



PWMS Material Flow Technical Proposal

Five AMR handling methods and the new MiR250 box jack option

Prepared for PWMS by Aetec Private Limited

Revision 12 | 14 September 2026

This proposal compares five ways to move PWMS material between production stations and storage. It retains the existing trolley and box routes, updates the handling geometry to the Rev 11 review, and adds direct box lifting between two fixed raised docks. The practical choice depends on the material envelope, measured gross load and the receiving task.

Method	What moves	Receiving action
C01 MiR250 Hook	Existing inclined trolley and part	Park the complete trolley
C02 MC600 and UR30	Six existing boxes on secured carriers	Present and transfer one carrier at a time
C03 MiR1200 Pallet Jack	Eight boxes in a pallet cassette	Index and extract one box at ASRS
C04 MiR250 lift carrier	One box with its connected carrier	Leave carrier on feet and transfer box by rollers
C05 MiR250 box jack	One qualified rigid-bottom box	Lower onto fixed dock rails and exit

C05 is an additional handling method. Both docking frames stay in position; the AMR carries the box between them. This differs from C04, where the structural carrier travels with the box.

Revision basis

Rev 12 applies the Rev 11 eight-box pallet cassette and six fixed carrier nests with side presentation lifts. These replace the earlier ten-box pallet and six-drawer illustrations. Animation time and layout envelopes are demonstration values, not promised production throughput.



Material flow and station coverage

Architecture A reuses the trolley and existing box

Register the incoming raw part and its traveller. C01 transports the existing inclined trolley through the raw-material route. After the qualified machining release point, place the part in the existing box for C02 or C03 handling. C05 provides another station-to-station transport option if the box bottom is qualified. Only Final Inspection PASS releases finished goods to the FG-ASRS; HOLD and rework follow separate controlled routes.

Architecture B uses one qualified standard container

A raw-compatible standard container can remain with the part through raw, WIP, HOLD and FG movements. C04 moves the container on a reusable carrier. The current 1,200 × 600 × 400 mm envelope is provisional. Raw-forging fit, restraint, process access, lifting structure and storage compatibility must be resolved before the container is frozen. The common-container ASRS is an alternative architecture to the FG-only store.

Planning item	Retained basis	Design implication
Production stations	17	Exact machines and route sequence require the current layout
Positions per station	2 to 6 or more	34 to 102 production positions before extra functions
Additional positions	Incoming, outgoing, charging and ASRS	Add separately to the station schedule
Buffers and exceptions	PASS, HOLD, rework and empty return	Reserve locations and prevent incorrect release

Transport and processing are separate interfaces

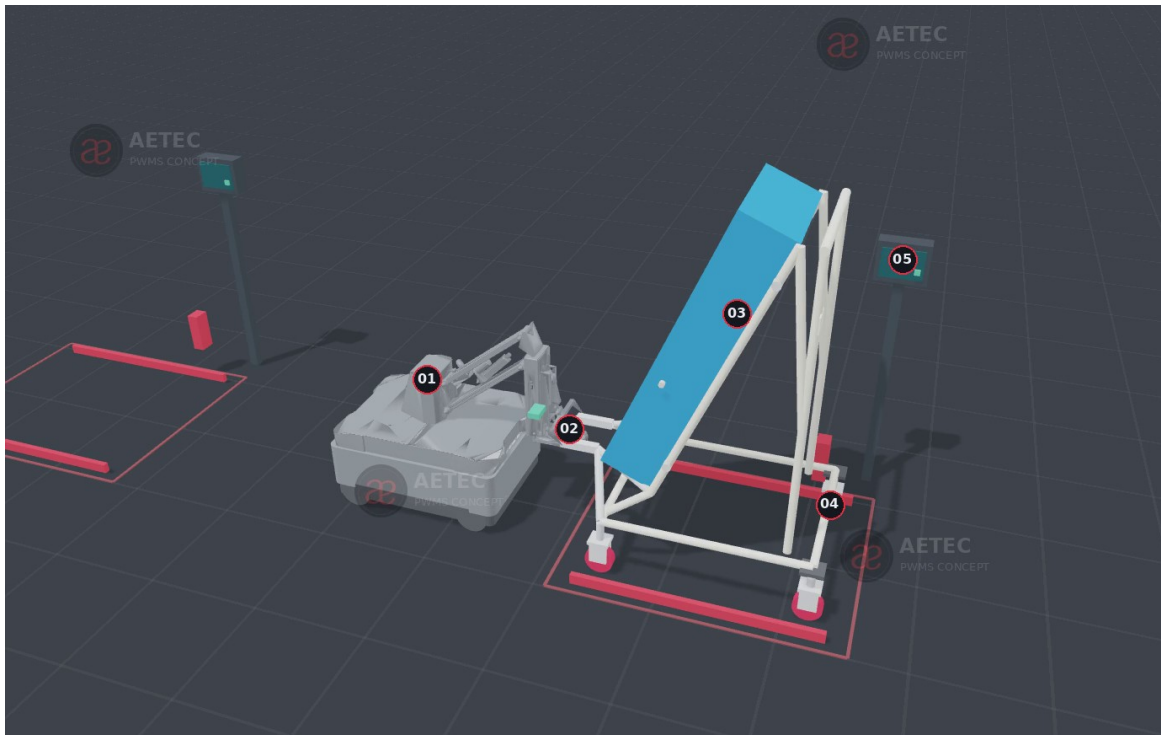
Parking a trolley or box does not automatically load a part into a machine tool. Machine doors, fixtures, part gripping and process verification are separate tasks. Likewise, moving a pallet or carrier to ASRS does not make it compatible with the tote rack. Each receiving interface must identify the load, support it positively and acknowledge ownership before the AMR departs.

