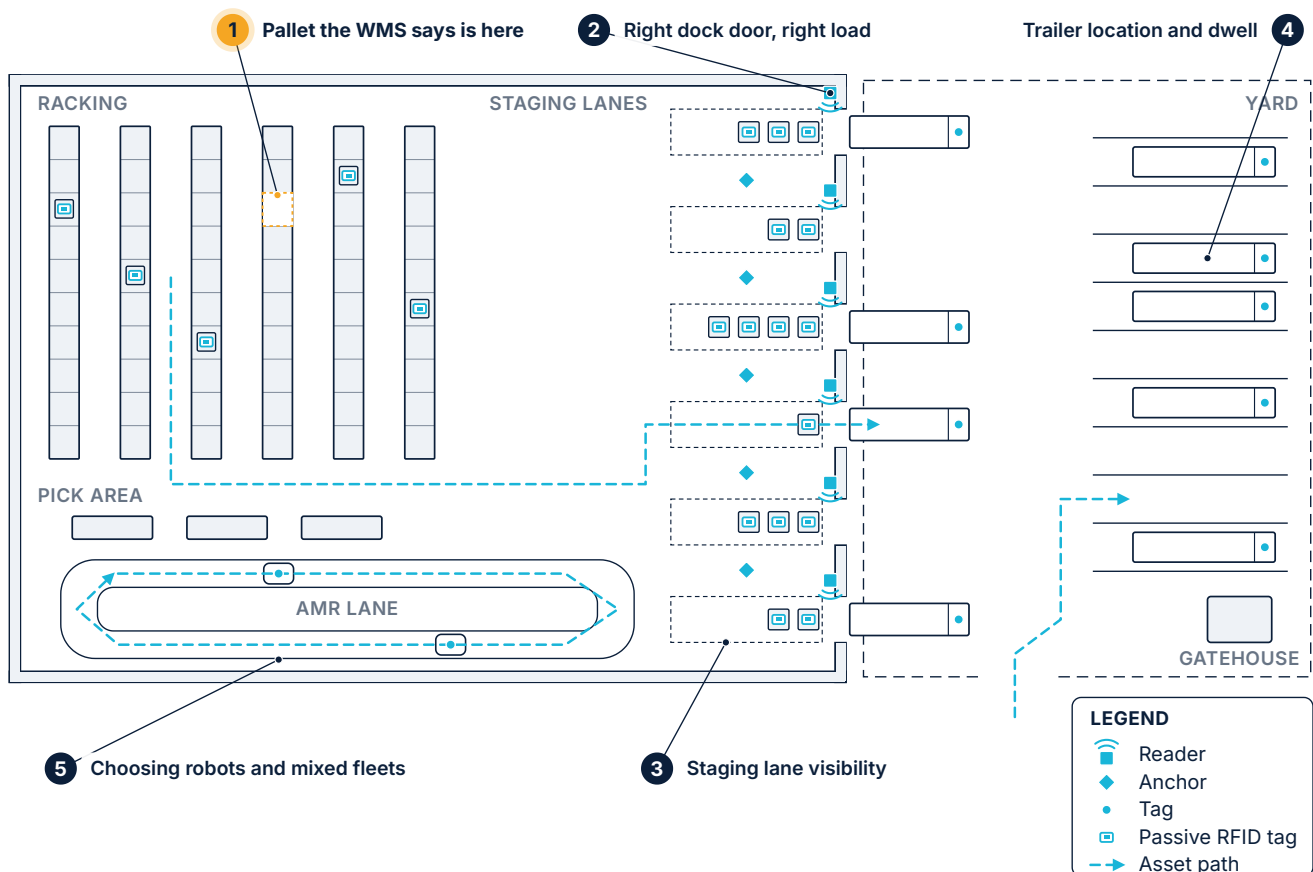


WAREHOUSE AND LOGISTICS · PALLETS, DOCKS, YARD, FORKLIFTS AND AMR FLEETS

The system says the pallet is here. The rack location is empty.

A plain guide for warehouses, distribution centres (DCs) and yards: finding pallets that are not where your WMS (warehouse management system) says, loading the right door, staging lanes, trailers in the yard and mixed fleets of AMRs (autonomous mobile robots) and AGVs (automated guided vehicles).



Callouts match the use cases on page 2. Legend: a **reader** reads passive RFID (radio-frequency identification) tags, which have no battery; a **tag** is an active tag, which has a battery; an **anchor** is a fixed unit that locates UWB (ultra-wideband) tags. Terms used: UHF RFID: ultra-high frequency RFID, passive tags read at longer range; VDA 5050: an open interface standard that aims to let one fleet manager direct robots from different manufacturers, where each robot supports it; BLE: a common low-energy radio standard, used in small battery tags; GNSS: global navigation satellite system, for satellite positioning; LPWAN: low-power wide-area network.

