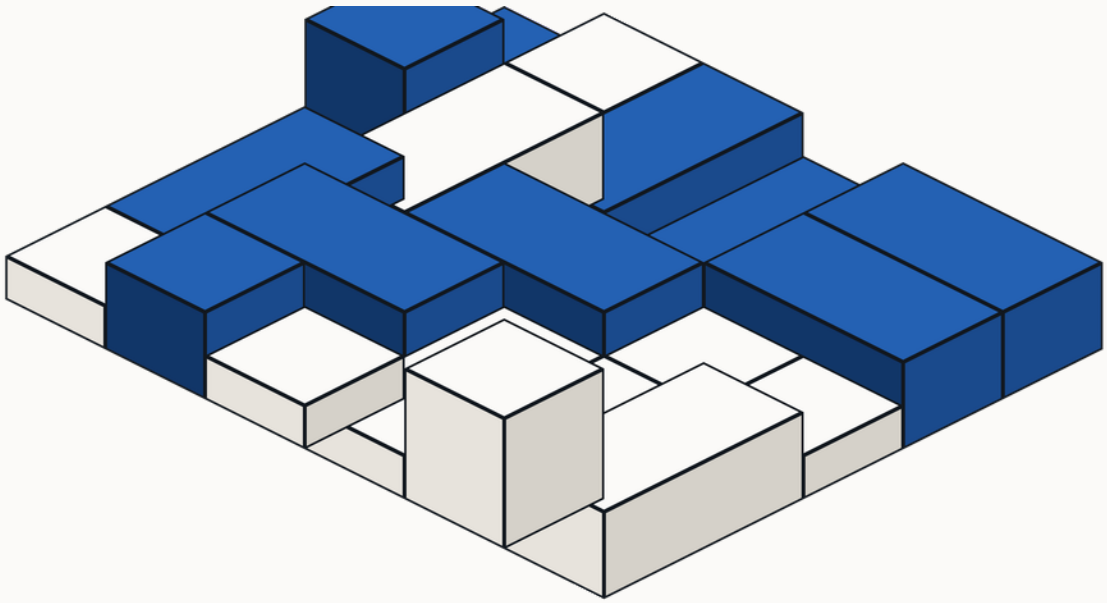
ATTABOTICS

FULFILLMENT STRATEGY WHITE PAPER

# The S.A.L.T. Framework

## Four Measures That Determine Fulfillment-Center Performance

*A practical method for evaluating distribution operations and automation technologies*



| S | A | L | T |
|---|---|---|---|
| SPACE | ACCURACY | LABOR | THROUGHPUT |

# The premise

Fulfillment automation is often evaluated through a list of benefits: save space, improve accuracy, reduce labor and increase throughput. The list is familiar—but incomplete. S.A.L.T. is most useful when its four measures are treated as an operating system. Each variable changes the others, and the best solution optimizes the total operation rather than maximizing one isolated metric.

**CORE IDEA**

S.A.L.T. is both a performance framework for an existing distribution center and an evaluation framework for comparing automation technologies.

## WHY THE MEASURES ARE INTERDEPENDENT

Greater density can shorten travel and reduce labor, but density without immediate access can slow throughput. Higher accuracy reduces rework, releasing labor and throughput capacity. Faster velocity can reduce work-in-process and the space it consumes. Additional stations increase bandwidth, but they also require space, people and inventory flow. The design question is therefore not “Which technology wins each category?” It is “Which system creates the best combined outcome for this operation, at peak and over time?”

## A DISCIPLINED EVALUATION

Establish a baseline for all four measures, model their interactions, test peak conditions and compare sustained results—not theoretical maxima. Evaluate current performance and each alternative with the same definitions, order profile, SKU profile, service levels and labor assumptions.

01 / 04

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SPACE

# Value the cube, not only the floor.

A warehouse lease is priced in square feet, but the asset operates in cubic feet. An analysis based only on floor area ignores the vertical volume between the top of product and the usable clear height. Leading operators therefore track warehouse utilization, pallet-footprint efficiency and cost per cubic foot—not just occupied square footage.[1]

## TWO LENSES ON SPACE

**PRODUCT CUBE**

**The liquid cube physically occupied by inventory and its required container or packaging.**

**FACILITY CUBE**

**The usable three-dimensional volume inside the building after accounting for structure, fire protection, access, equipment and operating clearances.**

> *The gap between the two is the opportunity. Travel aisles, lift-truck clearances, partially filled rack positions and unused vertical height all consume paid facility cube without holding sellable inventory. An aisle wastes more than its floor footprint: it creates a vertical column of non-storage volume from floor to ceiling.*

# Illustrative economics for a 300,000-square-foot facility

| SCENARIO | RATE | ANNUAL / PROJECT COST | WHAT IT SHOWS |
|---|---|---|---|
| Large ground-up warehouse | **$77/SF hard-cost benchmark** | **$23.1M** | Before land, soft costs, site complexity and automation |
| Dense metro: Chicago | **$9.30/SF annual asking rent** | **$2.79M/year** | A 10% footprint reduction is about $279K/year |
| Very urban: New York City | **$27.50/SF annual asking rent** | **$8.25M/year** | A 10% footprint reduction is about $825K/year |

Illustrative only. Cushman & Wakefield reports a 2025 average of $77/SF for large ground-up industrial projects; CBRE reports Chicago Q2 2026 net asking rent of $9.30/SF; a Q2 2026 market compilation reports NYC industrial asking rent of $27.50/SF NNN.[2–4] Actual occupancy economics require site-specific land, tax, operating-expense, fit-out and incentive assumptions.

