ALTEN TECHNOLOGY

Manufacturing Engineering

OUR PRODUCT DEVELOPMENT SERVICES:

- Brainstorming and Concept Generation
- Feasibility Studies and System Architecture
- Detailed Product Design
- Prototyping
- Design for Manufacturing (DFM)
- Verification Testing
- Manufacturing Assembly and Test Equipment
- Sustaining Engineering

INDUSTRIAL DECORATOR MECHANISM REDESIGN

Client: Global manufacturer of aluminum packaging for consumer products

OBJECTIVES

- Retrofit an existing decorator mechanism to allow for precise, computer-controlled registration
- Create a mechanical design capable of extremely fine registration adjustments
- Design mounting, housing, and interfaces to deliver a prototype and design documentation that can be duplicated throughout client facilities

APPROACH

- Capture requirements and create a test plan – to be done by systems engineer
- Brainstorm possible solutions ranked with criteria developed from the client's requirements
- Account for mechanical variances to guarantee precision
- Work closely with the client's controls contractor to ensure our mechanical design integrates with their control system.

RESULTS

- Created a computer-controlled system capable of extremely fine registration adjustments while the decorator is running at speeds of up to 2,200 rpm
- Eliminated an estimated 5–10% of machine downtime
- Reduced waste generated by manual adjustments, potentially saving the client millions of dollars per year
- Reduced the cost of making smaller batches of product, giving the client the ability to expand into new markets and provide custom imprints to smaller customers
- Delivered designs for mounting, housing, and interfaces, as well as a prototype and design documentation that can be duplicated throughout client facilities

CHALLENGE

A global manufacturer that produces aluminum packaging for consumer goods wanted help redesigning a subsystem within an industrial decorator used to apply designs to aluminum packaging. The decorator includes multiple patterns that each lay down one ink color in a multicolored design onto a rubber transfer pad. Once all patterns have transferred their individual colors to the transfer pad, the transfer pad is pressed against a piece of aluminum packaging to transfer the complete design to the package. Because each color of the design is added to the transfer pad one at a time, an operator must align the patterns holding each color of ink (in two directions) to ensure that they each print in the intended position when transferred to the aluminum packaging. To check the alignment, the operator runs packaging through the machine and then visually inspects the image to check for correct registration. The client's operators must perform this manual alignment each time the client switches out a design. This equates to a lot of downtime and material waste since checking the alignment can use more than 1,000 pieces of packaging to complete. A skilled operator can make a manual adjustment in approximately 15 minutes using 3,000–5,000 pieces of packaging, but a less experienced operator may take approximately 30 minutes or more for the same adjustments, potentially even adjusting the patterns in the wrong direction during the alignment process. The client therefore wanted to switch from manual adjustments to a precision-controlled system that could make adjustments while the decorator was running to produce visually perfect prints. With the risk presented by changing a proven system, the client also wanted this new system to be capable of easily reverting to the original, purely mechanically driven system if necessary.

APPROACH

ALTEN Technology assembled a multidisciplinary team including a project manager, a project coordinator, a systems engineer, and a mechanical engineer to tackle this project. The project started with the systems engineer gathering the client's requirements and identifying a test plan for each. While there were only around 30 requirements, the client wanted extremely fine distance resolutions in both linear and rotational movements.

Once the systems engineer gathered the requirements, the team conducted a brainstorming session with several mechanical engineers from outside the project team to gain a fresh perspective. The brainstorming team came up with many possible solutions for linear and rotational movement, then the systems engineer and lead mechanical engineer used a decision matrix to rate each possible solution on its robustness, function, and ease of manufacturing. They presented the highest-rated solution concepts to the client and moved forward with the client's top choice. Further development revealed that the motor needed for this method wouldn't integrate with the existing facilities. Furthermore, the motor vendor informed the team that the motors available would have difficulty providing the precision the client needed due to the amount of inertia in the system. Because the ALTEN Technology team already had a pool of possible design solutions to draw from, they were able to quickly pivot to an alternative design solution that, while more intricate, met the intentions of the design. This final design provided the precision the client required, was easy to retrofit into existing systems, and provided the ability to revert back to a purely mechanically driven system in less than half an hour.

Ranked Criteria—Description	Criteria #	Weight	Rank#
Robustness	3	10.00	1
Function	1	9.1	2
Liner/Rotation Concept Integration	7	6.9	3
Ease of Return to Normal Operation	5	5.3	4
System Integration/Modification	2	3.5	5
Ease of Manufacturing	4	2.9	6
Use of Bull Gear Drive	6	2.5	7

FIGURE 1. DECISION CRITERIA AND WEIGHTING

PINPOINT PRECISION

The main challenge throughout the project was the high degree of precision and accuracy the client required. Our team had to consider both the control and mechanical aspects of the design when implementing such a fine resolution. For the control system side of the design, the team checked encoder specifications to ensure that they selected an encoder capable of registering extremely small distances. Mechanically, the team took a multifaceted approach to address otherwise normal machining tolerances and assembly backlash that would have a huge negative impact on the system, such as using press-fits along with pre-loaded springs to hold pieces in a central location. They also oversized some parts and then locked them down with bolts to ensure proper alignment. The team even implemented a thermal expansion fit on some parts—heating one part and cooling the other before fitting them together so that the pieces would have no mechanical play when they returned to ambient temperatures.

CORDINATION WITH A THIRD-PARTY CONTRACTOR

The other challenging aspect of this project was that ALTEN Technology was only responsible for the mechanical design of the decorator mechanism. The electrical and software aspects of the design were handled by a third-party controls contractor with whom the client had a long-standing relationship, but ALTEN Technology hadn't worked with before. Our team had to ensure that our mechanical design would work with the electrical and software solutions proposed by the controls contractor. Our team addressed this in two ways. First, our team maintained open channels of communication and spoke to the controls contractor frequently. Second, the ALTEN Technology project manager set up responsibility matrices during the planning phase of the project to establish who was responsible for each decision. While everyone had input in the selection process, the designated party had to give final approval before our team moved forward. For example, our team worked with the motor manufacturer to choose a motor for its mechanical properties, then the controls contractor verified that it would work from an electrical perspective before our team placed any final purchases. This collaborative process, as a part of good project management, allowed our team to proceed efficiently and ensured that our team and the controls contractor weren't working at cross-purposes.

RESULTS

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ALTEN Technology delivered a fully functional prototype decorator mechanism and the native design files to the client. The redesigned decorator mechanism can make extremely fine adjustments on the fly while the machine is running at speeds of up to 2,200 rpm, with the ability to revert to a purely mechanically driven system in under half an hour if necessary. It facilitates precise registration and reduces the amount of total downtime for pattern changes. When combined with the reduction in the amount of packaging wasted during print registration, the redesigned mechanism could potentially save the client millions of dollars each year. It also allows them to remain competitive in its market by enabling the client to pursue future innovations that build on this high degree of precision. Furthermore, it allows the client to expand into new markets by accommodating requests from its customers for smaller production runs of more customized or individualized designs. Ultimately, the redesigned mechanism is a high-precision system that can reduce the client's operating costs and allow them to remain competitive in their market.

ABOUT ALTEN TECHNOLOGY

ALTEN Technology is an engineering services company that provides innovative solutions for engineering, IT, and product development projects across the product life cycle. For decades, ALTEN Technology has been helping clients develop products that are changing the world. We provide support across industries including aerospace, defense, automotive (including commercial vehicles), medtech, life science, rail, energy and environment, robotics, and uncrewed systems.