WHO SHOULD READ WHAT

KPI: key performance indicator, a measure you track. Everyone: your own row and KPI are in the table on page 4.

Site and DC managers

Page 2 use cases, page 3 payback.

Inventory control and shift leads

Page 2: use cases 1 to 3 and the KPIs you would own.

Yard and transport planners

Page 2: use case 4, trailers and dwell.

Automation, engineering and safety leads

Page 2: use case 5, robots. Safety: also use case 1, fewer searches on foot.

IT and OT, finance, procurement, leadership

Page 3: technology, links and payback. OT means operational technology: the systems that run the floor.

One next step: book a free 30-minute call to talk through your site and your use case.

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What goes wrong today

Lost pallets

The WMS shows one place. The pallet is in another.

Wrong door, wrong load

A pallet goes on the wrong trailer and is found at the customer.

Blind staging lanes

Nobody can see which lanes are full, waiting or ready to load.

Yard guesswork

Trailers are found by walking the yard. Waits go unmeasured.

USE CASES

Numbered to match the floor plan on page 1. Each card ends with the technology that usually fits.

1 Pallet the WMS says is here

Pain: Staff search racking for misplaced pallets.

What good looks like: Each pallet is read at put-away and its rack and level confirmed, such as by a location scan. Mismatches are flagged.

Fit: UHF RFID on pallets, forklift readers and positioning

2 Right dock door, right load

Pain: Load checks rely on a scan that can be skipped.

What good looks like: Door reads, with stray reads filtered, are checked against the docked trailer and load plan. Exceptions are flagged before it leaves.

Fit: UHF RFID portal at each dock door

3 Staging lane visibility

Pain: Lanes are checked by walking the floor.

What good looks like: A live view shows what is in each lane and how long it has waited.

Fit: UHF RFID or BLE (battery tags) by lane

4 Trailer location and dwell

Pain: Trailers are found on foot. Dwell time (waiting) is a guess.

What good looks like: Each trailer shows its last reported place, update time and time on site.

Fit: GNSS (satellite) trackers with LPWAN

5 Choosing AMRs and AGVs, and mixed fleets

Pain: Robots from different manufacturers often come with their own control systems, and many don't support VDA 5050 yet.

What good looks like: The right AMR or AGV is chosen for your use case first. Then we check which robots and fleet managers really support VDA 5050 and test them together before you rely on one fleet manager.

Fit: The right robot for each job; a VDA 5050 fleet manager only where every robot supports it.

ALSO COVERED

- **Forklift tracking:** where trucks are, utilisation and idle time.
- **Returnable assets:** roll cages, totes, stillages and pallets.
- **Cold chain monitoring:** temperature of stock and zones.
- **Cycle counting** and **inventory accuracy:** RFID counts with fixed readers and handheld scanners.
- **Flow and layout:** travel paths and congestion.
- **Collision avoidance:** forklift and pedestrian proximity alerts that support existing safety measures and don't replace them.

KPIS TO TRACK

A KPI is a number you track. Measure it the same way before and during the pilot, by sample if needed.

KPI	WHO OWNS IT	HOW TO MEASURE IT
Pallets not where the WMS says	Inventory control lead	Sampled pallets against the WMS.
Mis-loads caught and missed	Shift lead	Counted before and after departure.
Time pallets wait in staging	Site manager	Time from staging to load, per lane.
Trailer dwell time in the yard	Yard planner	Time from gate in to gate out.
Robot traffic waits	Automation lead	Traffic waits; safety stops kept apart.

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Technology fit

Pick the simplest option that answers the question you have

Technology	Where it fits here	Watch for
Barcode or 2D code (square barcode)	Pallet labels and scan points at put-away and load.	Only as good as the scan. Skipped scans mean wrong records.
UHF RFID (passive, longer read range)	Pallets and cages at doors, lanes and on forklifts.	Reads near metal and liquids need testing. Tag before the first point you need to read, and test tags stay readable.
BLE (low-energy radio tags with a battery)	Zone-level location of cages, lanes and returnable assets.	Usually zone level. Batteries need replacing.
UWB (ultra-wideband location tracking)	Position of forklifts and high-value assets.	Needs anchors and a survey. Racking reflects signal.
GNSS with LPWAN or cellular	Trailers and containers in the yard.	Works best outdoors. Check coverage and battery life on your site.

Integration

Confirmed events update your WMS or yard system, under your change control

- **WMS and ERP:** confirmed put-away, staging and load events update the WMS, and the ERP (enterprise resource planning) if needed. A tag being seen is not a confirmed move.
- **Yard:** trailer location feeds your yard or transport planning system.
- **Robots:** VDA 5050 is an open interface between a fleet manager and robots from different manufacturers that support it. Many robots do not yet, so we check before you buy. Each robot keeps its own safety functions, the mixed fleet needs a site safety assessment, and VDA 5050 sets no safety rules.
- **People:** Check local privacy and employee-consultation rules, such as works councils or unions, before tracking people, or tools and equipment linked to people.