Fleet sizing

Box moves equal demand multiplied by transfers and by one plus the rework fraction. Missions depend on the effective batch size, but handling work remains for every box. Size productive capacity from measured route and dwell times, round up, then add the selected reserve. The legacy planner retains these sensitivities; no fixed fleet count is imposed by the five concept animations.



C01 MiR250 Hook and existing trolley



C01 concept render from the retained four-method client video.

The Hook couples to an adapted capture interface on the existing trolley, verifies engagement, tows it to the called station, parks it at a defined datum and releases it. The larger raw forging stays in its inclined holder. A return collection repeats the same identified trolley cycle.

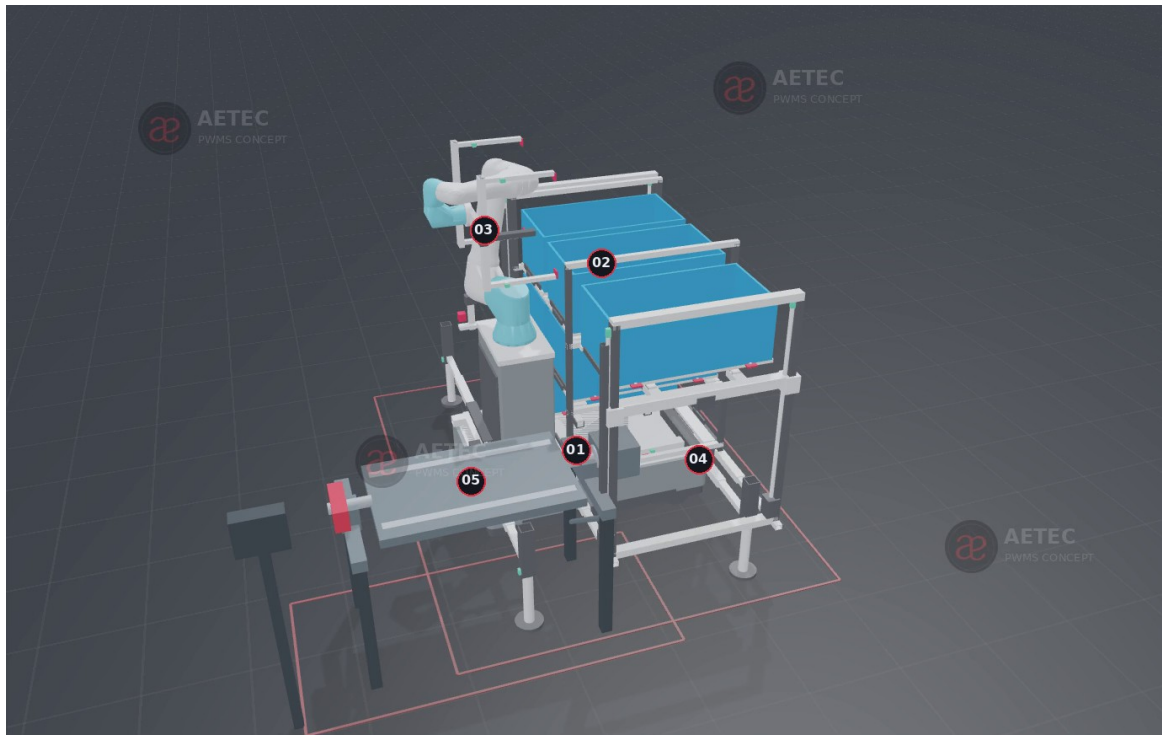
Reference dimension	Illustrated value
MiR250 base	800 × 580 × 300 mm
Existing holder envelope	Approximately 1,220 × 520 × 240 mm
Trolley overall height	Approximately 1,620 mm
Demonstration station spacing	3,400 mm

