

## **Dr. Shahrukh A. Irani, Ph.D.**

Lean & Flexible, LLC  
4102 Pensacola Oaks Lane  
Sugar Land, TX 77479

**Phone:** 832-475-4447

**Email:** [ShahrukhIrani1023@yahoo.com](mailto:ShahrukhIrani1023@yahoo.com)

**Website:** [www.LeanandFlexible.com](http://www.LeanandFlexible.com)

### **Education:**

- Ph.D. in Industrial Engineering, Pennsylvania State University, 1990.
- M.S. in Industrial Engineering, University of South Florida, 1986.
- B.Tech. in Mechanical Engineering, Indian Institute of Technology, Madras, India, 1983.

### **Employment History:**

- *04/2014 to present:* Independent consultant
- *09/2012 to 03/2014:* Director of IE Research, Hoerbiger Corporation of America, Houston, TX
- *10/2002 to 08/2012:* Associate Professor, Department of Integrated Systems Engineering, The Ohio State University, Columbus, OH
- *09/1996 to 09/2002:* Assistant Professor, Department of Integrated Systems Engineering, The Ohio State University, Columbus, OH
- *09/1990 to 08/1996:* Assistant Professor, IEOR Division, Department of Mechanical Engineering, University of Minnesota, Minneapolis, MN

### **Innovative Practices Developed:**

1. Virtual Cells
2. Design For Flow
3. Hybrid Cellular Layouts
4. [Software] PFAST (Production Flow Analysis and Simplification Toolkit)
5. Value Network Mapping
6. Job Shop Lean
7. Smart Chart
8. Hybrid Flexible Flow Shop
9. 3R's (Reduce, Rationalize, Re-Engineer) for Simplification of Material Flow

### **A Unique Model for Delivery of Consulting Services to any Client:**

1. I work one (or more) days full-time every week at the client's facility throughout my period of engagement with them.
2. I guide and mentor in-house teams on their projects.
3. I give Continuous Improvement training to in-house teams specific to their projects.
4. I recruit, train, supervise and mentor IE interns to support my projects and training at the client's facility.
5. I leverage co-curricular programs of IE departments to support my projects and training at the client's facility.

**Special Area of Subject Matter Expertise:** I have developed a methodology – *Job Shop Lean* – to implement Lean in *high*-mix *low*-volume manufacturing and service environments. Key features of this methodology are:<sup>1</sup>

- *PFAST (Production Flow Analysis and Simplification Toolkit)*: This software for material flow analysis, work cell design and facility layout design is used to design a Lean and Flexible facility layout to implement Job Shop Lean.
- *Lean Advisory Tools (LAT) for Jobshops*: These tools for implementing Job Shop Lean use different outputs from my PFAST software.
- *Teaching Job Shop Lean to Small and Medium Manufacturers*: This 5- DVD learning package contains my lectures, books, videos, etc. for teaching about Job Shop Lean.
- *Workforce Training and Management Education*: I have a diverse collection of games, video-aided lectures and hands-on workshops to deliver training on Job Shop Lean.
- *JSLEAN* (<http://finance.groups.yahoo.com/group/jslean>): In 1999 I created and moderated this online chat group of ≈ 1300 members to educate industry about Job Shop Lean.

**General Areas of Subject Matter Expertise:** Value Stream Mapping, Rapid Cost Reduction through Waste Elimination, Methods Analysis, Computer-aided Lean Tools, Setup Reduction, Group Technology, Cellular Manufacturing Systems, Facility Layout, Material Handling, Production Planning and Control, Operations Scheduling, Shop Floor Control, Visual Inventory Management

**Results from Earliest Client Engagements to Implement Job Shop Lean:**

- *Weber Metals (Los Angeles, CA)*: The layout improvements and scheduling changes that they made yielded a one-time work-in-process (WIP) inventory avoidance of \$3,000,000.
- *Bula Forge & Machine, Inc. (Cleveland, OH)*:
  - Idle time on a constraint work center was reduced by 8 hours
  - Excess work-in-process valued at approximately \$130,000 was eliminated
  - Average flow time for orders placed for a key part was reduced from 30 days to 12 days
- *TECT (Cleveland, OH)*:
  - The new layout designed for their facility reduced floor space requirements which reduced their annual facility leasing costs by \$350,000.
  - The production lead times for forging large fan blades installed in high bypass gas turbine fans that are supplied to the Defense Logistics Agency were reduced by 80%-85%.
- *G&G Mfg. Co. (Cincinnati, OH)*: The implementation of a flexible flow cell to produce a part family yielded the following results for two of the parts in that family:
  - Part Description: *Elbow Buddy Breather*
    - ✓ Production Hours reduced from 85 to 60
    - ✓ Manufacturing Lead Time reduced from 12 work days to 5 work days
    - ✓ Profitability increased from -13% to 19.5%
  - Part Description: *Aurand Shaft*
    - ✓ Production Hours reduced from 100 to 65
    - ✓ Manufacturing Lead Time reduced from 16 work days to 6 work days
    - ✓ Profitability increased from -11% to 32.6%
- *Alpha 1 Induction Service Center (Columbus, OH)*:
  - The first year's cost savings in the work cell that was implemented was \$64,000.
  - The investment in salaries paid to the three interns who were hired to design and implement the cell was \$20,000.

