

CHEF

— Case study

Chef & Sunbasket

CHEF **sunbasket**



Chef Robotics' collaborative robot system automates the highly flexible assembly process of Sunbasket's prepared meals. Within 3 weeks of signing the initial contract, Chef started production and has since helped Sunbasket displace **10%** of the staff it takes to do a run and increased consistency by **25%**.

Chef Robotics - Truly Intelligent Food Automation

- Contrasted with traditional singular task automation (e.g., dispensers, vertical form fillers, multi-head dispensers), Chef's robot systems can support any food ingredient, any portion size and any container, thus providing a flexible alternative to meal assembly line workers.
- Designed with AI and machine-learning, Chef's systems achieve high deposit consistency, reduce food wastage, while maintaining high throughput and minimal production downtime.
- Chef's system has a human-sized footprint and requires no retrofitting of the existing lines. It also doesn't require full-line automation and can start adding value from day 1. As a result, Chef can deploy robots quickly and **within 2-3 weeks**.
- The **Robot-as-a-Service** (RaaS) pricing model eliminates upfront CapEx investment and hidden fees.

Sunbasket

Sunbasket is a meal delivery company with a mission to empower people to live their healthiest lives. Ever since the COVID-19 pandemic, the demand for Sunbasket's prepared meals have skyrocketed, but the scarcity of food assembly labor constrained their growth.

They engaged with Chef Robotics in June 2022 to improve their food production output while maintaining the same level of consistency and quality. Since then, four Chef systems have been integrated into their assembly line.

Chef systems have **displaced 10% of the staff it requires to do a run, increased consistency by 25% and can increase throughput by 17%**. They allow Sunbasket to reallocate staff from production to other parts of the plant where more hands are needed.



Sunbasket's SVP of Operations, Mike Wargocki, talking about Chef

"[My ideal solution] is very similar to the solution that has been presented to me by Chef Robotics. ... The robots can run consistently all day, it [sic] can run multiple shifts, and the flexibility that they present to me where they can just scoop and deposit anything that I want to put in there, just as well as people can."

Labor shortage impedes Sunbasket from meeting increasing demands.

Difficulty of recruiting and retaining labor



Sunbasket's Production Before Chef

Ever since the COVID-19 pandemic, Sunbasket witnessed a huge growth in demand. They need to hire more people to fulfill the increasing number of orders.

However, there is a critical shortage of workers who are willing to work in harsh conditions required in the food production plant, such as repeating the same motion over many hours in a 34°F room.

Across the food production industry, there has been 150% labor turnover. This leads to higher recruiting costs. To overcome this, Sunbasket had to reallocate labor and staff from other parts of the food production plant (such as preparation, cooking, packaging) to food assembly.

Search for a flexible automation solution

To overcome the ever-increasing labor shortage, Sunbasket leaned into automation for their meal assembly lines.

Sunbasket has hundreds of SKUs. As a result, each of their lines is flexible and the staff will “changeover” a line from one SKU run to another SKU run. Thus each “station” on the line has to handle lots of different ingredients, portion sizes, containers, and placement regions in the containers.

To support 7-8 changeovers each shift, Sunbasket needs a solution that is easy to clean and fast to changeover. The company explored a variety of traditional “hard” automation solutions, such as vertical form fillers, auger-based dispensers, multi-head dispensers and vibratory feeds. Unfortunately, these all require hours to clean as they are designed to do singular tasks over a long period instead of changing over different tasks.

Additionally, **traditional automation solutions could not provide the flexibility to support Sunbasket’s ingredient variabilities**, as they are only designed to do one specific task very well. **Currently, humans are still the best solution.**

To summarize, Sunbasket was seeking the following from their automation partner:

01

Achieves human-level food assembly performance with the flexibility to handle various ingredients, portion sizes and placement aesthetics

Specifically:

- Ingredient flexibility: Can manipulate many different ingredients without damaging them
- Portion size flexibility: Can work with different portion sizes
- Container type flexibility: Can work with different container types
- Placement region flexibility: can place into any location of a container
- Conveyor flexibility: Can work with any conveyor and any conveyor speed up to the maximum throughput
- Product consistency: Can achieve Sunbasket standards for Material Usage Variance (MUV)
- Throughput: 18 bowls per minute per conveyor lane
- Fast Changeover: < 2 min for the robot and < 10 mins overall
- Minimal Downtime: Can refill the pans without production downtime
- Ease of Cleaning: Can be easily cleaned with existing cleaning procedures
- Sloped floor: Can work with sloped food facilities
- Temperature: Can work in a cold room at 34°F

02

Requires minimal installation effort and can start providing value by partially automating a line

03

Has the potential to fully automate their lines

04

Minimal CapEx investment

Chef robot systems can alleviate Sunbasket's labor shortage by providing human-level assembly performance that fits seamlessly into their existing facility and operations.

Product approach:

Equipped with a collaborative robot arm, machine learning, and proprietary utensils, Chef's system maximizes ingredient flexibility while maintaining high consistency, throughput and minimal downtime.

Food is highly variable, based on how it's grown, prepared and cooked. Traditional automation cannot handle the wide range of food texture and requires the food to be processed in a certain way. By mimicking human hand-eye coordination, Chef's systems are designed to handle a wide range of ingredients, portion sizes and container types. **Chef's systems are able to satisfy Sunbasket's product requirements:**

01

Ingredient Flexibility Requirement:

Can manipulate many different ingredients

Solution: Chef's system uses cameras and machine learning to find the best pick and place locations. Using a 6 degree-of-freedom robot arm, easily configurable control software and proprietary utensils, the robot can manipulate any scoopable ingredient without damaging them.

02

Portion Size Flexibility Requirement:

Can work with different portion sizes

Solution: Chef's proprietary utensils are designed to pick up different ingredients at different portion sizes while maintaining the placement aesthetics. By simply attaching a new utensil, Sunbasket can change to a different ingredient and portion size.

03

Container Type Flexibility Requirement:

Can work with different container types

Solution: Equipped with a camera over the conveyor and deep-learning models, Chef's systems can be quickly re-trained to work with containers that have different shapes and compartments.

04

Placement Region Flexibility Requirement:

Can place into any location in a container

Solution: Using cameras and computer vision, Chef's system can track the container location and deposit into any **1 of 9 regions in that container.**

05

Conveyor Flexibility Requirement: Can place into any conveyor at any speed within bounds

Solution: Chef's system does not physically connect to the conveyor or its encoders. Rather, it uses computer vision to infer the height and velocity of the conveyor. Thus, the system can be very easily re-configured to work with different conveyors at any velocity within the designed limits.

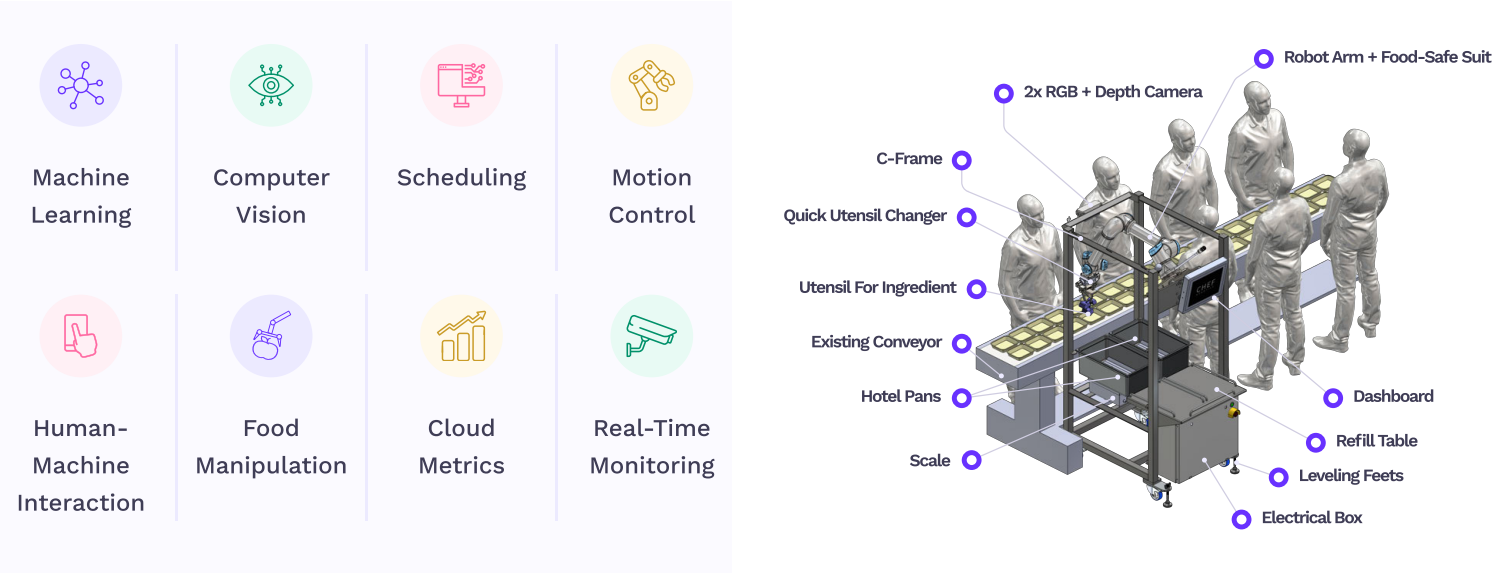
Product Consistency Requirement: Can achieve Sunbasket’s standards for Material Usage Variance

