MANUFACTURING INSIGHTS:
Lean Automation

SCENE 1.
LA01A
CG: FBI warning
white text centered on black to blue gradient

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SCENE 2.
LA02A
SME logo, with music

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FOR MORE INFORMATION ON AUTOMATION AND LEAN MANUFACTURING,

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WWW.SME.ORG

SCENE 3.
LA03A
Manufacturing Insights open, with music
narration
LA__ MP4: Aztec B-Roll (4:22:50 – 4:23:09) robots in action - zoom out.
CGI: Lean Automation.

MUSIC UP AND UNDER

NARRATION (VO):

MANUFACTURING INSIGHTS,

MANUFACTURING ENGINEERING MAGAZINE'S VIDEO SERIES FOR PROCESS IMPROVEMENT.

THIS PROGRAM EXPLORES THE MOTIVATIONS AND PRACTICAL IMPLEMENTATION OF AUTOMATION IN MANUFACTURING, ESPECIALLY WHEN GUIDED BY LEAN PRINCIPLES.

SCENE 4.
TBD Visual

NARRATION (VO):

THIS PROGRAM WILL FOCUS ON THREE COMPANIES AND WHAT MOTIVATED THEM TO USE AUTOMATION SYSTEMS AND LEAN MANUFACTURING PRINCIPLES.

SCENE 5. MP4: **Ophthonix B-Roll** TCR 1:01:21 – 1:01:41	**NARRATION (VO):** FIRST WE WILL SEE HOW OPHTHONIX, A SPECIALTY LENS MAKER, HAS EXPANDED THE MEANING OF THE TERM 'MASS CUSTOMIZATION.' FOR OPHTHONIX, LEAN NATURALLY WENT HAND IN HAND WITH AUTOMATION UPGRADES.
SCENE 6. CGI: Vickers Engineering Vickers B-Roll TCR (49:46:19 – 49:55:00) Zoom out on parts on table.	**NARRATION (VO)** NEXT AT VICKERS ENGINEERING, THIS SPECIALTY METAL CUTTING SHOP BEGAN ITS FIRST AUTOMATION EFFORTS WHILE STARTING A LEAN JOURNEY.
SCENE 7. Aztec B-Roll (4:41:35:21 – 4:41:44:01)	**NARRATION (VO)** FINALLY, WE'LL VISIT AZTEC MANUFACTURING, A MANUFACTURING FIRM SPECIALIZING IN MEDIUM TO HIGH VOLUME MACHINING OF ALUMINUM AND DUCTILE IRON CASTINGS, MAINLY FOR THE AUTOMOTIVE INDUSTRY. THEY INSTALLED AN AUTOMATION WORK CELL TO IMPROVE QUALITY AND CONSISTENCY.

SCENE 8.
MP4: Vickers B-Roll TCR (35:15:13 – 35:30:) Operator loading trays, zooming to robot

NARRATION (VO)

WHILE THERE IS A SCHOOL OF THOUGHT THAT BELIEVES LEAN EQUALS SIMPLE AND THEREFORE DOES NOT CONCERN ITSELF WITH AUTOMATION, A LEAN MIND-SET CAN ACTUALLY HELP OPTIMIZE THE USE OF AUTOMATION. USING LEAN PRINCIPLES HELPS GUIDE AUTOMATION IMPROVEMENTS TO SECURE GAINS IN THROUGHPUT, QUALITY, CONSISTENCY AND COST AS WELL AS WORKER SAFETY AND HEALTH.

SCENE 9.
CGI:

1. Directly observe work as activities, connections and flows

2. Systematic waste elimination

3. Establish agreement of what and how

4. Systematic problem solving

5. Create a learning organization

"Lean is not any one thing; it is how everything works together"

Source: "The Hitchhiker's guide to Lean" Flinchbaugh, Carlino

NARRATION (V0):

LEAN THINKING IS A FRAMEWORK OF HOW TO CONDUCT BUSINESS THAT SUPERSEDES ANY PARTICULAR TOOL. GENERALLY RECOGNIZED TO INCORPORATE FIVE BASIC PRINCIPLES, HOW AN ORGANIZATION ESTABLISHES ITS OVERALL BUSINESS PROCESS IN LINE WITH THESE PRINCIPLES WILL EVENTUALLY INFLUENCE ITS CHOICE OF TOOLS, SUCH AS AUTOMATION. TOOLS ALONE ARE NOT ENOUGH - TOOL SELECTION IS INFLUENCED BY A BUSINESS OPERATING SYSTEM THAT INCLUDES ORGANIZATION, PROCEDURES, GOALS, TRAINING AND CULTURE, AMONG OTHER FACTORS. SINCE AN ORGANIZATION-WIDE LEAN JOURNEY SUPERSEDES CONSIDERATION OF TOOLS, THIS VIDEO WILL CONCENTRATE ON THE PRINCIPLES THAT HAVE SPECIAL RELEVANCE, WHILE RECOGNIZING THAT A TRUE LEAN JOURNEY ENCOMPASSES MUCH MORE.

SCENE 10.
LA06A CGS:
1- Think 'Creativity Before Capital'
2- Develop a Value Stream Map
3- Set Goals:
- High repeatability and quality
- Worker safety and health
- Increased cycle time
- Reduce waste
- Develop the right level of automation
4- Plan for The Future

NARRATION (VO):

A NUMBER OF FACTORS IN PURSUING AUTOMATION WITH LEAN COULD BE CONSIDERED. FIRST AND FOREMOST IS 'CREATIVITY BEFORE CAPITAL.' BETTER IS NOT ALWAYS MORE AUTOMATION. PROCESS IMPROVEMENTS THAT CAN BE GAINED WITHOUT CAPITAL EXPENSE ARE THE MOST COST-EFFECTIVE. TO HELP GUIDE DECISIONS IN DEVELOPING AN IMPROVEMENT, IT IS SUGGESTED TO DEVELOP A VALUE STREAM MAP OF THE PRODUCTION PROCESS. A VALUE STREAM MAP CAN HELP SET GOALS FOR WHAT YOU HOPE TO ACHIEVE, GUIDING YOUR STRATEGY FOR AUTOMATION AFTER OTHER IMPROVEMENTS TO ACHIEVE GOALS ARE EXHAUSTED. SUCH GOALS COULD INCLUDE: INCREASED REPEATABILITY, WORKER SAFETY, OR FASTER CYCLE TIMES. PROPER IDENTIFICATION OF GOALS HELPS SET THE RIGHT LEVEL OF AUTOMATION. OVER AUTOMATION LEADS TO WASTE FROM EXCESS INVENTORY OR IDLE EQUIPMENT.

