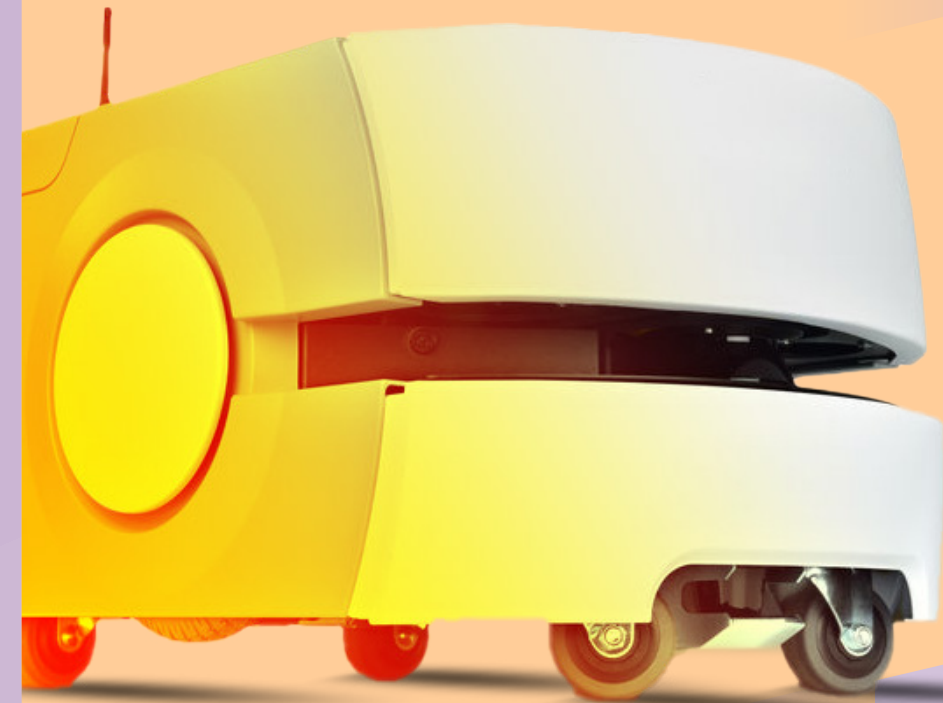


THE FUTURE MOVES HERE

THE AUTONOMOUS MOBILE ROBOT (AMR)
PLAYBOOK FOR ENTERPRISES



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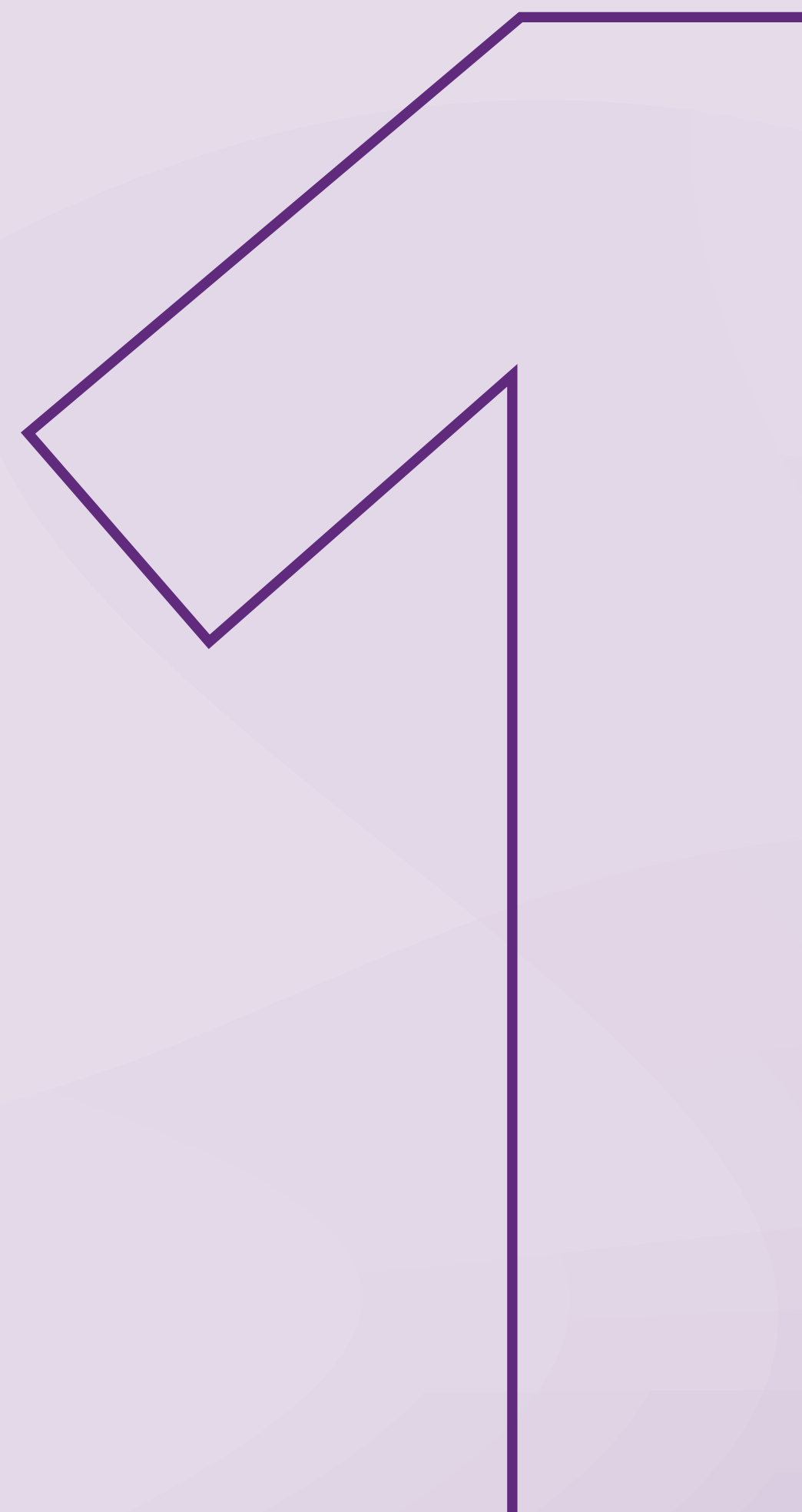
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INTRODUCTION TO AMR PLAYBOOK FOR ENTERPRISES



1.1 PURPOSE AND STRUCTURE OF THE GUIDEBOOK

OBJECTIVE

This playbook helps businesses leverage Autonomous Mobile Robots (AMRs) to streamline operations, boost productivity, and drive growth. It offers practical guidance for every stage of automation to achieve efficiency, resilience, and innovation.

