Innovations in the Flexibility of Food Packaging Machinery

Dana Mullen

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Clemson University

As the US population rapidly increases, the expanding middle class has shown a growing demand for consumer-ready food products. Consumers are increasingly demanding a variety in products, which have, in the past, been highly standardized. Where one size of a cookie was acceptable in the past, buyers now expect a range of a larger cookie in a larger package to a smaller version of the cookie in a single serving package. With this expanding need for increased convenience and variety among food products, companies are facing a variety of problems. Since a large percentage of capital expenditures are allocated to packaging equipment and a majority of this is dedicated to specific product lines this leaves relatively little opportunity to introduce variation in the package design, labeling and content configuration (Spada).

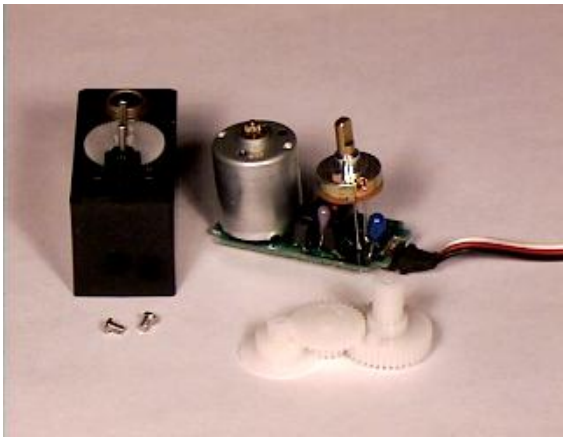
Any small change in either product or package characteristics can have an effect on each aspect of the packaging and distribution process. If the cookie size is increased only a small amount the primary and secondary packages will likely be increased. The change in primary package size may then trigger a need to alter the shipper size. When shipper size is affected significantly, the number of shippers per pallet may need to change. The problem with these changes is that filling, bagging, wrapping, labeling and other machinery may not be able to handle these changes. There are a number of possible solutions, one being increased flexibility in food packaging machinery.

Currently as high-volume retailers continue to demand customized packs, multipacks in particular from consumer packaged goods companies, CPG companies are relying on contract packagers like never before (Reynolds). According to a January 2004 study in Packaging World, 41% of contract packaging users do so because “certain technology is unavailable in-house” (Orloski). Another 32% utilizes co-packers in order to “minimize upfront capital investment” (Orloski). Because they are designed “to be flexible in both capacity and packaging options”

(Elston), contract packagers are an obvious solution for companies interested in experimenting with a new package. They give companies the chance to look before they leap, with regard to capital investment (Elston), which is extremely important in an industry where around 70-80% of new product launches fail each year. Also, purchasing and running new equipment can be a tedious and risky process. Contract packagers have validated equipment and preferred suppliers at the ready to tackle launch projects quickly (Elston). However, new innovations in machine capabilities, controls and flexibility are making it easier for companies to build the needed flexibility into their own networks. It is these companies that will be able to create new products and expand current product lines in shorter time periods without the high cost of using contract packagers.

One very common resolution to the flexibility problem for companies using their own packaging machinery is, simply, "gravitating toward two solutions: servo motors and robots" (Pierce). Servo motors are very small and powerful for their size. They consist of a variety of components including control circuits, a potentiometer (or variable resistor) and an output shaft.

"A servo dissembled"- (seattlerobotics.org)



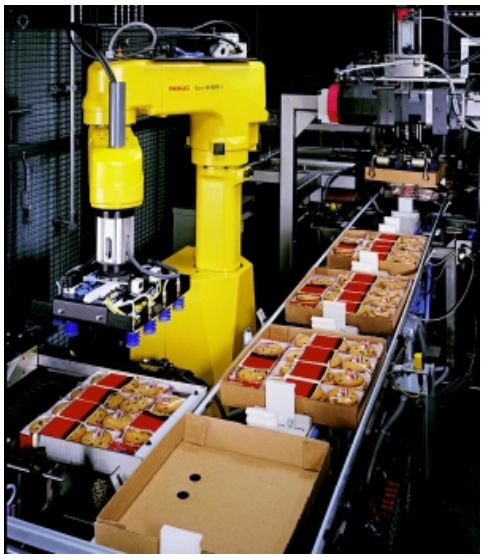
The potentiometer allows the control circuitry to monitor the current angle of the servo motor. If the shaft is at the correct angle, then the motor shuts off. If the circuit finds that the angle is not correct, it will turn the motor the correct direction until the angle is correct (Seattle Robotics Society). Most servos are used to control angular motion from 0 to 180 degrees, making them ideal for robotics. Other advantages of using servo motors include advanced vibration control, higher speeds and higher accuracies, and increased compatibility (Packworld). When Spee-Dee® Packaging introduced servo motors to their augering systems, they were able to increase both speed and reliability. More importantly perhaps, flexibility was increased since cycles can now be programmed to fill accurately to specified weights within a gram eliminating expensive product giveaway (Zero-Max). Since the machinery can now be programmed with a high degree of accuracy, products of different weights can now be filled on the same line.