FINALLY, PLAN FOR THE FUTURE. LEAN MEANS CONTINUOUS IMPROVEMENT. AUTOMATION BUILT WITHOUT FLEXIBILITY IS NOT LEAN. EXPECT CONFIGURATIONS AND PROGRAMMING TO CHANGE IF WANT TO GAIN FROM THE BENEFITS OF LEAN.

SCENE 11.
Ophthonix B-Roll TCR 1:01:21 - 1:01:41

NARRATION (VO):

OPHTHONIX IS A COMPANY THAT DECIDED LEAN PRINCIPLES AND AUTOMATION WERE A NATURAL FIT. OPHTHONIX IS A HIGH-PRECISION EYEGLASS MANUFACTURER BASED IN VISTA, CA THAT CREATED AN AUTOMATED MANUFACTURING FACILITY FOR DELIVERING LENSES CUT FOR EACH INDIVIDUAL.

SCENE 12.
Ophthonix B-Roll TCR 12:42:00 - 12:47:05 Hand holding lens, still last frame as necessary

NARRATION (VO):

EACH OF US HAVE A UNIQUE OPTICAL FINGERPRINT THAT CHARACTERIZES OUR VISION – LENSES CUT TO MATCH YOUR OPTICAL FINGERPRINT WILL CORRECT FOR MICROSCOPIC IRREGULARITIES AND PROVIDES HIGH-DEFINITION CORRECTION.

SCENE 13.
MP4: Ophthonix B-Roll TCR 4:35:00 – 5:00:00) Lens rotating on fixture

Cut to ->

MP4: Ophthonix B-Roll TCR (28:45:00 – 29:30:00) Close up of lens in packaging with barcodes.

NARRATION (VO)

A KEY ENABLER FOR THIS ARE FREE FORM LENS EQUIPMENT THAT CUT SUCH LENSES TUNED TO AN INDIVIDUAL'S PRESCRIPTION. A PATIENT'S PRECISE PRESCRIPTION IS CONVERTED TO A DIGITAL FILE THAT A COMPUTER-CONTROLLED-NUMERICAL CUTTING MACHINE, OR CNC, USES TO TURN A BLANK LENS INTO A HIGH-DEFINITION VERSION OF AN EYEGLASS LENS. THIS IS TRULY MASS CUSTOMIZATION – CONTINUOUS FLOW OF INDIVIDUALLY TUNED COMPONENTS. AFTER CUTTING, POLISHING AND COATING EACH LENS THAT COMES OUT OF THE FACTORY IS UNIQUE TO EACH INDIVIDUAL.

BUILDING AN AUTOMATED SYSTEM AROUND SUCH UNIQUE CNC MACHINES WAS THE CHALLENGE.

SCENE 14.
MP4 Lemperla TCR(0:00 – 1:09:10)

CGI: John Lemperle
Vice President of Operations
Ophthonix, Inc.

(Lemperle on camera)
From the get-go it became very clear that quality was going to be the key to our success. We start with very high accuracy prescription information from our Z-view, and we have to deliver it on the lens. Without that high level of precision, which I'm referring to as quality, we fail. To do that, we wanted to utilize the latest equipment, freeform, that is very precise, down to the 10th of the diopter, and take the human element out of it. Automation was the ticket to do that.

SCENE 15.
MP4: Ophthonix B-Roll TCR (21:18:11 – 21:46:00) Conveyor feeding cabinet with red/green light on top

NARRATION (VO)

RECOGNIZING THAT AUTOMATION WAS KEY TO ACHIEVING THEIR GOAL OF QUALITY AND REPEATABILITY, THEY ALSO KNEW THE POWER OF LEAN PRINCIPLES. LEAN THINKING WAS INTEGRAL TO THE DESIGN OF THEIR AUTOMATION, ESPECIALLY THE LEAN CONCEPT OF ONE-PIECE, CONTINUOUS FLOW.

SCENE 16.
MP4 Lemperla TCR(~2:02 – 2:38:15)

MP4 Lemperla TCR(2:57 – 3:14:01)

LEMPERLE ON CAMERA:
It's the only way to run a manufacturing business. This process will lend itself to that. We get jobs of one in from a doctor, one pair of spectacle lenses. Most labs run in batch. They load them up in carts and push them from station to station. What we utilize is a continuous flow automation system, pick and place one job at a time.

If you do batch, you make batches of bad things. If you do units of one, you make bad things in units of one. Eventually the process is going to change, you're going to drift, you're going to have rework. It's not going to be nominally set. You want to catch it with one. You want to stop.

SCENE 17.

MP4: Ophthonix B-Roll TCR (7:13:00 – 7:28:00)

Narration MP4: Lemperla TCR (30:06:03 – 30:21:00)

Lemperle off camera

there are no carts, there are no stacks, there's a fraction of work on the floor, because it's continuous and it's one job at a time. So essentially there is no expediting. Your expediters go away, your material handlers go away.