---

<sup>1</sup> Please see Appendix 1 for details about my consulting services and (project) delivery capabilities.

- *Ulven Forging (Hubbard, OR)*: The implementation of the recommended layout and investment in new equipment for that layout resulted in an annual savings of \$137,000.

**Detailed Descriptions of Some Client Engagements to Implement Job Shop:**

**Wear Technology (A Division of Milacron)**

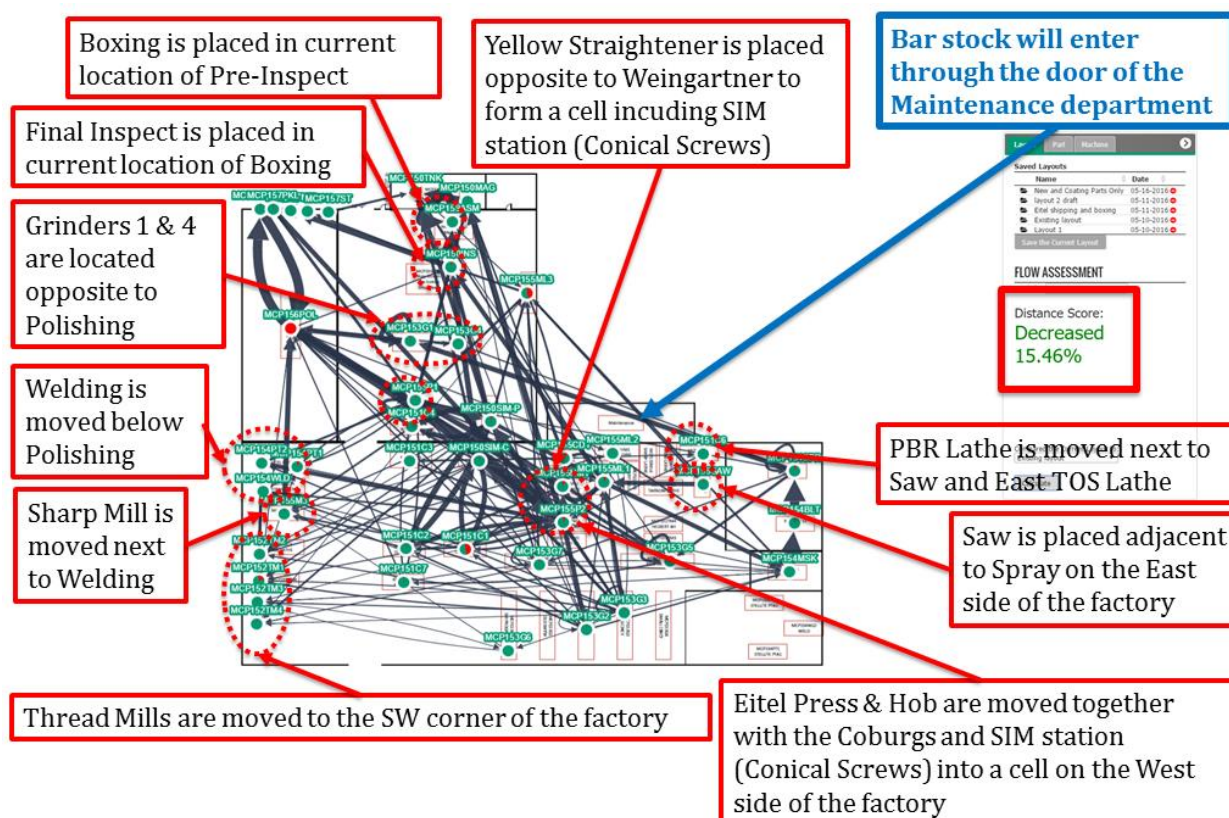
- I was their Lean Implementation Facilitator from February 2016 to August 2016.
- Some of the projects that I did were:
  - Design of the Overall Factory Layout
  - Re-Layout of the Shipping Department including Re-Location of Pre-Inspection Department
  - Single Orders Tracking Board for the Entire Shop
  - Improving Factory Logistics with Water Striders and ERP
  - Increasing Throughput in Polishing Department by Improving Productivity, Quality and Scheduling
  - Office Lead Time Reduction to Speed Up Release of Job Traveler Packets to the Shop Floor
- I gave Lean training to their employees on the following topics:
  - Introduction to Lean Manufacturing
  - Waste Identification and Elimination for Cost Reduction
  - 5 Why’s Problem-solving
  - Root Cause Analysis with Ishikawa Diagrams
  - 5S
- I mentored and gave OJT coaching to three graduate IE interns from Wichita State University who supported the in-house teams assigned to the Lean projects.
- I facilitated project review meetings between the executive team and the project teams.
- I provided strategic advice and operational assessments to the Plant Manager.
- **Sample Results:**

