick, or comfortable. In this candid presentation, the speaker shares the realities of rebuilding a manufacturing organization after making a difficult leadership change that had been delayed far too long. The journey that followed required cleaning house, hiring dozens of employees in a matter of months, establishing new operating standards across departments, sustaining thousands of hours of overtime, and implementing new software systems — all while keeping production running. The speaker will reflect on the hard lessons of leadership during a turnaround that this experience taught him --- the hidden cost of delaying tough decisions, the discipline required to rebuild a winning culture, the urgency of rebuilding teams quickly, and the necessity of pushing forward with operational improvements even in the middle of chaos.

X's and O's Interactive Session

4:15 – 4:45 p.m.	(Sultan Ahmed Mohammed and Shahrukh Irani) A Workforce Development and Training Curriculum for Job Shop Employees (and not Assembly Line Workers)

Overview of this presentation: A job shop is not an assembly line. An employee who works in a job shop (naturally) does not work on an assembly line. A press brake operator in a custom fabrication shop who makes one each of 10 different products in a single shift on their machine possesses different skills compared to an assembly line worked who makes 100 pieces of the same product in a single shift at his/her work station. Job Shop Lean accepts the well-known (and undeniable) usefulness of the Lean tools used at/by an automotive OEM like Toyota in any job shop:

1. Some Lean tools like Value Stream Mapping simply do not work for job shops.
2. Some Lean tools like 5S and SMED will need to be adapted for job shops.
3. Some Lean tools like gemba walks, team huddles and company leadership engaging with employees will work for job shops.

So, what training should be imparted to job shop employees so they possess all four capabilities --- Focus, Efficiency, Flexibility ***and*** Agility? Is it realistic to expect that every job shop employee can become cross-trained enough to learn and master the skills, capabilities and tools to implement all four l capabilities --- Focus, Efficiency, Flexibility ***and*** Agility? This presentation will discuss a spectrum of "hard" and "soft" thinking and problem-solving tools that will help employees doing work that rapidly changes:

Driving Team Discussion with Mind Maps	Visualizing High Mix using a Decision Tree
Visualizing High Mix using a Flow Chart	Visualizing High Mix using GT
Method Improvement using Motion Analysis	Flexible Standardized Work
Flow Process Chart	Converting Sequential Work into Parallel Work
Sequencing Setups for High Product Mix	Multi-Product Flow Process Chart
Man-Machine Chart	Multi-Product From-To Chart
Overall Equipment Effectiveness (OEE) versus Overall Labor Effectiveness (OLE)	
Revenue- and Time-based Metrics (versus SHmetrics like Productivity, Efficiency & Utilization)	
Gantt Chart	Multi-Product Flow Diagram
5S and Visual Management	Ergonomics Analysis using Tumeke.io
Value Network Mapping	Multi-Criterion Evaluation of Improvement Ideas

Backup	(Shahrukh Irani) A Chatbot to Teach Job Shop Lean

Overview of this presentation: This presentation will invite the audience to submit questions to a chatbot that has been trained on a curated knowledgebase containing "reliable literature" on Job Shop Lean.

4:45 – 5:00 p.m.	Q&A WITH SESSION SPEAKERS
5:00 p.m.	• ADJOURNMENT • NETWORKING

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August 18, 2026

TIME	TOPIC
7:00 – 8:00 a.m.	• BREAKFAST • NETWORKING
Employee-Centric Management	
8:00 – 8:30 a.m.	(Jyot Bawa) Running on EOS (Entrepreneurial Operating System) in an AS9100-certified Precision Machine Shop
Overview of this presentation: L. A. Gauge Company is a family-owned and led aerospace and defense manufacturing machine shop specializing in ultra-precision machining of exotic materials and electro-optics. The presenter, who is the President and co-owner of the company, will discuss (1) how the company uses EOS to support its AS9100 compliance and (2) how to resolve tensions between the two systems.	
8:30 – 9:00 a.m.	(Neville Divecha) Beyond the Blueprint: How Management and Employees Can ***Together*** Build a Culture of Continuous Improvement
Overview of this presentation: Most scrap, rework, expediting, and customer complaints in a job shop do not begin at the machine — they begin at the blueprint. When machinists repeatedly encounter ambiguous tolerances, missing datums, unstable revision control, and unrealistic surface finish or stack-up requirements, the question is not whether mistakes will occur, but whether the organization has built the trust and structure to surface those risks early. This session challenges CEOs and senior leaders to rethink "employee-centric management" as a competitive manufacturing strategy: empowering machinists to question prints, escalate manufacturability concerns, and participate in disciplined design-for-manufacturability reviews before chips are cut. Drawing on Covey's trust principles and Toyota's Respect for Humans philosophy, we will show how aligning authority with expertise on the shop floor reduces scrap, protects margins, improves first-pass yield, and converts blueprint chaos into institutional learning.	
9:00 – 9:30 a.m.	(Sai Ganesh Parimella, Manish Peddina, Paavan Sundar Showri Sunkari) No Employee Left Behind: A Case Study on Improving a One-Person Welding Department in a Custom Pipe Fabrication Shop
Overview of this presentation: This presentation will describe (1) the interactions that a team of IE students had with Henry throughout their 1-semester project in INDE6378, (2) the ideas that they recommended to the management team of McWane Plant & Industrial Inc. (Houston, TX) and (3) the justification that they provided for each recommendation.	
9:30 – 10:00 a.m.	(Cory Daniel Parks) Empowerment Without Chaos: The Hard Reality of Employee-Centric Management in an SME (Small Manufacturing Enterprise)
Overview of this presentation: In many small and mid-sized companies, the founder's instincts, relationships, and decision-making style shape the entire organization. Shifting toward employee-centric management therefore requires more than slogans about empowerment—it requires founders to deliberately share authority while maintaining clear performance expectations. This presentation examines both the promise and the pitfalls of employee-centric leadership in growing SMEs. When employees feel heard and trusted, retention improves and decision-making accelerates because ideas surface from those closest to the work. Yet the transition is rarely smooth. If founders are not genuinely committed, the effort becomes performative, and growth can dilute the culture that once held the company together. Drawing on real observations from small businesses, the presentation argues that employee-centric management works best when leaders first define a clear performance standard and then build a culture that supports it.	