SCENE 18.
MP4 Jay Hystercamp – Ophthonix (TCR 21:38 – 22:25)

CGI: Jay Hystercamp
Director of Optics Laboratory
Ophthonix

Hystercamp on camera

We had set up kanbans for our individual inventory locations for our raw lenses, as well as all our supply items, just to make sure we had enough on hand for a certain time period, to make sure we never run out. Then also we used line balancing and just-in-time for each job, so it would go automatically on the system, on the conveyor, and it would go machine to machine, to make sure we could keep that cycle time reduced as much as possible. It also helps with our quality issues, so that if something did pop up, if one of our machines was not giving us the quality that we wanted, we would know right away, without knowing exactly what we needed to change.

SCENE 19. MP4: Ophthonix B-Roll TCR (00:52:00 – 1:20:00) Pan over conveyor lines and three pieces of cabinet equipment Narration: MP4 Lemperle – Ophthonix TCR (~ 4:55 – 5:18:23)	Lemperle off Camera: The pull system, the product with the automated line, is really pretty straightforward. There are three pieces of equipment, and they all do the same thing. A job gets sent to each one. When one completes a job, another one gets sent to it. If it doesn't complete the job, they go to the other machines, which in fact are producing. So if it doesn't output something, nothing more comes.
SCENE 20. MP4: Ophthonix B-Roll TCR (21:35:00 – 22:00:00) cut to (23:37:00 – 23:48:00) Various people working	NARRATION (VO) WHILE AUTOMATION IS SEEN AS THE KEY TO SOLVING MANY PROBLEMS IN QUALITY AND REPEATABILITY, THE HUMAN FACTOR REMAINS. LEAN PRINCIPLES FOCUS ON SUPPORTING THE OPERATOR TO ELIMINATE WASTE. INTRODUCING AUTOMATION CHANGES THE PROBLEM BY BLENDING AUTOMATION WITH NECESSARY MANUAL WORK AND HUMAN GUIDANCE.
SCENE 21. MP4: Lemperle – Ophthonix (TCR 5:26:00 – 6:04)	Lemperle on camera: The investment in this type of business shifts from one of lots of people to lots of capital, very expensive. Fewer people, but more sophisticated, more highly trained. Their eye has to be keen to process, to variation, to something is different; to doing preventive maintenance, doing calibration, all up front kinds of things. Watching real good. You can't be asleep at the job. As opposed to manual labor. That's really the change.

SCENE 22. Narration MP4 Hystercamp – Ophthonix (TCR (24:45 – 25:58) MP4: Ophthonix B-Roll TCR 12:50:05 – 13:20:00) Lens Polishing	Hystercamp on-camera The roles changed in the fact that we now had to make sure each piece of equipment was calibrated every day and also that we had predictive and preventive maintenance plans in place, *(Hystercamp off-camera)* so if a piece of equipment did go down, we had the spare parts on hand, we could easily change the conveyor system to make sure it was shown that that piece of equipment was down for maintenance, and we could still keep running the lab, going through the different secondary pieces of equipment, and still keep the line going. So it was more of a training issue of up front, doing the calibration work, and then making sure we had the maintenance people to keep our capital equipment up and running.
SCENE 23. {Screen snap from Eagle Technologies}	NARRATION (VO) TODAY'S SIMULATION AND VISUALIZATION TOOLS AID IN DESIGNING AN AUTOMATED PRODUCTION LINE, REDUCING COST BY ALLOWING ENGINEERS TO DESIGN IN DETAIL MOVEMENTS, MOTIONS AND SPACINGS OF EQUIPMENT BEFORE INSTALLATION. USING SIMULATION IN DESIGN CAN BE ESPECIALLY USEFUL IN PLANNING FOR THE FUTURE, TO ANTICIPATE CHANGE THAT FITS IN WITH THE LEAN CONCEPT THAT IMPROVEMENT NEVER ENDS.
SCENE 24. {Screen snap from Eagle Technologies} MP4 Hystercamp – Ophthonix (TCR 27:15 – 27:52)	Hystercamp (on or off tbd on screen snap) Working with our architects, we had the floor space already mapped out. They put it into the 3D model. (Hystercamp on-camera) We then loaded in all the conveyor system and the complete build out of our equipment over our growth plan, just to be sure that we understood the base model of what we were going to input and install to begin with, but also knowing three years from now where we wanted to go and how we wanted to add that new equipment as our business grew.

SCENE 25. MP4 Lemperle – Ophthonix (TCR ~ 13:44 – 14:20)	LEMPERLE (ON CAMERA) We have throughputs from the manufacturers for the major pieces of equipment. So we know capacity. We know where there's a dwell time, where things have to cool. We built that into a simulation package where we can run the whole lab digitally, electronically. We could add equipment, we could balance conveyor speed for cooling time. As we added equipment and went from a lab at 600 jobs a day to 2500 jobs a day, what pieces of equipment do you add and in what order, to keep that lab balanced? We simulated that not only from day 1, but all the way through a 3-year build-out of that lab.
SCENE 26. MP4: Ophthonix B-Roll TCR (26:13:00 – 26:40:00) Conveyor belt feeding elevator. MP4 Lemperle – Ophthonix (TCR ~ 14:28 – 15:11)	LEMPERLE (OFF CAMERA) we used an elevator, that we can time, that takes it from waist height up 15 feet in the air, and then the trays move overhead. So we have a nice open lab, nice flow of people, and the job is cooling, so it solved both of those for us.
SCENE 27. MP4: Ophthonix B-Roll TCR (26:13:00 – 26:40:00) Conveyor belt feeding elevator.	NARRATION (VO) A STAGED APPROACH TO COMMISSIONING THEIR NEW AUTOMATED FACILITY EASED MANY OF THEIR TRANSITION DIFFICULTIES.