<b>Re-Layout of the Shipping Department including Re-Location of the Pre-Inspection Department</b>			
<b>Benefits</b>	<b>Labor Savings (Hours/year)</b>	<b>Cost Reduction (\$/year)</b>	<b>Lead Time Reduction (days)</b>
Additional production capacity to build 5-13 sets of screws per year (New, Rebuild or Repair)	Due to re-direction of 1063 hours at Straightener and Simulation from Rebuild to New orders	\$50K - \$375K	5 days
Ability to quote 18 additional Rebuilds due to faster response from Pre-Inspect department after it was re-located to the warehouse	250 hours of NVA time in Pre-Inspect department were “earned back”	\$360K	
1 FTE freed up in Pre-Inspect department	2000 hours		
<b>NOTE: The sub-project <i>Re-location of Pre-Inspect Department</i>, which moved that department out of the main building into the warehouse, allowed the implementation of all the changes in the existing factory layout shown in Figure 1.</b>			
<b>Design of the Overall Factory Layout</b>			
<b>Benefits</b>	<b>Labor Savings (Hours/year)</b>	<b>Cost Reduction (\$/year)</b>	<b>Lead Time Reduction (days)</b>
Reduction in annual material handling distance of ≈ 100 miles traveled by two Water Striders	532 hours	\$56,925	11 days
Reduction in annual material handling distance of ≈ 100 miles traveled by two Water Striders	This represents an automatic improvement in the safety of the two Water Striders who each has to push a cart that could weigh anywhere between		

		100 lbs. – 1600 lbs.	
<b>NOTE: The changes in the existing factory layout that are shown in Figure 1 were determined using a combination of the PFAST (Production Flow Analysis and Simplification Toolkit) software and FAT (Flow Assessment Tool) app.</b>			
<b>Improving Factory Logistics with Water Striders and ERP</b>			
<b>Benefits</b>	<b>Labor Savings (Hours/year)</b>	<b>Cost Reduction (\$/year)</b>	<b>Lead Time Reduction (days)</b>
The introduction of the Water Striders eliminated the current practice of the machine operator in any work center leaving their machine/s and walking around the shop looking for a cart. Once they found the cart, they would return to their machine and get the bridge crane to load the set of screws off their machine onto the cart. Then they would push the cart to the next machine and walk back to their machine	1440 hours	\$154,080	

If you would like to know more details about the results and benefits they achieved, please contact Chris Keating, Plant Manager, Milacron Wear Technology, [Chris\\_Keating@Milacron.com](mailto:Chris_Keating@Milacron.com), 620-241-1070.

**Figure 1 Layout Improvements Proposed in the Existing Factory Layout**



**Applied Cryo Technologies**

- I was their Lean Implementation Facilitator from October 2015 to January 2016.
- Some of the projects I did were:
  - Re-location and Re-layout of the Saws and Sub-Assembly Departments

- Visual Replenishment System for Raw Materials
- Order Status Tracking Board
- Lean Warehouse Design for Purchased Parts Inventory Management
- Kitting Zones for Visual Communication of Parts Shortages to Parts Fab
- Improving Throughput in Parts Fab
- I gave Lean training to their employees on the following topics:
  - 5 Why's Problem-solving
  - A3 Reports
  - Introduction to Lean Manufacturing
  - Waste Identification and Elimination for Cost Reduction
  - 5S
  - Cellular Manufacturing
- I mentored and trained one of their two Production Managers to become the internal Lean Champion for the company.
- I facilitated project review meetings between the executive team and the project teams.
- I provided strategic advice and operational assessments to the executive team.
- **Sample Results:** Re-location of the Saw department reduced annual labor costs by  $\approx$  \$20,000

**If you would like to know more details about the results and benefits they achieved,** please contact Bob Ernull, CEO, Applied Cryo Technologies, [Bob.Ernull@AppliedCryoTech.com](mailto:Bob.Ernull@AppliedCryoTech.com), 281-546-2103 and Mushahid Khan, Founder & CEO, MKhan Group, [MK@MKhanGroup.com](mailto:MK@MKhanGroup.com), 713-256-7613.

#### Trafficware Inc.

- I was their Lean Implementation Facilitator from August 2014 to December 2015.
- Some of the projects I did were:
  - Productivity Improvements and Re-layout of Panel Assembly Line
  - 2-bin Kanban System for Inventory Control of Electronic Components
  - 2-bin Kanban System for Inventory Control of Wire and Cable
  - Productivity Improvements and Re-Layout of Cabinet Assembly Department
  - Kit Carts: A Visual Kitting System to Detect Parts Shortages in Final Assembly
  - Warehouse Design using Lean Principles
  - 5S for Workstation Design
  - Assembly Cell Design for NEMA Power Supply Units
  - Assembly Cell Design for MMUs
  - Assembly Cell Design for Controllers
  - Design of Entire Factory Layout
  - Drum-Buffer-Rope Scheduling of PCB Fabrication Line
- I delivered training sessions to their employees and managers on these topics:
  - Introduction to Lean Manufacturing
  - Waste Identification
  - Kanban Systems
  - Problem-solving Tools for Daily Use
  - Manufacturing Cells
  - Theory Of Constraints
- **Sample Results:**
  - Productivity of Cabinet Assembly department increased from 5 cabinets/day to 6 cabinets/day  
**NOTE: I am not authorized to release my client's pricing information. However, a Google search for pricing information for these cabinets indicates that each could sell for anywhere between \$5000 and \$17000 per unit ([Hyperlink](#)).**
  - Productivity of Panel Line increased from 4 kits/day to 6 kits/day



- Annual rework cost was reduced by \$40,000 after implementation of a wire cart to stack panel kits coming off the Panel Line
- Annual investment in purchased inventory of wire and cable was reduced by \$40,000 after implementation of a Kanban system to link floor inventory and warehouse inventory
- Productivity of 980X Controller Cell increased from 11 controllers/day to 16 controllers/day

**If you would like to know more details about the results and benefits they achieved,** please contact Jeff Contreras, Vice President of Operations, Trafficware Inc., [JeffContreras@Trafficware.com](mailto:JeffContreras@Trafficware.com), 281-240-7233 x701 and Tim Rivali, Senior Manufacturing Manager, Trafficware Inc., [TimRivali@Trafficware.com](mailto:TimRivali@Trafficware.com), 281-269-6524.