Backup	(Shahrukh Irani) Toyota vs. Job Shop: A Comparison of Qualifications, Experience, etc. Needed By Company Leaders and Managers
Overview of this presentation: This presentation will make the case that the TWI program, Toyota Kata, Lean Six Sigma Certification, etc. need to be significantly modified to suit the operational conditions that exist in high-mix low-volume (HMLV) job shop-like manufacturing and service businesses.	
10:00 – 10:15 a.m.	• BREAK • NETWORKING
10:15 – 10:45 a.m.	(Ryan McAuley) Employee-Centric Management in an ESOP Manufacturing Environment
Overview of this presentation: This presentation will discuss how an ESOP structure can support employee involvement in operational improvements. Topics will include defining roles in workplace changes, incorporating employee input into workstation and layout decisions, and maintaining alignment with overall production flow. Examples from Howell Laboratories, Inc.'s Assembly Department will be referenced.	
10:45 – 11:15 a.m.	(Sultan Ahmed Mohammed) The Industrial Engineer as Change Manager in a Custom Pipe Fabrication Job Shop
Overview of this presentation: Custom pipe fabrication job shops operate in a world of constant variability — pipe diameters change, welding requirements differ, coatings vary, and routings change from order to order. In such environments, improvement initiatives cannot rely on "cookie-cutter" Lean implementations borrowed from repetitive manufacturing. They require the Industrial Engineer to play a much broader role: *Not only as an analyst of processes, but as a manager of change*. In this presentation, the presenter will share his experience leading the Lean transformation of a custom pipe fabrication operation in Houston, TX. By using Value Network Mapping, redesigning the facility layout to improve product flows, separating product families, feeding the system constraint, and improving scheduling logic, the team was able to double monthly output from roughly $600,000 to $1.2 million with the same 15 employees. ***However,*** the technical tools were only part of the story. The real challenge was cultural — earning the trust of machinists, welders, and other shop personnel, involving them in problem solving, and demonstrating that improvement initiatives would make their work easier and the business stronger. This presentation shows how Industrial Engineers can combine technical rigor and people-centered leadership to drive meaningful operational change in high-mix, low-volume (HMLV) custom fabrication job shops.	
11:15 – 11:45 a.m.	(Pelumi (Gladys) Alamu, Deepak Jacob, Gowtham Reddy, Naimah Tahmid) Teaching the IE Tools for Job Shop Employees to ***Themselves*** Critique and Improve their Daily Work
Overview of this presentation: Whether you are already on the Continuous Improvement journey or you are just beginning to realize the power of implementing Continuous Improvement implementation, the Toast Kaizen training video (Link) is an essential learning tool for providing a simple and effective introduction to Continuous Improvement for the entire work force. This 27-minute video highlights the Seven Forms of Waste aka TIMWOOD (Link) found in the process of making toast and recommends the process of Kaizen (continuously but incrementally making improvements). Unfortunately, the Go See approach of eliminating waste is a whack-a-mole approach that lacks a data-driven, analysis-aided structure. **In stark contrast**, this presentation will describe an alternative to approach to CI using the Kaizen approach. This new approach systematically uses a slew of charts and data analyses utilized by Industrial Engineers to do Operations Analysis aka Methods Engineering. Examples of these charts that were generated ***using only the Toast Kaizen training video as input data*** are Flow Process Chart, Flow Diagram, Bi-Criterion Pareto Analysis, Impact vs. Effort Matrix, Man-Machine Gantt Chart and Project Network will be explained.	

Relevant Information for this Presentation:

1. (**Read_Me**) Krafcik, John F. (1988, Fall). *Triumph of the Lean Production System*. Sloan Management Review, Volume 30, Number 1, 41-52. Quoting from this seminal publication "… An anecdote sheds some light on just how remarkable this shift in span of worker control can seem to a manager trained in the Fordist school, NUMMI, the GM-Toyota joint venture, is often used by General Motors to give employees an opportunity to see how the Toyota Production System (TPS) works. One GM IE (Industrial Engineering) manager, intent on discovering the real secret of the plant's superb productivity and quality record, asked a high-ranking NUMMI executive (actually a Toyota executive on loan to the joint venture) how many Industrial Engineers worked at NUMMI. The executive thought for a while and replied. "We have 2,100 team members working on the factory floor, therefore we have 2,100 Industrial Engineers." The GM IE manager could only walk away, shaking his head (because) his entire staff of Industrial Engineers would be largely redundant in a TPS plant …".

2. (**Read_Me**) To the absolute contrary, if you are an SME that does high-mix low-volume manufacturing, then this article --- Heston, Tim. (2026, March). *Lean, Flexible, Profitable --- How a Pipe Fabricator Doubled Monthly Revenue*. The Fabricator, 54-56 --- will justify why it is most inadvisable to do what Toyota does. Instead, you ought to hire at least one full-time Industrial Engineer!

11:45 a.m. – Noon	Q&A WITH SESSION SPEAKERS
Noon – 1:00 p.m.	• LUNCH • NETWORKING

Putting Job Shop Lean to Work at McWane Plant & Industrial Inc.

1:00 – 1:30 p.m.	(Henry Weissenborn) Establishing and Sustaining an Industry-University Partnership

Overview of this presentation: It took just an email from a Director of Operations to establish a thriving partnership between McWane Plant & Industrial Inc., Houston, TX, (MPI-HOUSTON) and the Department of Industrial & Systems Engineering at the University of Houston. The presentation will discuss how a Senior Manufacturing Engineer, IE interns working full-time on-site and student teams doing their industry projects in two courses --- INDE6378 and INDE6377 --- have made this partnership a success, despite the usual hiccups, glitches, doubts and questions.

1:30 – 2:00 p.m.	(Darin Alley) Common Sense Keys to Effective Leadership

Overview of this presentation: The presentation will discuss core elements of a successful manufacturing strategy that is pursued in this order --- Grow Revenue ⇨Eliminate Waste ⇨ Respect and Reward Your Employees --- with guaranteed results.

2:00 – 2:30 p.m.	(Sultan Ahmed Mohammed) Diary of an Industrial Engineer (and Lean Fanatic)

Overview of this session: The presenter will discuss the specific actions taken and practices instituted to grow MPI-HOUSTON's revenue from $600,000 per month in August 2024 to anywhere between $1 million to $1.2 million per month by December 2026.