ROI AND PAYBACK

ROI (return on investment) compares what you gain with what you spend. Payback is the time until the savings cover the cost. The method below works out payback from your own pilot data, not technology provider averages.

Payback (months) = one-off cost ÷ (annual benefit – annual running cost) × 12

Annual benefit = (search hours saved per year × loaded hourly rate) + (mis-loads avoided per year × cost per mis-load) + (trailer waiting hours avoided per year × cost per waiting hour)

The annual benefit is an estimate: count only savings you can really make, and count each one once. If it is not bigger than the running cost, there is no payback. Loaded hourly rate means pay plus on-costs such as tax, pension and overheads.

Inputs to gather

- **One-off cost:** tags, readers, portals, anchors, trackers, survey, installation, integration, training, adviser fees and travel.
- **Running cost per year:** licences, support, batteries, tags, data plans, staff time.
- **Hours today:** search and lane-check time, from your baseline.
- **Mis-loads per year** and the cost of each one, including returns.
- **Trailer waiting hours** and any waiting charges you pay.

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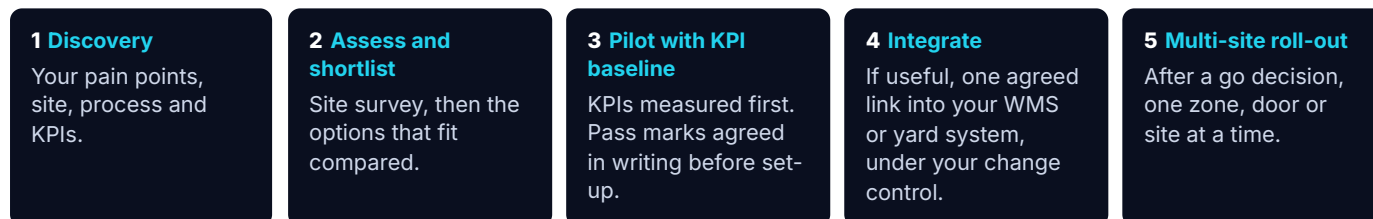
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What it means for you: find your role and your KPI

YOUR ROLE	WHAT IT MEANS FOR YOU	YOUR KPI
Site or DC manager	A clear view of staging lanes and the dock.	Time pallets wait in staging
Inventory control lead	Stock records that match the racking.	Pallets not where the WMS says
Shift or team leader	Less searching. Mis-loads caught at the door.	Mis-loads caught and missed
Yard and transport planner	See each trailer's last reported place and how long it has been on site.	Trailer dwell time in the yard
Automation and engineering lead	The right robot for each job, and a clear view of which robots can share one fleet manager. Safety functions stay.	Robot traffic waits
Health and safety	Fewer searches on foot in racking aisles.	Searches on foot per shift
IT and OT teams	Events into the WMS or yard system, under change control.	Events reaching the linked system
Finance, procurement and leadership	Payback on your numbers, then a go or no-go.	Payback months, go or no-go

Events reaching the linked system: the share of confirmed events that arrive without manual entry. Searches on foot: pallet searches walked per shift, from the baseline.

How a TRACIO project works: five stages



How a pilot runs: set-up, then live weeks in normal use, then a short written report with a go or no-go.

Questions we hear

"We already have a system."

We give a free second opinion and check how it performs against your KPIs, using your live data and a site visit.

"How do we know it will work here?"

Judge us on method: a pilot, KPIs measured before and during it, and a written go or no-go.

"Can you bid with us, or for us?"

Yes. We team with integrators, or act as the buyer's independent adviser, but never both on the same bid.

"Do you sell or resell hardware?"

No. We don't sell hardware, so our advice stays independent. We rent pilot equipment and offer survey and installation support.

Free second opinion

Send us your technology provider's quote or spec for a free second opinion. What to send: the quote or spec, a floor plan or site photos, item counts and your current process. Bring it to the call or send it via tracio.com/contact.

TRACIO consultancy fees

- **UK:** £3k to £30k per project, £1,200 a day
 - **Europe:** €3.5k to €35k per project, €1,400 a day
 - **US and Canada:** \$4k to \$40k per project, \$1,600 a day
 - **Middle East and Australia:** \$4k to \$40k per project, \$1,600 a day
 - **Rest of the world:** \$3.5k to \$35k per project, \$1,400 a day
- Scoped per project, no packages. Fees cover our work only; hardware, software licences and other supplier costs are separate. \$ = US dollars. Travel extra.

Why TRACIO: we work for you, not for the technology providers. We compare the options across the market that fit your site, provide site surveys and installation support, and work worldwide under your change control.

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