#### **Hardy Machine and Design Inc.**

- I was their Lean Implementation Facilitator from June 2014 to December 2014.
- Some of the projects I did were:
  - Time Studies for Machine Utilization Analysis
  - Design of a Central Tool Crib
  - Material Flow Analysis for New Factory Layout Design
  - Visual Scheduling Board for Order Tracking
  - Evaluation of Monitoring Software for CNC Machines
  - Reduction of Inter-Building Transfers of Steady Rests Shared by CNC Lathes
- I delivered a training session to two teams of employees on:
  - Fundamentals of Lean for CNC Machine Shops
- **Sample Results:**
  - Time studies were done on three “work horse” CNC machines (2 lathes and 1 mill). Data analysis revealed a Value Added Utilization (VAU) of  $\approx$  31%, 39% and 50%, respectively, on the 2 lathes and 1 mill. Recommendations were made to increase each machine’s VAU and implemented during the contract period.

**If you would like to know more details about the results and benefits they achieved,** please contact Ankur Goel, President, Hardy Machine and Design, Inc., [Ankur.Goel@HardyMachine.com](mailto:Ankur.Goel@HardyMachine.com), 713-690-3335 x115.

#### **Hoerbiger Corporation of America<sup>2</sup>**

- I was their Director of Industrial Engineering Research from September 2012 to March 2014.
- Some of the projects I did either as a team leader or a team member were:
  - Re-Layout of the Shipping Department
  - Design of a FLEAN (Flexible and Lean) Machining Cell for Packing Rings
  - Bicycle Rack Storage System for Corrugated Packing Materials
  - Co-Location of the Shipping and Receiving Departments
  - Setup Reduction on an 800T Molding Press
  - Estimation of Setup and Machining Cycle Times
  - Assessment of Operational Efficiency of Power Ring Cell
  - Waste Identification in Piston and Rider Rings Cell
  - Factory of the Future: Can Water Striders and MES Make Virtual Manufacturing Cells Feasible?
  - Process Improvement in Turbine Repair Shop
  - Office Flow Analysis of Quick Response Cup Manufacturing Orders
  - Value Stream Analysis of Robodrill and Cryogenic Deburring in CNC Packing Rings Cell

<sup>2</sup> Please see Appendix 2 for details on projects I did while employed at Hoerbiger Corporation of America.

- Based on the projects I did, I wrote the following columns for *Gear Technology* magazine that can be accessed at <http://www.geartechnology.com/issues/>:
  - *The idea factory*. Gear Technology, 2013 (January/February), 26-29.
  - *Strategies for assembling continuous improvement teams*. Gear Technology, 2013 (March/April), 24-29.
  - *The Tiger Team – Hear them roar*. Gear Technology, 2013 (May), 36-42.
  - *Design of a flexible and lean (FLEAN) machining cell - Part 1 (Theory)*. Gear Technology, 2013 (June/July), 20-26.
  - *Design of a flexible and lean (FLEAN) machining cell - Part 2 (Application)*. Gear Technology, 2013 (August), 58-63.
  - *Computer-aided Finite Capacity Scheduling of a flexible and lean (FLEAN) machining cell*. Gear Technology, 2013 (October), 42-48.
  - *Educating the workforce and management about FLEAN (Flexible and Lean) manufacturing cells*. Gear Technology, 2013 (November/December), 82-92.
- I delivered a weekly training session to members of their Tiger Team on a wide range of Lean topics relevant to their individual projects.

**If you would like to know the results and benefits they achieved**, please contact Hannes Hunschofsky, Head of Production Division and Executive VP of Global Operations at Hoerbiger Compression Technology Holdings, [Hannes.Hunschofsky@Hoerbiger.com](mailto:Hannes.Hunschofsky@Hoerbiger.com), 954-478-1800.

### Results from Job Shop Lean Client Engagements (2014 to 2022):

Please see Appendix 3.