SCENE 28.
MP4 Lemperle – Ophthonix (TCR ~ 17:26 – 18:29)

LEMPERLE

We bought the equipment ahead of time. Each of the work cells, or the majority of them, we ran as free-standing cells in a prototype R&D facility before we moved into this building. So we had experience running the cell, the individual machine. We didn't have experience with them all tied together. That we simulated. We had redundancy in equipment, so we kept our prototype facility running, installed the second piece of equipment in the new facility, commissioned it, before we shut down the other piece of equipment. ~~Like I said,~~ that process took two weeks, three weeks. Then we pulled the first piece of equipment and moved it up here. So we really were running production in both facilities. I would recommend that approach to anybody.

------- FADE TO BLACK ------

SCENE 29.
Vickers B-Roll TCR (58:53:03 – 59:30:00) Vickers building sign, Still last frame as needed

Narration (VO)

VICKERS ENGINEERING IS ANOTHER COMPANY INCORPORATING BOTH LEAN MANUFACTURING PRINCIPLES AND INCREASED AUTOMATION. IT RECENTLY INSTALLED ITS FIRST ROBOTIC WORK CELL AND PLANS ON ADDING MORE AS LESSONS ARE LEARNED FROM THE EXPERIENCE.

VICKERS ENGINEERING IS PRIMARILY A METAL-CUTTING SHOP. EXPANDING INTO FABRICATION IN RESPONSE TO CUSTOMER DEMAND, VICKERS BUILDS ASSEMBLIES AND PERFORMS WELDING. WITH APPROXIMATELY 60 DIFFERENT CUSTOMERS, VICKERS ENGINEERING BOASTS A DIVERSIFIED MARKET THAT ADDRESSES AGRICULTURE, AUTOMOTIVE, AND HEAVY EQUIPMENT. THEY CURRENTLY SUPPLY 1800 DIFFERENT PART NUMBERS ON A 'JUST IN TIME' DELIVERY BASIS, MINIMIZING INVENTORY, MACHINE AND LABOR COSTS.

THE DESIRE TO IMPROVE LED THEM TO IMPLEMENT BOTH LEAN AND AUTOMATION.

SCENE 30.
MP4: TCR (6:55:00 – 8:03:07)

CGI: Kurt Seger
Director of Mass Production
Vickers Engineering

Seger on Camera
We started a movement basically a year and a half ago, started into lean manufacturing. We felt a need to pull in some outside help from some of the local colleges. Their trainers had worked through the TPS system, which was great, because Toyota is one of our customers. So we started with 5S and standardized work. Vickers philosophy is always to start with the fundamentals, take baby steps, and always go forward. Right now we're cleaning the shop up, standardizing work, training operators to get them involved. Maintenance is starting to engage in that as well. We're not there, and I don't think in that system you're ever there, you always have to be striving to the next level.

SCENE 31.
MP4: Vickers B-Roll TCR (51:30:18 – 51:40:12) Operator holding teach pendant with robot in background.

NARRATION (VO)

VICKERS EARLY ON RECOGNIZED THE NEED FOR AUTOMATION TO SOLVE SAFETY, ERGONOMICS AND QUALITY ISSUES, COMMON REASONS FOR EMPLOYING AUTOMATION. THEIR EFFORTS TO AUTOMATE PRECEDED THE START OF THEIR LEAN JOURNEY.

SCENE 32.
MP4 Kurt Seger TCR (5:00 – 6:02:25)

Seger on Camera,

Vickers has a simple philosophy that's three-tiered, safety, quality, quantity, and all that ties into customer service. When we have difficulty reaching any one of those levels we set, then sometimes a potential is automation, whether it be robotics or auto gaging. In some of the cases that we have examples on the floor, it was all three, where we had heavy parts, ergonomic issues, fast pace where the operator just couldn't keep up, which ties into quality and throughput. Heavier in the quality end, if an operator has to load a part, there's the potential to mis-load the part. In a fast-paced environment, a robot is going to be very consistent, and we can put presence detection in there for the part. It just takes that right out of the equation. Then from the quality side, we're doing some auto gaging as well.

SCENE 33. MP4: Vicker B-Roll TCR (34:15:00 – 34:20:00) Cut to MP4: Vicker B-Roll TCR (38:00:00 – 38:30:00) {as needed}	NARRATION (VO) IN THE MOST RECENT AUTOMATED WORK CELL INSTALLED, VICKERS EMPLOYS DUPLICATE, IDENTICAL ROBOTS IN ITS AUTOMATED WORK CELL THAT PROCESSES TWO DISTINCT PARTS, A BRAKE CALIPER SUPPORT AND A ROOF HEADER. BOTH PARTS CAN RUN ON BOTH MACHINES, IMPROVING THROUGHPUT BY MINIMIZING DOWNTIME. AN OPERATOR LOADS PARTS FOR THE WORK CELL AND ONCE PROCESSED BY THE CELL, GAGES PARTS FOR QUALITY AND PACKS THE PART FOR SHIPMENT.
SCENE 34. MP4 Kurt Seger TCR (~6:09:00 – 6:28:19)	Seger on camera We'll take one operator and manage two cells, instead of having two operators. We're going with a higher qualified operator and paying them more for it, which they all appreciate. On the engineering side of things we have a much more robust process that we can rely on day in and day out.
SCENE 35. MP4: Vickers B-Roll TCR (53:14:19 – 53:30:12)Robot picking parts off circular moving belt.	NARRATION (VO) FOR VICKERS, PURSUING BOTH LEAN AND AUTOMATION WERE IMPORTANT TO THEIR LONG-TERM GOALS. COMBINING THEM WAS A NATURAL OUTCOME OF THEIR EFFORTS. CERTAIN LEAN PRINCIPLES STOOD OUT WHEN APPLIED WITH AUTOMATION. THE CONCEPT OF POKA-YOKE - OR ERROR PROOFING - USING AUTOMATION WAS ONE EXAMPLE.