The OEM Hook geometry comes from the supplied STEP; trolley dimensions are inferred from the reviewed reference. Verify capture-bar height, trolley wheel condition, rolling resistance, loaded stability, gradients and turning envelope. Straight reversing in the animation is a route concept. The AMR base payload rating is not the Hook towing limit.

The retained commercial basis includes an initial 20-trolley repeat modification batch at S\$300 each, or S\$6,000. Damaged wheels, structural repairs and major one-off trolley redesign remain separate from that repeat allowance.



C02 MC600 and UR30 with six box positions



C02 revised arrangement with six fixed nests and shared side presentation lifts.

Two side bays each hold three independently retained carriers. A selected side mechanism deploys, clears the shelf and lifts the chosen carrier to a common transfer height. The UR30 then grips the positively captured carrier and transfers it to a flat station, a locked tilt cradle or the ASRS interface. The return sequence restores the same carrier to its original nest.

Motion basis	Concept value
Existing box	840 × 450 × 330 mm
Side deployment and shelf clearance	575 mm deployment; 15 mm initial lift
Common box base height	1,275 mm
Receiving support plane	855 mm in the model
Tilt demonstration	55 degrees after the carrier is locked

The revised mechanism uses six fixed nests and two shared presentation lifts; it does not extend six independent drawers. Stabilize and acknowledge the dock before arm motion. Stow the arm and lock all carriers and mechanisms for AMR travel. Work-desk adaptation in the earlier 750–1,100 mm range still requires a site-specific interface.



C02 payload and operating envelope

Use the normal 30 kg UR30 payload as the planning screen. The tool, carrier, box and part all consume that capacity. Extended payload modes are not assumed. A simple mass screen is necessary but does not approve reach, load centre, dynamics or integrated mobile stability.

Load element	Planning mass	Interpretation
UR30 normal payload	30 kg	Normal planning limit
Positive tool assembly	12 kg	Current tooling allowance
Complete loaded carrier ceiling	18 kg	30 minus 12
Preferred loaded carrier target	16 kg or less	Leaves a 2 kg planning margin
Box and carrier allowance	4 kg + 3 kg	Measure actual production items
Part ceiling and target	11 kg / 9 kg	Mass screen ceiling / working target

