LINE AUTOMATION

A CASE STUDY

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ABSTRACT

Food and Beverage manufacturing both process and packaging is a competitive industry. Always striving for increased production at reduced costs while maintaining quality.

This works for the big guys, however, the specialty brands or co-packers with smaller custom runs often suffer. Typically these are highly manual processes that result in slower production times, fluctuations in quality, and higher product waste. Automation is costly to implement in the specialty market where runs are smaller and flexibility is critical.

How does the specialty market compete with the big guys?

INTRODUCTION

This case study is based on a consumer-focused frozen food entree manufacturer. The production process included hand dispensing multiple variations of recipe ingredients into an assortment of trays.

The process of manually dispensing liquids, slurry, proteins, mixed, and dry ingredients by multiple resources generated fluctuations in the volume and quality of the finished product. These fluctuations resulted in a variance of 10% representing annual losses up to a million dollars.

CSMI successfully addressed and implemented an automated solution to meet the objectives of mitigating product fluctuations, condensing resources, increasing line speed, and reducing product waste.

OBJECTIVE

The frozen food entrees included over 55 different recipes, made up of multiple ingredients, with varying temperatures, placed in a variety of trays to be flash frozen.

The objective was to provide a solution that would reduce costs in operating and waste, increase production throughput, and improve product quality on the line.

CHALLENGES

The line had to remain flexible with positioning and material flow to accommodate the variety of custom processes and packaging options. The number of manual stations and resource count varied by recipe but could be as many as 26 dispensing locations. The ingredients varied in viscosity, temperature, quantity, and placement in the tray. In addition, there were spatial limitations in the facility due to an adjacent line, material traffic flow, and adequate area for line resource stations.

The challenges included:

- Facility Specifications
- Line Layout
- Line Resources
- Recipe Ingredients
- Production/Throughput Rates
- Capital Budget

ASSESSMENT

An assessment was conducted on the challenges and while the review confirmed the variables would prevent a fully automated production line, it was determined a partially automated line would address many of the objectives.

- ✓ **Mitigate product fluctuations:**
  Could be met by automating by weight or count the dispensing of the products protein, the most costly ingredient, and the largest contributor to the over/under quality concerns.

- ✓ **Reduce resource costs:**
  Could be realized by reducing the number of manual stations required, also a contributor to the quality of the finished product in the ingredient placement and quantity dispensed.

- ✓ **Increase line speed:**
  Could be achieved by a programmed line speed in the automated stations, therefore setting the pace for the manual resources.

- ✓ **Diminish product waste:**
  Could be accomplished by utilizing equipment that dispensed by weight or count to eliminate the under/over specifications, as well as, reducing the variables in the manual dispensing.

ANALYSIS

The analysis considered the assessment findings for partial automation and what stations or ingredients could be most effective in achieving the objectives. The analysis considerations included 55 recipes with a review and test of product ingredients, quantity/measurement, number of process steps, the order of the steps, and the viability of using dispensing equipment.

- **Trays:**

  The first manual step on the line required a dedicated resource to place the product trays. With an automated tray dispenser, all (3) lanes would have a tray deposited in the cycle time of 1 second, faster than manually possible.

- **Conveyors:**

  Automated dispensing equipment would require timing and placement consistency of trays and products. An intermittent conveyor would provide a solution for dispensing and tracking the product throughout the line. This conveyor could be integrated with manual resource stations and other line equipment.

- **Fillers:**

  A scale filler for proteins, the largest wasted product, and slurry fillers the most time-consuming products could improve quality by automated dispensing. The fillers would need to retain the line flexibility and allow for manual resource stations.