2:30 – 2:45 p.m.	• BREAK • NETWORKING

Lean, Work Cells and Theory of Constraints

2:45 – 3:45 p.m.	(Pelumi (Gladys) Alamu, Deepak Jacob, Gowtham Reddy, Naimah Tahmid) How Implementing Manufacturing Cells at Milwaukee Electric Tool Benefitted ***All*** Levels of the Company Hierarchy

Overview of this presentation: A typical work cell assembles a final product or produces a family of similar components that go into one or more sub-assemblies to build the final product. In the book *Learning To See*, it is recommended that a Value Stream Map be developed for a product family which is "a group of products that pass through similar processing steps and over common equipment". A cell is the physical embodiment of a Value Stream because it co-locates (or at least tries to co-locate) all the machines, people, support services, etc. in a single location. However, for a cell to truly become an ABU (Autonomous Business Unit) in a large factory, it needs processes, practices and systems to be implemented at all levels of the company hierarchy:

1. Each machine (or work station) in the cell
2. The entire cell
3. Other cells that supply parts to the cell
4. Support departments outside the cell such as Maintenance, Quality Control, HR, Accounting, etc.
5. Suppliers
6. Executives and Middle Management

This presentation will play the SME video *Customer Focused Manufacturing* which describes the planning, implementation, commissioning, day-to-day operation and management of an assembly cell. Next, using screen grabs or audio from the video, we will provide an exhaustive list of the must-do's and must-have's at each of the six levels of the company hierarchy described above to ensure successful implementation and operational longevity of a cell.

3:45 – 5:00 p.m.	Implementation of TOC (Theory Of Constraints) in ***Any*** Job Shop

Overview of this presentation:

1. **First**, we will play the video based on Eliyahu Goldratt's book *The Goal* which teaches the Theory Of Constraints (TOC) and the POOGI (Process of Ongoing Improvement) used to implement it.

2. **Next**, we will debunk the claim by the TOC community that an entire job shop can be scheduled using the ad hoc and unscientific method Drum-Buffer-Rope method for Pull Scheduling.
3. **Finally**, we will propose the divide-and-conquer approach that Job Shop Lean advocates whereby the job shop is broken up (only to the extent possible) into several cells and a "C Cell" to produce the Strangers in the product mix. Each cell is essentially a smaller stand-alone job shop (or even a flow shop) that can be "scheduled" using Drum-Buffer-Rope.

Relevant Information for this Presentation:

1. (**Read_Me**) 10 Lean Manufacturing Ideas for Job Shops
2. (**Read_Me**) In a Machine Shop, The Labor of Lean is Data-Driven
3. (**Listen_To_Me**) A Viable Approach to Cellular Manufacturing for High-Mix Low-Volume Manufacturers
4. (**Listen_To_Me**) Job Shop Lean: Lean in High-Mix Low-Volume Production

5:00 p.m.	• ADJOURNMENT • NETWORKING

X's and O's Interactive Session

Backup (Sultan Ahmed Mohammed and Shahrukh Irani) Examples of All the Operational Improvements Implemented at MPI-HOUSTON from 2024-2026

Overview of this session: This presentation will step through all the improvements that were implemented at MPI-HOUSTON which is a custom pipe fabrication facility. Some projects were no-brainers such as the installation of large overhead fans to counter the extreme heat of Houston summers. Other projects were involved such as the splitting of the shop into two focused factories (one side for large pipes and the other side for small pipes) and the design of the Small Pipes Cell and dedicated Paint Booth for that segment of the product mix. All of these projects were planned and implemented by a team --- MPI-HOUSTON's management, Sultan Ahmed Mohammed and all the teams of UH graduate students who took two courses --- INDE6378 and INDE6377 --- Shahrukh Irani. Finally, since no university-industry partnership is perfect, the speakers will share the ups and downs that were experienced during this journey which continues to this day.

Backup (Shahrukh Irani) Kaizen, More Kaizen and Even More Kaizen --- The Reason Why Most Lean Transformations Fail

Overview of this session: This session seeks to initiate a healthy debate on a contentious topic that was inspired by my industrial experience as a consultant who does not hesitate to implement the recommendations that he makes to any of his clients. Kaizen (Continuous Improvement) is one of the 3 K's (Kaizen, Kaikaku, and Kakushin) which are Japanese business philosophies representing different scales of improvement:

- **Kaizen** (continuous, small, incremental changes)
- **Kaikaku** (radical, revolutionary, rapid system-wide changes)
- **Kakushin** (breakthrough innovation or total transformation)

A job shop that does anywhere between $10 million to $100 million in annual sales can start their CI journey with employee-led improvement projects (aka Kaizen). However, there are ***at least*** two shortcomings of this approach (1) the typical kaizen has limited project scope, duration and budget and (2) the standard Lean Six Sigma or Toyota Kata training given to employees cannot solve complex tactical/operational problems. Consequently, if management assumes that kaizens alone will solve their complex tactical/operational problems, then that assumption could leave their thinking "stuck in the weeds whereby they would miss **both** the trees **and** the forest". **In stark contrast**, with its blend of Lean, Industrial Engineering science, quantitative problem-solving tools of Operations Research and pragmatic adoption of technology, Job Shop Lean can (1) support employee-led kaizen **as well as** (2) undertake advanced projects (kaikaku and kakushin) that have greater scope, more strategic impact, increased problem-solving challenges, larger budgets and higher risks.

Relevant Information for this Presentation:

1. (**Read_Me**) Kaizen, Kaikaku and Kakushin
2. (**Read_Me**) Kaizen, Kaikaku and Kakushin – What's the Difference?
3. (**Listen_To_Me**) Difference between Kaizen, Kaikaku and Kakushin
4. (**Listen_To_Me**) The 3K Spectrum of Japanese Organizational Transformation

Backup Lean, Six Sigma, TOC, HMLV Lean, QRM --- Which Approach (or Approaches) Did ***You*** Use to Overcome ***Your*** HMLV (High-Mix Low-Volume) Manufacturing Challenges?