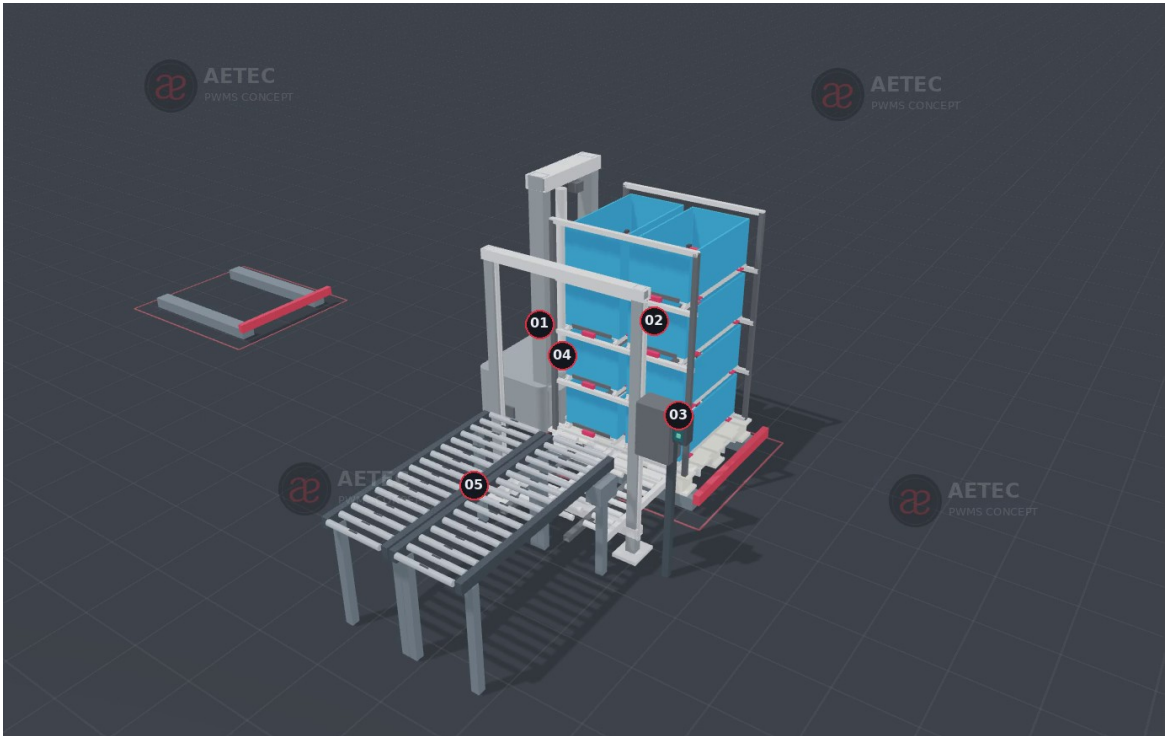
At the ceiling, six loaded carriers plus 170 kg of rack and lift mechanism and 12 kg of tool total 290 kg of added transport load. Compare this with the 380 kg additional transport-load figure for the relevant mobile-cobot package, and reconcile exactly what its vendor figure includes. Payload approval must address the combined centre of gravity and acceleration as well as total mass.

Geometric basis	Current concept
Travel envelope	Approximately 1,860 × 1,340 × 2,100 mm
Deployed station span	Approximately 2,450 mm, before protective clearance
Arm mounting datum	1,050 mm
Common flange reference	X -250 mm; Y ±835 mm; Z 1,660 mm

The three receiving modes were exercised for all six box positions. The animation verifies selected motion continuity and support transfer, while production design still needs calibrated reach and collision assessment, structural analysis, braking and stability evidence, protective fields and supplier acceptance.



C03 MiR1200 Pallet Jack with eight boxes



C03 pallet cassette and separate indexing extractor at the ASRS interface.

Load two columns of four boxes into a restrained cassette on the selected 1,200 × 1,000 mm pallet. The MiR1200 collects and transports the cassette, then leaves the pallet on raised docking supports. An independent extractor indexes to the selected position and transfers one identified box to the ASRS conveyor. Return handling restores the intended cassette position.

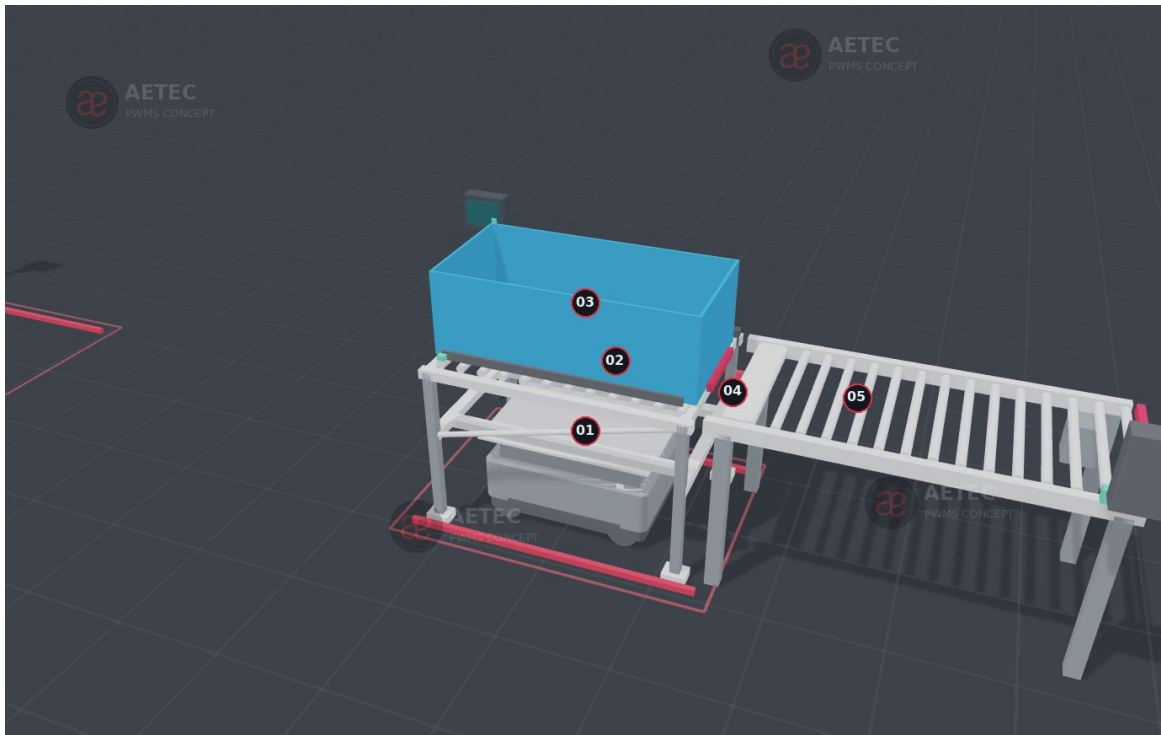
Design basis	Current concept
Cassette count	8 boxes; 2 per level across 4 levels
Existing box	840 × 450 × 330 mm
Pallet and dock	1,200 × 1,000 mm pallet; 100 mm raised supports
Loaded top and ASRS plane	Approximately 1,810 mm; ASRS conveyor 830 mm