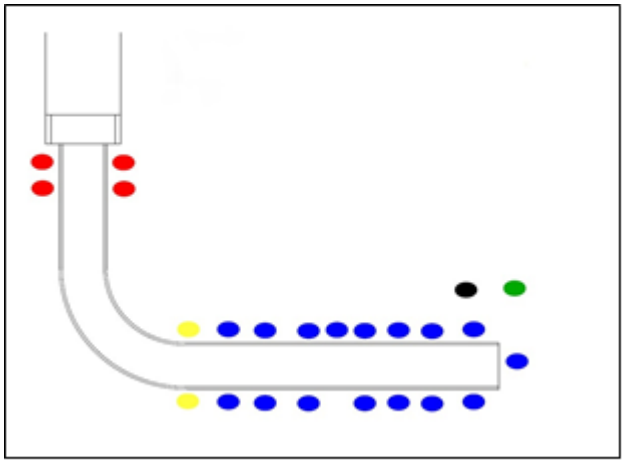
- **Checkweigher:**

  The last stage on the current line is a manual station requiring 4 resources to weight-check the trays. It is in this position that under/over-weighted products are identified and addressed before flash freezing.

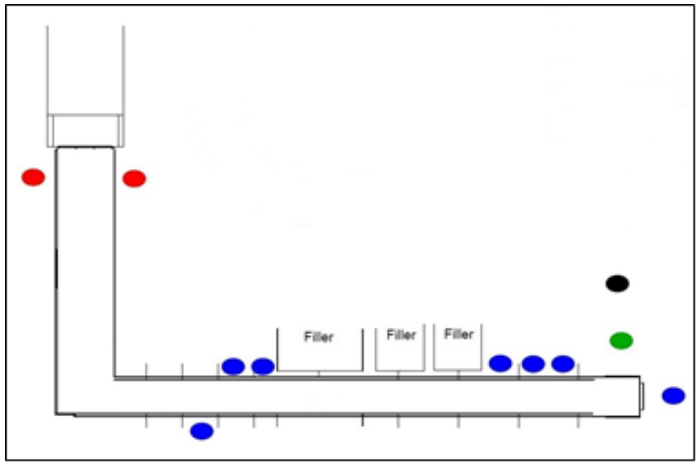
ENGINEERING DESIGN

The proposed solution included the validation of equipment for accuracy and line speed, resources for reduction in overhead, layout design for spatial considerations in the facility, and the budget restrictions.

The initial design evaluation revealed the proposed line would show positive results in meeting the objectives of reducing resources, decreasing product waste, improving quality and increasing throughput. Therefore, the estimated ROI would be captured in 12 months or less. *(The diagram below is a before and after based on one of the 55 recipes analyzed)*



Original line layout with 24 resources



Proposed line layout with 11 resources

PROPOSED SOLUTION

The following automated equipment was implemented to achieve the largest impact on the objective and a reasonable ROI. Some of the equipment would be stationary and positioned to allow the flexibility necessary for the product variations.

(all equipment met the objective of 90 units/minute)

- Tray De-nester: stationary (3) lanes
- Intermittent Conveyor: stationary (3) lanes
- Slurry Filler(s): (3) movable for (8) line positions
- Protein Filler – stationary (3) lanes
- Continuous Conveyor: stationary (6) lane
- Checkweigher: stationary (6) lane

IMPLEMENTATION SUCCESS

Reduced operating costs

The operating costs were reduced by 54 - 66% with a reduction in line resources. *(The total reduction in resources varies by recipe).*

If the average resource is $30,000 annually the reduction in cost ranges from $200,000 to $450,000 on resources alone.

Reduced product waste

Initial reports of over-filling trays accounted for 10% of waste and this represented $1,000,000 annually.

Utilizing the automated process for the higher priced ingredients reduced the costs associated with package overweight discrepancies.

The quality checkpoint had minimal product waste during weight checks and less than 2% of trays needed product modification and no trays were completely discarded.

Increased production

Accurate weight dispensing increased the volume of trays sent to the packaging area and resulted in improved throughput. A non-measurable amount of loss was seen through the assembly process.

Improved quality

Quality checks show very little variance in product distribution and tray weights. Less than 2% were pulled for modification and this was due in part to the product package counts, not weight.

Some products are stated as “count” on the packaging and require a count not a specific weight for assembly. Brussel Sprouts require a count of 3; however, the piece weight accuracy may have deviated from the count weight, adjustments were met by adding pieces to meet the packaging “count” claims.

Resource Reduction

54.1% reduction from 24 to 11 resources on recipe LU10576002
53.8% reduction from 26 to 12 resources on recipe LU10576007
65.2% reduction from 23 to 8 resources on recipe LU10576003
66.7% reduction