AUDIENCE

Designed for business leaders, project teams, and decision-makers exploring or scaling AMR adoption. It provides insights and actionable steps to tackle challenges and capture new opportunities.

SCOPE

This guide explains:

1. What AMRs are and how they work in business contexts
2. How AMRs enhance productivity, workforce capability, and innovation
3. Key considerations for integration — leadership, technology, infrastructure, people, and processes
4. Tools, standards, and resources to support adoption
5. How to get started with AMRs, including next steps and support channels





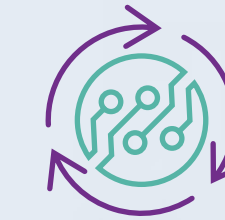
HOW CAN AMRs HELP MY BUSINESS?



2.1 INTRODUCTION TO AMRs

Autonomous Mobile Robots (AMRs) are advanced machines that can sense their environment, make decisions, and move independently without human control.

Unlike Autonomous Guided Vehicles (AGVs) that follow fixed paths, AMRs use sensors and mapping to navigate, avoid obstacles, and adapt to changing conditions — making them flexible, scalable, and ideal for complex spaces like warehouses, logistics hubs, and factories.



Autonomy

Operates independently using real-time data



Task execution

Performs functions like transporting goods or collecting data



Navigation

Plans and adjusts routes dynamically



Perception

Uses sensors to detect and interpret surroundings



Mobility

Moves across different terrains with wheels, tracks, or legs

Applications Across Sectors

AMRs are part of the wider robotics family, which includes:

- **Industrial robots** – Automated machines used mainly in manufacturing to perform repetitive, high-precision tasks within controlled environments
- **Service robots** – Robots that assist people or carry out useful tasks in dynamic spaces such as hospitals, hotels, and public areas

Building on these capabilities, AMRs deliver value across both **industrial** and **service** settings, such as:

- **Manufacturing:** Precision engineering, electronics
- **Logistics:** Warehouses, last-mile delivery
- **Facilities Management:** Environmental services, security
- **Hotel & Food Services:** Hotels, malls, attractions, F&B

(Applicable across both indoor and outdoor environments; sectors shown are non-exhaustive)

Source: SS ISO 8373:2025 (ISO 8373:2021 IDT) Robotics – Vocabulary



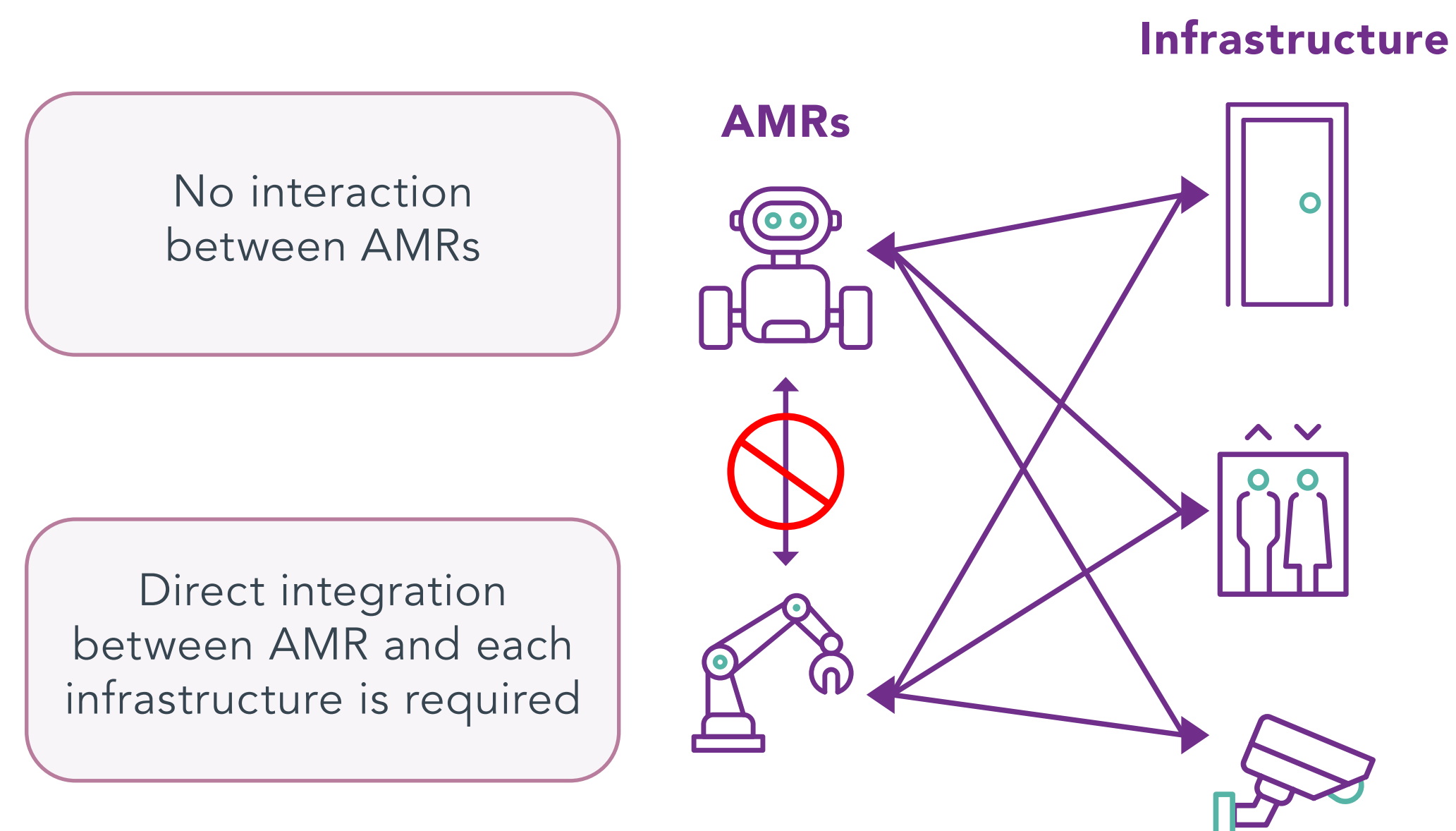
In modern business settings, AMRs are rarely operating alone. They need to communicate and coordinate with lifts, doors, security systems, other robots, and core digital platforms like warehouse management or building automation systems. This ability to connect different devices, brands, and software - what we call interoperability - is a foundational enabler for scalable, future-proof automation.