The eight-box arrangement supersedes the earlier ten-box, five-level illustration. Confirm the exact pallet construction, fork entry, cassette attachment, complete gross load and centre of gravity with the OEM. The complete pallet remains outside the tote ASRS; only individual compatible boxes enter the store.

Use this method for useful batch movements where the extra cassette and indexing station are justified. Nominal eight-box capacity does not mean every mission has eight available boxes or that production queues disappear.



C04 MiR250 with a removable lift carrier



C04 connected carrier travels with the box and is left on its docking feet.

The MiR250 moves under a connected structural carrier, raises it clear of the floor and transports the complete carrier and box. At the receiving station it lowers the carrier onto its feet, locks the dock and establishes the specified power and control interface. Powered rollers transfer the box over a supported bridge. The AMR can leave while the carrier remains at the station.

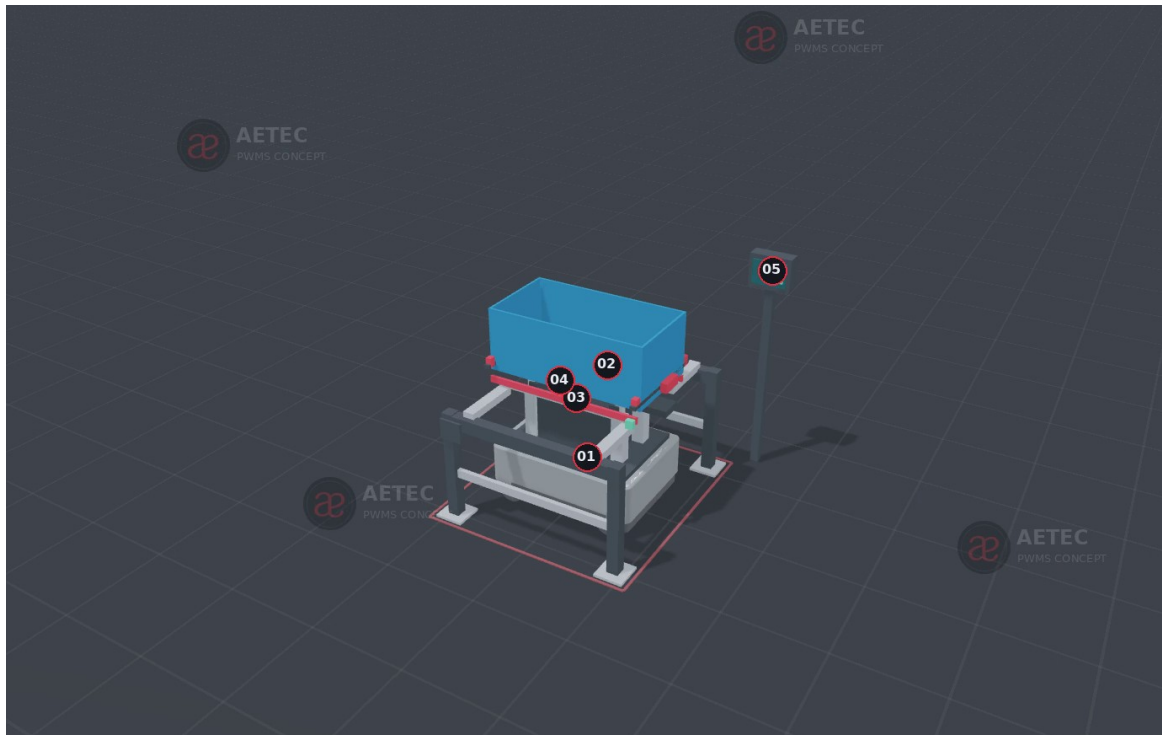
Interface	Concept value
Provisional standard box	1,200 × 600 × 400 mm
Lowered pad and carrier underside	400 mm / 430 mm
Total lift stroke	60 mm = 30 mm to contact + 30 mm floor clearance
Roller transfer plane	830 mm