Servo motors are also extremely important in that they have allowed the increased use of robotics. According to one author, "integral robotics is now becoming the most effective means to add agility and flexibility to a packaging line" (Spada). Historically, the main application for robotics use was for palletizers and case packers. Increasingly however, robotic parts are moving to more integral parts of packaging machinery. In a 2004 Packaging World survey to determine which manufacturing sectors are moving toward robotics, of 407 respondents, 29% were from a company in the food sector (Lewis).

With regard to case packing, robotics can improve the packaging line in a variety of ways. Several general reasons include labor savings, less scrap, better product quality, increase of production through higher efficiency and overcoming potential and existing labor shortages (Kirgis). One example of this application involves "a leading manufacturer of baked goods faced with ergonomic issues and labor shortages required a reliable means of case loading

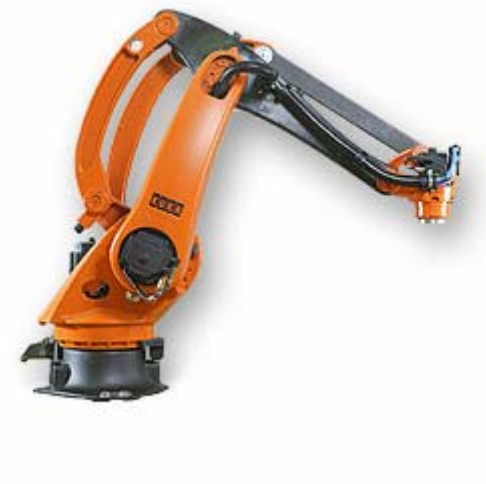
various sizes of plastic over wrapped chipboard and plastic trays into returnable snappy-bottom cases" (Roth). In this case, a case loading system was implemented using a variety of components. These included both "servo driven Cartesian components as well as a FANUC A-520i pedestal robot to address the various process steps" (Roth). The FANUC A-520i robot is important to this process because it has the ability to form different tray patterns using its' end-of-arm tooling. These different tray patterns allow the company to run different sizes, which can then be placed a single size of automatically formed returnable cases.

The FANUC A-520i robot- (RoboticsOnline.com)



In June of 2005, KUKA Robotics Corporation released what is known as the KUKA KR 40 PA™. This robot is designed specifically for case packing and is among the fastest in the industry. The robot arm is unique in that it is made from a carbon fiber composite, helping to make it both light and less expensive than highly priced metals. The lightness of the material keeps inertial forces low, ultimately allowing an increase in throughput. Also, the lowering of the weight allows higher acceleration and deceleration in the arm.

The KUKA KR 40 PA™ Robotic Arm- (Kuka.com)

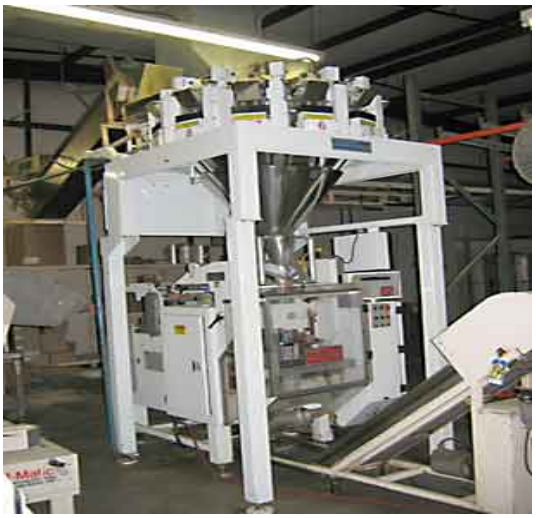


Other highlights of the arm include a 40kg payload capacity and also the ability to perform mixed palletizing. Mixed palletizing is extremely important to companies that need more flexibility as a result of a large number of product sizes and types. Additionally, companies who traditionally use horizontal cartoners are "looking at robotics as a way to move to vertical" (Parker). Moving to vertical cartoning allows companies more control over products and provides an opportunity for higher speeds (Parker).

