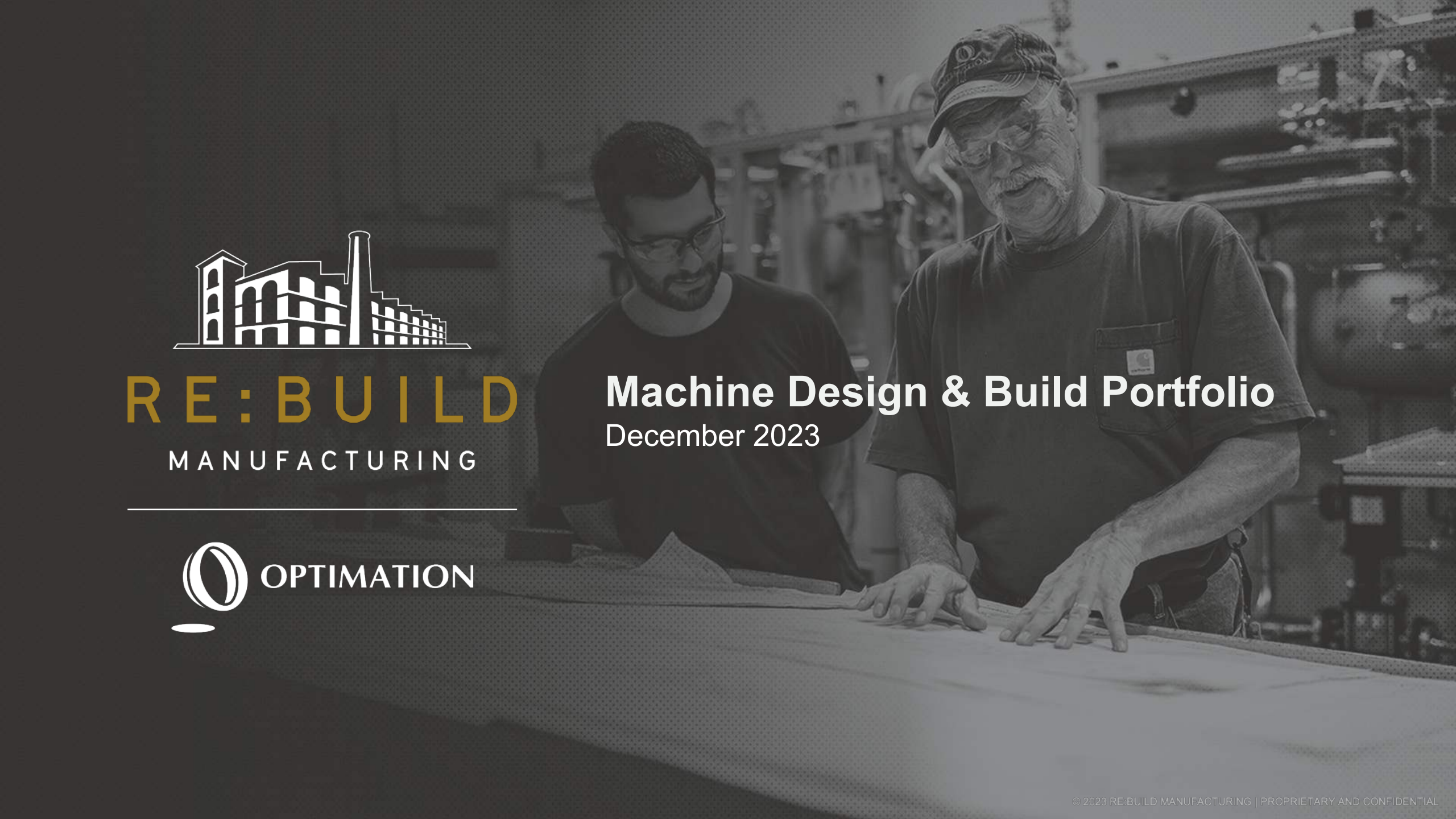
RE:BUILD MANUFACTURING

OPTIMATION

Machine Design & Build Portfolio

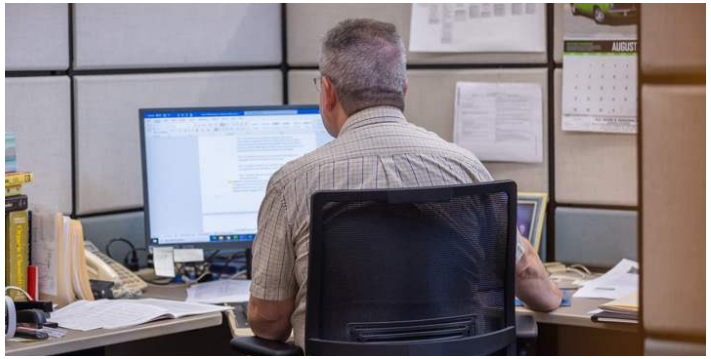
December 2023



Why Optimation?