AMRs capabilities can be extended by implementing interoperability middleware.

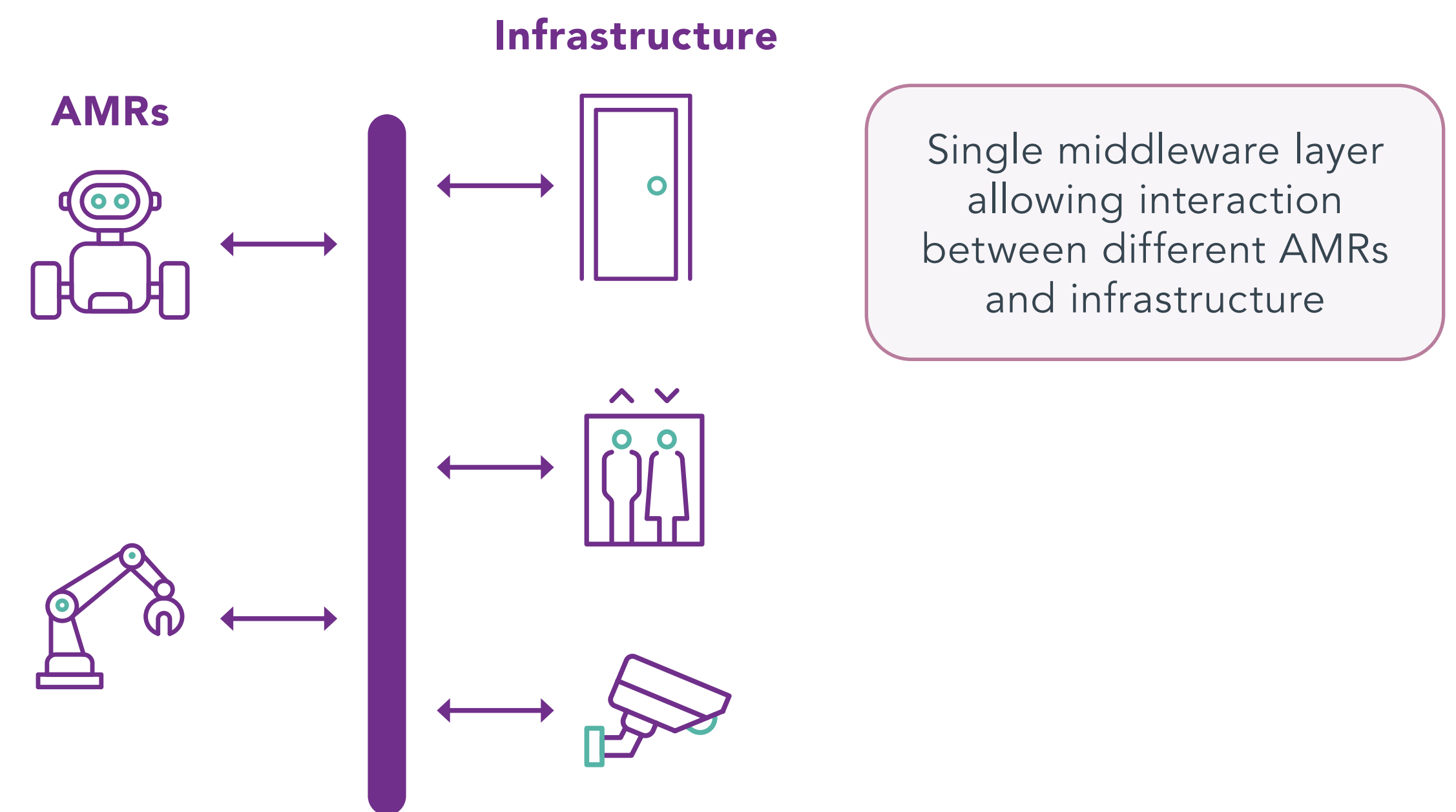
These middleware are more suitable in scenarios with one or more of the following factors:

- Enables coordination of different robots across vendors
- Manages traffic and avoids conflicts in shared spaces
- Integrates AMRs with building infrastructure for smooth communication

Without interoperability-based middleware



With interoperability-based middleware



2.2 AMR USE CASES

	Challenge	Action	Result
Facilities Management	Contracts lost due to market demand shifting towards outcome-based contracts (OBC) and AMR becoming a pre-requisite	Adapted infrastructure, integrated AMRs via middleware, retrained staff	Secured new cleaning contracts and productivity gains → expansion planned
Security Solutions	Ageing workforce, 24/7 surveillance needs, reliance on costly, risky human patrols	Adopted AMRs with AI integration for autonomous patrols; optimised ROI with usage	Flexible hybrid human-robot patrol teams, improved coverage and faster response times
Hospitality & Leisure	Enhance guest services and reduce delays in large properties	Piloted concierge, delivery, and surveillance AMRs; partnered with regulators and stakeholders	Improved safety, security, and way-finding; saved manpower and costs
Food Manufacturing	Outdated processes, low throughput, rising market demands	Drove tech transformation, integrated AMRs in repetitive workflows, trained staff, secured buy-in	Higher output, lower costs, new revenue streams, stronger market position