Solution: Chef’s system optimizes the motion to achieve the most desirable deposit weight using deep learning, proprietary tools and control algorithms. This allows it to keep the deposit weights on average **86% closer to the target weight and 25% more consistent than humans**, thus reducing food waste.

Throughput Requirement: 18 containers per minute per conveyor lane

Solution: Chef’s system maximizes throughput while maintaining a safe speed to work alongside human operators. It can deposit into as much as **18 containers per minute per conveyor lane**. This is **17% higher than the average throughput of a human operator**, which is around 15 containers per minute.

Chef's software and hardware architecture



Inside Chef's computer vision and robotics software

08

Fast Changeover Requirement: < 2 min for the robot and < 10 min in total

Solution: Only two components of the Chef's system, the utensil and the food pans, are in contact with the food and need to be swapped out during a changeover. Chef's proprietary dove-tail quick-change mechanism and simple touchscreen instructions enable the user to swap out the utensil very quickly. Thus the changeover time is less than 2min for the robot and **less than 10min in total** (including cleaning).

09

Downtime Requirement: Can refill the robot without production downtime

Solution: For Sunbasket, downtime equates to money lost. Chef's system's dual-pan design allows one pan to be picked from continuously while the other pan is refilled. The touchscreen also notifies the user when pans need to be refilled. Thus, Chef's systems can be refilled with **zero production downtime**.

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Cleaning Requirement: Can be easily cleaned with existing cleaning procedures

Solution: Chef's systems are food safe and designed with Sunbasket's existing cleaning procedures in mind. The utensils, made out of titanium and food grade Delrin, can be cleaned in a Cleaning-out-of-place (COP) tank. The robot frame is made out of Stainless Steel, has 45° rotated horizontal members to avoid moisture build-up, and doesn't have any small gap that could harbor bacteria, allowing it to be easily wiped down.

11

Sloped Floor Requirement: Can work with sloped food facilities

Solution: Chef's system has stabilizing feet to prevent wobbling on sloped floors commonly found in food facilities. Further, it uses computer vision to detect the slope of the conveyor and find the accurate height of a container depending on where it is on the conveyor.

