Robotics in the Meat Industry

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The red meat industry has made major advances in productivity and cost savings during recent years with innovations such as boxed beef fabrication systems, computer-controlled ground beef systems, paced ham boning lines and continuous cooking and chilling systems.

But none of those systems utilize robotics. Most of the more than 6,000 robots used in the U.S. are relatively simple machines performing basic pick-and-place tasks, but they are becoming more complex. At a recent robotics show in Chicago, over 200 types of robots were exhibited. 1984 sales are now expected to reach $340,000,000. The new robots have sensory capacities to see, feel and hear. They send that information to a controller which makes decisions and directs the robot's movements. These sophisticated robots have found very few homes in the red meat industry and for several reasons. For example, the wash down environment is too harsh; they are very expensive; and no two animals are alike, making it difficult to apply the technology to the kill floor.

Nonetheless, the current applications of robotics in meat processing include a wide range of tasks. Hormel moves boxes of supplies throughout their new Austin, Minnesota plant using a robot made in Sweden. They are also developing automatic eviscerating and head removal equipment and a robot to feed boning machines.

Automatic carcass cutting work is still being done and the seared meat phenomenon originally experienced in laser prototypes has been reported solved with "cool" lasers. Cameras scan the carcass and the computer directs the cutting device (laser or saw) where to cut the carcass. Water jets at 25,000 PSI are able to cut meat effectively, but costs seem prohibitive. Omeco-Boss is now manufacturing their first automatic hog stunner, which uses two restrainers so scanners can locate the position of the head and direct the stunner.

Accroloc is developing a reciprocating saw for frozen pork or beef loins that cuts a steak, weighs it, then adjusts the thickness of the following cut while considering the natural taper of the product. A robot pork loin puller is being tested in Canada.

Proman KC, division of KemaNobel of Sweden, introduced the Beef-A-Matic system for boning out fore and hind quarters at IFFA in Frankfurt and the AMI Show in Chicago during 1983. This system, more so than most of the others mentioned, actually *looks* like a robot.

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Reciprocal Meat Conference Proceedings, Volume 37, 1984.

The idea for the system and the method came from a seasoned beef boner who injured his back and then devised a way to ease the physical work involved in his job. He reasoned that the beef market requires muscles to be removed *intact*, so he chose rail boning with a mechanical assist, rather than a 'black box" approach wherein the bones come out one end and the meat out the other. This concept is seen in the Protocon ham deboner and/or the H.J. Langen shoulder deboner, which are designed for meat that will be further processed but not for beef cuts.

Worldwide, Canadian and U.S. patents were gained by KemaNobel and the inventor after several years of trial and error developing the system. KemaNobel is a major Swedish holding company with 7,000 employees in 30 countries.

The first commercial installation was in Wisconsin. Since then, systems have been installed in Switzerland, France, Norway and Sweden. Ireland, England and Australia (where entire sides are boned) are expected to be added to the list soon. These systems are producing primal beef cuts and boning cows and sows. Hot sows have been boned in the pilot plant. Hot beef has been boned after a waiting period to overcome the difficulty of gripping the slippery and soft meat and to ease cutting it away from the bone. Single or double electrical stimulation shortens that waiting time and more work is being done here.

A pair of arms with mechanical grippers pull the meat away from the bones as the boner severs the connection with his knife. In essence, the system gives the boner 2 extra hands with considerable muscle power. Operator fatigue is thereby reduced, allowing the boner to focus his efforts on the skill areas of seeing where to cut and making the cut. Then Beef-A-Matic pulls the meat away and onto a takeaway conveyor leading to finishing trimmers on an adjacent table.

With the Beef-A-Matic system, it takes 2 men about 2 minutes to completely bone one forequarter. One boner prepares the forequarter by making a few opening cuts. After the brisket is marked and the shank is cut, further cuts are made on the arm, down into the blade and then the blade is loosened. The forequarter is sawed along the feather bones and then it is ready for boning out while another quarter is prepared. The forequarter is put into a fixed position on the rail and strippers are attached to the ribcage. A press of the button on the control panel and Beef-A-Matic pulls the rib cage off in a steady, even motion without tearing the meat.

