

Satair Warehouse Automation

Connected Material Flow & Local Engineering Support



Initial concept for discussion

The business case: time, space and traceability

01 LESS WALKING

Reduce repeat transport and searching. Reassign released time to higher-value tasks.

Measure: attended minutes per completed job.

02 BETTER MATERIAL FLOW

Plan deliveries closer to need, reducing avoidable waiting and buffer stock.

Measure: queue time and buffer occupancy.

03 MORE USABLE SPACE

Review staged loads, empty carts and tray quantities against replenishment demand.

Measure: usable area and carriers required.

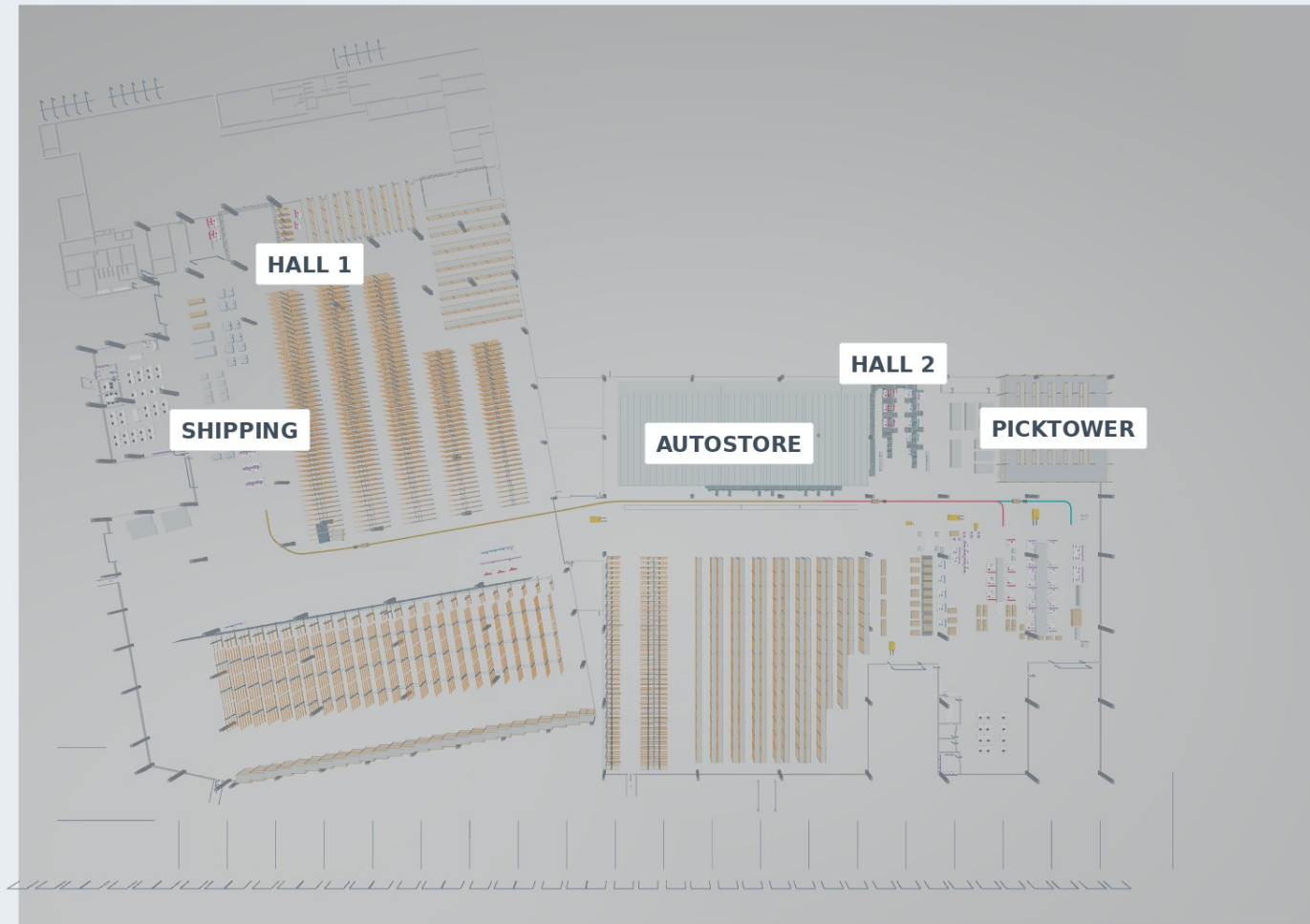
04 FEWER MISMATCHES

Link load identities to requests and destinations, with hold-and-review rules.

Measure: exceptions, search time and error cost.

Benefits are targets to verify with a pilot. Capacity released and cash savings are reported separately.

Three candidate transport flows



01 Hall 2 transfer

Aisle handoff near AutoStore to the Hall 2 transfer area.

