AUTONOMY@WORK™

# THE CASE FOR AMR-BASED SMART INTRALOGISTICS

## WHITE PAPER

**THIS DOCUMENT PROVIDES READERS ACTIONABLE INSIGHTS RELATED TO THE IMPLEMENTATION OF SMART INTRALOGISTICS PROCESSES BASED ON AUTONOMOUS MOBILE ROBOTS (AMR).**

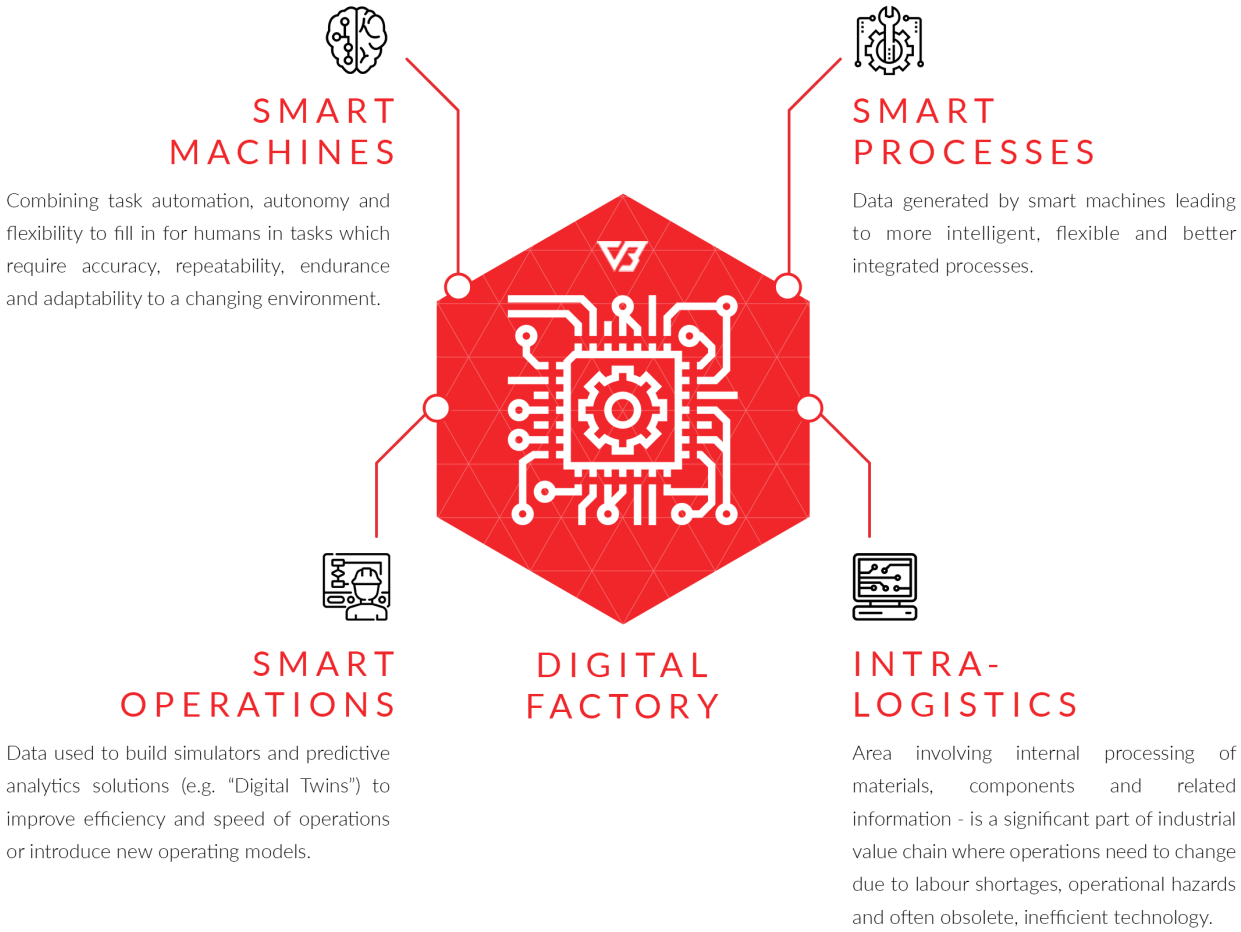
**ACTION POINTS:**

- SMART INTRALOGISTICS IS AN ESSENTIAL COMPONENT OF ANY DIGITAL TRANSFORMATION INITIATIVE OF MANUFACTURING ORGANIZATION.
- THE SMART INTRALOGISTICS TRANSFORMATION PROGRAM SHOULD FOLLOW THE EVOLVING REQUIREMENTS FOR PROCESS EFFICIENCY AS WELL AS PROCESS FLEXIBILITY.
- A THOROUGH READINESS CHECK SHOULD BE EXECUTED WHEN INITIATING TRIALS, PILOT IMPLEMENTATIONS AND PROOF OF CONCEPT FOR INTRALOGISTICS TRANSFORMATION.