Overview of this session: Typically, at any conference, the audience is supposed to listen to and learn from the

speakers. I reject that model/structure because, having attended numerous conferences throughout my career, I have sat and listened to many vacuous presentations (aka fluff). So this session has flipped the speaker-audience roles at a typical conference. In this session, members of the audience will become the speakers and share the work that they have done to tackle the challenges of high-mix low-volume (HMLV) manufacturing in their place of work. It does not matter how you present your achievements --- just stand up and speak while at your seat, walk up to the podium and speak from there, walk up to the whiteboard and write/diagram your work or hook up your laptop to the computer on the podium. Just do not hesitate to share what you have done because all that matters is that you successfully implemented your ideas!	
5:00 p.m.	• ADJOURNMENT • NETWORKING

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August 19, 2026

TIME	TOPIC
7:00 – 8:00 a.m.	• BREAKFAST • NETWORKING
Software to Overcome the Operational Complexity of Job Shops	
8:00 – 8:30 a.m.	(Moulydharan Vallal) Real-Time Scheduling of a High-Mix Batch Production Flow Shop using KAIROS
Overview of this presentation: *Part 1 of this presentation* will describe Kairos, a simulation-based scheduling and execution system built internally at Sila Nanotechnologies for a high-mix, constraint-heavy batch-processing flexible flow shop environment. Key topics that will be discussed include (i) why traditional ERP and MRP scheduling failed in this context, (ii) how we designed a heuristic simulation engine that re-optimizes the entire plant every 15 minutes, (iii) how the system integrates directly with plant operations and MES data, (iv) lessons learned from deployment and adoption in a live factory, and (v) a short live demonstration of the system. *Part 2 of this presentation* will focus specifically on how AI tools were used to design, prototype, test, and harden Kairos. The emphasis will not be on AI-driven scheduling logic but on AI as a software development accelerator. Key topics that will be discussed include how AI helped to (i) translate plant constraints into executable simulation code, (ii) generate test scenarios, (iii) validate edge cases and (iv) rapidly iterate on data integration with ERP and MES systems. Key topics that will be discussed include practical examples of moving from whiteboard logic to a production-ready scheduling engine in weeks rather than months, while maintaining deterministic and explainable decision logic. *Part 3 of this presentation* will focus on Kairos as a case study in architecting and implementing a plant-wide scheduling system from first principles. It was not built as an IT project but as an operations system designed by an Industrial Engineer embedded in the factory. The system architecture was shaped by end-to-end ownership of flow, costing, bottlenecks, WIP policies and maintenance constraints. Key topics that will be discussed include (i) how traditional requirements hand-offs often fail in complex manufacturing environments, (ii) how functional system builders bridge the gap between plant reality and software design and (iii) how change management was handled during deployment.	
8:30 – 9:00 a.m.	(Smart Khaewsukkho) Facilitating Shop Floor Management in a High-Variety High-Variability Job Shop using SGETTI
Overview of this presentation: Job shops deal with constant variability caused by rush orders, shared machines, shifting bottlenecks, unpredictable demand, changing product mix, etc. on a weekly, sometimes daily, basis. Traditional Lean tools may help identify to identify waste but, otherwise, they provide a static view (at best, snapshots) of a dynamic system. SGETTI is a simulation-powered Lean tool built for high-mix, low-volume manufacturing facilities, in particular, job shops. Using real time data pulled from the ERP, MES, MMS and other IT systems, it allows shops to model their operations and test improvement ideas virtually before making changes on the floor. With SGETTI, any HMLV (high-mix low-volume) manufacturer, including job shops, will be able to (i) Visualize actual production flow that occurred during any period of shop floor operations, (ii) Identify true system constraints, (iii) Compare improvement options and (iv) Estimate impact on lead time, WIP, and throughput. SGETTI has a simple goal --- to improve flow in any job shop with less risk and high predictability based on data that is being gathered continuously and fed to its machine learning algorithms and simulation models.	
9:00 – 9:30 a.m.	(Amir Ben-Assa) Navigating Manufacturing Disruptions by Leveraging AI-Driven Sandbox Simulations using PLATAINE
Overview of this presentation: This presentation will provide an educational look at how simulation-driven planning helps manufacturers respond to disruptions and plan for the future with data-driven decisions rather than guesswork. Manufacturing schedules rarely unfold exactly as planned and constantly disrupt the *expected* ("hoped	

for") production flow --- machines fail, material deliveries are delayed, urgent orders are "dropped" into the daily schedule at short notice, workforce availability constraints are perpetual, quality issues add unplanned operations to the schedule, and quality issues. In this session we explore the shift from reactive to proactive production planning using "Digital Twin" sandbox environments. *How to quickly evaluate multiple response strategies before making operational decisions?* Through practical examples, we will demonstrate how planners can quickly test alternative scenarios, such as reallocating machines, adjusting schedule priorities, modifying batch sizes or adding shifts, and compare their impact on delivery performance (OTD), resource utilization, and production stability.

9:30 – 10:00 a.m.	(Akhil George, Deepak Jacob, Aswin Jojo, Adwaith Krishna, Joel Thomas) Finding the Product Families in a Job Shop's Product Mix using GTS2021

Overview of this presentation: This presentation will discuss an app that finds the part families that exist in the large and diverse product mix of any job shop. A Part Family is "a collection of parts which are similar either because of geometric shape and size or because similar processing steps are required to manufacture them". Due to the similarity of the parts in a part family, a job shop can rationalize, standardize and semi-automate all their decisions, such as purchasing, tooling, machine selection for the operations in a part's routing, quoting and estimation, etc., for an order that they receive which can be matched to one, at most two, part families in their product mix. GTS2021 is an app that uses a variety of machine learning algorithms that utilize part data extracted from CAD drawings, routers, machinist input, etc. to solve a fundamental problem that has plagued job shops to this day.

10:00 – 10:15 a.m.	• BREAK • NETWORKING
10:15 – 10:45 a.m.	(Susindra Reddy, Sai Ganesh Parimella, Nithin Palusa, Manish Peddina) Self-Directed Work Improvement by an Employee (or Kaizen Team) using SMART CHART

Overview of this presentation: This presentation will discuss an app designed to assist a motivated employee (or a kaizen team) to collaborate with an Industrial Engineer to improve their daily productivity, ergonomics and efficiency. Smart Chart enhances the capabilities of the 100+ years old Flow Process Chart (FPC) that IEs have been using for Work Study, Operations Analysis and Methods Engineering. The app can analyze the Flow Process Chart of any macro-level work process (or system) that can be described using only seven activity symbols --- **O, ⇨, ⬆, □, ∇, D, ◇**. The app helps to create the Flow Process Chart for the work process (or system) using a combination of video analysis, voice-directed augmentation and manual input.