02 Picktower

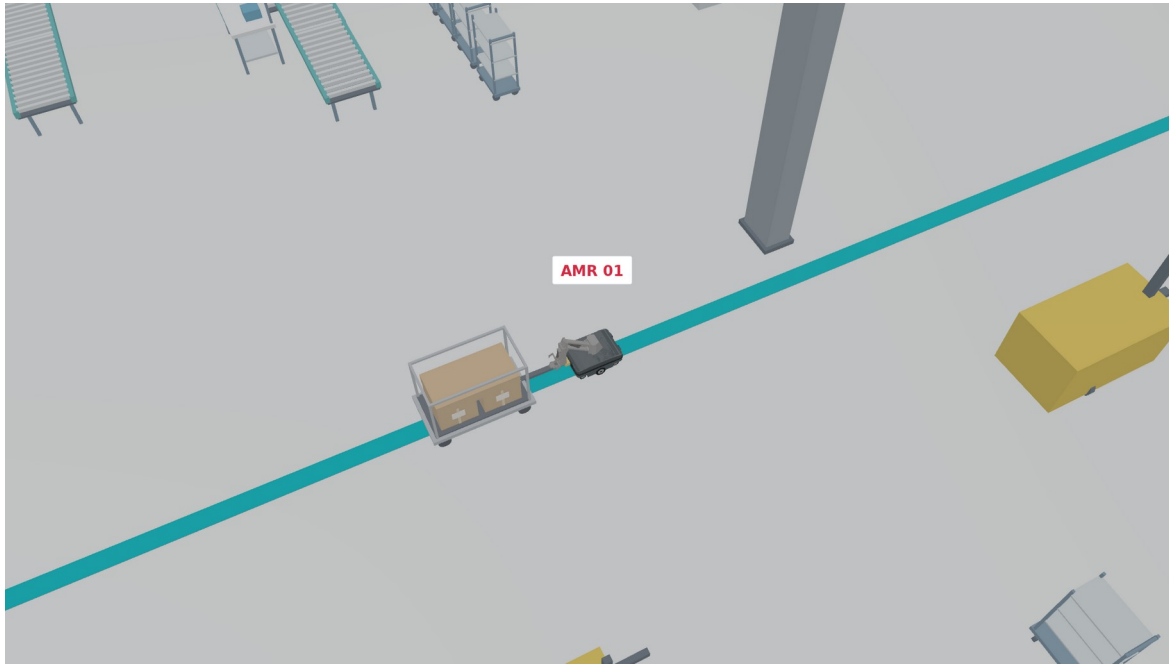
Shared corridor to a proposed external handover bay.

03 Shipping route

Cross-hall transport toward the shipping approach.

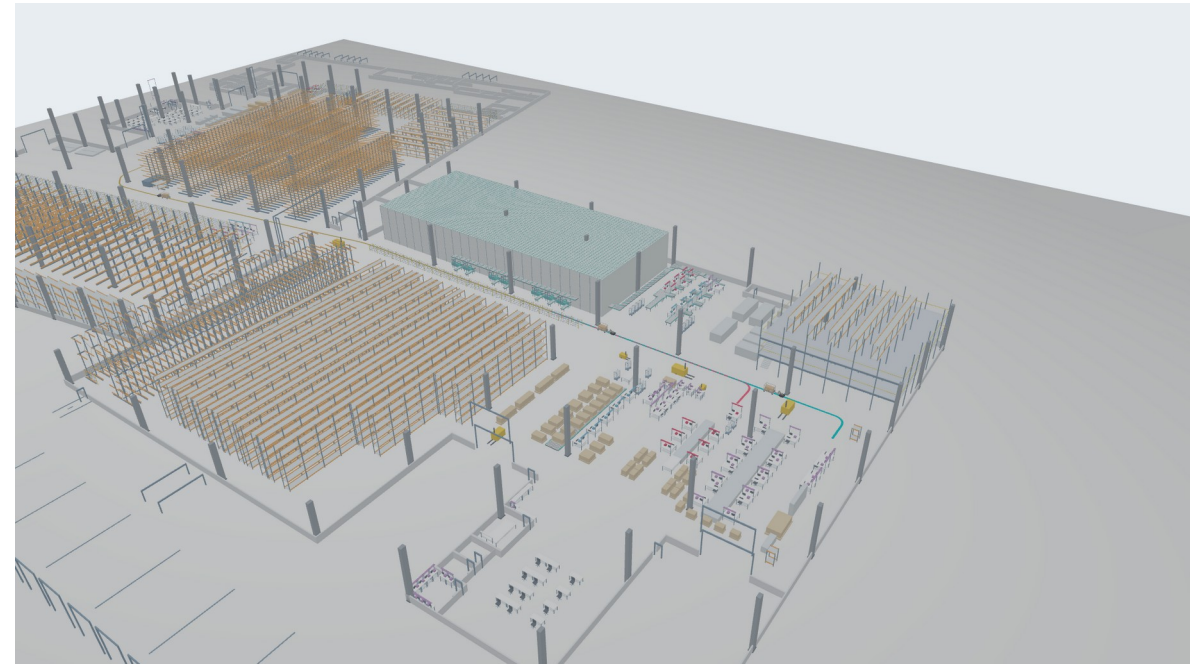
Routes and waiting bays are concepts. Final docking and traffic arrangements require a site review.

Hall 2 and the Picktower approach



AMR 01 / HALL 2

The MiR250 turns along its route. It does not move sideways.