12

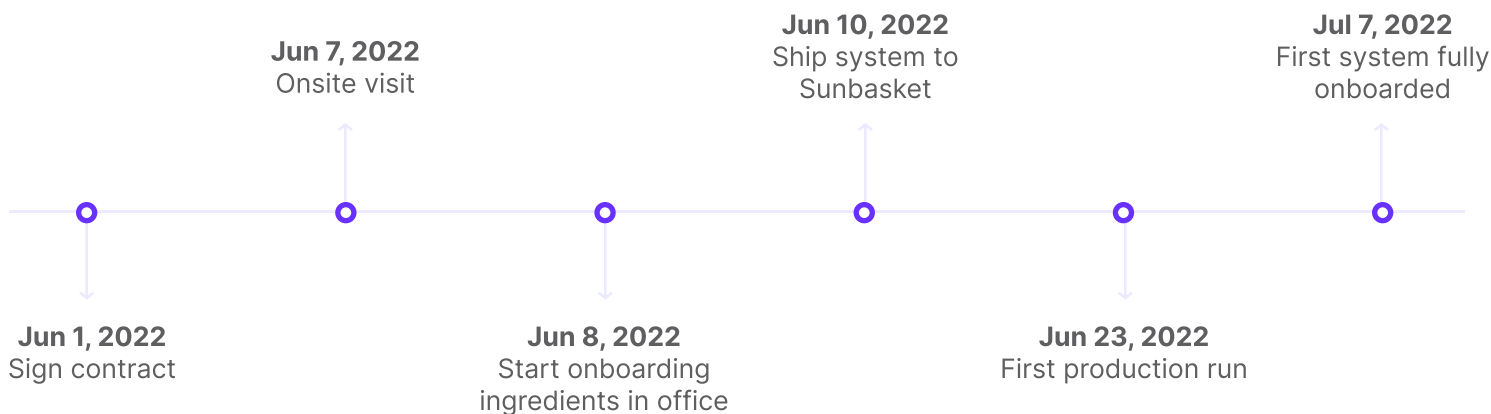
Temperature Requirement: Can operate at 34°F

Solution: Chef's system uses almost all off-the-shelf hardware components that have high mean-time-before-failure and also are designed to withstand above freezing temperatures.

Deployment approach:

The robot module requires minimal retrofitting and can slide onto an existing human-staffed line.

Sunbasket was able to start using Chef's robot during production **3 weeks after signing the contract** and **complete onboarding in 5 weeks**. This is driven by two factors: the robots require no retrofitting of the existing lines, and they can start to add value without needing to automate the full line.



No customization or retrofitting needed

Chef's system is physically as small as a station on a line, which is reserved for a human and their food tray. As a result, the system can be slotted into existing lines without any customization or retrofitting.

All that the 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.



Sunbasket's Production Line with Chef systems

Don't need full line automation

Chef's system is designed for plug-and-play. Thus it's possible to deploy the system at one station at a time without having to automate the full line. This allows the system to start assembling food and creating value from day 1. Each assembly line at Sunbasket is staffed by 10 people on average, thus each Chef system can **displace 10% of the staff required to run a line**.

Business approach:

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. However, this approach requires Sunbasket to budget adequate time for planning and limits their cash flow.

Chef Robotics uses an innovative Robot-as-a-Service (RaaS) model, wherein Chef acts as a staffing agency for Sunbasket, providing both the hardware and needed support. This model eliminates the various challenges of CapEx by removing the upfront investment, providing transparent pricing and charging a standard monthly fee instead of service add-ons.

For a flat monthly fee, Chef provides the following:



Core Hardware
And Software



Sunbasket-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 and Engineering Time	N/A	Engineering NRE Fees
Parts	N/A	BOM + Material Fees
Build and Manufacturing	N/A	Labor Fees
System Upgrades	N/A	Upgrade Fees
Spare Parts	N/A	Spare Part Fees
Shipping and Training	N/A	Shipping + Training Fees
Downtime and Onsite Support	N/A	Emergency Maintenance Fees
Recurring Service Plan	A monthly service fee	Service Plan

Chef robot systems can alleviate Sunbasket’s labor shortage and improve their meal assembly production performance, while minimizing the onboarding time and cost.

Production:

78K+ Servings Created In Production By Chef*	↓ 10% Fewer Workers Required To Run A Line	↑ 25% More Consistent In Deposit Weight Than Humans	↑ 17% Higher Throughput Than Humans
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*As of 10/18/2022

Onboarding:

0 CapEx And Integration Costs	3 weeks Time To Production
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Sunbasket's Operations Manager, Prakash Khatri, talking about Chef

Chef Robotics leads transformation in food companies by increasing production volume with flexible robotics and machine learning.

Learn more at <https://chefrobotics.ai/>

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

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

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

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

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

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LET'S TRANSFORM TOGETHER

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