### Trade Journal Articles on Job Shop Lean Success Stories:<sup>3</sup>

1. [Hyperlink] [Custom Forge Shops: Where Job Shop Lean was Born](#)
2. [Hyperlink] [From Job Shop Chaos to Lean Order](#)
3. [Hyperlink] [Design of a Flexible and Lean Machining Cell \(Part I\)](#)
4. [Hyperlink] [Design of a Flexible and Lean Machining Cell \(Part II\)](#)
5. [Hyperlink] [The Idea Factory: Every Employee’s Idea Counts!](#)
6. [Hyperlink] [The Tiger Team: An Approach to Companywide Implementation of Job Shop Lean](#)
7. [Hyperlink] [Strategies for Implementing Continuous Improvement Teams in a Shipping Department](#)
8. [Hyperlink] [Lean Manufacturing Begins with Layout, Commitment](#)
9. [Hyperlink] [In a Machine Shop, The Labor of Lean is Data-driven](#)
10. [Hyperlink] [Ulven Forging Succeeds with Job Shop Lean](#)
11. [Hyperlink] [Implementing Job Shop Lean in a Maritime Foundry](#)
12. [Hyperlink] [Implementing Job Shop Lean in Heat Treatment Facilities](#)

### References:

Todd Chretien Director of Manufacturing Superior Energy Services 16610 Aldine Westfield Road Houston, TX 77032 Phone: 281-784-6111 Email: <a href="mailto:Todd.Chretien@SuperiorEnergy.com">Todd.Chretien@SuperiorEnergy.com</a>	Jeff Contreras VP Operations Trafficware Inc. 522 Gillingham Lane Sugar Land, TX77478 Phone: 281-269-6520 Email: <a href="mailto:JeffContreras@Trafficware.com">JeffContreras@Trafficware.com</a>
Ana Hanna Manager, Training & Development	Chris Keating Plant Manager

<sup>3</sup> Please see Appendix 3 for a summary of the results I achieved in my client engagements from 2014 to 2022.

<p>Superior Completion Services  16610 Aldine Westfield Road  Houston, TX 77032  Phone: 281-784-6181  Email: <a href="mailto:Ana.Hanna@SuperiorEnergy.com">Ana.Hanna@SuperiorEnergy.com</a></p>	<p>Milacron Wear Technology  2085 East First Street  McPherson, KS 67460  Phone: 620-241-1070  Email: <a href="mailto:Chris_Keating@milacron.com">Chris_Keating@milacron.com</a></p>
<p>Keith Farnham  General Manager  MedPlast Monticello  225 West 11<sup>th</sup> Street  Monticello, IA52310  Phone: 450-553-6400 x1  Email: <a href="mailto:KeithFarnham@Yahoo.com">KeithFarnham@Yahoo.com</a></p>	<p>Jon D. Tirpak, PE, FASM  Chief Engineer  Sabattis, LLC  974 Casseque Province  Mount Pleasant, SC29464  Phone: 843-480-5784  Email: <a href="mailto:JonTirpak@att.net">JonTirpak@att.net</a></p>



---

# APPENDIX 1

---

## Consulting Expertise and Delivery Capabilities

Website: [www.LeanandFlexible.com](http://www.LeanandFlexible.com)

### Core Focus of Consulting:

I have developed a unique approach – *Job Shop Lean* – to adapt and extend Lean for high-mix low-volume manufacturing. This approach achieves both Lean **and** Flexibility by marrying the rigor of IE (Industrial Engineering) science and data-driven heuristic optimization with the proven simplicity and effectiveness of the standard Lean tools. To implement improvement projects specific to each client’s needs, I use the software package – *PFAST (Production Flow Analysis and Simplification Toolkit)* – that my team developed at The Ohio State University with funding from the Department Of Defense. In addition, I have partnered with a network of software vendors to complete my Job Shop Lean software toolkit, such as the Sgetti app for mapping material flows on a large scale ([www.Sgetti.com](http://www.Sgetti.com)).

Please click [here](#) for details on the origin of Job Shop Lean

Please click [here](#) for an introductory workshop that gives an overview of Job Shop Lean

### Other Areas of Consulting Expertise:

Cost Reduction through Waste Elimination	Finite Capacity Scheduling
Work Simplification using Methods Analysis	Product Mix Segmentation
Facility Layout	Warehouse Design & Storage Systems
Material Handling Analysis	Setup Reduction
Cellular Manufacturing	Workstation Design
Process/Product Standardization	Flexible Equipment Selection
Bottleneck Equipment Utilization	Visual Management
ERP-aided Business Process Execution	Variety Reduction
Information and Communications Flow Analysis	Production Planning & Control

### Would Job Shop Lean Work in your Factory?

The Job Shop Lean Assessment Tool is a multi-page questionnaire that I request every client to complete. Based on their responses, I quickly assess if Job Shop Lean would work in their factory. If you wish to get a pro bono assessment of the current state of your factory operations and are willing to answer all the diagnostic questions in the Job Shop Lean Assessment Tool, please email me at [ShahrukhIrani1023@yahoo.com](mailto:ShahrukhIrani1023@yahoo.com). After the pro bono assessment, would you be willing to pay a student who will help me do a pro bono analysis of material flow in your current factory layout? It takes me about 1-2 days to use the cleaned-and-scrubbed data that the student provides to me to do an analysis using the PFAST and SGETTI software tools in the Job Shop Lean toolkit. If you are interested, please email me at [ShahrukhIrani1023@yahoo.com](mailto:ShahrukhIrani1023@yahoo.com) to request this file (Filename: 9B\_Factory\_Flow\_Diagnosis\_as\_a\_REMOTE\_Service).