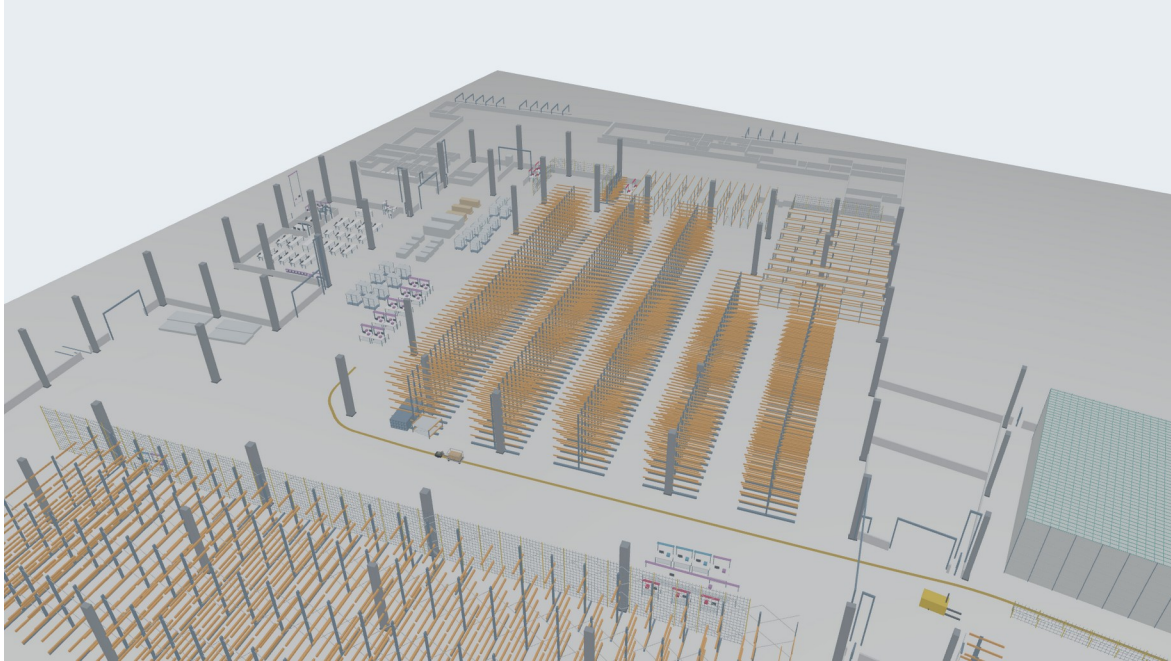


AMR 02 / PICKTOWER

A reserved waiting bay and destination-ready signal govern the final approach.

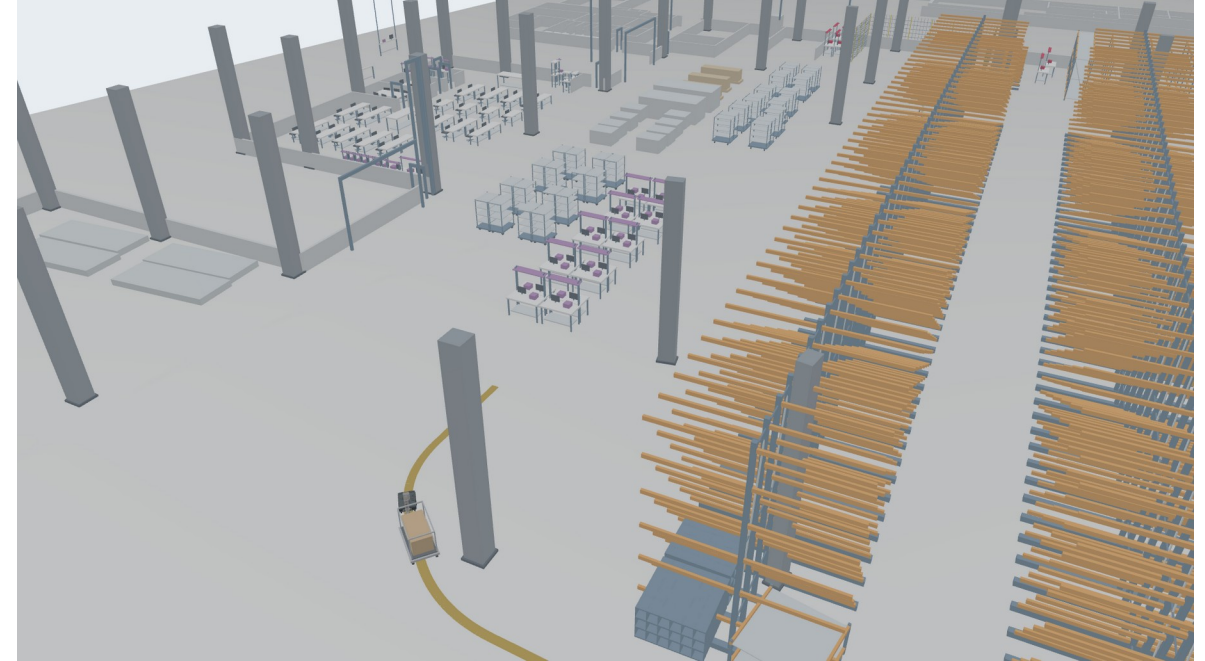
Illustrative trolley and load. Motion and station interfaces remain subject to application assessment.

Hall 1 and the shipping approach



CROSS-HALL CORRIDOR

Review the complete trolley train, pedestrian crossings and rack access.