SCENE 36.
MP4:Kurt Seger TCR (8:58:00 – ~9:20:00)

MP4: Kurt Seger TCR (9:20:00 – 9:42:07) off-camera narration

Vickers B-Roll TCR (38:01 – 38:23) Robot moving material in and out of machine cabinets.

Seger on Camera
~~Some of our biggest,~~ if you look at our corrective actions we've gotten through the years, a lot of them are simple mistakes, they are typically not the technical ones. They are all relative to operator levels training and accountability. Those are the things that we immediately recognized that a robot, time in, time out, as well as you program it and maintain it, it's going to perform. (off camera) Then we put limit switches in for certain conditions that interface back into the machine control, which will put the machine into a Stop, whether it be tool life, missing features, certain levels of throughput not being hit. Those are all things we tried to incorporate.

SCENE 37.

MP4 Vickers B-Roll TCR (42:43 – 43:05)

NARRATION (VO)

END-EFFECTORS, DEVICES THAT ARE APPLICATION SPECIFIC AND ARE FITTED TO THE ARMS OF ROBOTS, ARE WHERE THE WORK IS DONE. END-EFFECTORS MAY INCLUDE SPRAY GUNS, WELDERS, DRILLS, DEBURRING TOOLS OR TOOLS DESIGNED FOR PART MANIPULATION.

THE VERSATILITY OF ROBOTIC AUTOMATION FITS WELL INTO THE LEAN CONCEPT OF CONTINUOUS IMPROVEMENT. PROGRAMS CAN BE ADJUSTED OR END-OF-ARM TOOLING TUNED WITHOUT A MAJOR INVESTMENT IN NEW EQUIPMENT. ONCE PURCHASED, 'CREATIVITY BEFORE CAPITAL' IS A REALISTIC OPTION IN AN AUTOMATED ENVIRONMENT.

SCENE 38.

MP4:Kurt Seger TCR (17:47:00 – 18:34:00)

Seger on camera

The end of arm tooling is just like the chuck is to your CNC machine, it's only as good as you design your end of arm tooling. Your robot is going to be useless unless it can interface with your cell correctly and robustly, and repeat time in and time out.

Your material selection, your pneumatic system, if it's hydraulic or pneumatic, those all have to be well designed and well maintained, or it's just not going to repeat. We went through some design changes in regards to some of those features, and have learned some things along the way. Robust design is really what it boils down to.

SCENE 39.
CGI: Robot Interfaces and Control System Logic on blue background.

MP4: Vikcers B-Roll (39:20:00 – 39:30:00)Robot in action

NARRATION (VO)

IMPORTANT TO THAT ROBUST DESIGN IS INCLUDING THE ENTIRE SYSTEM IN THE DESIGN, ESPECIALLY IN COMPLEX MACHINING ENVIRONMENTS.

SCENE 40.
MP4:Kurt Seger TCR (14:20:00 – 14:55:00)

Seger on camera

We purchased secondary logic systems that interface multiple if-then-what else as the robot goes through its function. We needed much more logic than a typical robot would come with in this control package. We're trying to get the most out of it, trying to eliminate as many redundant processes as possible, from deburring to just simple checks for hole presence.

SCENE 41.
MP4 Vickers B-Roll TCR (53:18:32:00 - 53:28:32:00) Robot lifting parts and placing them into machining cabinet

NARRATION (VO)

WITH ROBOTIC AUTOMATION CAPABLE OF GREATER LOADS AND HIGHER REPEATABILITY TODAY, THESE BENEFITS OF SAFETY AND ERGONOMICS WILL CONTINUE TO BE ATTRACTIVE.

SCENE 42.
MP4 Vickers B-Roll TCR (54:30:00-55:33:00) Robot lifting parts and placing them into machining cabinet – still last frame as needed.

Narration - MP4:Kurt Seger TCR (~ 18:45:00 – 19:52:17)

Seger off camera (VO)

We have cells that we have to rotate people just from burnout and the physical load they carry. We deal a lot with ductile iron, and a lot of the parts are heavy. We have reduced our medical claims in regards to carpel tunnel, for example. You reduce your risk of dropping parts on your feet, smashing your fingers in fixtures. Those types of instances have dropped in the cells we implemented this in. Cuts from handling sharp edges on parts—the robot will debur the part before the operator even touches it, so the operators that are interacting in those cells are in a much safer environment now

SCENE 43.

MP4: Vickers B-Roll TCR (51:45 – 52:00) Operator working teach pendant.

NARRATION (VO)

WITH THE CAPABILITIES OF TODAY'S AUTOMATION, IT MIGHT BE A FAIR QUESTION TO ASK: WHY ARE OPERATORS NEEDED IN A PRODUCTION CELL AT ALL? OFF-LINE PROGRAMMING USING SIMULATION SOFTWARE COUPLED WITH ROBOTS EQUIPPED WITH ADVANCED SENSING, SUCH AS MACHINE VISION, COULD MEAN 'LIGHTS OUT' MANUFACTURING.

SCENE 44.
MP4:Kurt Seger TCR (~ 10:21:00 – 11:34:)

Seger on camera
There are times when it would just flat out cost too much money to implement or program every piece of logic necessary to run a cell. Too many times the areas are a shade of grey instead of black and white, and when you're trying to program for that it just becomes impossible, there are too many variables. So there are cases where a high level operator that can make decisions based on certain conditions is a must. There are times when you can automate a system in a lights-out environment, and your operator would interact really only at a point when they're loading up a bar feeder or loading up a vibratory hopper to feed the system. If your quality is all taken care of, your tooling can be redundant, it can be as simple as that. So the level at which you need an operator can change. You would always need them at some level. We like to think that there is no need to design an operator totally out of the system.

