SEMI-ANNUAL PROGRESS REPORT

COMMERCIALIZATION OF A RESIDENTIAL PANEL DOOR

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February 1995
Project No. 545340
NRRI/TR-95/14

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Commercialization of a Residential Panel Door

Semi-Annual Progress and Financial Report for Minnesota Technology, Inc.

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Reporting Period: July 1, 1994 - December 31, 1994

Introduction: The project's goal is to continue technical and business development efforts to facilitate the commercialization of a veneered residential wood door designed with an engineered substrate and an engineered veneered door skin. Specifically, to continue product performance testing. This task will be accomplished by combining business expertise of Lexington Manufacturing of Coon Rapids, Minnesota, and the product development skills of the Natural Resources Research Institute (NRRI) scientists. The successful completion of this work will posture Lexington Manufacturing closer to expanding their business with a veneered panel door product line.

Background: Stile and rail panel doors have been popular in North America since colonial times. The traditional panel door designs require manufacturing methods utilizing a number of individual components and a number of labor intensive steps. The domestic panel door market has been flooded with imports, fueled primarily by low cost labor. We believe a traditional appearing marketable six panel door can be made with the techniques developed. The proposed manufacturing process replaces a number of labor steps and joinery processes with automated processes. These processes also reduce raw material costs by replacing clear solid lumber with decorative veneer. The essential ingredient to the successful commercialization of this product concept are the specialized manufacturing knowledge of Lexington Manufacturing and a specialized door skin application developed by NRRI Center for Applied Research and Technology Development (CARTD) scientists. The project work to date has allowed Lexington Manufacturing and CARTD scientists to successfully prototype door designs. Lexington Manufacturing provided management time, manufacturing, engineering time, raw materials, and labor to produce prototypes. Also completed was market research on imported products, precisely defining competition from Mexico and Malaysia and the competitive pricing structure.

Summary of Results: A highlight of this projects' technical objectives was the construction of a slam cycle testing device, designed according to National Wood Window and Door Association standards. This test machine allowed for evaluation of critical performance parameters on competitive products as well as our designs. In test results the imported products failed very early, and our design failed earlier than expected. Both designs fell off the test machine due to failure at the hinges. Hinge failure on the imported door appeared to be the result of the stile construction (low density hardwood). Hinge failure on our design was caused by the excessive weight of the door. The traditional construction techniques used on the imported door also showed failure in the stile and rail joint, our design showed no failure.

These failures prompted a redesign of the door. Prototypes are underdevelopment which significantly reduce the weight by replacing the heavy particleboard with either a Styrofoam core or use a new technology referred to as Reaction Injection Moulding (RIM). The RIM process will be provided by Multi-Material Enterprises of St. Paul, Minnesota. Either option will produce a door half of the original weight and 15 pounds less than the imported products' weight. Another redesign was the specification of a face laminated two piece stile constructed of Timberstand from Trus Joist MacMillan of Deerwood, Minnesota, and a high density hardwood which can be supplied by a number of local vendors.

Plans are to slam test these new prototype products at Lexington's Corporate office in Coon Rapids, Minnesota. Lexington Manufacturing has personnel at the plant around the clock and can monitor the performance testing closer.

A highlight of business development efforts was the accurate costing of the originally concept door by the President and CFO of Lexington Manufacturing. Again an unexpected result had to be dealt with. The door priced out too high to penetrate the target market. To reduce costs prototypes are being developed which use a raised panel area. This panel could be assembled first and then placed into a dye cut sketch face skin. Cost reductions occur due to reduced labor from reducing the material handling steps and by significantly reducing the routing steps in manufacturing the door. These changes also make it feasible to have a door pilot plant assembly line within Lexington's current facility.

These design changes have resulted in a 100 percent veneer face door using profile wrapped technology and membrane pressing technology. This makes manipulating the species of the door offered extremely easy. The wrapping will be provided by Lexington Manufacturing and the membrane pressed panels will be provided by Northern Contours of Fergus Falls, Minnesota. The dye cut skin will be Supercore hardboard from Georgia Pacific of Bemidji, Minnesota, laminated with a sketch face hardwood veneer skin. The veneer will be sourced from a wide group of vendors. The pilot subassembly and final assembly will be done at Lexington Manufacturing in Coon Rapids, Minnesota.

A project management highlight is the development of a strong working relationship with Lexington Manufacturing and NRRI/CARTD. Lexington Manufacturing has accurately accounted for there project match by billing the project with a company invoice for a dollar amount of service but at no charge.

An unexpected highlight of this work was the development of bench samples of fiber backed veneer skins. This result was accomplished by pressing "low density fiber mat" and veneer skins in one step, creating high density fiberboard laminated with veneer. The fiber mat was supplied by Mat, Inc. of Floodwood, Minnesota. Developing and incorporating this product concept into the current project was beyond the scope of the work plan for this project. However, if this concept were developed it could reduce the cost of a sketch face door skin (a specialty product) but also potentially reduce the cost of producing flush door skins (a commodity product). It's believed this topic is a strong candidate for SBIR funding and the Principle Investigator is considering submitting a proposal by the September 1, 1995, USDA due date.

In summary, expected results of this project is a door manufacturing plant producing a door with advance woodworking technologies which will be competitive with imported doors. It is important to note that the current MTI process promotes spin-off opportunities for Minnesota's secondary products manufacturers. The continuation of the project will lead us closer to launching a new product line and will accelerate other industrial expansion opportunities.