2.3

BUSINESS MOTIVATIONS AND OUTCOMES

Where AMRs work best



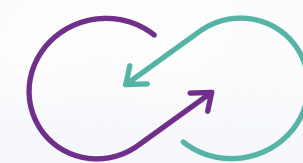
Hazardous or unsafe tasks



Pursuing new offerings or business models



Labour-intensive or manpower-constrained operations



Seamless integration with digital systems (interoperability)



Multi-shift or time-consuming workflows



Dirty, unpleasant, or repetitive jobs needing accuracy

What AMRs help you achieve



Augment manpower and close workforce gaps



Free up staff for higher-value tasks



Boost productivity and efficiency



Scale cost-effectively



Reduce operating and labour costs



Enable innovation in services and business models



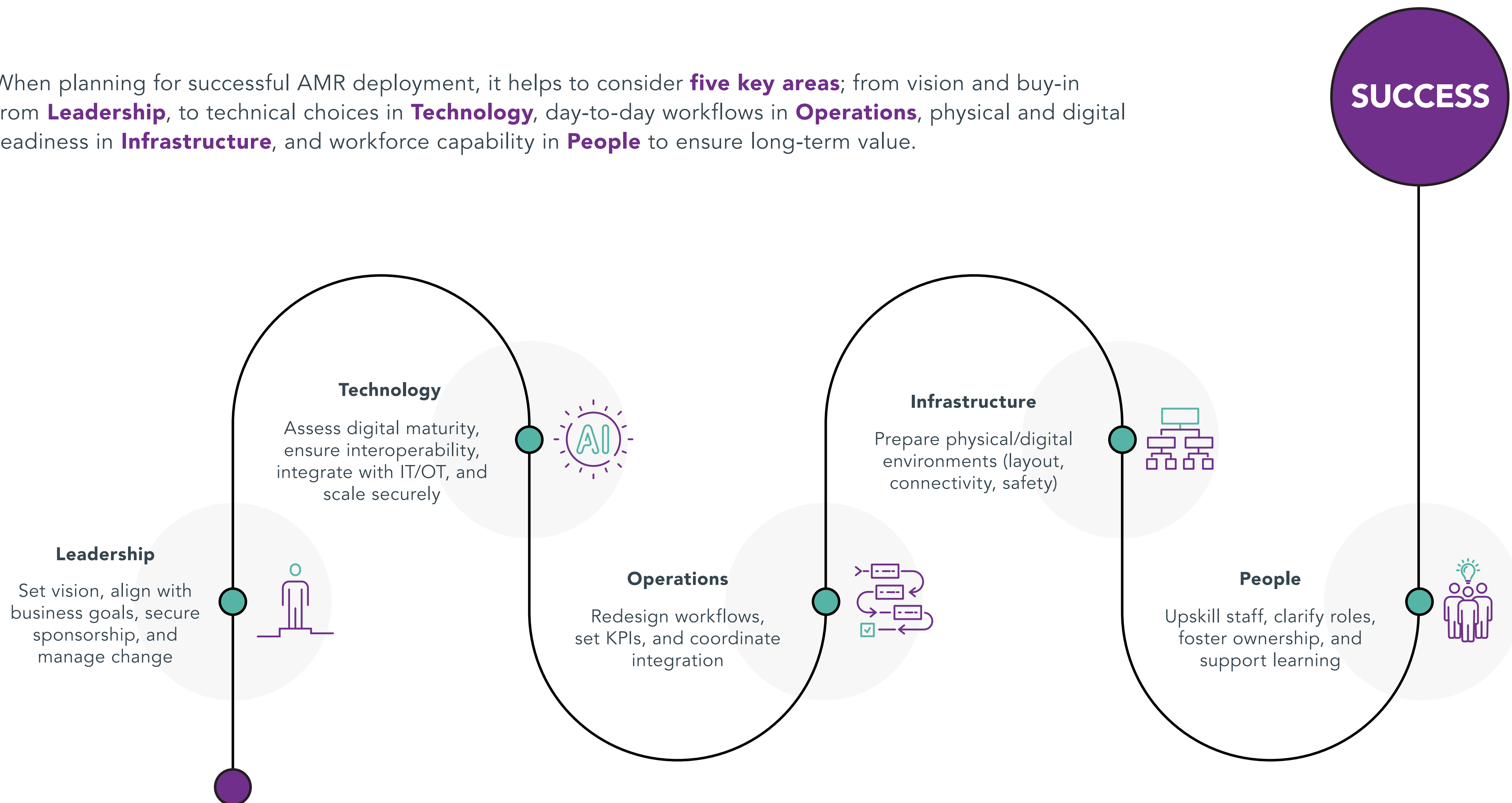
Maintain consistent, high-quality performance



WHAT DO I NEED TO CONSIDER WHEN ADOPTING AMRs?



When planning for successful AMR deployment, it helps to consider **five key areas**; from vision and buy-in from **Leadership**, to technical choices in **Technology**, day-to-day workflows in **Operations**, physical and digital readiness in **Infrastructure**, and workforce capability in **People** to ensure long-term value.