In addition to case packing, there are a variety of other areas in food packaging where the ability to alternate between package sizes is crucial. Bagging equipment is one example of a category that requires a certain degree of flexibility, as items such as potato chips are commonly desired in both a large and single serving bag size. In November of 2005, the Autobag AB 145 Bagging System was released by Automated Packaging systems. The machine is capable of speeds up to "45 bags per minute in a semi-automatic fill and seal operation" (ThomasNet). The importance of the machine, however, is that "package size changeovers can be achieved in less than 2 minutes using Autobag pre-opened bags-on-a-roll" (ThomasNet). This allows companies to run a variety of sizes without the downtime that usually goes along with size changeovers.

Frito Lay is another example of a company that has made efficient use of new innovations in bagging flexibility. Frito Lay is an industry leader, with a "more than 60% market share in its category" (Pierce). Thus, it is extremely important that the company stay on top of new trends in an area where all products are closely related. Previously, most of Frito Lays product line was packaged in the pillow-style bag. Given the fact that this was such a widely used package, it became increasingly difficult for the company to stand out amongst its competitors. The company "realized it would need an innovative package to gain space in new areas of the store" (Pierce) however, most ideas for new packages "were costly and didn't fit with the manufacturing capabilities in [Frito Lay's] plants" (Pierce). The solution for Doritos® and Rollitos™ products was a "new Vertical Stand Up™ pouch" (Pierce). According to Food & Drug Packaging, "The new style of stand-up pouch is cost-effectively made on a high-speed vertical form-fill seal (VFFS) machine." For the Rollitos™ launch, the VSU™ pouch was produced on an existing Woodman Polaris bag maker, which was retrofit by Frito-Lay engineers in early 2004 with new plows and other parts. No other changes were required upstream (Pierce).

The Woodman Polaris bag maker- (Rabin.com)



Thus, Frito-Lay was not required to purchase large amounts of additional machinery in order to run the new pouch. The change in packaging required little retraining for operators and showed no measurable increase in material waste (Pierce). The line change exhibited virtually the same line speeds as had been previously run and offered the additional flexibility of pack sizes through simple depth and position changes in the gusset. Frito-Lay is able to switch between running the typical pillow-style pouch and the new Vertical Stand Up™ pouch (Pierce). This changeover process typical takes around 30 minutes and is simple enough that the company alternates bag styles at least once per week. The new package has been well accepted by consumers as "more than 10 million VSU™ bags were sold in 2004 (Pierce). Had Frito-Lay not been able to integrate this sort of flexibility into their pouch line, the success of the new package would have been much more unlikely. The use of a contract packager or purchase of new equipment would likely have boosted the cost of production to a level consumers are unwilling to pay.

Technology for this flexibility was developed "in cooperation with machine maker and rebuilder CMD Packaging Systems" (Pierce). The "retrofit" was performed on Frito-Lay's Woodman bagger and has also proven successful on Hayssen machinery. CMD packaging "is looking at incorporating this on Bosch and Triangle machines" (Pierce), as this will expand possibilities with additional companies. Currently, Frito-Lay holds five patents related to the technology involved in the process. Non-snack manufacturers can purchase a license to the technology for between $10,000 and $20,000 (Pierce), a small price to pay when compared with purchasing new equipment.

In addition to Frito Lay, Espoma (a plant food producer) has recently implemented efficiently flexible packaging machinery, which is noteworthy from a human food perspective as

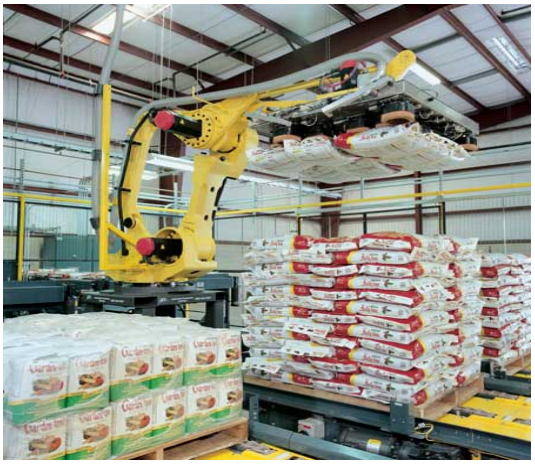
well. In the last couple years, Espoma has switched from paper bags to Bischof + Klein pre-made bags, which have also been used for items such as coffee (Butschli). It was this switch that led to the company's acquisition of new and more efficient packaging equipment (Butschli). At this time, Espoma acquired a robotic palletizing system from Automated Production Systems. The company runs product on three different lines. Two of these lines produce 25, 35 and 50 lb bags, while the third produces "the plastic-bundled U-Pack bags" (Butschli). Espoma utilizes the U-Pack bag for 33 different stock keeping units, whose dimensions range from 5 1/2"x 3 1/8"x 14 1/4" to 7"x 4 1/2"x 16 3/4". The first step in implementing the U-Pack bags was to perform the necessary changes to Espoma's Parsons machine, which was added to the packaging line in the 90's (Butschli). To begin this process, modifications were made in the machine's two bag magazines that enable mechanical picker heads with vacuum cups to more easily grab the individual bag and place it under the filling station (Butschli). Here, opener arms containing vacuum cups are able to open the bag, fill it and drop the bags onto the conveyor. Thus, Espoma was able to easily modify the filling portion of its' packaging line without purchasing an entirely new filler.

