

CHEF



BOMBAY
CHEF

Case Study

Chef Robotics helped drive large operational improvements for Chef Bombay including Yield, Throughput, and Labor Productivity.

Production:

↑ 30%

Reduced Product
Standard Deviation

↓ 88%

Reduced Food
Giveaway

↑ 33%

Increased Labor
Productivity ¹

↑ 9%

Increased
Throughput

To accomplish this, Chef Robotics deployed a novel AI-enabled system at Chef Bombay that can pick and place many different kinds of ingredients with varied portion sizes into many kinds of trays, positions within the trays, and conveyors, all with easy changeover. Unlike traditional automation which requires costly infrastructure changes, Chef Robotics' flexible automation System fits within a human-sized footprint on existing lines with no retrofitting required.

About Chef Bombay



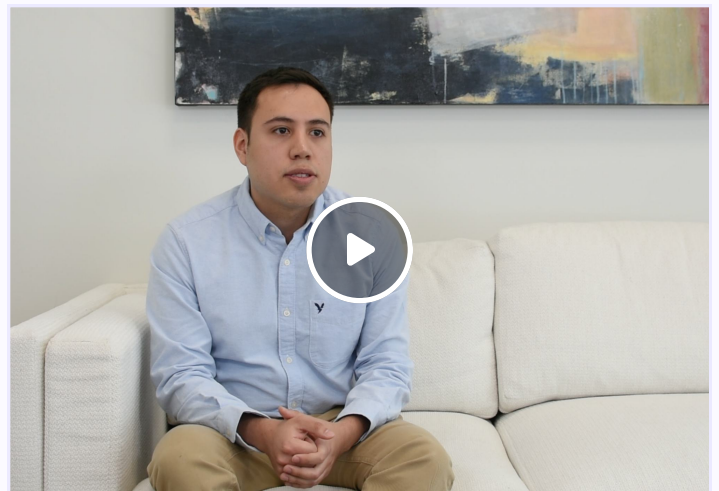
Contract Manufacturer for Major Retailers in the US and Canada.



Based in Edmonton, Alberta, Canada

”Chef allows us to track the standard deviation of the rice and how much we’re putting and it helps us continuously improve... The standard deviation of our rice has decreased 30% with Chef compared to the job people were doing.”

*Chef Bombay Continuous Improvement
Manager*



1. To Measure Labor Productivity, Chef Compared The Number Of Line Workers Required To Operate An Assembly Line Before And After Chef. See The 'Results' Section For More Details.

PROBLEM 1: Redundant Motions In Cold Room Makes Retaining Labor Hard.

Chef Bombay's labor-intensive operations require workers to do a lot of redundant motions, which makes it difficult to retain labor. Also, Chef Bombay is always seeking more automation to improve workers' safety and reallocate those workers to other jobs in the plant.



Chef Bombay Line Before Chef

PROBLEM 2: Difficulty in Maintaining High Product Consistency and Low Giveaway.

Chef Bombay is constantly working to improve the consistency of ingredient weights and to minimize giveaway (to maximize yield). For one key ingredient, for the baseline process, they found that 14.1% of the deposits were outside of a 10% tolerance bound of the target weight, and this may have led to some customer dissatisfaction.

The inconsistency also led to food waste as human line workers tend to over-deposit by 2.3% on average over the run (e.g., the average pick weight over a run is 168.8 for a desired target of 165g). The giveaway resulted in a reduction to Chef Bombay's yield.

PROBLEM 3: Traditional Automation Solutions Don't Work

To overcome the labor shortage, Chef Bombay embraced automation. They experimented with many different kinds of traditional automation and even implemented some. However, traditional automation did not work for rice deposits because:

- ▶ The rice is very sticky and traditional automation led to unacceptable consistency and poor quality due to damage to rice.
- ▶ Traditional automation could not accommodate the various portion sizes used in Chef Bombay meals.
- ▶ Placement flexibility into different compartments of a tray was too limited.
- ▶ Chef Bombay introduces new meals frequently and seeks to avoid expensive hardware change orders to make the new meal work with existing automation.