Please click [here](#) to learn the process for implementing Job Shop Lean

Please click [here](#) to read about a typical Job Shop Lean consulting project

#### Success Stories:

- [Bula Forge & Machine Inc.](#)
- [Custom Furniture Manufacturing Facility](#)
- [G&G Manufacturing Co.](#)
- [Hoerbiger Corporation of America](#)
- [Maritime Castings Repair Facility](#)
- [Ulven Forging](#)
- [Wear Technology \(A Division of Milacron, LLC\)](#)
- [Superior Completion Services \(A Division of Superior Energy Services\)](#)

Please click [here](#) to access additional case studies on Job Shop Lean

#### How I Engage With My Clients:

6. Doing an operations assessment based on a facility walkthrough
7. Teaching an introductory workshop on Job Shop Lean (including/excluding a plant tour of the client's facility)
8. Conducting a simulation-aided learning seminar followed by a plant tour to identify opportunities for the host company to implement ideas learned during the simulation
9. Conducting a video-aided learning seminar using my video collection
10. Supporting a kaizen team seeking ideas on how to improve their project
11. Leading a kaizen team on a 3-5 days kaizen
12. Mentoring an intern hired by the company
13. Moderating a deep-dive discussion on a management bestseller book
14. Arranging a benchmarking visit to a non-competitor company
15. Helping a team to brainstorm on how best to implement a new management strategy
16. Leading a discussion on pros and cons of a new manufacturing technology
17. Teaching a tutorial on a new method (or tool) for Continuous Improvement
18. Arranging for a software demo by an invited vendor
19. Participating, mainly as an observer, in strategic planning meetings of the executive team

**Educational Resources:** [Online Lectures on Lean & Job Shop Lean](#)

Please click [here](#) for further information on educational resources for Job Shop Lean

#### Work Force Training & Development Resources:

If any client desires in-house training on Job Shop Lean, I develop a customized program by drawing from a diverse collection of simulations, video-aided lectures, seminars and hands-on workshops. For example, I created a training program to teach the management and supervisors of Howell Laboratories (<https://www.howelllabs.com/>) on how to stop *complaining* about a

problem and focus on leading the efforts to *solving* that problem. If you wish to receive information about the sequence and content of the lectures in that training program, please email me at [Shahrukhirani1023@yahoo.com](mailto:Shahrukhirani1023@yahoo.com).

**My Book:**

Irani, S. A. (2020). *Job Shop Lean: An Industrial Engineering Approach to Implementing Lean in High-Mix Low-Volume Production Systems*. Boca Raton, FL: CRC Press. ISBN 9781498740692.

1. [Information on Publisher's Website](#)
2. [Website to Download Appendices in the Book](#)

**Please click [here](#) for a representative list of publications on Job Shop Lean**

**Graduate IE Courses that I Currently Teach at the University of Houston:**

1. *INDE6378 Case Studies in Applied Industrial Engineering*: I teach this course in the Spring semester. If you wish to receive the syllabus for this course, please email me at [Shahrukhirani1023@yahoo.com](mailto:Shahrukhirani1023@yahoo.com).
2. *INDE6377 Flexible and Lean Production Systems*: I teach this course in the Fall semester. If you wish to receive the syllabus for this course, please email me at [Shahrukhirani1023@yahoo.com](mailto:Shahrukhirani1023@yahoo.com).

**LEAP (Learn, Earn, Apply, Practice) Internship Program:**

At least for the stellar students in my first course (INDE6378 Case Studies in Applied Industrial Engineering), I try my best to find internships for them during the Summer semester. It serves as an incentive for some of those students to return in the Fall semester and take my second course (INDE6377 Flexible and Lean Production Systems). If you wish to receive the brochure about the LEAP Internship Program, please email me at [Shahrukhirani1023@yahoo.com](mailto:Shahrukhirani1023@yahoo.com).

---

## APPENDIX 2

---

### Results from Projects at Hoerbiger Corporation of America

- *Re-Layout of the Shipping Department:*
  - The area occupied by the department was reduced by almost 50%.
  - For the same annual shipment volume, the new layout design showed the total operator walk time to be 87 hours, compared to 294 hours in the old layout. The time saved equated to a potential increase in \$ shipped annually of \$284,136.
  - Employees appreciated the compact, clean and organized layouts of their work stations.
  - A 2-bin kanban system and a computer model to predict weekly purchase quantities for various sizes of corrugated were implemented. Key results were:
    - ✓ Number of Emergency Orders due to stock-outs was reduced to 0.
    - ✓ On-hand inventory costs for various sizes of corrugated packaging materials were reduced by 18%.
    - ✓ Management could use the computer model to monitor and replenish inventories for high-value SKU's.
- *Design of a FLean (Flexible and Lean) Machining Cell:*
  - Order tracking outside the cell was reduced to only the delivery of raw materials to the cell by the Receiving department.
  - The Line Of Sight Efficiency (LOSE) of visual order management improved from 0.286 to 0.714.
  - Two pairs of machines in the cell could be tended by a single operator.
  - The distance travelled by any order processed in this cell was reduced from 618 ft. to 368 ft.
  - Order Flow Times, which were as high as 16 days, reduced to  $\leq 5$  days.
  - Standard Lead Time quoted to customers reduced from 20+ days to 10 days.
  - Shop labor time wasted every year in material transport for all orders processed in the cell reduced by 51 hours.
  - The cell footprint was reduced from 2816 sq. ft. to 1410 sq. ft. Potential benefits of this freed-up area were:
    - ✓ Fit a second cell (QRC, Quick Response Cell) into the current area occupied by this cell.
    - ✓ Use the area where the QRC was located to co-locate the Receiving department adjacent to the Shipping department.
  - Equipment purchased for this cell would free up capacity on the bottleneck machine in the CNCPC cell.
  - Reduction in Order Flow Time automatically increased the Cash Earning Velocity of the cell.
  - Order batches could be split into two or more Transfer Batches which reduced Order Flow Times and Work-In-Process.
- *Bicycle Rack Storage System for Corrugated Inventory:* These compact storage racks were implemented (i) for bulk storage outside the Shipping department and (ii) for daily usage at the packaging workstation inside the department.
- *Workforce Training Activities to Establish a Lean Culture:*
  - Every week I would give the Tiger Team about 1 hour of video-aided training or play a game to demonstrate a Lean tool relevant to their ongoing project.
  - Every week I would work with the Tiger Team for about 1.5 hours in a particular cell (or department).