10:45 – 11:15 a.m.	(Kishan Sapariya and Shahrukh Irani) Implementing Value Network Mapping using PFAST ($100), LEKIN ($0) and Google OR-Tools ($0)

Overview of this presentation: This presentation will describe a case study to explain how Value Network Mapping was implemented for a vertically-integrated Make-To-Order manufacturer of a multi-component product with a multi-level BOM (Bills of Material).

The details of the product that was used in the case study are:

1. Truck scale used to weight 18-wheeler trucks that ply on US highways
2. Indented BOM (Bills of Material) with 4 levels of indentation
3. Product consists of 3 major sub-assemblies
4. Sub-assemblies are built from 16 unique components that have identical or different routings
5. Routings include 22 different work centers such as Shear, Ironworker, MIG Welding, etc.

Using the different analyses and visualizations provided by the software tools, these were the Top 15 improvement ideas that were identified:

- Increase capacity at the 763WELDM welding work center to relieve the system bottleneck.
- Reorganize the shop from a functional layout to manufacturing cells based on product families.
- Implement Kanban-based pull systems to regulate flow between key operations.
- Allocate dedicated machine time for each cell to reduce conflicts and waiting.
- Implement real-time machine monitoring across critical work centers.
- Create small WIP storage buffers near the welding operation to stabilize flow.
- Cross-train cell operators so they can run multiple machines.
- Establish SQDC performance boards and continuous improvement routines in each cell.
- Deploy shop-floor tracking systems for machine utilization and job progress.

- Postpone purchasing an additional 761PUNCH machine because it is not currently the bottleneck.
- Implement group scheduling of part families to reduce setup changes and improve machine utilization.
- Launch a formal setup reduction (SMED) program on key machines.
- Introduce dedicated material handlers (water spiders) to support each manufacturing cell.
- Standardize tooling, fixtures, and part features using Group Technology principles.
- Implement a pull-based shop floor communication system using visual signals, andons and dispatch boards.

Due to time restrictions, the speakers will flesh out the details about specific recommendations that one or more audience members would like to discuss further.

11:15 – 11:45 a.m.	(Anan Mumani) Optimizing Production Scheduling and Resource Planning using FEDRA APS (Advanced Planning & Scheduling)

Overview of this presentation: Many manufacturers rely on ERP systems to plan production, yet most ERP tools were never designed to solve the real complexity of modern factory scheduling. When multiple jobs compete for machines, tools, materials, and skilled operators across several work centers—or even multiple plants—traditional planning approaches quickly break down. This presentation introduces **APS FEDRA**, an advanced planning and scheduling system designed to manage the real-world dynamics of manufacturing operations. Using advanced optimization techniques and artificial intelligence, FEDRA simultaneously plans machines, workforce, tools, and multi-stage production orders while allowing planners to simulate alternative scenarios and respond quickly to changes in demand or capacity. The result is a more realistic, synchronized planning process that improves capacity utilization, reduces setup and lead times, and significantly strengthens on-time delivery performance across complex manufacturing environments.

Backup	(Shahrukh Irani) Implementing Lean in ***Any*** Job Shop using Product Families and Manufacturing Cells

Overview of this presentation: Any job shop increases their operational complexity and erodes margin on every order they produce and ship by making wrong decisions in one or more of these critical areas:

1. Products they decide to make
2. Machines they choose to use or acquire
3. Routing(s) they develop to produce each product

If they seek proof, they only need to (i) select 10-25 of the best performing products in their product mix and (ii) trace the routing for each of these products on a CAD drawing of the current layout of their manufacturing facility. The Spaghetti Diagram that results at the end of this exercise will vindicate me! Unfortunately, that same job shop further increases their operational complexity and erodes margin on every order they produce and ship by:

1. Choosing a functional layout for their shop floor
2. Using an ERP system that cannot handle the complexity of a job shop
3. Selecting the wrong performance metrics to drive their business and operational decisions

This presentation will explain how to use 0-1 Part-Machine Matrix Clustering (aka PQPR Analysis) helps to identify the product families that surely exist in the product mix of any job shop. Each product family is the basis for a manufacturing cell that can make any of the products in its product family. Using results from a past client engagement with a custom forge shop, these are some of the flow improvement opportunities that were considered:

1. "Cull" the product mix by removing the low-revenue low-volume parts that did not fit the factory flow
2. Implement a stand-alone independent cell
3. Co-locate 2-3 different machines into a partial cell to allow multi-machine operation by a single employee
4. Purchase and distribute identical equipment at multiple locations
5. Pursue new customers who need parts being produced in any of the existing cells
6. etc.

11:45 a.m. – Noon	Q&A WITH SESSION SPEAKERS
Noon – 1:00 p.m.	• LUNCH • NETWORKING

X's and O's Interactive Session

1:00 – 2:30 p.m.	(Shahrukh Irani) Shall We "Crowd Solve" ***Your*** Job Shop's Challenges?

Overview of this session: This session will have the format of a random lottery. Every member of the audience will write any one challenge that his/her job shop is facing on a Post It note ("chit"), fold it and drop it into a bucket. Once I have collected the chits from interested members of the audience, I will run my hand through the bucket, pick one chit and announce the challenge written on it. That will be the signal for the rest of us to offer helpful ideas, share experiences, give condolences, etc. Hopefully, the individual who submitted that challenge will walk away with an Aha! or two about what he/she could do once they get back to work. Then I will read out the next challenge and the next challenge…. this process will continue until we run out of time.

Relevant Information for this Presentation:

1. Please see Appendix 2 **Challenges Faced by Any Job Shop and Suggestions to Address the Challenges**.
2. Please see Appendix 3 **Debunking Myths about Running a High-Performance Job Shop**.

2:30 – 2:45 p.m.	• BREAK • NETWORKING

X's and O's Interactive Session

2:45 – 4:30 p.m.	(Shahrukh Irani) Do You Seek "Starter Advice" to Implement Job Shop Lean?