SCENE 45. MP4: Vickers B-Roll TCR (58:42:11 – ~58:51:00) Operator working inside cabinet	Narration (VO) WHILE AUTOMATION IS A BOON TO PROCESS – IMPROVING QUALITY, REDUCING WORKER STRAINS AND IMPROVING SAFETY – THERE CAN BE NO DOUBT THAT INCREASINGLY COMPLEX MACHINERY REQUIRES A HIGHER LEVEL OF OPERATOR SKILL. DEVELOPING THAT OPERATOR SKILL THROUGH TRAINING IS ESSENTIAL IN A LEAN ENVIRONMENT.
SCENE 46. MP4:Kurt Seger TCR (~ 11:44:00 – 12:34:00)	Seger on camera There is a lot more one-on-one time with the engineering staff, both the process engineer and the interface engineers, and the maintenance personnel. We try to make standardized work for recoveries. There are certain scenarios where the simplest things will wear, and the machines will go into an interlock state, and we like to have the operators have the ability to get the machine back to a zero point so they don't need maintenance or engineering. That becomes very nice on the weekends when there is minimal staff here. The other side of that, the typical operator gets mentor trained by a senior operator or a lead man, who wouldn't necessarily have the capability to walk them through all these scenarios.

SCENE 47.
Fanuc Simulation Video
(I am expecting some from Cathy Powell at Fanuc or use Motoman if needed)

Narration: MP4 Kurt Seger TCR (~ 20:40:00 – 21:10:00)

NARRATION (V0)

LIKE MANY OTHERS, VICKERS HAD THE OPPORTUNITY TO USE OFF-LINE SIMULATION TO ESTABLISH A WORKABLE PLAN FOR THEIR SYSTEM.

(Seger - Off Camera)
It takes all the guesswork out of it. You can statistically look at all of your white points, where your cell may not have been programmed correctly. You may find you have 5 extra minutes of robot time, so what else can that robot do now. Where you may have just thought you wanted to do one thing or a couple things, you find out through simulation that you actually have an extra X-amount of minutes to incorporate even more into the automated cell.

SCENE 48.
CGI:
Seven Wastes of Lean:
- Defects
- Transportation
- Overprocessing
- Motion
- Waiting
- Excess Inventory
- Overproduction

Source: "Lean Lexicon" 3rd edition, Lean Enterprise Institute

NARRATION (VO)

LEAN TERMINOLOGY DISCUSSES SEVEN WASTES, ANY ONE OF WHICH AUTOMATION COULD CONTRIBUTE TO. IN PARTICULAR, 'OVER AUTOMATION' CAN LEAD TO OVERPRODUCTION AND EXCESS INVENTORY, EVEN IF IT LEADS TO FEWER DEFECTS OR MOTION ON THE PART OF OPERATORS. SOMETIMES IT IS SIMPLY A MATTER OF CONVERTING THESE PRINCIPLES INTO COST.

SCENE 49.
MP4:Kurt Seger TCR (~ 25:16:00 – 25:42)

Seger on camera

You can over-automate from the standpoint of looking at your piece price, your dollars per piece, what you're selling the product for. You may be able to gain 30 percent more profit by having an operator do X amount, and if your minimum profit level is set here, and you're here because you have too much automation, that's a question that has to be asked.

SCENE 50. MP4: Vickers B-Roll TCR (35:45: – ~36:00:00) Zoom out of equipment, jump to robot in cell.	**NARRATION (VO)** ESTABLISHING AN AUTOMATED OR ROBOTIC WORK CELL CAN BE A CHALLENGE, ESPECIALLY IF A COMPANY IS DOING SO FOR THE FIRST TIME. IN THE CASE OF VICKERS, THE LESSONS LEARNED WERE MORE IN THE SYSTEM SURROUNDING ITS ROBOTIC AUTOMATION.
SCENE 51. MP4:Kurt Seger TCR (~ 26:19:00 – 26:58)	Seger on camera ~~What we have experienced,~~ we have had close to perfect uptime on the robot itself. Other than a couple hoses getting pinched, airlines close to the end of arm tooling, we have not had any robotic downtime. It has all been support functions—logic problems, different parts of the process interfacing the main control logic system. It's all support systems that have typically led to our downtime, ~~your hydraulic systems, your pneumatic systems.~~
SCENE 52. MP4: Vickers B-Roll (47:33:00 – 48:00:00) robot in action, moving parts from cabinet to gauging station. Narration- MP4:Kurt Seger TCR (~ 24:12:00 – 24:39:00)	SEGER OFF CAMERA There is a ramp-up, there is a learning curve, and it is a pretty steep one. Do the work up front, design a robust system, get help from your vendors, make sure your maintenance staff are well trained both on the mechanical and the software side. You do that and you'll have a good, robust, solid process.
SCENE 53. MP4:Kurt Seger TCR (~ 9:42:00 – 10:14:00)	Seger on camera There is a lot of interface and secondary logic systems that are tied into these robotic systems, and it has been a struggle and hurdle getting them to a stable platform. We've just gotten over that level where you can rely on them day in and day out, but we did have a lot of trial and error for these periods, getting the interface just right. **------- fade to black ------**

SCENE 54.
MP4: Aztec B-Roll TCR (04:41:44:01 – 04:42:00) Sign before Aztec Building

IN ADDITION TO AUTOMATION, AZTEC MANUFACTURING IN ROMULUS MICHIGAN DEFINED LEAN MANUFACTURING PRINCIPLES AS A KEY ELEMENT BOTH TO THEIR OVERALL OPERATIONS AND TO THE BASIC DESIGN OF THEIR AUTOMATED MACHINING CELL. THE FOUNDATION OF THEIR IMPROVEMENT PROGRAM STARTED WITH LEAN.

SCENE 55.
CGI: Mark Kroll
Vice President of Operations
Aztec Manufacturing

MP4:Kroll TCR 04:16:45 – 04:16:55:03

MP4:Aztec B-Roll (04:40:22:00 – 04:40:31:00) Wall of statistics and lean artifacts

Narration MP4:Kroll TCR 04:17:00 – 04:17:09:00

Mark Kroll on camera
All of our employees have gone through training focused on lean principles, the various types of waste, and the tools out there for lean activities to eliminate the waste.