- At the end of every Friday's production meetings at 7:00 a.m. with the entire first shift crew, I recognized employees for their contributions that week and concluded with an inspirational message to submit their ideas using the Employee Suggestion Form that I got approved by management.
- *Co-Location of the Shipping and Receiving Departments:* This project resulted in the following ideas for waste elimination and cost reduction:
  - Bar stock currently stored in the Barn on 18+ racks (each with 5 shelves) was consolidated into at most 6 racks.
  - Footprint of the Receiving department was reduced by 50%.
  - Co-location of the Receiving and Shipping departments eliminated 1 of 2 Supervisors.
  - Total # of employees in both departments was reduced from 5 to 3 (in Shipping) and 4 to 2 (in Receiving).
- *Setup Reduction on an 800T Press:* This project resulted in the following ideas for improving labor productivity and safety:
  - The racks that stored the End Rings, which were dispersed over multiple locations spread over the department, were consolidated into a single point-of-use location.
  - The Board Mounting Cell, which was creating noxious fumes due to the glue, was relocated to the end of the building.
  - The massive pneumatic rack that stored the extra-large molds was eliminated and replaced with a simple floor-mounted pallet system to store the molds.

## APPENDIX 3

### Results from Job Shop Lean Client Engagements (2014 to 2022)

Year	Company Name and Website	Type of Industry	Classification of Interest <sup>4</sup>	Revenue <sup>5</sup>	Cost <sup>6</sup>	Duration of Project
2014	Trafficware <a href="https://www.trafficware.com/">https://www.trafficware.com/</a>		Customer			Several months
2014	Hardy Machine & Design Inc. (Permanently closed)		Customer			Several months
2014	W. S. Darley <a href="https://www.darley.com/pumps">https://www.darley.com/pumps</a>		Prospect			Single Visit
2014	Fabrico <a href="https://www.fabrico.com/news">https://www.fabrico.com/news</a>		Customer			The contract involved using PFAST to identify manufacturing cells and propose a new layout for their facility
2015	Trafficware <a href="https://www.trafficware.com/">https://www.trafficware.com/</a>		Customer			Several months
2015	Applied Cryo Technologies <a href="https://www.appliedcryotech.com/">https://www.appliedcryotech.com/</a>		Customer			Several months
2015	Compressor Products International <a href="https://www.cpicompression.com/">https://www.cpicompression.com/</a>		Lead			N/A
2016	Trafficware <a href="https://www.trafficware.com/">https://www.trafficware.com/</a>		Customer			Several months
2016	Applied Cryo Technologies <a href="https://www.appliedcryotech.com/">https://www.appliedcryotech.com/</a>		Customer			Several months
2016	Milacron – Wear Technology <a href="https://www.milacron.com/our-brands/wear-technology/">https://www.milacron.com/our-brands/wear-technology/</a>		Customer			Several Months
2016	Milacron – Uniloy <a href="https://www.uniloy.com/">https://www.uniloy.com/</a>		Prospect			Single Visit
2016	Adoramapix <a href="https://www.printique.com/">https://www.printique.com/</a>		Prospect			Single Visit
2016	Smith’s Machine <a href="https://alignprecision.com/">https://alignprecision.com/</a>		Customer			Several months
2016	Rid-Lom Precision Manufacturing Corporation <a href="https://focusbankers.com/deal/arch-global-precision-acquired-rid-lom-precision-">https://focusbankers.com/deal/arch-global-precision-acquired-rid-lom-precision-</a>	Prospect	Rid-Lom was bought out by Jasco Tools. The contract			

<sup>4</sup> **“Lead”**: I did a free analysis but the customer did not order an implementation project. **“Prospect”**: I did a paid analysis but the customer did not order an implementation project. **“Customer”**: I did a paid/unpaid analysis that convinced the customer to order an implementation project.

<sup>5</sup> This is the revenue generated per prospect or customer in respective year.

<sup>6</sup> This is any cost associated with value creation. Typically, consulting has no material cost besides salaries and if there are no other employees involved, their salaries do not exist. How about software subscriptions or office rent?