Deployment Requirements	
Required Infrastructure	Can work within existing lines without infrastructure changes
Footprint	Similar to a human footprint
Product Quality Requirements	
Product Consistency	Similar or improved consistency and yield over current process.
Product Aesthetics	Acceptable to Chef Bombay's culinary standards. Doesn't damage the ingredients.
Product Portion Sizes	Works with various portion sizes.
Placement Requirements	
Conveyor	Can work with a four lane conveyor.
Placement Position	Can place into different compartments of a tray.
Container Type	Can work with various container types.
Flexibility Requirements	
Changeovers	Can work with various placement compartments, portion sizes, and containers.
Throughput Requirements	
Throughput	At least 66 trays per min for the four lanes or at least 16.5 trays per min per lane.

Chef's Mandate

Build a modern automation solution with the flexibility and placement aesthetics of a human.

Since traditional automation was not flexible enough, Chef Bombay worked with Chef Robotics to implement a flexible intelligent automation system to increase production volume, increase worker productivity, increase yield, and improve product quality.



Chef Bombay's Line After Chef

Product Approach

Equipped with AI-enabled perception, a collaborative robot arm, and proprietary utensils, Chef AI-Enabled System maximizes SKU compatibility while maintaining product quality and production throughput, all with maximum uptime.



Machine Learning Based Perception:

Eyes of Chef's Flexible Automation System. The perception system leverages Machine Learning to accurately detect bowl location and food topology for accurate deposit placement and weights.



Collaborative Robots:

Arms of Chef's Flexible Automation System. It provides great throughput while meeting industry standards (ISO 10218) for working alongside humans.



Proprietary Utensils

Hands of Chef's Flexible Automation System. By simply swapping utensils, Chef can deposit hundreds of different SKUs with quick changeover and minimal sanitation time.



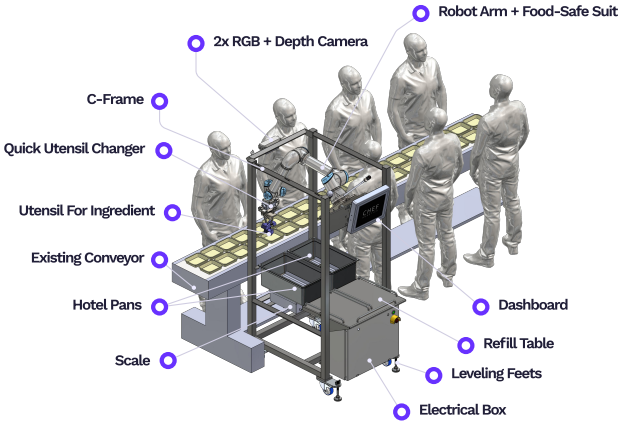
Inside Chef's computer vision and robotics software

Deployment Approach (Low Integration Risk)

LOW INTEGRATION RISK

Deploying a Chef Robotics System is low risk. Customers do not have to buy new infrastructure. Chef Robotics' Flexible Automation System easily slides next to conveyor lines with the same footprint of a single human. All that Chef Robotics' Flexible Automation System needs is a 120V AC power and a pneumatic line with a standard industrial quick-disconnect air coupling, both of which are commonly available in food assembly facilities.

Further, since each System is the footprint of a person, it is possible to deploy the systems at one station at a time without having to automate the full line (e.g., you can have traditional automation like depositors for sauce, humans, and Chef Systems all on the same line). This allows Chef to start assembling food and creating value from day 1 of deployment.



Robotics-as-a-Service (RaaS) eliminates upfront CapEx and hidden fees.

Most traditional automation partners create custom, one-off automation, which requires an initial capital (CapEx) investment. Chef Robotics uses an innovative Robot-as-a-Service (RaaS) model, wherein Chef acts as a robotic staffing agency, providing the hardware, software, updates, and support for a flat yearly cost. This model enabled a cost-effective path for Chef Bombay to

bring on robotic automation, eliminating the upfront capital-intensive investment and providing transparent pricing.

Further, because Chef does not require full line automation, the risk for Chef Bombay was low: they decided to start with a 4-6 robot “Starter Pack,” allowing their team to familiarize themselves with the technology and evaluate the value it generated before deciding to deploy more systems.