This approach requires a qualified carrier, guided lift module, load restraint, docking lock, roller power connection and bridged box transfer. Carrier, lift hardware and loaded box all count in the MiR250 application mass budget. The standard box dimensions and selected lift module remain engineering choices, subject to measured requirements and OEM acceptance.

C04 can support an engineered roller handoff. It does not demonstrate that an arbitrary carrier can enter the ASRS or that a raw part can be gripped automatically at every process station.



C05 MiR250 directly lifts the box



C05 lifts the box from fixed support rails using a custom guided and braked pad.

The box rests on two raised support rails. The MiR250 enters below it with the pad lowered, raises the pad into contact, lifts the box clear and proves the transport retainers. It carries the box to a reserved empty dock, lowers the box onto that dock, unloads the pad and exits. The complete video also shows collection and return to the original dock.

Geometry	Nominal value
Qualified box envelope	840 × 450 × 330 mm
Fixed support plane	650 mm
Pad low and high positions	610 mm / 710 mm
Stroke breakdown	100 mm = 40 mm to contact + 60 mm clearance
Pad width and rail opening	330 mm / 375 mm
Dock centre spacing	4,000 mm in the illustrated 8,600 × 3,000 mm cell

Both docking frames remain fixed. The illustrated lift is a custom guided and braked mechanism, not a standard Shelf Carrier attachment. Direct bottom support requires a structurally qualified rigid box base; the old corrugated-plastic box or its rim is not assumed suitable for lifting.



C05 sequence and design checks

Phase	Required action and acknowledgement
1 Reserve	Confirm source identity, load status and destination availability
2 Enter	Approach the fixed rails with the pad lowered and lift inhibited
3 Contact and lift	Detect support contact; raise the box clear of both rails
4 Retain	Prove load presence and positive side and end retention
5 Travel	Authorize motion only with the selected transport state established
6 Set down	Align at the reserved dock; lower onto both support rails
7 Release and exit	Prove supported load, release retainers, lower pad and depart
8 Return	Collect the identified box after process release and repeat in reverse

Nominal geometry check

The 330 mm pad fits between the 375 mm rail opening, leaving 22.5 mm per side before tolerances. The model has a 980 mm dock-leg gap around the 580 mm-wide base. These are mechanical dimensions, not an approved protective-field corridor. Manufacturing variation, box deflection, docking error, floor variation and load movement must be included in the final tolerance stack.

A bounded sweep checked 69 entry positions in both the empty and loaded states for interference between the nominal lift module and the fixed dock. No intersection was detected in that specific check. The full application, all safety fields and production tolerances have not been certified by this model.

Release requirements

Freeze the box bottom and bearing areas, maximum gross mass and centre of gravity. Select lift capacity, braking, anti-drop retention, stroke and position sensing. Confirm power-loss behaviour, docking repeatability, station occupancy detection and recovery from a missing or skewed box. Review the complete top module and application with MiR before production design release.

C05 ends with the box supported at a dock. Machine part loading and ASRS transfer require separate receiving mechanisms if those functions are required.



Finished goods storage and traceability

FG ASRS planning basis

The retained six-metre FG-ASRS concept provides 1,008 physical positions arranged as four faces, 21 bays and 12 levels, with 1,000 enabled locations and eight reserves. At 85–90% working occupancy it supports approximately 850–900 occupied locations. If the requirement is 1,000 continuously stored units, review extra operating space and the 1,200-location alternative.