3.1 LEADERSHIP

Organisational Direction

Define the organisation's AMR-driven digital transformation pathway:

Operational (day-to-day efficiency focus)

Drive immediate productivity gains and operational improvements, e.g., automating repetitive tasks to reduce errors, accelerate workflows, and boost throughput

Tactical (mid-term process improvements)

Enhance specific functions or departments by redesigning processes to integrate and optimise AMR workflows/integrations

Strategic (long-term transformation)

Position AMRs within the organisation's broader digital transformation vision, enabling flexibility, scalability, and future business model shifts

Strategy & Use Case Development

Develop a use-case roadmap and implementation plan aligned with business needs:

Short-term planning (single-function AMRs)

Capture quick wins by piloting AMRs in focused, well-defined applications (e.g., material handling, cleaning, single-task robots)

Build organisational learning and iteration with minimal risk prior to large-scale rollout

Long-term planning (full autonomous operations)

Define ambitions for comprehensive, multi-functional, or fully integrated AMR ecosystems

Set milestones for scaling, including adoption of multi-fleet/multi-vendor solutions, ensuring interoperability, and driving ongoing innovation

Change Management

Instill a mindset shift and enable cultural transformation by focusing on:

Change resistance management

Proactively address employee and operational resistance by anticipating concerns around job security, disrupted routines, or unfamiliar technology

Conduct townhalls to communicate AMR benefits, clarify misconceptions, and address questions

Run pilot projects to build confidence, gather staff feedback, and refine SOPs before large-scale deployment

Change resistance management

Engage all relevant stakeholders to ensure understanding and buy-in

Form cross-functional task forces, define clear responsibilities, and align key metrics and milestones

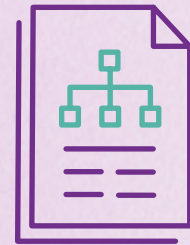
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3.2

TECHNOLOGY



Technology Planning

Ensure your AMR strategy is future-proof, integrated, and sustainable:

Scalability as business needs change

Plan fleet management (homogeneous/heterogeneous) and system architecture to support expansion without complexity

Integration readiness of AMRs

Account for interoperability with other solutions and ease of data exchange

Lifecycle and system management

Consider expected system life (e.g., how often to replace/upgrade) and future-proofing needs such as modular hardware and software updates

Maintenance and support

Define operational model (e.g., spare parts, in-house vs outsourced, regular servicing schedules)

Ownership model of hardware

Explore procurement options, purchase, lease, or hybrid, based on budget, flexibility, and risk appetite



Solution Selection

Choose the right AMR system for your business needs and use cases:

Capability matching

Evaluate capabilities such as navigation, sensing, task automation, payload, actuation, environmental adaptability (indoor/outdoor), and safety features

Interoperable capability

Between systems: assess AMRs' ability to integrate with other automation solutions, digital infrastructure, and building systems

Between fleets: consider platforms supporting heterogeneous fleets (multiple AMR types/brands) to work together through shared middleware (RMF) or industry standards

Integration flexibility

Consider solutions that enable future upgrades or integration of new automation technologies with minimal disruption



Reference Standards*

Align your AMR deployment with recognised standards and best practices:

Robotics-related standards

Apply robotics and automation standards (e.g., ISO 12100, ISO 3691, ISO 13482, ISO 8373, TR 104, TR 108, SS 713, VDA 5050 (safety, reliability, compliance))

Robotics framework

Reference frameworks such as RMF-based middleware, and TR Interoperability for navigation

Environmental and safety ratings

Ensure AMRs meet IP/weatherproofing and other environment-specific certifications

Cyber security standards

Ensure compliance with protocols

**List of Standards are non-exhaustive*



3.3

OPERATIONS

Operation Workflow**Ensure AMRs are successfully integrated into daily operations:****Workflow assessment**

- Determine whether to enhance existing workflows or conduct a full redesign
- Analyse task and workflow complexity managed by AMRs (e.g., variability, frequency, scale, interdependence, scheduling, data flow, manual intervention)
- Identify touchpoints where humans and AMRs interact to ensure smooth handoffs and minimal disruption
- Consider phased implementation: start with bottlenecks or manual processes and gradually expand AMR use for end-to-end automation

**Regulations & Policies****Ensure awareness of relevant standards and guidelines to meet:****Reference regulations**

- Comply with outdoor deployment standards (e.g., LTA)
- Apply regulations for indoor deployment (e.g., BCA, SCDF)

**Performance Monitoring****Measure and enhance the impact of AMRs for continuous improvement:****KPI selection**

- Use and adapt existing operational KPIs (e.g., work output, response time) to measure changes from AMR deployment

Value generation KPIs

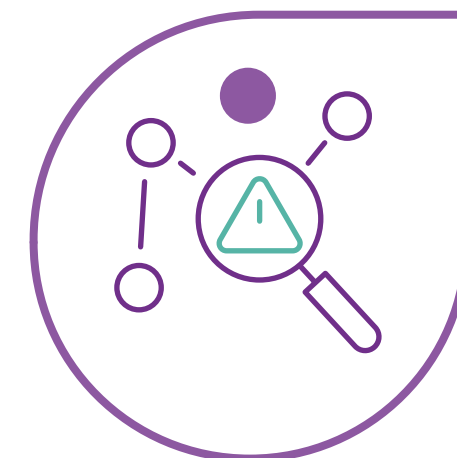
- Track AMR-specific value creation (e.g., productivity, cost savings, reduced manual errors, improved response times, and service reliability)

Comprehensive ROI calculations

- Establish systems to capture tangible (e.g., direct cost and error reduction) and intangible benefits (e.g., staff morale, customer satisfaction)

Continuous review and adjustment

- Regularly monitor operations, review performance data and update targets to support scaling

**Risk Management****Proactively manage operational risks for resilient AMR operations:****Downtime impact assessment**

- Evaluate potential effects on business operations and develop SOPs and alternative workflows for exceptions

Insurance and compliance

- Assess and secure insurance coverage for AMR-related risks
- Maintain logbooks, risk assessments, and SOPs, and schedule regular compliance checks for each AMR type and deployment environment

3.4

INFRASTRUCTURE



Physical Infrastructure

Ensure that the physical environment is AMR-ready and accessible:

Spatial layout optimisation

- Plan navigation routes, waiting areas, and frequent AMR operational zones
- Adjust floor plans as needed to allow AMRs to move freely without creating bottlenecks

Environment for AMR accessibility

- Ensure AMRs can reach all required destinations, accounting for ramps, slope gradients, and varied terrains

Charging and staging

- Identify optimal locations for charging/docking stations to minimise travel distance from frequently serviced areas
- Designate specific areas for AMR parking when not in use, avoiding interference with traffic



Risk Management

Proactively manage operational risks for resilient AMR operations:

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Insurance and compliance

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Continuous review and adjustment

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Regulations & Policies

Ensure awareness of relevant standards and guidelines to meet legal, safety, and quality benchmarks:

Reference regulations

- Comply with outdoor deployment standards (e.g., LTA)
- Apply regulations for indoor deployment (e.g., BCA, SCDF)

3.5

PEOPLE

Skills and Training

Consider adopting a structured pathway for upskilling and reskilling staff to work with AMRs:

Structured learning pathways

- Establish programs covering both basic operational training for day-to-day AMR interaction and advanced troubleshooting for IT/maintenance teams

Onboarding and refresher training

- Provide initial induction for new technologies and regular follow-up sessions as AMR systems evolve

Cross-training opportunities

- Offer workforce members opportunities to learn adjacent roles (e.g., operational staff learning AMR maintenance or data interpretation) to reduce disruption during scaling or transitions

Change Enablers

Foster a culture that embraces AMRs and continuous innovation:

Empower change agents/champions

- Identify and support team members who can motivate peers, mediate concerns, and share success stories

Create two-way communication channels

- Establish regular feedback loops to surface operational issues and ideas from all staff levels

Recognise and share wins

- Celebrate teams and individuals for adapting to AMRs, highlight learning moments during review meetings, and maintain transparency on deployment progress

Roles and Responsibilities

Connect vision to day-to-day needs; act as adoption agents by mediating change and driving process improvements, such as:

Appoint a POC (i.e., for daily operations, troubleshooting and workflow design)

- AMR operators: Responsible for safe daily use, basic maintenance, and escalating operational issues
- AMR lead & IT support: Own deployment coordination, vendor management, troubleshooting, workflow integration, and advanced system support
- Process owners: Bridge between AMR technical/operational teams and business units, ensuring process alignment and championing benefits

Clarify accountability

- Document responsibilities to all involved, including escalation paths and handoff procedures

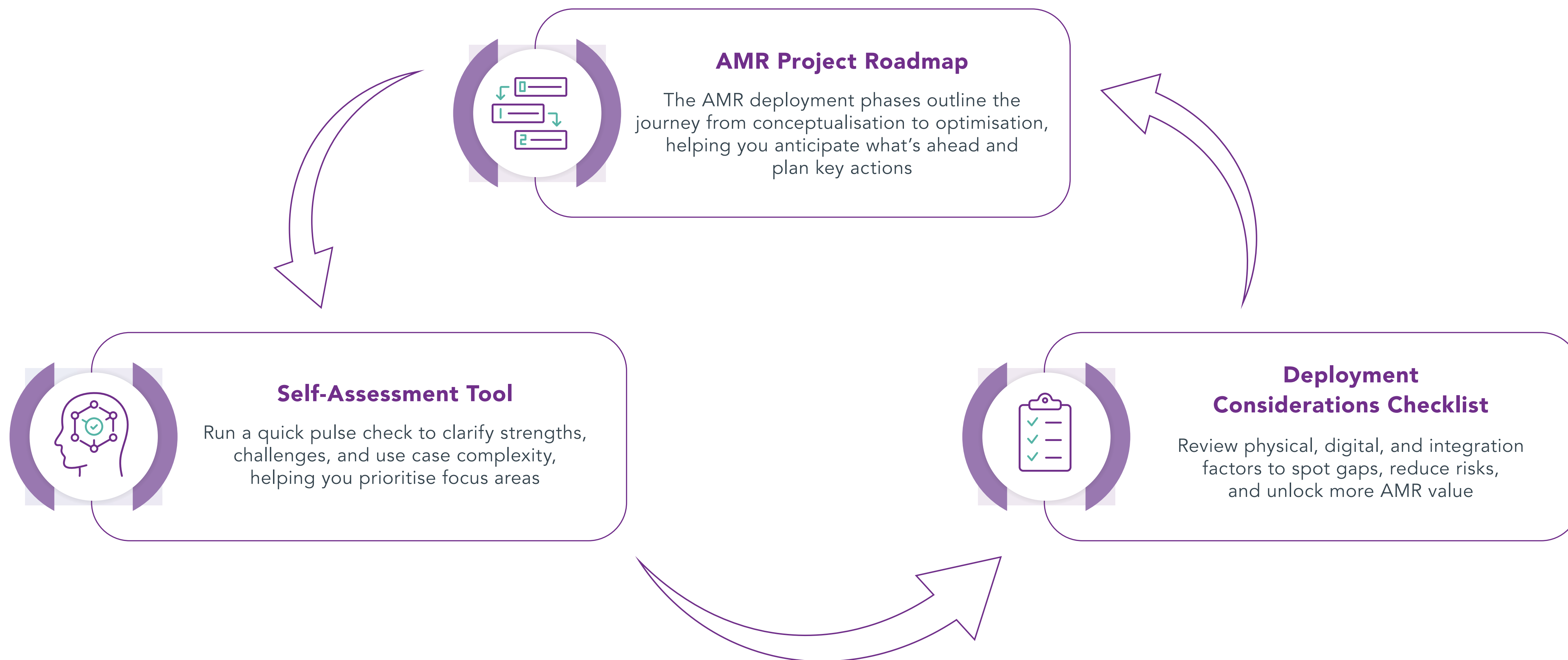




WHERE AND HOW DO I START?



Think of the **AMR Project Roadmap** as a starting point—a generic, phased guide to structure your adoption journey. But every organisation and project is different. That’s where the **Self-Assessment Tool** comes in: it helps you identify your unique gaps in leadership, operations, technology, people, and infrastructure—so you can customise the roadmap to your needs. Treat the **Deployment Considerations Checklist** like a final cross-check to ensure nothing critical is missed before project launch. Remember this roadmap is a live document, regular review and updates are to be expected as the project evolves.



4.1 AMR PROJECT ROADMAP

This roadmap serves as a **guide to plan your AMR adoption journey**, outlining key milestones and a high-level timeline illustrated by **BrightMove Logistics** — a local firm using AMRs to automate order picking, enhance productivity, and address workforce gaps.