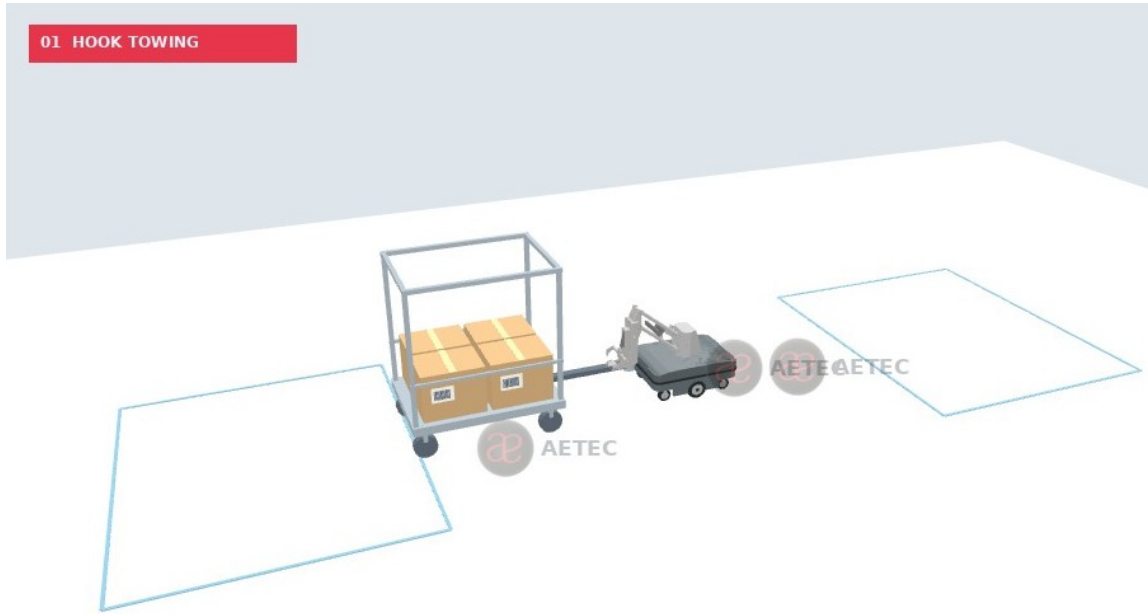


SHIPPING HANDOVER

Confirm arrival space, load exchange, operator access and release conditions.

Cart and carton transport

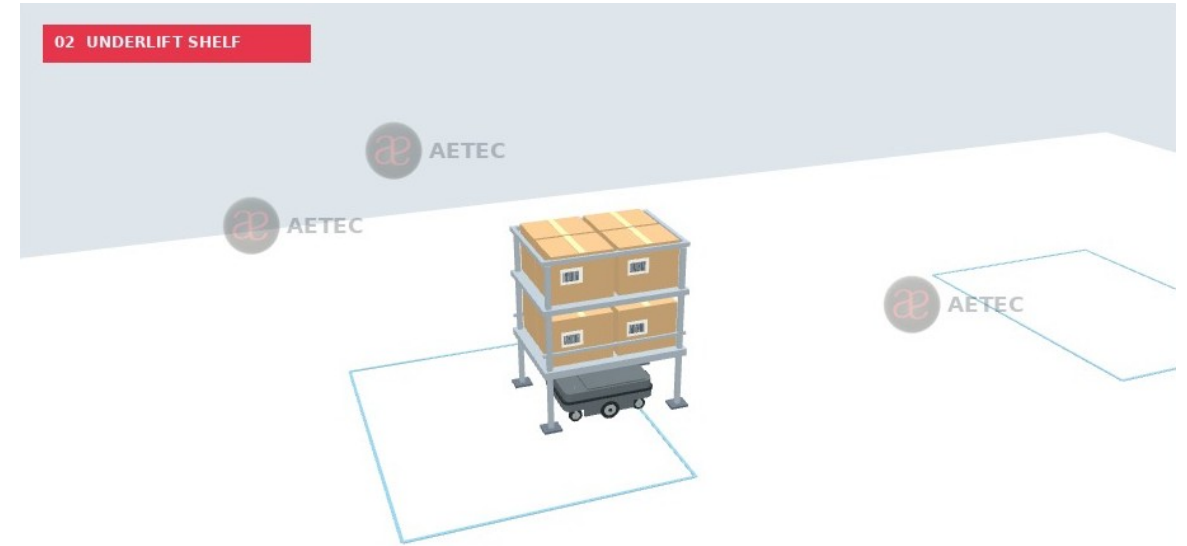
01 HOOK TOWING



HOOK / TOWING

A compatible trolley supports the cartons. Assess the hitch, wheels and swept turning envelope.

02 UNDERLIFT SHELF



UNDERLIFT CARRIER

A rigid frame carries the load. Assess the lifting interface, clearance and loaded stability.

Pallet and conveyor handovers



PALLET JACK

Check pallet construction, fork access, floor condition and docking space.

PALLET LIFT + DOCKS

Match the load support and fixed transfer stand to the selected AMR.

CONVEYOR TOP

Reserve the station, verify readiness and confirm each transfer. Use trays where needed.

The video illustrates all three methods. Final accessory selection and station design require confirmation.

Mobile cobots for transport and handling



MC250 CONCEPT

Explore carton or component handling at selected workstations.