Flat yearly fee, Chef provides the following:



Core Hardware And Software



Customer-Specific Configurations



Hardware And Software Upgrades



Field Support And Maintenance

	Robotics as a Service (RaaS)	Traditional Automation, Capital Expenditure (CapEx)
Application Scoping	N/A	Scoping + Feasibility Study Fees
Design + Engineering Time		Engineering NRE Fees
Parts		BOM + Material Fees
Build + Manufacturing		Labor Fees
System Upgrades		Upgrade Fees
Spare Parts		Spare part Fees
Shipping and Training		Shipping fees and training Fees
Downtime and Onsite Support		Emergency maintenance Fees
Recurring Service Plan		✓ A monthly service fee

There are a few other notable wins Chef Bombay had with the RaaS model. One was that Chef fully covers support. For conventional, capital-intensive automation solutions, operational costs and technology barriers usually don't change, except when customers need an improvement, a repair, or to scale. Then, customers often find hidden capital-intensive expenses and expensive maintenance contracts, which together, still don't address their needs. On the other hand, service is included with Chef and there are no hidden operational / service / maintenance / repair costs.

Another win was that incentives are aligned. With RaaS, Chef is directly incentivized to deliver benefits to Chef Bombay's operations, to their bottom line. Chef is not paid a large multi-million dollar CapEx fee in advance like traditional system integrators; rather, Chef earns business along the way – on a yearly basis – which ensures that Chef delivers what customers ask for: throughput for output, consistency for yield and reduced giveaway, presentation quality for customer satisfaction. The incentives are aligned; the same cannot be said for a capital purchase once the vendor has received its large upfront payment.

Technology updates and upgrades are yet another win given that AI-enabled robotics is evolving rapidly. In AI, just as with ChatGPT, every single day and with every single pick, the AI is being trained and getting better; better as in: more ingredients and doing the current ingredients more consistently and faster. That's a recurring cost for Chef - Chef trains our model in the cloud daily. But for customers like Chef Bombay, Chef's RaaS ensures access to the latest AI technology, and regular upgrades targeted to improving customer-specific performance, including both AI software updates and hardware. Every month, Chef expects to ship customers new software releases that will help increase yield, increase consistency, reduce spillage, and increase placement accuracy.

Finally, RaaS prevents obsolescence and stranded capital for Chef Bombay. The rapid rate of advancement in AI will bring meaningful new capabilities and increases in performance on a monthly and yearly basis that will help Chef Bombay continually reduce costs - most drastically through yield improvements. Chef's RaaS allows them to always have access to the most cutting-edge technology. It allows them an alternative from discovering a year or two after a big capitalized robot purchase that their purchase is now obsolete and their performance related to output, quality, and cost is at risk of being surpassed by competitors.



Reduced deposit standard deviation by 30%, reduced food giveaway by 88%, increased labor productivity by 33%, and increased throughput by 9%.



“We increased our capacity by just adding the four [Chef] robots by just over 20%. So a simple math tells you that the ROI is just amazing.”

Video of Chef Bombay President Speaking about Chef

Reduced deposit standard deviation by 30% and reduced food giveaway by 88%, therefore increasing consistency and increasing yield.

With Chef Robotics Systems, Chef Bombay has been able to reduce estimated giveaway during assembly by 88% on average for meals leveraging Chef. In the ‘Basmati Rice’ weight distribution plot below, you can see that human line workers tend to over-deposit this ingredient by 2.3% on average (e.g., a 168.4g average for a 165g target deposit), while Chef is able to deposit this ingredient within 0.2% of the target weight on average (e.g., a 165.4g average for a 165g target deposit). This leads to improved yield.

Chef’s standard deviation was 30% lower than than the human baseline. This further helps with yield.