The earlier FG box basis was 980 × 640 × 320 mm. The current existing-box illustration is 840 × 450 × 330 mm, so the 330 mm height must be checked against the earlier 320 mm basis. The provisional 1,200 mm standard container requires its own storage design. No automatic rack fit or price reduction follows from a changed box envelope.

Record	Required information
Part and routing	Serial or batch; traveller; router revision; process status
Transport	Box, carrier or trolley ID; AMR ID; mission and timestamps
Station work	Exact machine, fixture, operator, start and finish
Quality	PASS, HOLD, rework reason and release authority
Storage	ASRS location, entry and exit, inventory reconciliation
Audit	Exceptions, recovery action, export and access history

Control ownership

The Aetec application requests missions and records traceability. MiR Fleet and equipment controllers retain motion authority. WCS owns storage operations; station PLCs own physical handshakes and protective functions. Customer MES, WMS and QMS interfaces exchange approved business states. The web app is a planning and demonstration interface, not a safety PLC or production machine controller.

End-to-end traveller tracking and customer-system integration are chargeable project scope. The existing quotation includes specific platform allowances; reconcile them before adding further software charges.



Implementation and acceptance plan

Stage	Concrete output
Confirm material	Measured envelopes, maximum gross loads, centre of gravity and qualified support surfaces
Survey the route	Current 17-station layout, docking schedule, buffers, slopes, floor and wireless coverage
Freeze the interface	Select a pilot method, box or trolley standard and receiving mechanism
Engineer the application	OEM review, detailed geometry, load cases, recovery states and risk assessment
Prove the pilot	FAT with representative loads; site trial across the agreed route and exceptions
Roll out	Approved station-by-station plan, operator training, data acceptance and SAT

Acceptance measures to agree before the pilot

Measure successful pickup and setdown across the agreed load and alignment range, repeatability after charging and interrupted missions, load retention, station handshakes, identity reconciliation and recovery without lost traceability. Define route time, throughput, uptime and permitted manual interventions using PWMS demand and operating conditions. The animation does not establish these performance targets.

Demonstration checks completed for this revision

The deterministic scene suite exercised 29 configurations: 18 MC600 combinations across six nests and three receiving modes, eight pallet positions, Hook, lift carrier and direct box lift. It checked defined support changes, return-state continuity and selected motion interlocks. The separate direct-lift nominal geometry sweep is reported on the preceding C05 sequence page.

Items to confirm for final selection

PWMS and Aetec should confirm the raw and downstream load cases, acceptable container changes, stage where the existing box is introduced, station service heights, actual routes and queues, enabled ASRS capacity, direct machine-loading scope, IT interfaces and pilot acceptance measures. These inputs determine whether C05 is sufficient for simple transport or whether C02, C03 or C04 receiving functions are needed.



Reference and revision register

Reference	Role in this revision
PWMS Option A B Technical Proposal Rev 10	Retained architecture, 17-station context, traceability and Aetec presentation language
PWMS 3D Practicality Review Rev 11	Current MC600 presentation-lift geometry and eight-box pallet correction
PWMS End to End ASRS AMR Quotation Rev 6	Retained scope-specific selling ROM and commercial boundaries
PWMS FG ASRS Technical Proposal Rev 7	Storage capacity and interface planning basis
PWMS Transfer Studio source and four-method video v2	Existing articulated concepts and original four chapters
MiR250 box jack design in Transfer Studio	New C05 fixed-dock concept, 21-step cycle and nominal geometry

Manufacturer references

MiR250 robot dimensions and base payload

<https://mobile-industrial-robots.com/products/robots/mir250>

MiR Shelf Carrier 250 application reference

<https://mobile-industrial-robots.com/products/applications/mir-shelf-carrier-250>

Universal Robots UR30 product reference

<https://www.universal-robots.com/products/ur30-1300/>

Enabled Robotics mobile cobot package reference

<https://www.enabled-robotics.com/mobilecobots>

The supplied MiR1200 Pallet Jack technical package remains the basis for its OEM dimensions and load limits. Use the selected configuration and current supplier offer during design freeze. A manufacturer base rating alone does not approve any custom top module or complete application.

Companion deliverables

The client presentation compares all five methods. The full client video includes all five chapters, and a separate clip shows C05. Transfer Studio contains the interactive 3D cycles and the Cloudflare upload package reproduces that app. The commercial supplement adds a clearly separated two-dock C05 planning allowance. The continuation record lists recovered sources and completed handover files.