# DIGITAL TRANSFORMATION IN MANUFACTURING

Manufacturing has been a leading adopter of digital solutions for decades with industrial robots, computer-controlled devices, manufacturing execution & management information systems. Some widely used business solutions – such as ERP systems – have originated in manufacturing. The current digital transformation tsunami, which has already disrupted many industries, may have seemed to bypass the world of manufacturing. Operational excellence, economies of scale achieved through standardization, just-in-time logistics and consolidation of product volumes have been a safe and proven way to profits. This approach is no longer sufficient.

The powerful incumbents of global manufacturing as well as midmarket or small players have to quickly learn the new rules, adopting and implementing the concept of "digital enterprise", or in their case – "digital factory". The basic building blocks digital factory are smart processes and operations: optimizing in real time the allocation of resources, sequences of actions and workloads in order to achieve the performance goals, while increasing the organizations capability to handle diversity of demand and personalized production. Such mix of flexibility and performance requires new breed of automation solutions – smart machines and execution platforms with increased capacity to plan and re-plan activities, and high interoperability of devices, processes and systems.



# THE CASE FOR AMR-BASED SMART INTRALOGISTICS

Intralogistics - the area involving internal processing of materials, components and related information - is a significant part of industrial value chain where operations need to change due to labour shortages, operational hazards and often obsolete, inefficient technology. The automation of intralogistics tasks has to meet the growing demand for flexibility of shop floor operations. Product personalisation and unpredictable fluctuations of production volumes become important aspects of modern manufacturing which challenging traditional intralogistics solutions.

## ENABLING INDUSTRY 4.0 OPPORTUNITIES

### Manufacturing Paradigms Change:

**FROM RETEABILITY**
- Stable Demand
- Low Differentiation
- Process Optimization

**TO AGILITY**
- Variable Demand
- Mass Personalization
- Lifecycle Optimization

### Human Role Change:

**FROM TASK EXECUTOR**
- Acknowledge
- Execute
- Report

**PROCESS ORCHESTRATOR**
- Design
- Control
- Improve

## NEW REQUIREMENTS FOR MAINSTREAM INTRALOGISTICS SOLUTIONS:

- FLEXIBLE ROUTING
- FLEXIBLE CYCLE TIMING
- HUMAN COLLABORATION
- END-TO-END OPERATIONS INTEGRATION
- MINIMUM INFRASTRUCTURE

## DELIVERED ON INDUSTRIAL SCALE BY AUTONOMOUS MOBILE ROBOTS

For this reason many manufacturing organisations select SMART INTRALOGISTCS as the key, enabling concept of manufacturing transformation driven by digital innovations. The following capabilities are critical for successful rollout of smart intralogistics:

## AMR/AGV BASED AGILITY

The key capability of smart intralogistics is to quickly and cheaply introduce changes in material flow, to enable changing requirements of manufacturing or warehousing processes. Naturally the flexibility must not compromise fundamental productivity of operations and its cost efficiency. In discrete manufacturing and warehousing the most mature technology that delivers this capability is represented by Autonomous Mobile Robots (AMRs), the most advanced segment of AGVs (Automated Guided Vehicles).

## RELIABLE AUTONOMY

This is the capability of executing intralogistics tasks (pickup, transport, handover of materials, components and goods) without human intervention or process related navigational "hard" infrastructure. Human intelligence creates benefits when applied to process optimisation, not to execution of mundane tasks related to transport of material. The "zero infrastructure" requirement is another important enabler of process agility. Autonomous units which are fully self reliant in executing transport assignments, can adopt to changes in intralogistics processes in real-time, without the need for costly and time consuming reconfiguration of beacons, guiding lines etc. In an industrial environment a fundamental requirement for this capability is reliable performance. It is not enough that autonomy works "most of the time". From the perspective of master process (manufacturing or warehouse management) the reliability and performance of smart intralogistics solution has to match the reliability of all other process automation solutions.