Phase 0 – Conceptualising

- **Identify readiness, problem statement and use case complexity:** BrightMove determines their order-picking task is repetitive, moderately complex, and ideal for initial automation
- **Secure funding and project resources:** Leadership commits resources and sets clear objectives for the pilot
- **Develop a change management plan:** Operational champions are identified early to manage staff communication, anticipate concerns, and collect ongoing feedback from warehouse teams

- **Form a cross-functional team:** Include representatives from operations, IT, HR, a warehouse staff member and finance to cover key aspects, including technical, training and budget considerations, for effective buy-in
- **Define KPIs:** Set metrics such as 30% faster pick time, 40% less manual handling and zero safety incidents during pilot
- **Assess site:** Map AMR routes, identify bottlenecks such as congested aisles and consider layout or charging upgrades
- **Select solution:** After demos, choose a modular AMR system compatible with existing inventory platforms, prioritising flexibility, integration and safety



Phase 1 – Planning (1–2 months)

Phase 2 – Preparation (1–3 months)

- **Use assessment to guide modifications:** Findings from planning stage prompt changes – BrightMove adds a ramp for AMR access and moves frequent SKUs to AMR-ready shelves
- **Upgrade digital and physical infrastructure:** IT extends Wi-Fi coverage throughout the warehouse, ensuring no “dead spots” for robot navigation and data transfers
- **Train key personnel:** Warehouse pickers and maintenance staff attend vendor-run operational training





Phase 3 – Pilot Implementation (1–2 months)

- **Deploy limited AMRs in a test environment:** Team starts with 2 robots during the night shift, minimising disruption and allowing close supervision
- **Gather feedback:** Operators hold daily debriefs with users to track downtime, handover points, and workflow clarity, continuously refining processes based on user input and addressing practical issues as they arise
- **Address technical issues:** The IT team monitors connectivity and resolves network dropouts affecting robot performance troubleshoots network dropouts that delayed AMRs at one end of the warehouse

- **Scale to full implementation:** Based on successful pilot data, BrightMove rolls out 10 AMRs to cover all shifts, ensuring steady rollout and sufficient support coverage
- **Complete staff training:** All warehouse staff and supervisors trained on AMR interaction and emergency procedures
- **Establish maintenance protocols:** Weekly servicing schedule and troubleshooting SOPs regarding servicing and troubleshooting are put in place

Phase 4 – Full Deployment (2–4 months)

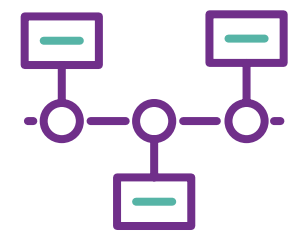


Phase 5 – Optimisation (Ongoing)

- **Regular performance reviews:** Monthly review meetings track picking speeds, error rates, and overtime costs. KPIs indicate continued productivity improvement
- **Continuous improvement:** With the AMR system well integrated, BrightMove explores additional deployments such as using robots for goods-inward handling, and meets regularly with vendors to discuss updates or possible new features
- **Scale to additional sites:** After 6 months, with lessons learned, BrightMove initiates planning for automation at its second warehouse

4.2 SELF-ASSESSMENT TOOL

This self-assessment tool helps validate which AMR use cases to pursue, gauge current readiness and identify potential areas for improvement and further planning which can be incorporated into your AMR roadmap.



1. Task Workflow

- How complex is the primary task the AMR will perform?
- How automated is the workflow today (manual vs. scheduled/automated)?
- Are tasks repetitive, predictable, and measurable enough to justify automation?



2. Site Conditions

- Are spaces navigable (corridors, lobbies, high-traffic areas) without excessive retrofitting?
- How frequently must AMRs operate in challenging environments (rain, dust, uneven terrain)?
- Has a facility layout review been done to identify choke points, ramps, or lift access issues?



3. System Integration & Technical Setup

- How well will AMRs integrate with existing IT/OT systems (doors, lifts, WMS, ERP)?
- Is your facility's Wi-Fi/communication infrastructure reliable and secure across all AMR zones?
- Are current cybersecurity protocols sufficient to protect AMRs, data, and networks?
- Can the AMR solution scale easily (number and type of robots, vendor interoperability)?



4. People & Organisation

- Do you have strong executive sponsorship and cross-functional leadership support?
- Have staff training needs (operators, IT, supervisors) been identified and resourced?
- How prepared is the organisation for change (resistance management, communication plan)?
- Are roles and responsibilities for AMR operations clearly defined?



5. Operational Planning

- How well-mapped are your current workflows for automation opportunities?
- Have you identified where AMRs add the most value (efficiency, safety, service)?
- Are contingency plans in place for AMR downtime or malfunctions?
- Is there a robust maintenance and update schedule for both hardware and software?



6. Financial Considerations

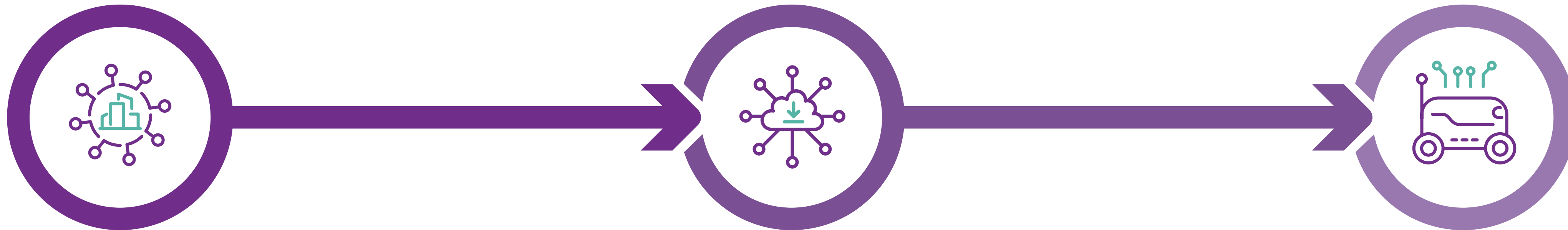
- Have you calculated Total Cost of Ownership (TCO) including hardware, integration, training, and maintenance?
- How accurate is your ROI projection (cost savings, productivity improvements, error reduction)?
- Can the solution be scaled sustainably across multiple locations or departments?
- Have funding sources or grants been identified to support phased adoption?