(off camera) We started it several years ago. Last year we reinitiated it, brought in people to do more training, and it’s an ongoing way of business for us.

SCENE 56.
MP4:Aztec B-Roll TCR (04:26:15:0 – 04:26:47:00) Robots in work cell in motion (use as needed)

NARRATION (VO)

BUILDING ON THEIR EXISTING BASE OF LEAN PRINCIPLES, AZTEC IDENTIFIED A FEW, KEY PRINCIPLES THAT THEY FELT WERE PARTICULARLY IMPORTANT IN THE DESIGN OF THE AUTOMATION WORK CELL. IN PARTICULAR, SINGLE PIECE, CONTINUOUS FLOW AND MISTAKE PROOFING TOPPED THEIR PRIORITIES TO ACHIEVE CONSISTENCY OF PROCESS AND SPEED AS WELL AS COST-EFFICIENCIES. PLANNING A PROCESS AROUND SINGLE PIECE FLOW AVOIDS ‘ISLANDS OF AUTOMATION’

SCENE 57.

MP4:Kroll TCR 04:17:23 – 04:17:43:03

Mark Kroll on camera
The primary focus with the lean initiative for that cell was continuous flow. We wanted to make sure with the flow of parts through the automated cell that we didn't have any work in process inventory. Also with the continuous flow, we wanted to be sure there was standardized work, so every operator at every level could operate that cell.

SCENE 58.
MP4: Aztec B-Roll TCR (04:22:37:01 – 04:22:50:00)Two robots in action, zoom into one (use as needed)

NARRATION (VO)

AZTEC DEVELOPED A ROBOTIC WORK CELL DESIGNED AROUND A MACHINING OPERATION FOR A BRAKE ADAPTER. THE ROBOT PICKS UP RAW PARTS DELIVERED FROM A CASTING PROCESS, FEEDS THEM INTO A CNC MACHINE TWO AT A TIME...

SCENE 59.
MP4: Aztec B-Roll TCR (04:22:50:00 – 04:23:15:00) Two robots in scene with parts on rotary table

NARRATION (VO)

...AFTER A DEBURRING OPERATION, FINISHED PARTS ARE LOADED ONTO A ROTARY TABLE THAT TRANSPORTS IT TO THE NEXT ROBOTIC SUB-CELL...

SCENE 60.
MP4: Aztec B-Roll TCR (04:27:10:19 – 04:27:43) Robot checking hole presence with hard gage.

NARRATION (VO)

...WHERE ASSEMBLY OF BOLTS IS COMPLETED. QUALITY CONTROL IS DONE WITH A THREAD AND HOLE CHECK AS WELL AS AN IN-PROCESS GAUGE ONCE BOLTS ARE ASSEMBLED BY THE ROBOT.

SCENE 61. MP4: Aztec B-Roll TCR (04:23:44:19 – 04:23:52:00) Robot packing parts (use as much as needed)	NARRATION (VO) FINAL ASSEMBLIES ARE PACKED IN LAYERS IN SHIPPING BOXES FOR TRANSPORT TO THE CUSTOMER.
SCENE 62. MP4:Kroll TCR 04:21:26 – 04:21:49:06	Kroll On Camera The lean initiatives were integral and key to the development of the cell. It was something we thought of beforehand, and the aspects related to lean was something we really wanted to build into the cell. It's a very automated cell. Our operators were used to handling each part going into a machine and coming out of a machine, so we wanted the lean principles there so we could eliminate the waste, but also make sure we're making a good, quality part.
SCENE 63. MP4:Aztec B-Roll (04:35:51:16 – 04:36:11:12) Robot end effector moving parts in and out of hard gage. Narration - MP4:Kroll TCR 04:17:23 – 04:17:43:03	Kroll Off-camera The mistake proofing was built into the cell based on the fact that the operator would only be touching the part in the raw state. Once they loaded it into the cell, it would be packed by the robot into the shipping container, and ready to ship to the customer. We wanted to make sure we had the appropriate poke-yokes in the cell to catch any potential issues that might arise.
SCENE 64. MP4:Aztec B-Roll TCR (04:31:41:12 – 04:31:57:00)Shot of roller table Cut to -> MP4:Aztec B-Roll TCR (04:33:35:12 – 04:33:40:00) Shot of in-going conveyor, repeat as necessary. Narration - MP4:Kroll TCR 04:18:27 – 04:18:48:06	KROLL OFF-CAMERA The conveyors were another area we looked at, based on the parts they could hold, ingoing and outgoing, to keep a smooth flow of material. Based on the unit pack of the outgoing containers, we used lean initiatives to design the layout of the cell and conveyor, so the Hilo drivers were spaced out accordingly and didn't have to be there every 30 or 40 minutes. We calculated the amount of time and built it accordingly

SCENE 65.
MP4:Aztec B-Roll TCR ~(04:34:09:00 – 04:34:13:09) Man loading parts

NARRATION (VO)

WHILE ROBOTIC AUTOMATION DELIVERS COST EFFICIENCIES AND CONSISTENCY OF PROCESS, HUMAN OPERATORS REMAIN AN INTEGRAL PART OF THE WORK CELL AT AZTEC. THEIR ARE A NUMBER OF REASONS FOR THIS.

SCENE 66.

CGI: Myron Deviney

Engineering Supervisor

Aztec Manufacturing

MP4:Deviney TCR 04:03:29 –

04:03:48:00

Myron Deviney on-camera
The robots cannot see. You still need people to review, assure quality, maintain the equipment, toolsetters, maintenance people, to keep it up and running.