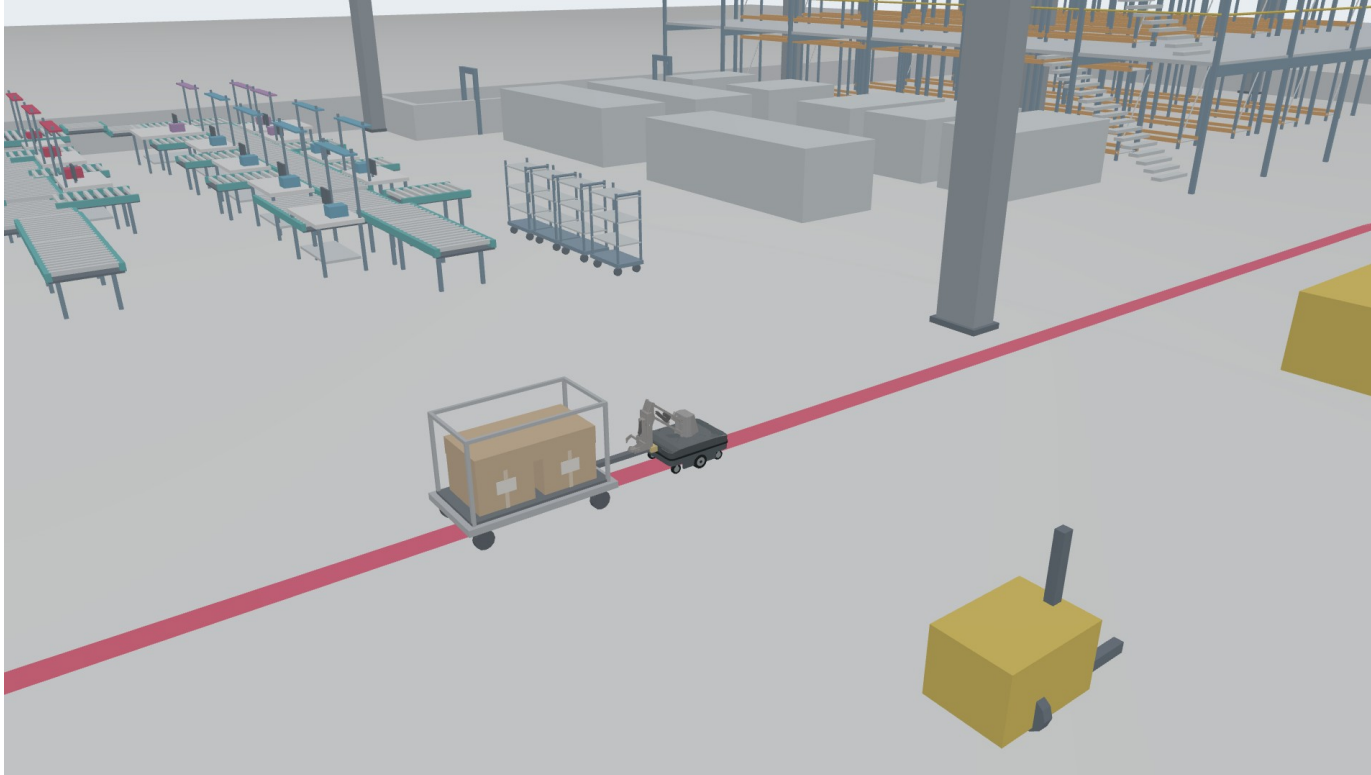


MC600 CONCEPT

Explore alternative mobile handling arrangements as the application develops.

MiR base, Universal Robots arm, tooling, payload and safeguarding depend on the complete application.

Existing carts: adaptation or a new carrier



ADAPT THE EXISTING CART

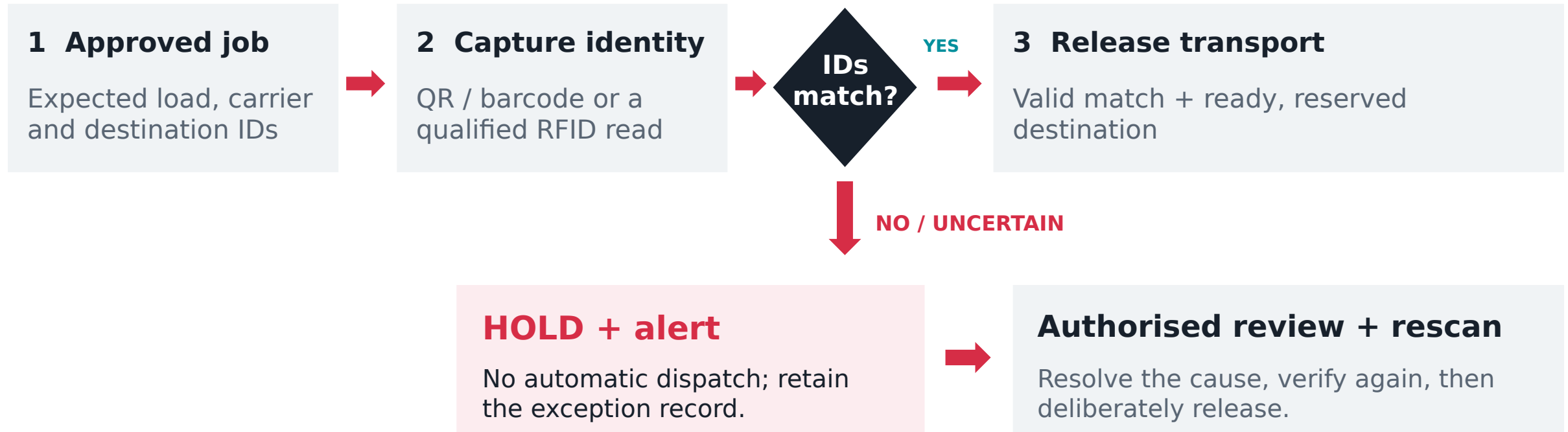
Review the lifting or towing interface, frame rigidity, length and loaded centre of gravity.

DESIGN A COMPACT CARRIER

Match the load, route and docking method while protecting sensor visibility.

Inputs needed: cart drawings, maximum load, loading pattern and preferred handling method

Right load. Right destination. Recorded handover.