## THE ACTIVE-PICK-FACE PROBLEM

A newly replenished pick slot may appear full while irregular product dimensions leave only 60–80% of its theoretical cube occupied. As picking continues, void space grows until the next replenishment. The location remains assigned—and therefore unavailable—even though much of its volume may be air. High occupancy is not the same as high cube utilization.

## THE ATTABOTICS SPACE PROPOSITION

Cubic AS/RS designs seek to reclaim horizontal and vertical void. With binning, a tote can be divided into separate inventory bins; as one bin empties, it becomes available for new inventory rather than leaving an entire location stranded. Attabotics also extends storage upward within common North American clear-height envelopes, including facilities with approximately 35 to 45 feet of usable height, while preserving direct robotic access to stored bins. The business result can be deferred expansion, avoided relocation, more inventory in the same footprint or more operational capacity without proportional building growth.

**SPACE KPI**

**Cube utilization (%) = product storage volume ÷ usable storage-system volume × 100**

Track it together with cost per stored unit, inventory capacity per square foot and expansion avoided.

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ACCURACY

# Protect truth from receipt to customer.

Accuracy is not one picking statistic. It is a chain of inventory truth, transactional integrity and customer outcome. A correct pick cannot rescue incorrect receiving data; a correct order can still fail when it receives the wrong shipping label. Evaluation should identify where errors are created, inherited, detected, corrected or allowed to escape.

## THREE HEADLINE OUTCOMES

### INVENTORY TRUTH

The system accurately represents what inventory exists, where it is and its status.

### PROCESS INTEGRITY

Every physical movement agrees with its digital transaction; nothing is lost between processes.

### PERFECT FULFILLMENT

Correct products and quantities reach the correct customer, on time and undamaged.

# Where accuracy is won—or lost

- **Inventory and master data:** wrong SKU, color, size, style, unit of measure, serial, lot, status or quantity.
- **Transactions and process:** a physical movement occurs without the matching digital transaction—or the system records a move that never occurred.
- **Human picking:** wrong item, omitted line, incorrect count, over-pick, under-pick, or wrong serial/batch selection. Asking a person to pick 300 units once creates a different counting risk than ten controlled lots of 30.
- **Work in process:** totes, cartons or items become stranded, orphaned or placed in uncontrolled exception areas.
- **Consolidation and packing:** correct items are mixed between orders, an item remains in a batch container, or the completed carton receives the wrong label.

## MEASURE THE CUSTOMER OUTCOME

> **PERFECT ORDER RATE** — **Perfect Order Rate = orders complete, correct, undamaged, on time and properly documented ÷ total orders × 100**

A high line-pick accuracy can still produce a materially lower perfect-order rate when orders contain multiple lines and several downstream steps. The perfect-order measure forces the operation to examine the entire chain rather than celebrating a local metric.

# Make error economics visible

> **Cost per Error = Detection + Investigation + Rework + Replacement + Reshipping + Returns + Customer Service + Lost Margin + Customer Impact**

Errors become more expensive as they travel downstream. A discrepancy corrected at induction may require seconds; one found after delivery can require research, return authorization, replacement inventory, premium freight and customer recovery. Accuracy therefore contributes directly to labor and throughput by eliminating non-value-added work.

## HOW ATTABOTICS CONTRIBUTES

Attabotics supports a controlled chain of custody from storage through presentation. Its software manages bin identity, location, status and robotic movement, reducing misplaced inventory, incorrect putaway, unrecorded travel and wrong-location selection. The system-designated bin is delivered to the operator; directed instructions and integrated scanning, lights, weight checks or vision can verify item, quantity and destination. Exceptions can be isolated before they contaminate downstream orders. Disciplined receiving, induction, cycle counting and workstation validation remain essential: automation strengthens accuracy controls, but it does not cure bad master data or an incorrect item placed into a bin.[5–6]

03 / 04

LABOR

# Convert walking into productive work.

Picking labor is easier to improve when the hour is decomposed into three activities. This same logic applies to receiving, putaway, replenishment and inventory control.

1

### Setup & Discharge

Obtain the order tote or carton, receive the assignment, place completed work onto a cart or conveyor and transition to the next task.

2

### Travel

Move to and from work-release points and inventory locations. Necessary in manual systems, but non-value-added from the customer's perspective.

3

### Bin-Face Time

Locate and validate the item, count the quantity, execute the pick and acknowledge completion.

## THE 60-MINUTE OPERATING CLOCK

If a picker walks for 20 minutes of every hour, only 40 minutes remain for setup, validation and picking. Eliminating that travel does not automatically create a 50% productivity gain—but it creates the capacity for one: 60 productive minutes versus 40 is 1.5 times the available work time before accounting for workstation delays, rest, exceptions and system performance.