## INDUSTRIAL SAFETY

The shop floor is a living environment, with many participants of daily traffic, changing floor layouts and traffic patterns. The autonomous components of intralogistics solution have to cope well with unpredictable behaviour of other traffic participants, enabling undisturbed execution of manufacturing operations. Also, they need to provide uncompromised compliance with industrial standards related to health and safety. Finally - as any digital solution - smart intralogistics requires mature approach to cybersecurity in deployment and operations.

## PREDICTABLE AMR AND PROCESS PERFORMANCE

This is the capability of simulating and predicting key performance aspects of intralogistics process configuration (such as throughput, cycle times, asset utilisation, energy consumption) without costly, and potentially disruptive experiments on the actual shop floor. This capability is the key to developing and maintaining a positive business case of investment in smart intralogistics solution based on AMRs.

## MODULARITY AND INTEROPERABILITY

Truly effective smart intralogistics solution takes more than deployment of smart robots. Essential components of the solution include AMR fleet coordination software (Mulit Robotic System - MRS), simulation environment, and seamless integration with systems governing shop floor operations (MES/WMS/ERP). Well designed smart intralogistics platform enables factory managers to view the intralogistics as a "Plug-N-Play" process component of their manufacturing operations. Such capability simplifies management and improves the organisations potential for comprehensive digital transformation.

# AMR BASED SMART INTRALOGISTICS – READINESS CHECK

## UNDERSTANDING THE MASTER PROCESS & TRANSFORMATION GOALS

Master process – be it a manufacturing or warehousing operation – is the primary context for smart intralogistics. It is critical to understand the future evolution of this process in order to define a vision of smart intralogistics and specify requirements for initial implementation and rollout. AMRs are delivering great performance where processes need to be both efficient and flexible, cargo can be naturally partitioned into "chunks" handled with standardized interfaces (trolley, palette, dolly etc). Among their advantages is the capability to cope with uneven material flows and unpredictable shop floor traffic, etc.

The starting point for readiness check would be to define our rationale for AMR based intralogistics solution:

1. Why do we need new solution for intralogistics. Efficiency? Workforce deficits? Obsolete or inadequate tools, such as expensive forklifts customarily transporting light, standardized cargo over flat surface?
2. What aspects of the master process topology favor AMR-based intralogistics solution? Are there complex relationships or non-sequential transport activities involved?
3. What are the business goals behind the intralogistics transformation? Are they quantized? Is flexibility an essential business requirement?
4. Can the process be broken down into predictable, repeatable activity patterns?

### INADEQUATE TECHNOLOGY
(Expensive heavy load equipment underutilized and relies on human operators)

### OPERATIONAL RISKS & HAZARDS
(Work-related accidents and injuries cost EU €476 billion a year according to 2017 global estimates)

### LOCKED SKILLS
(Skilled workers executing simple tasks)

### LABOUR SHORTAGE
Rising labor shortages in EU/Global Industrial sector

### EFFICIENCY
In production plants and warehouses transport represents over 50% of operations

### TOPOLOGY
- Sequential
- Non-linear (e.g. Packing + Return Handling)
- Complex structure (e.g. 1-N)

### EFFICIENCY
- Are the efficiency requirements stable?
- Is there a significant flexibility required (peaks, patterns)?

### PARAMETRIZATION
- Repeatibility
- Predictability

### CARGO
- Type of Cargo, Volumes, Weight
- Pick-up and Delivery interfaces

## DATA DRIVEN PROCESS DESIGN & EVALUATION

The thorough understanding of intralogistics transformation goals and process patterns allows organization to design and evaluate new processes using modeling and simulation tools. Such data driven approach is often cheaper, faster and less risky than trials and experiments run on the real-world shop floor environment, provided that potential vendors offer such capability. The goal is not to eliminate real-world Proof of Concept or Pilot implementations, but to focus these time consuming, and potentially disruptive activities on well understood and most promising scenarios. Contact VersaBox for more information on our unique VIRTUAL FACTORY™ offering, enabling Data Driven Process Design and Evaluation.

## UNDERSTANDING THE INFORMATION SYSTEMS CONTEXT

A master process is usually automated using a combination of MES / WMS and ERP information systems.
Each of these systems can potentially be an origination point for intralogistics related events (such as material/ component transport request), and each of them can rely on information originating from the intralogistics process (such as cycle completion, or transport availability). Processing of events forms a communication protocol which should be well defined in terms of information content and modes of operation (e.g. synchronous or asynchronous).

Each of the systems – including intralogistics platform – has its own, independent logic which needs coordination/ integration mechanisms with other systems. These aspects can be simplified during the PoC or pilot implementation, but a vision of final architecture of master process supported by intralogistics platform needs to be decided.