Overview of this session: This session will be a Q&A session with an open forum format. If any member of the audience would like to bounce their ideas about implementing Job Shop Lean in their facility when they return to work, this is the moment when they can get free advice from the rest of us. So step right up to the podium and share you plan with us. You are in the company of peers, experts and well-wishers whose only desire is to help you to successfully implement Job Shop Lean --- or whatever practice will benefit both your company's bottom line and top line.

4:30 - 5:00 p.m.	• CONFERENCE EVALUATIONS • TEARFUL FAREWELLS • ADJOURNMENT

Appendix 1

Will You Benefit By Attending This Conference?

Please answer the following questions to indicate the severity of each of the challenges of high-mix low-volume (HMLV) manufacturing that are listed below:

Our product mix widens every year but we do not rationalize it using Value Analysis.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Our Work-In-Process and Finished Goods Inventory is a significant %age of Annual $ales.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Our Time To Ship (TTS) for any order is high.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Setup Times and Cycle Times in our routers are inaccurate.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Vendor lead times are high, their deliveries are unpredictable and quality rejects are common.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Our factory layout is not organized into work cells such that each cell produces a product family.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Our factory could not handle changes in product mix and/or production volumes.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

We have no formal program to reduce setup times on bottleneck equipment.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

We use the daily production schedule from our ERP (Enterprise Resource Planning) system.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Factory logistics finds it difficult to coordinate the timely delivery of kits of parts for assembly.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Our on-floor tracking and control of tooling, inventory, consumables, dies/molds, etc. is poor.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

We do not track and display key metrics on factory performance on the factory floor.
☐ **Major Problem** ☐ **Minor Problem** ☐ **No Problem**

Appendix 2

Challenges Faced by Any Job Shop and Suggestions to Address the Challenges

Challenge	Suggestions to Address the Challenge
Our shop owner(s) do not walk their talk which makes our morning huddles a waste of our time!	1. Gemba Walks? Stand on the X? Obeyas? Morning Huddles? – all these "Lean tools" may be necessary but are far from sufficient. 2. Instead, if you can identify part families in your product mix **AND** you implement a cell to produce each part family, then on any given day you need to go to that areas in the shop where a cell is located and get a run down about their problems, their improvement ideas, their morale, their manpower needs, etc.
How to offset increase in material costs and lead times due to tariffs?	1. Partner with local competitors (or even non-competitors) to do bulk buys of key RMs to get quantity discounts to offset material costs? 2. Switch from Minimum Quantity purchasing by SKUs to Minimum $ purchasing regardless of SKUs?
AI: How Does a Job Shop Get Value From It?	I will defer to members of the audience take the lead on solving this challenge.
What to do about fluctuating demand?	1. You sleep in the bed you make! ☹ There is no question that being a Make To Order manufacturer (as does any job shop) is hard compared to being a Make To Stock manufacturer (as does Toyota). Frankly, the best job shop is no job shop! 2. When you buy (or get) the RM only after the order has been signed off with the customer, and that RM is coming in from China …..? 3. **My Solution?** Segment the product mix into Runners, Repeater and Strangers --- Produce the Runners + Repeaters in one shop and produce the Strangers in a "C-Cell" --- In the shop that produces the Runner and Repeaters, implement cells to the maximum extent possible (even if you have to revise your product mix along the way)! 4. Cull the Strangers from the product mix? 5. Find any part families in that segment then go seek out markets to move them into the other two segments? 6. Partner with a local mom-and-pop shop to be an extension of your shop?
How does one cash in on the re-shoring that is ongoing?	I will defer to members of the audience take the lead on solving this challenge
How do we tackle the shortage of skilled labor?	1. Are you sure that you have one? If you could, please record and share with me the video of your bottleneck machine (or department) in operation for an entire shift. Be sure to have the clock display time on the video! 2. **My Solution?** Segment the product mix into Runners, Repeater and Strangers --- Produce the Runners + Repeaters in one shop and produce the Strangers in a "C-Cell" --- In the shop that produces the Runner and Repeaters, implement cells to the maximum extent possible (even if you have to revise your product mix along the way to throw out the outliers)! 3. Cross train the operators in the cell so that multi-machine tending by the same operator becomes possible

	4. **My Humble Request?** Please do not fire employees as the first step to respond to lost sales, low sales, customers switching to competitors, etc. For each employee that you wish to fire, please consider cross-training them and repurposing them to fill a role (or roles) that are currently vacant.
Can a small shop retain employees by training and developing them …. or is that a sure way to lose them?	I will defer to members of the audience take the lead on solving this challenge
How does one tackled issues like work ethics, honesty, safety, mutual respect-without-boundaries, etc.?	I will defer to members of the audience take the lead on solving this challenge
Can a job shop justify a full-time Industrial Engineer?	1. I urge you to partner with academic department at a local university 2. If time permits, please meet with these speakers at the conference --- Abhinav Goyal and/or (Henry Weissenborn, Darin Alley and Sultan Ahmed Mohammed) .
Growth Planning: What are the pros and cons of (1) diversifying into new markets, (2) acquiring businesses, expanding the current facility or moving into another (bigger) facility, etc.?	1. How sure are you that you have all your ducks in a row in the shop that you are currently managing? 2. I believe firmly in the growing using knowledge of your part families to have "flexible focus" i.e. do not be reliant on one market, one customer, etc. but also not think that flexibility can be achieved with a snap of the fingers. 3. "Goodness of fit", even when you are going to buy out and absorb another business into your existing facility must take into consideration re-layout of the factory, merging of different shop cultures (and leadership styles), integrating ERP, QMS, MES and other IT systems, etc. 4. Now I would like to throw a helpline to the audience.
Can a small manufacturer form partnerships with suppliers in order to get better customer service (shorter lead times, less uncertainty about delivery dates, better quality, etc.)?	1. Co-Opetition? 2. Virtual OEM?
Is machine utilization an important metric? Or should capacity "win back" using the POOGI advocated by TOC practitioners be the priority?	1. OEE is a SH**metric --- my argument against (A*P*Q) in favor of (A+P+Q) to determine available capacity on any machine. Also, please read ***The Goal*** (because TOC offers the right advice on Machine Utilization). 2. What about OLE (Overall Labor Effectiveness) as a metric? 3. Do a time study of the video of at least a shift of uninterrupted operation of your bottleneck machine(s) ex. a welder because he/she is adding value to a product **if and only if** the arc on the welding gun is on (which is proof that welding is in-process). 4. Right-sized machines 5. Minimize machine sharing between cells by exploring the market for used machines (instead of buying new)
Production Planning and Control … uh, what is that?	1. Do **not** let your ERP do it for you! 2. Check out the better Finite Capacity Scheduling systems on the market to see if they do Demand Management. 3. Dr. Prasad Velaga has a valid claim --- in principle, a Finite Capacity Scheduler could be used for order slotting subject to resource constraints for each week of a 4-week rolling horizon. In principle, Schedlyzer can do dual resource-constrained JSS (Job Shop Scheduling) at both levels --- Master Production Schedule and Work Order Release (which is more challenging to implement successfully).