Attabotics attacks the nonproductive portion of the hour by bringing inventory to a stationary worker, simplifying order setup and discharge, and presenting the system-selected bin instead of asking the worker to travel, search and choose among many locations. Measure lines per paid hour, productive-time percentage, touches per unit, training time and ergonomic exposure—not only peak picks per hour.

04 / 04

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THROUGHPUT

# Combine bandwidth and velocity.

Throughput is achieved—or constrained—by two factors. Bandwidth is the quantity of resources available: people, robots, ports, workstations and downstream capacity. Velocity is how quickly each resource completes useful work. A wide fire hose at low flow can fill a pail at a rate similar to a narrow garden hose running at high velocity. Warehouse capacity behaves the same way.

**BANDWIDTH**

More people, robots, stations, induction points and pack capacity

**VELOCITY**

Faster task completion, less travel, less waiting and less rework

## FROM ORDER TRAVEL TO ITEM PRESENTATION

Consider a three-line e-commerce order. In a conventional warehouse, the three items may be hundreds of yards apart and reach packing at different times. In an Attabotics goods-to-person flow, the required bins can be sequenced to the operator one after another. The worker stays in the productive zone while software and robots perform retrieval. Higher accuracy further increases effective velocity because errors do not consume capacity through search, exception handling, repicking and repacking.

**THROUGHPUT DISCIPLINE**

Compare sustained peak-hour output and end-to-end order cycle time—not a robot's maximum speed or a workstation's short-duration demonstration rate.

S.A.L.T. IN PRACTICE

# Optimize the whole system

S.A.L.T. turns technology evaluation away from isolated feature claims and toward an operating model. A credible comparison fixes the demand profile, SKU characteristics, order mix, service window and boundary conditions; then measures how each alternative changes the combined economics.

## THE INTERACTION LOOP

- → **Space → Labor:** higher density and goods-to-person access reduce travel distance and replenishment movement.
- → **Accuracy → Labor:** fewer errors eliminate investigation, rework, repicking and customer recovery.
- → **Labor → Throughput:** more of each paid hour becomes productive picking and handling.
- → **Throughput → Space:** faster flow reduces work-in-process, staging and buffer requirements.
- → **Accuracy → Throughput:** less exception work returns capacity to the order stream and improves cycle time.
- ↔ **Space ↔ Throughput:** density creates value only when access, sequencing and station capacity preserve velocity.

# A common evaluation scorecard

| MEASURE | BASELINE | PROPOSED SOLUTION | PEAK / SENSITIVITY TEST |
|---|---|---|---|
| **Space** | Product cube; usable cube; cost/SF | Cube utilization; capacity/SF | SKU growth; inventory peak; clear height |
| **Accuracy** | Inventory, line and perfect-order rates | Chain-of-custody and verification controls | Bad scans; shortages; exceptions; recovery |
| **Labor** | Paid hours; travel; touches; lines/hour | Productive-time mix; labor per 1,000 lines | Absence; learning curve; replenishment labor |
| **Throughput** | Orders/lines/hour; cycle time | Sustained system and station output | Peak mix; downtime; downstream bottlenecks |

# Questions every automation proposal should answer

- What boundary is included—storage only, or receiving through shipping?
- Are capacity and throughput based on sustained peak conditions or theoretical maxima?
- Which labor remains outside the automated system, including induction, replenishment, exceptions and maintenance?
- What verification controls are included, and where can errors still enter or escape?
- How does the solution perform as SKU mix, order profile, inventory and service windows change?

## CONCLUSION

The strongest automation business case is not four independent promises. It is a measurable system effect: denser use of the building reduces travel; controlled inventory movement improves truth and traceability; goods-to-person presentation converts walking into productive work; and higher velocity, with less rework, increases sustained throughput. Attabotics should therefore be evaluated not simply as a storage technology, but as a three-dimensional fulfillment platform whose value emerges through the interaction of Space, Accuracy, Labor and Throughput.

**FINAL TAKEAWAY**

Measure the total system—not just the technology.

# Sources and notes

[1] Amazon Jobs, “Warehouse Network Program Manager, AWS Cloud Logistics,” accessed August 2026 (KPIs include warehouse utilization, pallet-footprint efficiency and cost per cubic foot).

[2] Cushman & Wakefield, U.S. Industrial Construction Cost Guide, 2025 (large projects averaged $77/SF; medium projects $85/SF).

[3] CBRE, Chicago Industrial Figures, Q2 2026 (net average asking rent $9.30/SF).

[4] WARE Commercial Real Estate, Industrial Market Intelligence Hub, Q2 2026 (NYC asking rent $27.50/SF NNN).

[5] Attabotics, The Role of Warehouse Automation in Uncertain Times, 2023 (Weave software and intelligent inventory management).

[6] Attabotics, “The Importance of Order Accuracy in E-commerce and Fulfillment,” accessed August 2026.

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*Framework only—not a project-specific engineering, financial or performance guarantee. Results vary by market, facility, product profile, integration scope and operating practice.*