- Optimation offers a wide range of machine design and build services based on a knowledgeable and proven group of engineers & designers with decades of prior machine building experience.
- Optimation engineers and designers are both generalists and specialists, drawing from rigorous technical backgrounds and knowledge of industry standards and adapting to each client's unique and diverse requirements to develop highly optimized machine solutions.
- Optimation specializes in providing unique solutions to client challenges with varying degrees of technical complexity, from small assembly fixtures (6-8 weeks/<$100k), to testing skids and machine retro-fits (10-20 weeks/$100k-$500k), to full-scale industrial automation systems (20-40 weeks/$500k-$1M+).
- Optimation is well-versed in industry-standard equipment, robotics integration, food grade process requirements, operator safety/machine guarding and more, incorporating lean principles to all developed solutions.

Experience & Staffing



Engineering

- Senior Technical Consultants
- Machine Design Engineers
  - Principals, seniors, mid-level
- Machine Designers
  - Seniors, mid-level
- System Integrators
- E/I & Controls Engineers
  - Principals, seniors, mid-level

Management

- Senior Program Managers
- Project Managers
  - Seniors, mid-level
- Construction Managers

Trades

- Metal workers, pipe fitters, welders
- Demo, assembly, install

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Capabilities

Optimation engineers and designers pride themselves on their vast previous experience and ability to adapt to not only dynamic client requirements and constraints, but also to contemporary equipment and processes across a wide array of industries. Capabilities include, but are not limited to:

- Project management, including ROI cost studies and active monitoring of project analytics
- Definition of technical project requirements
- Product development and design for manufacturing
- Manufacturing process selection
- Industrial automation including robot integration
- Material and/or product conveyance

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Proven strengths in the following areas:

- Custom machine solutions
- Vintage equipment retro-fitting
- Process development including cycle time optimization
- Web handling
- High-precision manufacturing
- Quality improvements including defect root cause analysis
- Dial machines
- High speed assembly and test
- Operator assists

PROJECT EXAMPLES

Small Scale Project Example

20-week timeline, $150k budget

Project Background

- Client has a single machine through which all of their product must pass.
- Machine was purchased new but has reliability problems that the OEM wouldn't address. These reliability problems hinder production and cause waste.
- Client asked us to assess the machine and implement solutions to improve its performance.

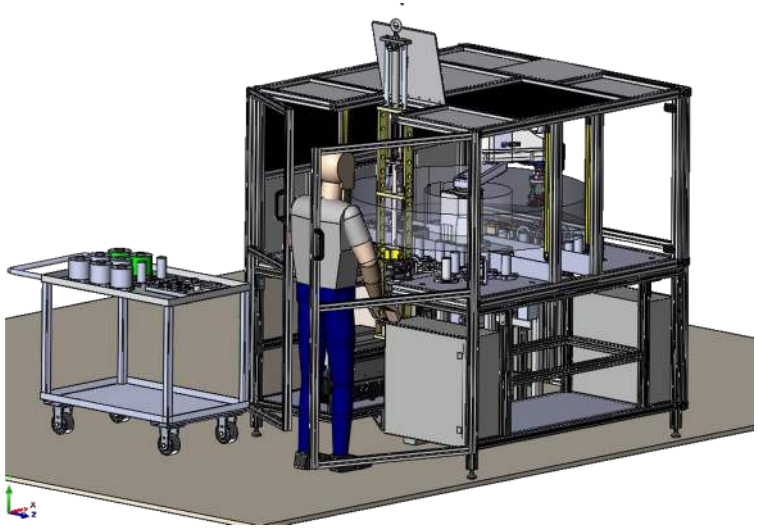
CHALLENGE	SOLUTION
Only a 3D pdf file and some 2D pdf assembly drawings were available.	A combination of studying drawings plus taking measurements on the machine allowed Optimation to reverse engineer the areas of interest.
Identify key areas of the machine that were causing most of the issues and design a solution to remedy them.	Chain drive converted from a push design to a pull design by re-locating the main drive to the end of the machine. Engineers also identified issues with the discharge assembly which was then redesigned prior to building and integrating both major solutions.
Install, test and debug major changes in a short 2-week plant shut-down window.	Optimation engineers assembled and tested the new designs in house prior to delivering to client's plant, installing/testing the new assemblies in place, and starting back up within the shut-down window.