Record every confirmed movement

Job / load / carrier / AMR / origin / destination / timestamp / status / exception

Identity checks reduce risk. Qualify RFID read zones, label quality and loading controls; a matching label alone does not verify contents.

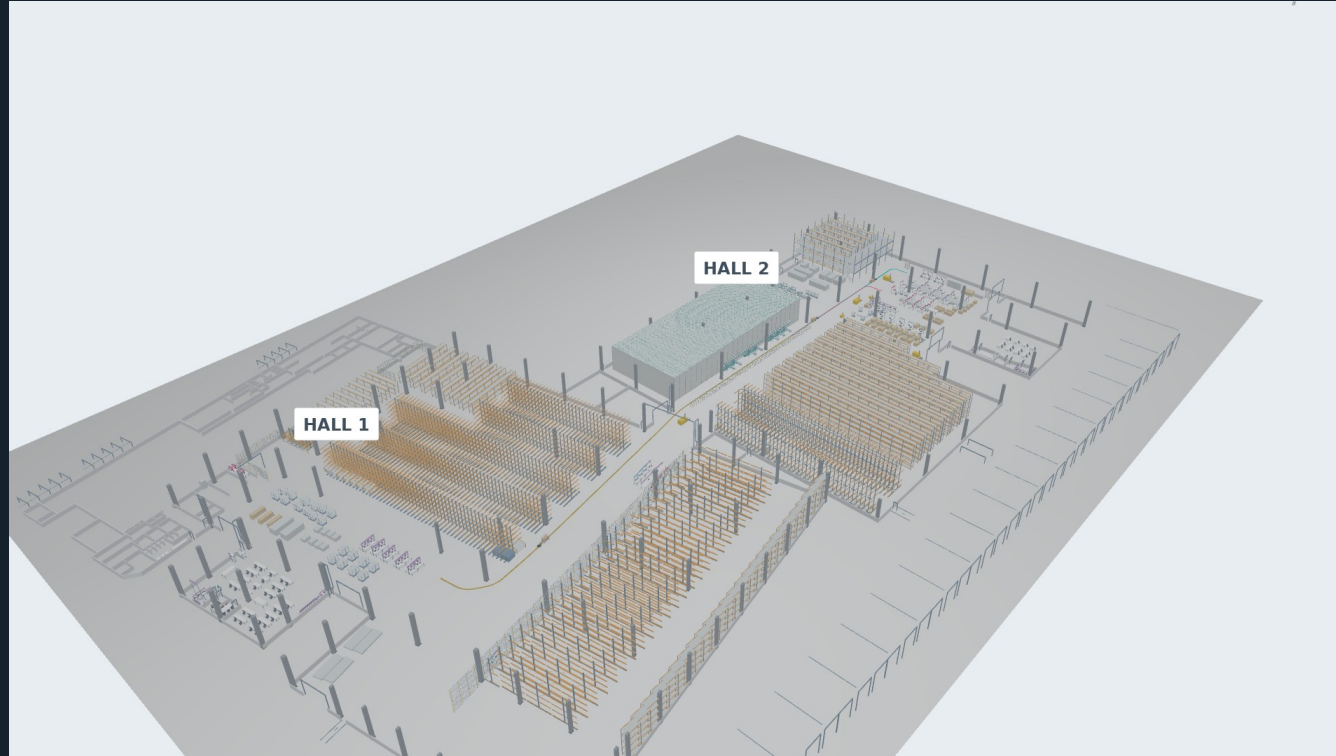
Proposed interface: 3D planning

AETEC / WAREHOUSE CONTROL

PROPOSED INTERFACE · DEMO DATA

3D planning

Jobs & schedule
Fleet
Stations
Records
Network
Alarms



SCENARIO

Hall 2 transfer

Candidate route
Waiting bay
Traffic zone
Station availability

Review before release

Compare route and schedule assumptions before releasing an approved operating configuration.

Proposed interface: scheduling and records

JOBS & SCHEDULE

ILLUSTRATIVE DEMO DATA

Job / load	Destination	Release	Due	State
DEMO-001 / C01	Hall 2	09:00	09:15	In transit
DEMO-002 / C02	Picktower	09:05	09:25	Bay hold
DEMO-003 / P01	Shipping	09:20	10:00	Scheduled