Then the rib cage is conveyed to adjacent trimming tables while the strippers are reattached to the brisket. While Beef-A-Matic begins pulling the meat, the boner performs a few simple cuts that follow the bone. Beef-A-Matic pulls the meat from the bone in one complete piece. In an operation of about 2 minutes, only a clean bone is left in the gripper while the

meat is on its way to the trimming table.

The hindquarter is also prepared for boning with a few opening cuts. When the flank is removed, the butcher cuts and pulls out the tenderloin, and opens the knuckle and shank. One final mark down the backbone and the boner has only to saw the finger bones for preparation for the Beef-A-Matic equipment with the hindquarter locked in place. The strippers are attached to the knuckle and hind tendon. The strippers begin pulling while the boner follows along the bone with his knife.

Normal preparation and boning time are so short (1 minute each) that there is virtually no wait time and a consistent flow of quarters is always ready for trimming. With the controlled power of Beef-A-Matic, the meat is stripped in one piece and the conveyor will take it to the trimming table.

Seam cutting and trimming becomes a quicker and simpler operation. Once again a clean bone remains and the robot returns to its starting position and is ready for a new quarter.

In addition to boneless cuts, bone-in primal cuts are also handled with this system. For bone-in prime rib and boneless front, the procedure is slightly varied. The ribs are vertically sawed and the chine sawed horizontally, then a slightly different hand cutting pattern is followed.

The Beef-A-Matic system uses 3 boners; 1 for precutting, 1 on the Beef-a-Matic and 1 for table trimming. Proman assures us that 3 boners plus 1 Beef-A-Matic can produce as follows:

50 hindquarters per hour
or
30-36 forequarters per hour
or
9.4 to 10.5 carcasses per hour

This means productivity of 3.1 to 3.5 carcasses per man/hour on beef quarters. Multiple machine installations are practical up to about 10 machines or 90+ head per hour.

This method of boning appears to have a solid future in cow and sow boning operations, and projected productivity of choice primal cuts should justify utilization in that market as well.

Another robotic innovation is a method of loading frozen hamburger patties into a box. The Patty Packer from RMF fits onto the standard RMF Patty Stacker that has been in use successfully for several years around the country. The basic stacker units accept frozen patties (+15°F or less) from spiral or tunnel freezers. Variable-speed drive matches the pace of the patty maker. Lane dividers orient scrambled patties; then augers at the bottom of a slide separate and stack patties in as many as 6 columns in troughs. A wide range of sizes and shapes requires no changeover.

Conventionally, 2 operators remove the patties and stack them in boxes. In a joint venture with Carl Karcher Enterprises in Anaheim, CA, the RMF Patty Packer goes one step further and replaces 1½ of those last 2 operators.

Directed by the Modicon 84 programmable controller, the robotic Patty Packer lifts columns of patties and slides them into a box, still on their edge. Edge stacking allows the patties themselves to share the load so lighter, less expensive boxes can be used. Telescoping boxes load easier than the flapped boxes now used at Carl's. Patty temperature should be under 10°F, or 5° colder than the stacker alone requires.

Unlike the patty stacker, which requires no size changeover, the packer must undergo a 1½ to 2½ hour procedure when patty diameter changes.

One man monitors the operation of 2 systems or lines and watches for occasional folded patties or patties frozen together so those problems can be corrected.

The Patty Packer will work well in an environment of quality patty production with limited size changeovers.

Another pick-and-place example is the Overpack, also from Sweden. This brand new system is a box loading device for chubs or luncheon meats or hams. Packages are conveyed to the loading area where a robot arm lowers a 10″ × 12″ pad into contact with the packages. The pad has 8 adjustable vacuum nozzles which hold the packages while the arm raises, positions over the box, lowers and releases. Capable of up to 40 cycles/minute at a maximum load of 25 pounds, the machine can also load horizontal with smoked sausages and small hams. A 30-minute changeover time converts to loading luncheon meat packages into boxes.