	<a href="#">manufacturing/</a>			involved using PFAST to “fit and locate” all machines from the Rid-Lom machine shop into the Jasco Tools machine shop.
2017	Smith’s Machine <a href="https://alignprecision.com/">https://alignprecision.com/</a>		Customer	Several months
2017	Atlantic Constructor’s Inc. <a href="https://acibuilds.com/">https://acibuilds.com/</a>		Prospect	Single Visit The contract involved re-layout of their HVAC components fabrication line.
2017	Valley Machine <a href="https://alignprecision.com/">https://alignprecision.com/</a>		Prospect	The contract involved using PFAST to design a new layout for a major expansion of the existing machine shop
2017	Azco Corporation <a href="https://www.azcocorp.com/">https://www.azcocorp.com/</a>		Prospect	Single Visit
2017	Factory Glass Direct <a href="https://www.fgdglass.com/">https://www.fgdglass.com/</a>		Lead	N/A
2017	Tilco Machine Works <a href="https://tilcomachine.com/">https://tilcomachine.com/</a>		Lead	Several months
2018	Evonik Cryo LLC <a href="https://corporate.evonik.com/en/products-and-solutions/markets/construction">https://corporate.evonik.com/en/products-and-solutions/markets/construction</a>		Prospect	Single Visit
2018	Airtomic <a href="https://www.sargentaerospace.com/">https://www.sargentaerospace.com/</a>		Prospect	Single Visit
2018	Superior Completion Services <a href="https://superiorenergy.com/brands/superior-energy-completion-services/">https://superiorenergy.com/brands/superior-energy-completion-services/</a>		Customer	Several months
2018	Speed Shore Corporation <a href="https://www.speedshore.com/">https://www.speedshore.com/</a>		Prospect	Single Visit
2018	Oil Tanking North America, llc <a href="https://www.oiltanking.com/en/about-us.html">https://www.oiltanking.com/en/about-us.html</a>		Prospect	Single Visit
2018	Piping Technology & Products <a href="https://pipingtech.com/products/">https://pipingtech.com/products/</a>		Lead	N/A
2019	Addition Manufacturing Technologies, llc (Permanently closed)		Prospect	Single Visit
2019	Superior Completion Services <a href="https://superiorenergy.com/brands/superior-energy-completion-services/">https://superiorenergy.com/brands/superior-energy-completion-services/</a>		Customer	Several months

2019	National Wire, llc <a href="https://nationalwirellc.com/">https://nationalwirellc.com/</a>	Customer	Several months
2019	Apex Tool Group <a href="https://www.apextoolgroup.com/product-types">https://www.apextoolgroup.com/product-types</a>	Prospect	Single Visit
2019	Dimensional Machine Works <a href="https://www.dimensional.us/">https://www.dimensional.us/</a>	Customer	Several months
2020	Howell Laboratories Inc. <a href="https://www.howelllabs.com/">https://www.howelllabs.com/</a>	Customer	Several months
2020	Suncoast Post Tension <a href="https://suncoast-pt.com/">https://suncoast-pt.com/</a>	Prospect	Single Visit
2020	Arihant Forgings <a href="https://arihantforgings.com/">https://arihantforgings.com/</a>	Prospect	The contract involved using PFAST to design a new layout for the existing machine shop.
2020	Flowserve Corporation <a href="https://www.flowserve.com/en/">https://www.flowserve.com/en/</a>	Lead	The pilot project for my INDE6377 course used PFAST to design an Impellers Cell.
2021	Enprotech Corporation <a href="https://www.enprotech.com/">https://www.enprotech.com/</a>	Prospect	Single Visit
2021	Sundaram Clayton, Ridgeville, SC <a href="https://www.sundaram-clayton.com/Diecasting.htm">https://www.sundaram-clayton.com/Diecasting.htm</a>	Customer	Several months
2021	Envirosafe Tanks (MEMCO) <a href="https://abovegroundfuelstorage.com/">https://abovegroundfuelstorage.com/</a>	Prospect	Single Visit
2021	Jankos Mek Verksted AS <a href="http://www.jankos.no">www.jankos.no</a>	Lead	The pilot project was done to explore the market in Norway by supporting a student project at NTNU.
2021	Safran Aerospace <a href="https://www.safran-group.com/">https://www.safran-group.com/</a>	Lead	N/A
2022	Sundaram Clayton, Chennai, India <a href="https://www.sundaram-clayton.com/Diecasting.htm">https://www.sundaram-clayton.com/Diecasting.htm</a>	Customer	Several months (Ongoing)
2022	LSI Solutions <a href="https://www.lsisolutions.com/">https://www.lsisolutions.com/</a>	Prospect	Single Visit
2022	Herb Pharm <a href="https://www.herb-pharm.com/pages/our-herbs">https://www.herb-pharm.com/pages/our-herbs</a>	Prospect	Single Visit
2022	Nature's Sunshine <a href="https://www.naturessunshine.com/">https://www.naturessunshine.com/</a>	Prospect	Single Visit
2022	Central Oklahoma Manufacturers	Prospect	In Process

	Association (COMA) <a href="https://www.oklahomamanufacturers.org/">https://www.oklahomamanufacturers.org/</a>			
2022	Hai Sia Seafood Pte. Ltd. <a href="https://haisia.com.sg/">https://haisia.com.sg/</a>		Prospect	In Process
2022	Print Logic, llc <a href="https://printlogicllc.com/">https://printlogicllc.com/</a>		Prospect	In Process