4.3 DEPLOYMENT CONSIDERATIONS CHECKLIST

This section breaks down critical technical and operational considerations for a practical review of your AMR roadmap.

Digital Infrastructure

- ☐ Assess network coverage (Wi-Fi, telco), redundancy, and interference risks
- ☐ Implement interoperability middleware for traffic management and multi-AMR coordination
- ☐ Enforce cybersecurity protocols: firewalls, encryption, restricted access, and regular updates



Physical Infrastructure

- ☐ Assess compatibility of automated doors, lifts, ramps, and charging stations with AMR communication protocols
- ☐ Ensure accessibility (ramps, slopes, undulating terrain) and sufficient space around docking stations
- ☐ Check facility layout, width/height/weight clearances, and protective measures for charging stations

Robot Capabilities & Features

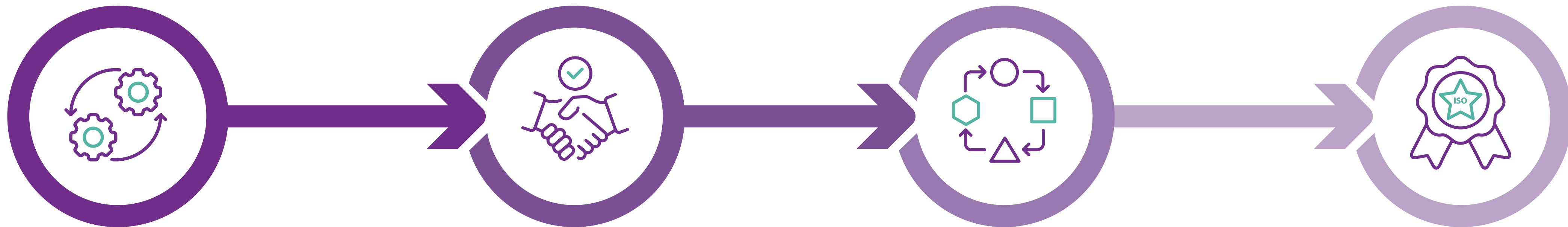
- ☐ Evaluate navigation (line-of-sight, corners, obstacles), localisation, and positioning suitability
- ☐ Assess payload capacity, environment fit (indoor/outdoor), suspension needs, and battery life
- ☐ Check safety compliance (e.g., ISO-13850) and establish maintenance routines for components

Business & Organisational Readiness

- ☐ Align with business goals, change management, KPI/ROI tracking, and workforce impact
- ☐ Plan staff training, townhalls, and pilot runs to build confidence and refine SOP
- ☐ Address risk management with insurance coverage, SOPs for downtime, and exception handling

Governance, Risk & Compliance

- ☐ Ensure compliance with security standards (e.g., ISO 27001) and vendor cybersecurity protocol
- ☐ Clarify insurance policies: coverage for liability, product safety, cyber incidents, and business interruption
- ☐ Define contractual liability terms, indemnification, warranty, and incident reporting processes



Operations & Maintenance

- ☐ Assess operating environment (peak loads, geo-fencing, AMR-only lanes, surface materials)
- ☐ Plan scheduled maintenance, downtime procedures, and recovery for immobilised AMRs
- ☐ Establish teleoperations, monitoring protocols, and remote supervision processes

Future Readiness

- ☐ Evaluate scalability: fleet size, modularity, software/hardware upgrades, ROI for scaling
- ☐ Are contingency plans in place for AMR downtime or malfunctions?
- ☐ Is there a robust maintenance and update schedule for both hardware and software?

4.4

STANDARDS AND GUIDELINES

	What it Covers	Why it's Useful
ISO 3691-4:2023 Machinery Safety Principles	Safety requirements for driverless trucks and AMRs	Ensures autonomous systems operate safely with humans, mitigates risks
ISO 8373:2021 Robotics Vocabulary	Common terminology for robotics	Ensures consistent communication among manufacturers, users, regulators
ISO 12100:2010 Machinery Safety Principles	Framework for evaluating safety features	Aligns vendors and enterprises on risk methods, foundation for other standards
ISO 13482:2014 Personal Care Robots	Safety requirements for robots supporting humans	Provides cost-benefit clarity (infra upgrades, training, inspections)
ISO/IEC 27001:2022 Cybersecurity	Security management systems for AMRs	Seamless integration, resource optimisation
SS 713:2025 Data Exchange	Communication standard between robots, lifts, doors	Enables AMR use in multi-story/smart buildings
TR 104:2022 Safe use of AMRs in Warehouses	Safety requirements for navigation and control in warehouses	Evaluates operational/environmental readiness for safe AMR use
TR 108:2022 Robots in Healthcare	Safety evaluation for dynamic healthcare settings	Anticipates changes needed for safe deployment in healthcare
IP Ratings Ingress Protection	Protection standards against dust/liquids	Ensures AMRs suit site conditions
CETRAN T1 Assessment Assessment for AVs/AMRs	Public path requirements testing for AVs/AMRs	Mandatory for Active Mobility Act compliance
Robotic Middleware Framework (RMF) Open-source middleware	Enables interoperability between different AMR manufacturers	Enhances safety, efficiency, and scalable robot fleet operations
VDA 5050 Open-source Protocol	Task allocation and interoperability for mixed fleets	Seamless integration, resource optimisation





Connect with us to find out more about how IMDA can help your company in leveraging emerging technologies to support your digital transformation journey.

ABOUT IMDA

The Infocomm Media Development Authority (IMDA) leads Singapore's digital transformation with infocomm media. To do this, IMDA will develop a dynamic digital economy and a cohesive digital society, driven by an exceptional infocomm media (ICM) ecosystem — by developing talent, strengthening business capabilities, and enhancing Singapore's ICM infrastructure. IMDA also regulates the telecommunications and media sectors to safeguard consumer interests while fostering a pro-business environment and enhances Singapore's data protection regime through the Personal Data Protection Commission.

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