We feel this has very good potential for use with our continuous chub chilling systems so we will give it particular attention this year.

Suppliers to the meat industry are making progress in the field of robotics, but it will take very close cooperation between the packer/processors and suppliers to make the R&D work. Many of the old-line meat processors have trimmed down or done away with their equipment design groups now that innovation is needed more than ever. On the other hand, some suppliers have beefed up their R&D staffs and facilities to prepare for the technology revolution expected in the balance of the 80's. But the suppliers cannot assume the risk of development costs alone. They must be assured of a sale, provided thay can make the innovation work. Shared risks between packers and suppliers reduce the hazard of failure. If the potential user has a vested interest in a prototype, things always seem to work out. The packer knows meat. The supplier knows machinery. Together things happen. University cooperation in a three-way joint venture provides credible data for future sales by valid scientific techniques to insure accuracy.

If you have an idea for a needed machine or system, seek out an aggressive supplier and talk it over. Together with an interested meat processor, you can all be in the robotics business.

References

Design Fax editorial, "Robots That See", August, 1983.
Kelsey, R.J. "The Mechanical Worker Begins to Grow", Food and Drug Packaging, August, 1983.
Mans, J. "Robotics Blueprint", Prepared Foods, November, 1983.
Meat Industry editorial, "Robots in Meat Plants", June, 1983.
Meat Industry, "Patty Pack-Off Robot", June, 1983.
Meat Industry, "Excel, An Automated Marvel at Dodge City", September, 1983.
Meat Processing editorial, "Future Trends", August, 1983.
Morris, C. "Robots with Spirit", Food Engineering, November, 1983.
Susnjara, K. "Fundamentals of Robots", Design News, March 28, 1984.
Wellborn, S.N.E. "Machines That Think", U.S. News and World Report, December 5, 1982.
Wolfe, G. "The Anatomy of a Robot", Plant Engineering, July 21, 1983.

Additional Sources:

Abbott, George; Vice President, Omeco-Boss, Omaha, Nebraska
McDougal, Don B.; Director of Manufacturing, Carl Karcher Enterprises, Anaheim, California
Norling, Lars-Erik; Vice President, KemaNobel Food Systems, Klippan, Sweden
Oyster, Royal J.; Industrial Specialist, Equipment Group, Technical Service, Animal and Plant Health Inspection Service, USDA, Washington, D.C.

Discussion

C.C. Melton: How do you think the unions will react to machines replacing people?

K. Mauser: We are a non-union shop in Kansas City. I don't think we will be very popular with them, except for the fact that they have fought the lowering of salaries for the last few years and by now I think the shock has hit them that they are going to have to work for less money, be more productive and not draw butcher's rate for making the same cut day in and day out. If we can put machines in the place to increase the productivity of those men, then perhaps their wage scale can raise again. We certainly can't afford to continue paying them the rates we were paying them to do repetitive motion which can be replaced in the not-too-distant future with robots.

J. Ziegler: We all keep talking about replacing labor and bringing down prices, but the serious question is "how much meat does the robot eat?"

K. Mauser: The people in Kansas City that build the robots eat a lot. We are back to that same problem. They have to earn their keep or something's going to happen.

N. Marriott: My question is related to the last equipment that you showed us that handles the packaged processed meats. Do you have any data that reflect damage to the packages of product that this equipment handles?

K. Mauser: We have just been introduced to this machine in the last two weeks. The tape was sent to me last week and I just hurriedly added it to this. I don't know any damage numbers on it, but I would expect that they are very low. In analyzing the machine from an equipment standpoint, it is all a very open operation. Those chubs just simply roll down a trough and there is a vacuum-assist pressure-sensitive device which goes down and touches the product and holds it in place by vacuum and lifts it up and then again drops it over here. I would expect very little damage.