REQUESTED

ACKNOWLEDGED

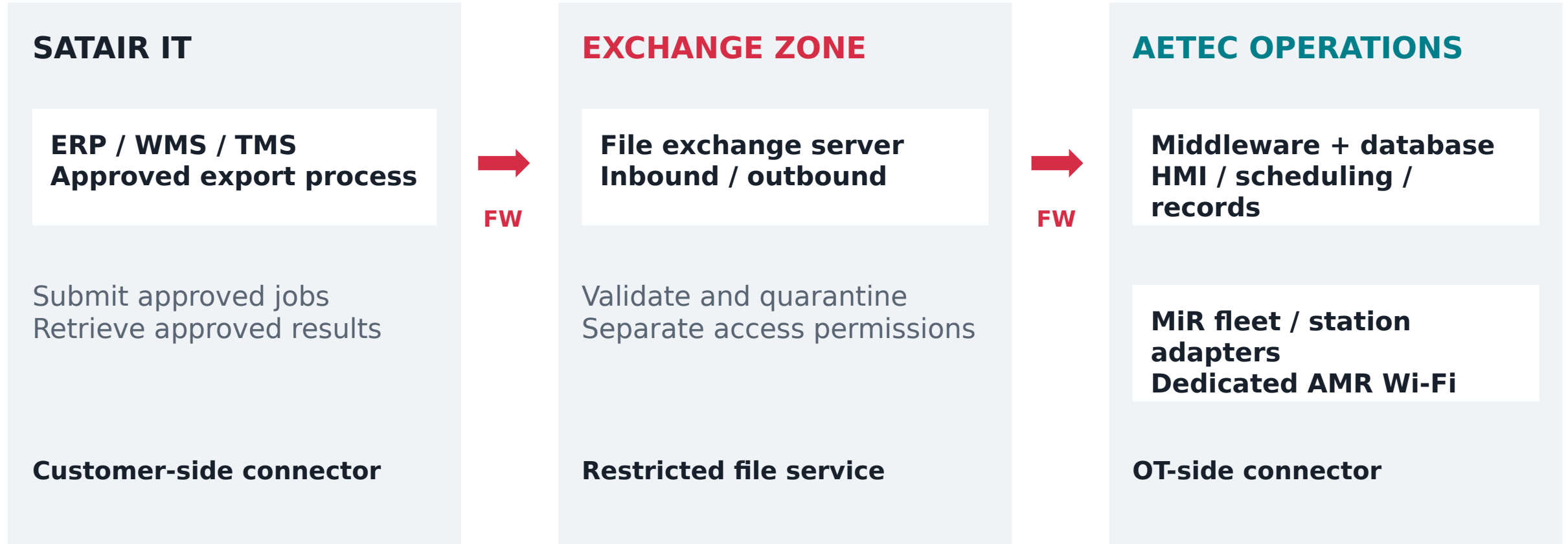
DISPATCHED

CONFIRMED

Job history and load traceability with timestamps and exception records

Plan releases around shipment cutoffs and station availability. Times shown are examples, not forecasts.

Proposed control architecture



No direct ERP access. No corporate Wi-Fi use. Firewalls allow only agreed connections.

Controlled connection, not an air gap. FW = firewall. Proposed design follows NIST OT segmentation principles.

Middleware and file exchange

1 Shared folder
Approved task / result files



2 Middleware application
Validation / queue / job state



3 Local database
Operational records

EXCHANGE FORMAT

Agree job, load and carrier IDs, origin, destination, priority and release / due times.

CONTROLLED PROCESS

Check file type and schema. Quarantine failures. Reject stale jobs and prevent replay.

APPROVED RESULTS

Publish acknowledgements, completion and exceptions. Retain detailed records locally.

TRANSFER OPTIONS FOR IT REVIEW

SFTP, or an approved SMB 3 service with encryption and signing. Separate service accounts and folder permissions.

A shared folder is the interface. The middleware and its database perform different roles.

Independent AMR Wi-Fi



SITE COVERAGE

Survey racks, aisles and handover bays. Confirm AP placement and radio channels.

ROAMING & LOSS

Test transitions between access points and the agreed loss / recovery behaviour.

NETWORK SERVICES

Define local addressing, time service and administration access with IT.

ROBOT CONFIGURATION

Use supported authentication and unique credentials. Disable setup APs after commissioning.

Own Wi-Fi does not mean automatic isolation. Final firmware, radio settings and security require approval.

Cybersecurity and recovery boundaries

LIMIT THE DATA

Exchange only task and status fields. Agree ownership, retention and access to confidential records.

MAINTAIN & RECOVER

Audit access, review updates and test backup restoration. Protect backup access separately.

CONTROL ACCESS

Named users, restricted service accounts and encrypted transfer. Remote support needs separate approval.

HANDLE INTERRUPTIONS

Show stale status and hold new dispatches. Revalidate the load and station before deliberate resume.

Alarm acknowledgement or reset does not automatically restart transport.

Proposed controls reduce exposure. Satair IT and the OEMs must agree the detailed security and recovery design.



Job execution and confirmation



EXCEPTIONS

Invalid or stale file: reject / quarantine

Duplicate job: acknowledge the existing state, do not repeat the mission

ID mismatch, busy bay or unconfirmed load: hold, resolve and deliberately resume

Valid IDs and station readiness before dispatch; physical handover confirmation before completion.

ASRS and station handovers

AETEC middleware
Transport job / records



Approved station adapter
Vendor-agreed handshake



ASRS / station controls
Internal motion + safety

Exchange signal	Purpose
Request / reservation	Identify the job and reserve the bay
Ready / clear / load ID	Confirm the station can accept the transfer
Exchange confirmed	Verify physical handover before closing the job
Fault / timeout / hold	Stop task progression and agree recovery

Each ASRS vendor retains machine control and safety. Available interfaces and responsibilities must be agreed.

ROI starts with an agreed operating baseline

Measure	Baseline and pilot data	Decision supported
Transport time	Jobs/day; walking, handling and waiting min/job	Productive hours released
Space + carriers	Occupied buffer m ² ; loaded/empty carts and trays	Space reuse or avoidable expansion
Traceability + errors	Search time; misdeliveries; rework and incident cost	Avoidable annual operating cost
Service + investment	Installed scope; training; running and support costs	Net benefit and payback

Use a representative shift and peak period, then compare the same workflow during the pilot.

Agree data owners and measurement rules before testing. Report capacity, service improvement and financial savings separately.