Project Outcome

- ✓ Station registration improved across the length of the machine
- ✓ Chain drive reliability improved
- ✓ Discharge functionality improved with a new sweep bar design

Robot Integration Project Example

20-week timeline, $200k budget



Project Background

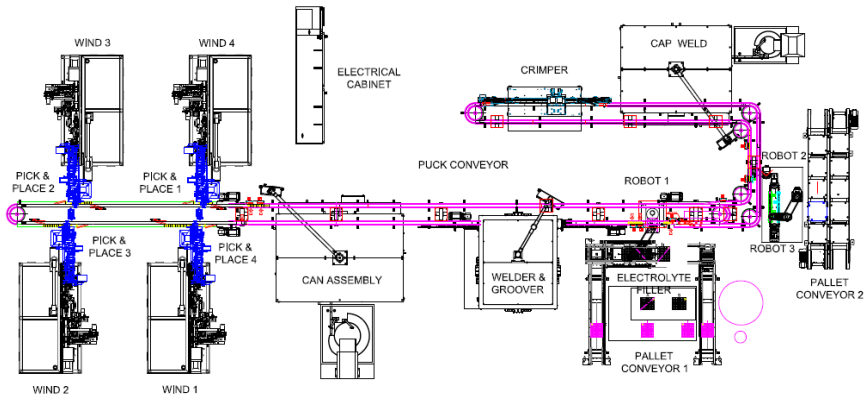
- Client required a fully automated stacking system to build their fuel cell stack at a high rate
- Prototype machine with many operator touchpoints and manual processes to be replaced by fully automated robotic solution to usher in full-scale production
- Concept development to fixed bid estimate to build
- Client purchased nine modules from various OEM's for different assembly processes of the final product to expedite completion of the new manufacturing line

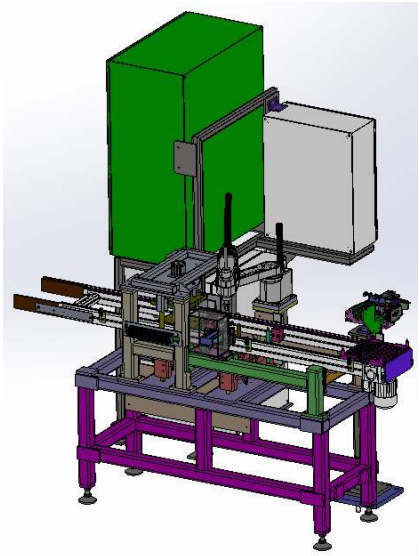
CHALLENGE	SOLUTION
Maintain compression of the stack during build while parts are added to the top.	Durable and compliant wheel array designed to allow pass-through of new parts while holding compression on previously placed parts.
The operator refills Station 1 with parts while the robot builds at Station 2.	Series of light curtains employed to create alternating zones of operator and robot activity.
Inspection of each part before placement.	Vision system build into robot EOAT inspects parts at same time as establishing virtual center for accurate placement.

Project Outcome

- ✓ Optimation designed and developed a two-station, fully enclosed machine capable of repeatably and accurately building fuel cell stacks
- ✓ Cycle time less than 1/3rd of the prototype machine
- ✓ Single operator, three shift machine replaces three operators, single shift production
- ✓ Fixed bid proposal for the build, install, and start-up provided with expected delivery in 2024

Battery Manufacturing Project Example





Project Background

- Client in a rush to enter the market with a new size cylindrical cell in high demand
- Client purchased nine modules from various OEM's for different assembly processes of the final product to expedite completion of the new manufacturing line