Can a job shop ever have a reliable schedule to work with every day (or at least for a week) – Part 1 of 2?	1. A job shop is not an assembly line. So please be warned if your favorite Toyota-trained Lean consultant recommends that you use "Pull Scheduling" which, in turn, requires you to use heijunka, part-specific kanbans, part-specific inventory buffers, etc.! 2. **However**, it may be possible to use this scheduling approach for a portion of your product mix if you have LTA (Long Term Agreements) from customers to produce those parts.
Can a job shop ever have a reliable schedule to work with every day (or at least for a week) – Part 2 of 2?	1. A schedule is only as good as the effectiveness of shop floor execution ex. Do you have an MES bolted onto your FCS? Are your material handlers trained to be "water spiders"? … and more 2. Beware of (i) "schedule nervousness" and (ii) indirect costs of updating shop floor status and feeding that data into the FCS so it can re-generate yet another schedule --- I urge initial focus on eliminating avoidable disruptions to the daily schedule
Are we using the correct metrics to measure the performance of our shop, our machines, our people, our suppliers, etc.?	1. There are Metrics and then there are SH**Metrics. 2. Cash Flow Velocity is a (valid) metric. 3. Total #of Pieces Shipped Per Day is a valid Sh**metric.
Overtime: Should it be an entitlement or an incentive (maybe even a reward) for good performance?	1. I am of the firm belief that O/T is not an entitlement. Instead, it should be a reward and selectively paid to employees depending on whether they are working in the Bottleneck department or any non-bottleneck department too.
To make or not to make this d##n part?	1. Unplanned proliferation of product mix is easily an example of self-increased complexity of a job shop's already high product mix. 2. I could provide (if requested by the individual) relevant literature that explains how to use Machine Learning (or Advanced Lean Six Sigma methods) to approach this problem with a data-driven decision-making mindset. 3. If time permits, please meet with this speaker at the conference --- Sultan Ahmed Mohammed --- as he is using a predictive analytics tool that you could adopt/adapt/reject as the case may turn out to be.
Are we pricing our jobs correctly (or incorrectly …. and therefore are losing money)?	1. This is a highly erroneous ill-informed statement "Estimating is not an exact science and the variation in demand makes accurate estimating difficult". I say this because Sultan Ahmed Mohammed is using a data-driven predictive analytics tool that was developed by a team of students from the Department of Statistics and Data Science at the University of Houston. 2. Especially today when Machine Learning algorithms are freely available online, I will humbly (but honestly) advise you that you should use either (or both) the Variant and Generative AI approaches that can work with mixed data. 3. If time permits, please meet with the team that is developing the GTS2021 app that was introduced during this session "**Apps to Simplify the Operational Challenges of Job Shops**" earlier in the conference.
How good is that Quoting and Estimating software?	I will defer to members of the audience take the lead on solving this challenge. Especially, if there are users of apps that do Quoting and Estimating such as Paperless Parts, Swarf and UpTool, then there is even more reason to do so.

Appendix 3

Debunking Myths about Running a High-Performance Job Shop

Myth	Reason(s) for Debunking the Myth
Cells do not work in job shops because (1) their product mix is diverse, (2) their product mix keeps changing (often frequently) and (2) the demand for the different products is volatile.[1]	Since the 1960's, cells have been successfully implemented in a variety of high-mix low-volume job shop-like manufacturing facilities.
Heijunka is an effective method for Master Production Scheduling.	The underlying assumptions of this approach do not match the typical operational environment of any job shop. A job shop only commits to produce an order when the customer accepts price and due date (else a Make-To-Stock policy is ill-advised for any job shop)
Pull Scheduling using a kanban system works in any job shop.	Yes but for only those P/Ns in the product mix that are Runners (maybe even Strangers) with an LTA (Long Term Agreement) with their customers. Otherwise, if time buffers are preferable in job shops, it is a bigger challenge to have kanban sizes measured in hours of work on any machine (instead of # of units of product).
Master Production Scheduling (MPS) as done by any ERP on the market slots orders subject to delivery dates and resource capacity constraints.	I do not know of any ERP that has the capabilities of a genuine FCS (Finite Capacity Scheduler) like OpCenter to do this. The standard approach used by any ERP is to slot orders in the production schedule using the age-old proven-to-be-totally-wrong approach of backward scheduling from due dates using fixed Lead Times.
Work centers need not be sub-divided into smaller groups of machines with identical/interchangeable capabilities.	Here is the consequence (if you think that Operator Motion waste cannot be ignored), the supervisor of each work center makes a real-time decision to load a job on the earliest available machine using FIFO priority dispatching.
CONWIP is an effective method for Production Planning, Work Order Release and Job Shop Scheduling.	The underlying assumptions of CONWIP do not align with those of a job shop. Also, I have not come across well-documented success stories in the open literature.
Drum-Buffer-Rope is an effective method for Production Planning, Work Order Release and Job Shop Scheduling.	Drum-Buffer-Rope is an effective method for Production Planning, Work Order Release and Job Shop Scheduling.
If we are not making chips, we are not making money.	**First**, you are not making money if you are making chips on the non-bottleneck machine(s) in the shop. Every job shop owner ought to read (and understand) what Eliyahu Goldratt teaches in his book (and video) *The Goal*. **Next**, despite making a humongous amount of chips on the metal cutting machines in a shop, those gains could be nullified by the non-machining work centers like the Parts Washing Station or Inspection department, not to mention the high lead times (say 1-2 weeks) of your Outside Vendors (heat treatment, electroplating, thread grinding. etc.). **Finally**, what good does it do "to hurry up to slow down" when the functional/departmental layout is guaranteed to create a batch-and-queue mode of production which embeds the costs and delays of waste (TIMWOODS) in each and every order that you produce?
To implement Lean in a job shop, start with 5S.	It is foolhardy to undertake 5S as a goal unto itself. Instead, it should be undertaken with the intention to facilitate the implementation of more meaningful "higher level" projects such as