Turn measured improvements into a clear ROI case

Annual net benefit = realised benefits - incremental annual operating costs

Benefit	Calculation basis
Labour	Annual attended hours released × loaded hourly cost × realisation factor
Space	Usable area released × genuinely avoidable annual cost per m ²
Errors + searching	Verified annual incident/search cost avoided; avoid double counting labour

Simple payback = total installed investment ÷ annual net benefit

Calculate payback only when net benefit is positive. Report reduced cart purchases separately as one-off avoidance. No saving is claimed yet.



A phased integration plan

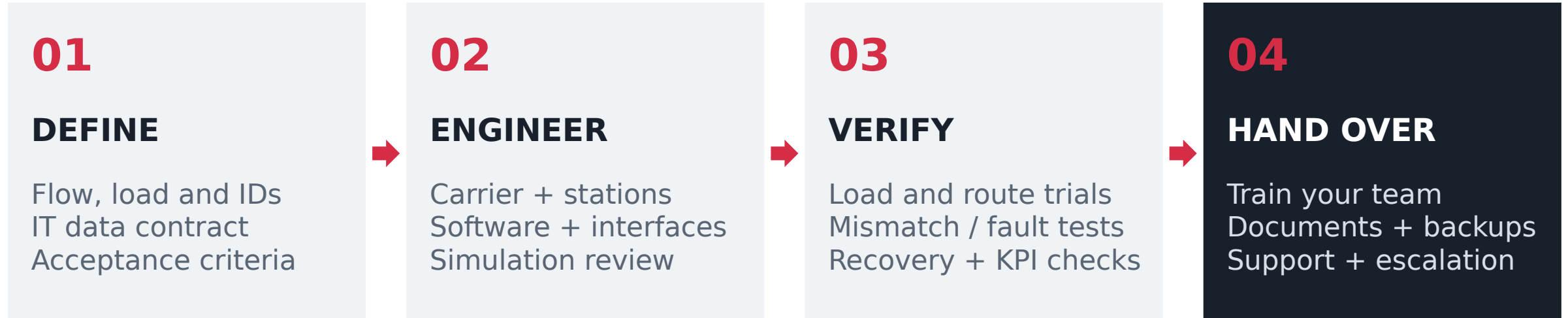
Stage	Proposed scope	Decision before release
1 Transport pilot	Operator request + independent fleet	Carrier, route, Wi-Fi and recovery
2 Data exchange	Approved job / result files	IT architecture and data contract
3 Station integration	Selected ASRS / conveyor handovers	Vendor interface and responsibility
4 Further automation	Mobile cobot, vision or other robotics	Separate application study

NEXT WORKSHOP

Operations + IT + equipment vendors: choose one flow, confirm inputs and agree a measurable pilot.

Acceptance should cover transport, handover, communication loss, access controls and record reconciliation.

From requirements to a supported handover



AETEC

Design, programming, integration, testing and training within the agreed scope.

SATAIR + EQUIPMENT SUPPLIERS

Operational requirements, approved data access, equipment interfaces and joint acceptance.

Handover pack: operating / recovery guides, configuration backups, interface register, test results and support contacts.

Local engineering. Continued support.

AETEC is your Singapore integration and support contact.

IN-HOUSE PROGRAMMING

Workflow, middleware, operator screens and interface logic.

DESIGN + APPLICATION ENGINEERING

Carriers, stations, tooling and complete-process integration.

MiR EXPERIENCE + LOCAL COORDINATION

Work with your team and the equipment suppliers on practical improvements.

A closed loop for issues and improvements

Capture evidence

Job IDs, logs, load and station state



Investigate together

Root cause and containment



Test + release

Verify correction and controlled change



Confirm + improve

Check the outcome with your team

Agree service hours, response targets, site attendance, spares and follow-up reviews before handover.

Agree one flow. Measure it. Improve it.

A focused pilot gives management a decision based on evidence.

START WITH

One load family
One carrier method
One pickup-to-delivery flow

SHARE THE INPUTS

Cart dimensions + loaded weight
Daily / peak movements
Systems, IDs and IT requirements

AGREE THE SUCCESS MEASURES

Completed jobs + attended time
Buffer space + traceability
Exceptions + recovery performance

Operations + IT + equipment suppliers + AETEC

Review the concept together, define scope and acceptance, then expand only after the pilot demonstrates value.



Design basis and review boundaries

NIST SP 800-82r3

Guide to Operational Technology Security

nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-82r3.pdf

MiR product security guidance

Commissioning access point configuration

mobile-industrial-robots.com/pl/security-advisories/cve-2020-10269

Microsoft SMB guidance

Authenticated, protected file exchange

learn.microsoft.com/en-us/windows-server/storage/file-server/smb-interception-defense

CISA remote access guidance

Controlled remote access to industrial systems

cisa.gov/sites/default/files/2023-01/RP_Managing_Remote_Access_S508NC.pdf

Proposed design only. Satair IT requirements, OEM compatibility and site acceptance govern the final solution.

Key terms used in this proposal

The video explains technical terms in full. Standard abbreviations remain in diagrams and product names.

Term	Meaning
AMR	Autonomous mobile robot
MiR	Mobile Industrial Robots
MC	Mobile cobot (MC250 / MC600)
UR	Universal Robots
QR	Quick Response code
RFID	Radio frequency identification
ASRS	Automated storage and retrieval system
HMI	Human-machine interface

Term	Meaning
IT	Information technology
OT	Operational technology
ERP	Enterprise resource planning
WMS	Warehouse management system
TMS	Transport management system
PLC	Programmable logic controller
ROI	Return on investment
KPI	Key performance indicator

System interfaces and product selection remain subject to joint requirements and application review.