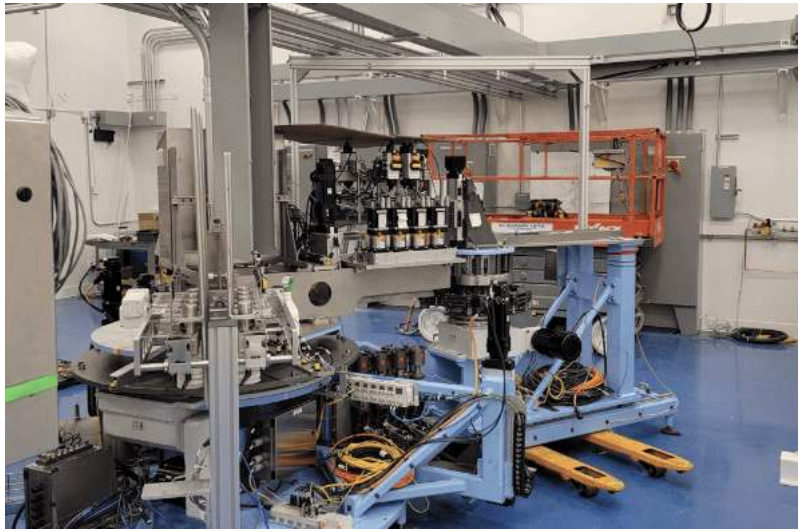
CHALLENGE	SOLUTION
Integrate modules from numerous suppliers into a single manufacturing line to produce a new size cylindrical cell	As the integrator, the sub-assembly modules were interfaced with puck and pallet conveyor systems along with robots and pick & place units for the handling of the parts through the assembly process
Accommodate scope change of the manufacturing line as the product design evolved	As an example a 3 winder layout with a single robot needed to be replaced with a 4 winder layout with 4 pick & place units to provide the needed capacity output of the jelly-rolls
Provide the capability of 100% OCV & CCV testing of the finished product	A single station was designed and built for simultaneous testing of finished cells on a pallet, sorting the rejects and singularly conveying the good cells to a labeler

Project Outcome

- ✓ Optimation designed, built, installed and generated control software for the material handling of the individual parts through the assembly process. Pick and Place mechanisms were designed to offload jelly-rolls from the winders to the Puck Conveyor which conveyed the parts sequentially to each of the sub-assembly modules and to the offload station. Robots were used to transfer parts from individual pucks to pallets to group parts on Pallet Conveyors for electrolyte filling and offloading the finished cells.
- ✓ Optimation designed, built, installed and generated software for a station that engages test probes to the anode and cathodes of 64 cells held in a pallet to simultaneously test the OCV and CCV of each cell. The cells were then removed from the pallet with a robot with rejects sorted and placed in reject bins and the good cells fed into a star wheel to dispense the cells individually onto a conveyor to the labeler

Dial Machine Project Example

60-week timeline, $1.8m budget



Project Background

- Client has need to substantially increase production of their new energy drink product 3D printed to the inside of plastic cups
- Scope of work includes cup dispensing, conveyance, interface to 3D print heads, and stacking onto trays for handling and drying

CHALLENGE	SOLUTION
Desired production rate of 50,000 cups/8-hour shift	High speed indexing dial utilizing cup nesting of 4 cups per row and 40 total rows to achieve individual production time of 0.5s per cup
Equipment to be designed to handle 4 different cup sizes with a desired changeover time of 2 hours or less	Cup de-nesting, dial nest plates, and cup handling grippers designed to be easily changed or to have “dual” nesting or gripping features to handle more than one size
Due to significant off-line drying time, cups need to be stacked 10 high while leaving a gap in between	Cup holding trays designed for ease of loading and stacking onto dedicated carts to allow for desired gap between each cup and drying time

Project Outcome

- ✓ Optimation engineered, fabricated, and assembled complete production equipment at client site
- ✓ Cycle time of 50,000 cups/8-hour shift was accomplished successfully

Product Conveyance Project Example

30-week timeline, $300k budget

Project Background

- Client sought to integrate a shrink wrapper to their food production line to respect customer's updated packaging requirements
- Requested controls to monitor line for jams and optimize product flow
- Initial investigation and research to fixed bid design & build