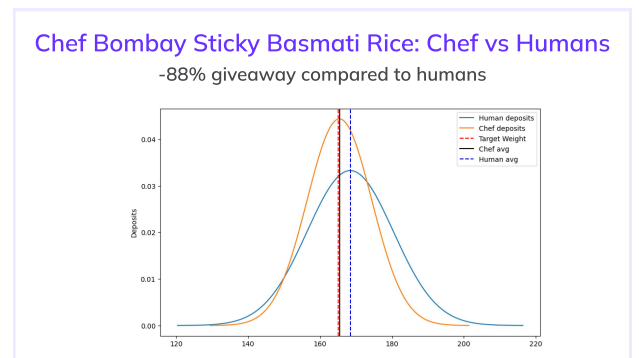
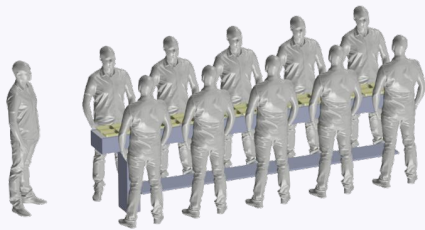


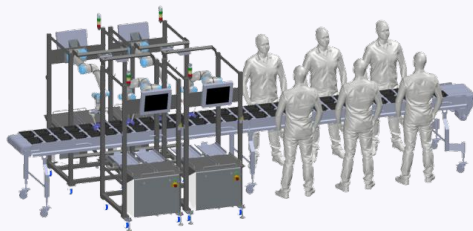
Figure 1: Giveaway Study for Ingredients deposited before and after Chef

Increased Throughput by 9%.

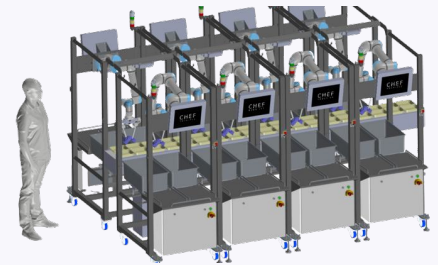
Previously, each person doing basmati rice was depositing at a rate of 16.5 deposits per min, leading to a total of 66 deposits per min with four people. With Chef, with four robots, Chef Bombay was able to increase the rate to 72 deposits per min, a 9% increase. This means an extra 2,016,000 trays per year for Chef Bombay, which translates to millions of dollars in additional revenue.



Past: Chef Bombay Line Before Chef



Today: Chef Bombay Line After Chef



Future: Fully Automated Line with Chef

Increased Worker Productivity by 33%.

Chef Bombay's meals leveraging Chef increased labor productivity during assembly by 33%. Before Chef, each of Chef Bombay's assembly lines required 12 people, on average. With four Chef robots, Chef Bombay's line only needs ~8 people to operate. Chef Bombay could reallocate those original assembly line workers to do higher-value tasks in other parts of the plant.

No CapEx

There was no CapEx for Chef Bombay to integrate Chef. Chef Bombay did not have to retrofit their lines or buy new infrastructure. Value was returned from Day 1.

Reduced Redundant Motions for Staff

Before Chef, the redundant pick and place motions that workers had to do on the line could lead to repetitive strain injuries for workers and high workers' compensation claims for Chef Bombay. With Chef, Chef Bombay has been able to reduce the amount of redundant motions that workers have to do on the line.

Higher Data / Visibility into Production Operations

Via Chef's sensor suite and manager dashboard, Chef Bombay now has data on every single deposit made by Chef, accessible from anywhere in the world. Chef Bombay has been able to receive live feedback on the operation status and quickly adjust the deposit weight and placement positions on the fly. Chef Bombay has also been able to track historical deposit data via Chef's manager dashboard.

Let's work together to transform your business

Chef leads transformation in food companies by increasing production volume, improving product quality, and saving costs with flexible robotics and machine learning.

Learn more at chefrobotics.ai

Chef Has A Strong Technical And Product Team With Experience From:

cruise • Google • **nuro** • **WAYMO** • **TESLA**

vicarious • **VERB SURGICAL** • **ZOOX** • **fetch ROBOTICS**

KITTYHAWK • **THIRD WAVE™ AUTOMATION** • **strateos**

BUILT ROBOTICS • **LOCKHEED MARTIN** • **yelp** • **THINK SURGICAL**

fellowAI • **NEURALINK** • **facebook**

Investors

KLEINER PERKINS • **CONSTRUCT** • **Bloomberg BETA** • **promusventures**

LET'S TRANSFORM FOOD PRODUCTION TOGETHER.

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