Further down the line, the bags are labeled using a Doboy S-CH-S continuous band sealer. Espoma markets its' bags by weight, so the fill level can easily vary from product to product. To accommodate these differences, the Doboy has a plastic cover whose height is adjustable based on bag height and product differences (Butschli).

After labeling, bags are bundled and conveyed to the robotic palletizer (Butschli). This palletizer receives bags from the U-Pack line as well as the lines producing 25, 35 and 50 lb bags. In order to efficiently palletize each of these four packaged products, the "robotic

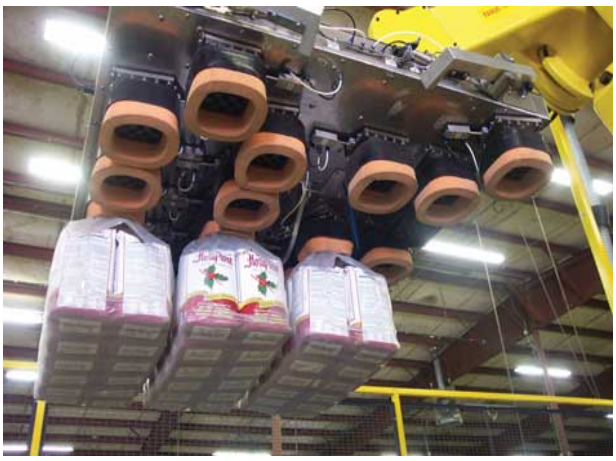
palletizing system keeps recipes of each of Espoma's packaged product in a PLC" (Butschli). Product enters on a conveyor, where bags/ bundles are laid out to form a layer.

A layer pattern used by the palletizing system.



Here, the Fanuc robot uses a specialized end of arm tooling, approximately 40"x 48", to pick up an entire layer rather than a single bag. Not only is this quicker that picking up an individual bag/ bundle, but it also allows the same palletizer to be used for a variety of packaging sizes.

Fanuc's specialized end of arm tooling.



In this case, the payback of utilizing this new, more efficient packaging system has been obvious. According to Espoma, "since installing the equipment, productivity is up, while labor costs have dropped substantially" (Butschli). Espoma still maintains the same crew size but, due to increased production, many employees have been moved to other areas where labor was needed. Also, the U-Pack bags have resulted in "double-digit sales increases that wouldn't have been possible without the equipment" (Butschli).

For both Frito-Lay and Espoma, implementing new and flexible machinery components into a current packaging machinery line proved successful. However, for some companies and or products relying on contract packaging may be more efficient. When debating outsourcing a certain packaging project, a variety of aspects must be considered. First of all, if your product volume under or over utilizes your own manufacturing lines, either short or long term (Packaging Graphics) it may make more sense to employ a contract packager for those particular needs. If the volume being tested under utilizes lines, the company is wasting valuable time that could have been spent running a product that is known to be profitable. If volumes over utilizes the lines, goals and or timelines will not be met and the product will likely fail. Also, if there is no available in-house packaging equipment or expertise for a particular job (Packaging Graphics) then quality will likely be poor due to the lack of assistance from a co-packer's expertise. Finally, the implementation of more flexible equipment into an existing line may require a high investment to meet regulatory and environmental compliances (Packaging Graphics). Simply, adding machinery components may be too expensive to risk the possible failure of a new package. Although utilizing a co-packer is often considered expensive, in some cases it may prove far more efficient that purchasing additions to a packaging line.

Overall, increasing the flexibility of in-house packaging equipment can be extremely efficient. In cases, such as Frito-Lay and Espoma, incorporating additional components to existing lines proved far more profitable than costly. It is important to remember that no two packaging situations are alike. All costs and benefits must be examined thoroughly, as in some cases it may be more beneficial, from both a financial and quality standpoint, to hire a contract packager. For other companies, however, increasing flexibility of machinery lines will further promote the ability to produce packages of different sizes and varieties in a timely manner. As consumer demand for greater selection in consumption goods increases, it is companies who can implement new and innovative packaging quickly that will prosper in the competitive food product industry.

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