N.C. State ISE students join forces with hosiery mill to create face masks

Inside Harris & Covington Hosiery Mills, beneath spools of bright-colored thread, workers crisscross among heavy machinery. Hovering at workstations and perched on swivel chairs, they sift through stacks of garments, inspecting each before sending the finished fabric down the line to be packaged by others who seal the product in plastic sleeves.

Making clothing is a five-generation affair at the High Point, North Carolina, textile mill. Specifically, they’ve built the 100-year-old business on the strength of hosiery – stockings and socks, mainly. But in these unique times, the business has added a new item to the mix: washable, two-layer face masks.

At the start of the pandemic, the mill partnered with EHOP Health, an occupational health service also in North Carolina, to create the brand, Easy Masks. It was a huge success.

“With the high demand for masks, Easy Masks saw fast-paced growth,” said Eric
Swanson, a student in the Edward P. Fitts Department of Industrial and Systems Engineering at North Carolina State University. “The increase in demand meant rapid changes to optimize the production line. This is where we came in as industrial engineering consultants. We played a major role in the optimization of production and mask design.”

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Swanson, an IISE member, and fellow N.C. State industrial engineering student Katie Lawson joined the company as consultants at Easy Mask working on safe packaging as well as maximizing mask quality and quantity. Since the start of the pandemic, the company has sold more than 250,000 masks.

“During the North Carolina economic shutdown, the team worked tirelessly to offer a solution and needed product using all resources from North Carolina,” Lawson said. “Countless hours were devoted to the essential task of creating a durable, washable, comfortable, easy-to-use protective mask that could help our state and our country safely get back to work. Only essential businesses were able to operate, so collaboration with Easy Masks allowed the hosiery mill to operate at a minimal capacity.”

Tyler Covington, co-president of Harriss & Covington, said transitioning the company to mask-making indeed allowed the mill to “register as an essential business ... to remain open and bring more people back to work sooner once we transitioned from (research and development) to production.”

Covington said the shift was
“a challenge that our talented R&D staff embraced and was appreciated by our entire team as a way to use our skills and resources to help during a challenging time.”

He added that working with Lawson and Swanson “helped us both in product design as well as packaging efficiency. We appreciated their abilities to contribute in 2D and 3D modeling as well as completing time-motion studies to help us optimize packing of the finished products.”

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— Katie Lawson

Lawson and Swanson’s ISE consulting consisted of three projects: a time study and linear analysis; product design; and creating a package insert for the product’s filters.

The time study aimed to evaluate two things: the most efficient way to package masks while limiting worker fatigue and to calculate how to maximize the number of masks produced — while maximizing profit — in a given week, depending on the amount of time attributed to different processes of production. Swanson said it was a direct application of the college course Deterministic Models in Industrial Engineering.

For the second project, the duo tackled product design. Swanson designed a plastic insert to hold the filter in place by modeling in Fusion 360, the cloud-based CAD/CAM tool for collaborative product development.

“By printing prototypes, we can finalize a patentable design with customer feedback and then work with an injection molding company to formulate a mold for production,” Swanson said, adding that the project applied knowledge from Foundations of Design and 3D Modeling for Engineers and Product Development and Rapid Prototyping, two other courses that prepared him for real life problem-solving.

Finally, the ISE students sought to create a package insert for the non-woven filters that allowed users to easily slide the filter between the masks’ double layers. Swanson used Fusion 360 for this as well.

Covington said that in bringing a new product to market, there were certain key lessons: “Listen to the customer and never stop improving.”

“The masks we are manufacturing today are significantly improved from where we started in March, and just like with our sock business, we continue to look for ways to improve comfort, fit and performance,” Covington said.

Lawson said that, “while there are numerous masks on the market,” she and Swanson sought to create a mask that maximized protection against COVID-19 exposure. To accomplish this, they designed the fabric to “create a seal around the face and also have a place to hold an optional nonwoven filter.”

Swanson said it’s not enough for the masks “just to look good. We want our masks to help keep us safe by reducing the dose of viral particles. All our masks offer a two-layer design for improved filtration, as well as the ability to add additional filtration inserts between the mask’s two layers. Protection,
comfort and breathability are the main focus points we looked at when first creating and continually improving the masks.”

Online, Easy Masks sells about 2,000 masks per week. It also sells wholesale to business for resale at Ingles, Whole Foods, Weaver Street Market and Print Works.

On a recent tour, donning the company’s masks themselves naturally, Lawson and Swanson watched their industrial engineering work put into practice on the mill floor. Employees moved about beneath a spectrum of spooled colors, manufacturing the masks, then sending them down the line for packaging, boxing and mailing.

Lawson said being part of the effort was an “invaluable opportunity” to apply the skills she and Swanson learned at N.C. State and “do more than just watch Easy Masks take off. … Working and applying our industrial engineering knowledge with Easy Masks meant we collected the data ourselves, looked at all the outside influencing factors that are normally overlooked in the ‘ideal setting’ classroom calculations, and then had to interpret the data in order to direct Easy Masks into the most optimal direction for the increasing demand and their business plan.”

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