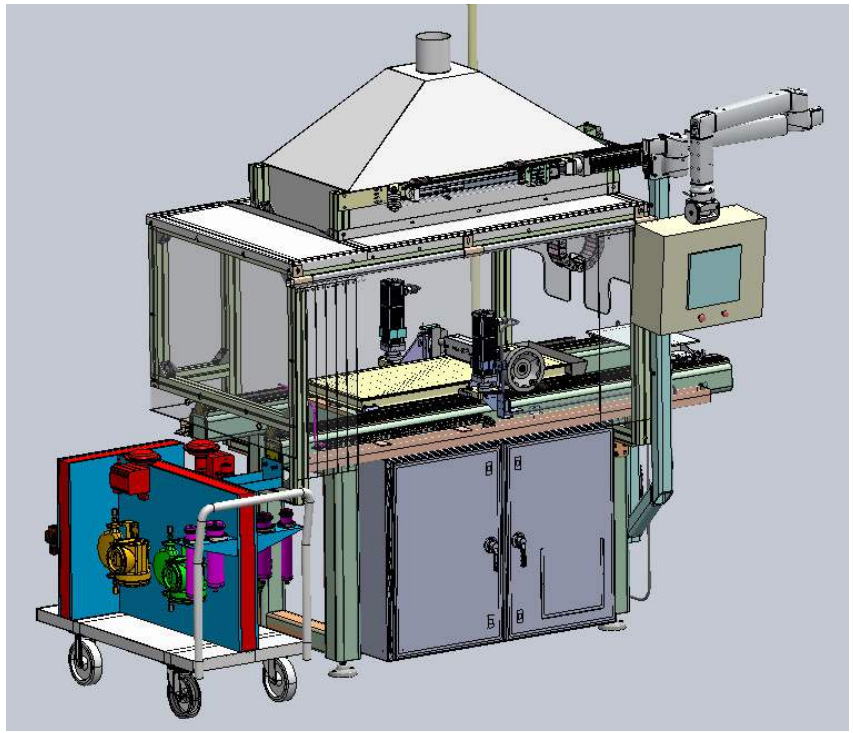
CHALLENGE	SOLUTION
Single shrink wrapper to be used for a family of products with differing dimensions and wrapping requirements	Shrink wrapper offerings researched and flexible yet robust wrapper specified capable of rate and dimensional requirements
Wrapping must keep up with upstream production of goods	Staging area with recirculation integrated to allow product build-up for cases where product flow exceeds wrapper throughput
Floor space must be cleared for future production lines	Conveyors re-routed and mounted on the ceiling
Conveyors must prevent, detect, and notify of jams within the line	Conveyors specified with dedicated photo eyes and integrated to plant PLC with flow controls

Project Outcome

- ✓ Full system developed to wrap and control/monitor conveyance of wrapped goods
- ✓ Refined conveyor system mitigated jam risk with flow controls/active jam detection and cleared floor space for future lines
- ✓ Optimation tradesmen assembled and installed new equipment prior to starting up

Coating System Project Example

30-week timeline, $400k budget



Project Background

- Client requested a custom design utilizing a slot die provided by others for laboratory developmental work
- Wide range of solutions to be coated onto a 16in wide x 32in length stationary substrate

CHALLENGE	SOLUTION
Die translation with a 0.002-0.030 in uniform gap range at speed range of 0.5-10 in/sec with vibration free movement	Utilized precision linear profile rails with rack and pinion driven servos for smooth translation of die mounted on vertical linear profile rails
System to dry coating prior to removal of coated substrate from platen	Utilized IR Heater Ass'y with 700°F temperature capability with height adjustment from 4-24 in
Delivery System with capability to supply solid particle dispersion solutions with a 5-200 centipoise viscosity range to the die at a fixed and consistent flowrate range of 1-200 ml/min.	Designed and built a small portable Solution Delivery Cart that could feed 2 fluids at the same time to the Coating Die. The system was also capable of setting 2 different flowrates if needed once the flowpath and delivery rates were set.

Project Outcome

- ✓ Support framework weldment constructed with large structural steel tubing providing vibration free functionality for long term alignment and dimensional stability .
- ✓ Coater provided with enclosure, exhaust hood and intrinsically safe components to accommodate solvent-based fluids
- ✓ Electronically synchronized servos provide smooth and precise variable speed translation of the die for flexibility in coating fluids with different properties and varying coating thicknesses
- ✓ Servo driven linear actuator and integral cable mechanism provide accurate height adjustment of variable temperature IR heaters for optimum drying of coatings

Test Stand Project Example

35-week timeline, $400k budget

Project Background

- Client had an existing system that was intended as a prototype and was forced into production.
- Existing system with significant operator input and potential for errors/delays required to be replaced with an automated connection and test system.