1. Partitioning of process logic between systems (what is the responsibility of participating systems for executing and enforcing business rules, information management).
2. Standardization of task execution orders (systems, formats, master data, interfaces).
3. Standardization of coordination protocols (systems, events, modes, interfaces).

## UNDERSTANDING PHYSICAL ENVIRONMENT

When planning to introduce AMR-based intralogistics solution it is important to assess the potential challenges of the physical environment. Some of them can be addressed by combining AMR based transport with other technologies (such as handing over palettes or standardized containers to vertical warehouse transport systems) or integrated through bespoke hardware/software interfaces.

1. Floor plan – is there a necessity to combine or integrate horizontal and vertical transport?
2. Footprint – what are the parts of factory layout that may generate footprint issues (width, height, vs requirements of one-way or two-way traffic).
3. Floor quality – are there any areas on the shop floor which may create traction issues (wet, oily floor, rubble, excessive dirt) which should be addressed by solution or by the factory).
4. Traffic patterns – what are other transport systems and their traffic patterns that should be accounted for by the solution.

## UNDERSTANDING THE WORK SECURITY

Work security is a well-regulated in many geographies and intralogistics is definitely an area where such regulations and standards are understood and defined. Most organizations will have a process of assessing solutions which operate on the shop floor, and this process should be involved when defining solution requirements for smart intralogistics, to understand security and regulatory issues.

1. What are the potential hazard/risks related to AMR operations (overcharging, "traffic accidents")?
2. How are these risks mitigated in the solution design?
3. Which risks will require changes in the operating manuals, safety instructions?
4. How will these risks affect potential liabilities and insurance solutions?

## UNDERSTANDING CYBERSECURITY

It should be stressed that the existing cybersecurity policies often need a thorough reassessment when introducing digital innovations. Existing policies have been defined for solutions which have been intrinsically in-house and implemented proprietary communication protocols. While such approach can usually be extended to cover solutions such as autonomous mobile robots, there are many important benefits of digital transformation which advocate more advanced concepts of solution architecture, based on Industrial Cloud / Industrial Internet of Things:

1. Remote fleet monitoring and preventive maintenance operations by the solution vendor and/or their implementation partners (Value Added Resellers).
2. Remote data collection enabling data driven approach to process management, including benchmarking of intralogistics process by groups of industry peers.
3. Creating composite solutions combining cloud based data sets created by digital automation assets (robots, sensors, IT systems) with cloud based applications, such as using Machine Learning components to create and improve models of manufacturing operations.

For these opportunities to remain open option aligned with the vision of Digital Factory, cybersecurity standards and policies need to be extended to define what a secure Industrial Cloud/IoT means in the context of given business strategy and processes.

## UNDERSTANDING RESKILLING NEEDS

Introducing robotic coworkers always raises questions of the new role for human workers who are currently executing the activities related to intralogistics processes. The general rule is: human roles should migrate from transport task execution (such as manually handling the transport of components) to process control and management. Also, there is an opportunity for technicians capable of maintaining and integrating the fleets of autonomous devices and other elements of intralogistics infrastructure in-house.

Currently solutions such as AMR are implemented by organizations plagued by workforce deficits – workers for intralogistics operations execution are hard to find and retain as these jobs are not considered to be a high quality work offering. Still, a reskilling or upskilling program is an important signal to the employee that intralogistics based on autonomous devices is a career opportunity for those wishing to invest time in their skillset.

1. What are the new roles created by robotic automation?
2. How many workers will be affected by decreased demand for transport execution tasks?
3. How can we provide the reskilling/upskilling service of employees?
4. How will be the reskilling/upskilling plan coordinated with the progress of intralogistics transformation?

# FOLLOWING UP ...

## FURTHER READING

Please stay in touch with VersaBox to access other educational and technical materials by subscribing to VersaBox newsletter at: https://versabox.eu/newsletter/

## CONTACT VERSABOX

VersaBox is a Smart Robotics company that brings together talents of new generation of innovators, software designers and engineers to develop world class, advanced technology solutions for the transforming global manufacturing and logistics.

We put autonomy to work for our clients by implementing Smart Intralogistics platform based on autonomous robotic units. VersaBox solutions fill out the growing human workforce deficits with efficient, intelligent devices and enable productivity improvements through new generation of agile intralogistics processes (Intralogistics 4.0). We achieve this by implementing systems of collaborative autonomous robotic units, orchestrated by an innovative process management platform.

Contact VersaBox when considering an investment in AMR-based, Smart Intralogistics.

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