SCENE 67.
MP4:Aztec B-Roll TCR (04:34:11:05 – 04:34:14:24)Man working

Cut to

MP4:Aztec B-Roll TCR (04:31:00:00 – 04:31:02:00) Man loading parts (use as needed, repeat)

NARRATION (VO)

WITH HUMAN OPERATORS COMES TRAINING, A SHARED PROBLEM OTHER MANUFACTURERS THAT COMBINE LEAN WITH AUTOMATION. FOR AZTEC, THE LEAN PRINCIPLE OF STANDARDIZATION OF WORK IS A GUIDING FOCUS FOR THEIR TRAINING.

SCENE 68.

MP4:Deviney TCR ~(04:03:55:00 – 04:04:18:00

Myron Deviney on-camera
The big thing is consistency. You need to do the job exactly the same every time. The robots, or any kind of automated cell, relies on consistency. You can’t have somebody doing things their own way. It has to be done the same way

SCENE 69.
MP4:Aztec B-Roll TCR (04:33:43:04 – 04:34:05:00) Zoom out on brake assemblies (as needed)

Narration (vo)

CONSISTENCY IN WORK PRACTICES FROM OPERATORS COMBINED WITH CONSISTENCY OF THE PROCESS ITSELF BY USING AUTOMATION HAS LED TO SATISFACTORY PRODUCT RESULTS FOR AZTEC. FOR THOSE CONCERNED ABOUT THE INCREASED COMPLEXITY OF AN AUTOMATED LINE, FOR AZTEC AT LEAST, THEIR AUTOMATED WORK CELL HAS PERFORMED WELL.

SCENE 70.
MP4:Deviney TCR ~(04:06:30:00 – 04:04:07:00)

Myron Deviney on-camera
The Motoman robots have been extremely reliable. We have had them running two and three shifts for five years, and just about a month ago we had our first real breakdown. The only minor problems we've had is cabling, the cables get stepped on, or just from the action of the wrist, the cables wear out. But the actual robots themselves we have had very little problems with.

SCENE 71.
Machine Load 6.avi: 00:00:00 – 00:50:00 Motoman simulation tool.

CGI: Sample output from robotic simulation software utility from Motoman, Inc.

Narration - MP4:Deviney TCR ~(04:11:18:00 – 04:12:08:00)

NARRATION (VO)

LIKE OTHER MANUFACTURERS, AZTEC USES SIMULATION TOOLS IN ALL ASPECTS OF ITS PLANNING OPERATIONS, FROM PRODUCT PLANNING TO ROBOTIC AUTOMATION ANALYSES

Deviney (Off Camera)
We used simulation quite effectively not only in the cell design, but also in the product design. ... In the cell we will do robotic simulations to help program, point out collision problems, just basically make sure you work out all the bugs before you physically start to manufacture the equipment.

SCENE 72.

Vision Bin Pick 00:00:00 – 1:00:00

(use more as needed)

CGI: Video Clip courtesy of

Motoman, Inc.

NARRATION (VO)

THE FUTURE OF AZTEC INCLUDES MORE AUTOMATION AS WELL AS A CONTINUING FOCUS ON LEAN PRINCIPLES. ADVANCES THAT HAVE BEEN MATURING FOR THE LAST FEW YEARS ARE SEEN AS IMPORTANT IN THE NEXT GENERATION OF AUTOMATION

Narration - MP4:Deviney TCR

~(04:09:35:00 – 04:10:24:00)

Deviney (off camera)

I think the big advance is going to be vision. There are obviously vision systems now. Every day they are getting cheaper and cheaper and more and more capable. The big advance will be vision on the robot. To this point, vision on a robot has been limited. The robot can't really pick up parts that are not staged. But vision systems are getting to the point now where you can just bring in a box of raw parts, and it will go in and pick up the part, no matter how it is sitting in the box, and load it on the machine and/or conveyor.

SCENE 73.

MP4:Deviney TCR ~(04:13:06:00 – 04:13:43:23)

DEVINEY (ON CAMERA)

Planning is crucial, including vision and/or human observation. Robots are not good at finding things that are not preprogrammed. You're always going to need people to keep an eye on the process. Once you find a problem, then you can program the robot or vision systems or your cell in general to take care of that. But you still need human intervention to see those things that crop up every once in a while that are unexpected.

MP4:Deviney TCR ~(04:14:32:00 – 04:14:50:23)

Do not go cheap on the equipment. This equipment is going to run 24 hours a day or whatever you run it at. The efficiency of the cell is based on the equipment lasting, not breaking down.

---fade to black---

SCENE 74.
MP4: Ophthonix B-Roll TCR (32:56:22 – 33:12:07)People Working

Cut to ->

MP4: Vickers B-Roll TCR (51:20:00 – 51:39:00) Woman working with Teach Pendant (as needed)

NARRATION (VO)

INCREASED USE OF BOTH LEAN MANUFACTURING AND EVER MORE CAPABLE AUTOMATION TECHNOLOGY ARE EASY PREDICTIONS TO MAKE WHEN IT COMES TO MORE EFFICIENT MANUFACTURING. WHILE AUTOMATION WILL INCREASE THE EFFECTIVENESS OF HUMAN OPERATORS, PEOPLE WILL REMAIN THE HEART OF EVOLVING, LEARNING ORGANIZATIONS. LEAN, PRIMARILY AIMED AT MAKING ORGANIZATIONS MORE EFFICIENT AND CUSTOMER RESPONSIVE, CAN AID IN THE PROPER MARRYING OF AUTOMATION AND HUMAN SYSTEMS. AS A TOOL IN THE LEAN JOURNEY, AUTOMATION NEEDS TO BE FLEXIBLE, SIZED APPROPRIATELY AND ALWAYS SUBORDINATE TO HUMAN INVENTIVENESS.

SCENE 75.
HSM97A, CGS: credit roll
white text, fade up mid-screen,
black to blue gradient background

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