CHALLENGE	SOLUTION
Connecting to multiple part configurations that have poor connection location tolerancing and high-pressure flow.	An integrated approach combining a conformable sealing design with part verification scans to ensure the correct actuators engaged and sealed.
Total time on stand per part reduction of 25-50%	Automated connection system with hydraulic cylinders and balancing, combined with improved flow between tests and the ability to identify and re-run only failed tests rather than the entire test set.
Tests extremely sensitive to pressure loss through system outside of part.	Specialized high CV valves, filters, and check valves combined with efficient routing and connection minimized pressure loss through system.

Project Outcome

✓ Overall target reduction in cycle time achieved.

- Part load/unload time reduced from 4-6 minutes per part to less than 1 minute, less down time due to failed connections & subsequent cleanup.
- Stand idle time reduced through automated test cycles that no longer require operator to interact during tests.

Machine Retro-Fit Project Example

45-week timeline, $1.1m budget

Project Background

- Private college and industrial company consortium desired a thin film coating line as a teaching tool for continuing education track
- New equipment as proposed for application exceeded budget
- Optimation proposed refurbished machine as alternative

CHALLENGE	SOLUTION
Locate and procure suitable machine with needed features, useful life.	Optimation worked with established used equipment supplier to locate a qualified machine in Europe and ship it to shop in USA
Design/build additional modules per teaching requirements	Optimation designed and build extra coating hardware, accumulator and integrated into machine
Create plan to inspect, repair/replace worn components	Optimation skilled trades personnel performed dismantlement, component disposition, executed repairs, cleaned and repainted to refurbish main machine
Upgrade machine drives and controls for ease of use, maintenance	Optimation controls engineer converted to Allen Bradley based controls, programmed machine with HMI screens using intuitive buttons and text suitable for teaching, student operation

Project Outcome

- ✓ Machine procure, refurbish, modify, and reprogram costs totaled approx. 1/3 cost of new machine and met budget
- ✓ Client (consortium) inspection team was pleased with overall machine presentation. Appearance approached that of new.
- ✓ Factory Acceptance Testing/run off met all customer objectives without single error.
- ✓ Machine presently installed in college wing and being utilized to educate prospective technologists in thin web coating

High Speed Manufacturing Project Example

40-week timeline, $1.2m budget

Project Background

- Client purchased defunct machine line and aimed to revitalize the line while adapting it to produce their prismatic battery design
- Aggressive volume requirement of 500,000 batteries/year required robust machine capable of three shift production

CHALLENGE	SOLUTION
Investigate existing equipment without technical documentation and software written in foreign language	Optimation engineers inspected and tested each module, documenting required replacements and re-writing all core software
Replace laser welding with ultrasonic	Ultrasonic welders researched and developed to ensure capability
On-line testing capability at rate	Produced batteries queued and tested in parallel to keep lengthy testing in line with production rate

Project Outcome

- ✓ Capability and functionality of existing equipment confirmed prior to designing and building replacement and/or new hardware capable of producing new battery design
- ✓ Machine line concepted with parallel, mirrored left-hand and right-hand modules to streamline production and limit operator involvement
- ✓ Complete system built and tested at Optimation facility prior to shipment and installation at client site

Strategic Client Relationship Project Example

60-week timeline, $5.2m budget

Project Background

- Strategic relationship with the WARP Speed Project during COVID crisis.
- Engineering and design involved with precision assembly and preparation for acceptance test of ten (10) 10ml vaccine vials at a time.
- Includes blowout and vial cleanliness inspection machines as part of a seven (7) section machine vaccine assembly/fill process.
- Medical grade clean room requirements and wipe down capabilities.

CHALLENGE	SOLUTION
Overall system worked on in parallel by several machine builders in the interest of time	Collaboration required ample documentation and communication between teams to avoid mistakes and streamline design effort
Unavailability of some clean room components within required timeline	Design effort led off with significant vendor research to specify appropriate and available clean room materials and equipment
Extremely aggressive timeline	Optimized project management resulted in workload spread across several design houses as well as internally across Optimation multidisciplinary teams

Project Outcome

- ✓ Aggressive schedule was ultimately met.
- ✓ Optimation supplied resources to other machine builders to assist on schedule.
- ✓ Optimation chosen to integrate all lines together at client site.

Thank You!

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