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	Facility Layout, Shop Floor Communications, Inventory Control, etc.
We do not need a Finite Capacity Scheduler to schedule our shop. Instead, our scheduler has her spreadsheets and our ERP system. We have a morning huddle, and if need be, an afternoon huddle in our obeya on the shop floor. Our team communicates all the time to keep our orders on track.	Firefighting and expediting has been in use since the 1900s. If that is substitute for rejecting the time, effort and resources to objectively evaluate the pros and cons of integrating an FCS with the ERP …. I concede that I cannot win this argument with any job shop owner who thinks this way!
We are a data-driven shop. We have a machine monitoring system with TV monitors all over the shop displaying a range of operational metrics for all our machines such as OEE, production rates, scrap rates, etc.	A machine monitoring system presents only the "machines side" of the shop. What about the "parts side" of the shop? If being data-driven means to base planning and execution on junk metrics like the OEE of individual machines. I do not know of any job shop owner who seeks to impress their customers by boasting about their machine utilization and/or machine uptime. Instead, I think it makes more sense to track (and display) the progress of every active job on the floor to ensure on-time shipment by customer-specified due date. In particular, similar to have an andon works on a Toyota assembly line, the operators log problems/issues that they fixed (or were unable to fix) as the order flowed through the shop.
To implement Lean in a job shop, develop a Value Stream Map for one of the high-volume P/N's in the product mix.	And ignore the remainder of the product mix which typically consists of three segments --- Runners, Repeaters and Strangers?
A job shop, even one that does about $10-$15 million in sales per year, cannot afford to hire a full-time Industrial Engineer.	Please feel free to listen to the speakers in the afternoon session of this workshop --- **Darin Alley**, **Henry Weissenborn** and **Sultan Ahmed Mohammed**.
A job shop does not need to have a Finite Capacity Scheduler (FCS) as a front end to its ERP in order to generate viable production schedules subject to machine, labor, material, tooling, etc. constraints.	The case studies published on the website of FCS vendors like OpCenter, Tactic, PlanetTogether, Schedlyzer, Plataine, etc. will easily debunk this myth.
A job shop should focus on all-out shop wide elimination of the Eight Forms of Waste (TIMWOODS).	I believe that *Waste Elimination* is not the primary objective of any business! Instead, I contend that the Seven Forms of Waste are (1) symptoms and (2) quantifiable measure for the delays (and costs) of fulfilling every order placed by every customer. **IMHO**, I believe that *Lead Time Reduction* is the primary objective of any business! The reason is that a detailed timeline of all activities performed to fulfill an order constitutes the Lead Time for that order (and the individual costs that constitute the overall Fulfillment Cost for that order). And the easiest **and** simplest way to do this is to NOT do what we ought not to do at all in the first place --- NVA activities --- because every NVA activity equates to (1) a delivery delay added to the Lead Time, (2) an additional cost added to the Order Fulfillment Cost and, worst of all, (3) a potential loss of goodwill (and possibly business too) if the customer receives defective product(s) that need rework or, in the worst case, have to be scrapped!
We are a machine shop. We are in the business of selling capacity not products.	**First**, the product mix of any job shop contains Runners Repeaters and Strangers. So, depending on whether it was used to produce a P/N in one of those three typical segments in any job shop's product mix, a machine hour (and labor hour associated with that machine hour) is not going to earn the same Revenue (and Margin) for the shop. **Next**, which machine's capacity are you selling --- capacity on a bottleneck machine (or machines) or the (remaining) non-bottleneck machines? If any job shop owner has not yet read (and

	understood) what Eliyahu Goldratt teaches in his book (and video) *The Goal*, please do so (because it is a waste of capacity and hard-earned money to maximize utilization on the non-bottleneck machines in any job shop. **Finally**, if a job shop owner values his/her employees' talent and loyalty, would they not show off to customers the variety of complex P/Ns that are produced instead of photos of their expensive machines? A job shop must focus on selling CAPABILITY (not CAPACITY) to its customers.
It is the strategy of a job shop to convert all raw material for an order into finished parts. These extra parts can be sold at the higher small quantity price in the future. **Source:** Nathan Cline	Maybe if there is an LTA (Long Term Agreement) with a kanban system with minimum buy quantities on every pull, then I would agree? Otherwise, I know of cases where the job shop had to write off those parts at the end of the year for any number of reasons given to them by their customers. In that case, those parts (1) wasted bar stock (or forgings or casting or plate) that could have been used to produce parts if-and-when needed, (2) ate up machine and labor capacity that could have been used to produce other firm orders, (3) incurred inventory carrying costs, (4) (possibly) incurred tooling costs, etc. *On a somewhat unrelated note*, I worked with a "plastics produces manufacturer in Ohio" who would charge their customer top dollar to build a prototype for a new product that they wanted to introduce to the market. The price included all the above costs/losses that were listed earlier. Despite that marked-up price, the customer went with them because this supplier of theirs was their top-of-the-line supplier.
We do not need for the router for any order to show specific machines used for each operation in the router. We only specify the work center for that operation then let the supervisor on the floor take a real-time decision to load that order on a particular machine. Alternatively, if our client has purchased our MES, it will automatically route the order to the earliest available machine in the work center. **Source:** Prasad Velaga	An MES cannot (and never will) schedule because it needs an FCS (Finite Capacity Scheduler) sitting between it and the ERP system to perform that step. Job Shop Scheduling with dual resource (machine and labor) constraints is not an easy problem to solve. And even if it is solved on a computer using heuristic algorithms (today AI is claimed to be capable of doing that --- yeah right!), there is no telling that once the schedule hits the shop floor that it will not suffer from multiple disruptions due to any number of unanticipated and unplanned events. Ideally, per my experience, an FCS has "to sit between" an ERP and MES!