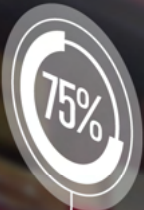




METRICS THAT MATTER

From Automation Software Perspective



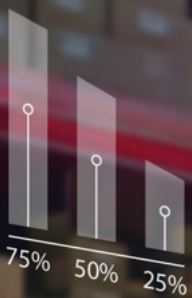
TOTAL
OCCUPANCY



COMPLETED
ORDERS



INPROGRESS
ORDER



AISLE LEVEL OCCUPANCY



DASH BOARD

NO. OF ROBOTS 50

THROUGHPUT 5246
sorts/hr



PERFORMED

IN PROGRESS

START
TASK

PENDING

FROM PAPER TO PAPERLESS

The first step towards automation isn't introducing robots to replace manual handling, but building a system that can support scalable operations. Digitising previously paper based processes opens the door to creating a world class warehousing system. There are simple, intuitive reasons for this shift, so let's address them in this summary itself.

- First, it is easy to lose paper. People do it every day.
- Second, you have to read paper. Reading warehouse documents usually requires searching through a maze of information for just a single line that matters for the transaction at hand.
- Third, people have to write on paper. Again, it is easy to transpose something.
- Fourth, things on paper cannot be communicated in real time. As a result, errors in inventory levels, product locations, task status, and/or order status are not known with real-time reliability, making it difficult or impossible to implement cross-docking and transaction interleaving.
- Fifth, paper is expensive to print, handle and file.
- Sixth, it is easy to damage and smudge paper. Paperless modern warehousing and world-class warehousing go hand in hand.





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EXECUTIVE SUMMARY

Imagine a scenario where a production line achieves its daily target, inventory levels are perfectly balanced and yet the facility is struggling to meet its overall performance. What could be the issue?

As organizations seek to streamline their processes, the integration of advanced software such as Warehouse Management Systems (WMS), Warehouse Execution Systems (WES), Warehouse Control System (WCS), and Fleet Management Systems (FMS) emerges as a vital strategy. These systems contribute to enhanced decision-making capabilities, enabling warehouses to optimize their operations in real-time.

However, access to large amounts of data makes it increasingly hard to keep focus on the real goal.

This question boils down to a choice between global and local optimization strategies. While a balanced approach fosters overall growth, it can also leave some room for specific local enhancements. Similarly, meeting the local metrics without a view on global metrics, which is often a case in contemporary warehousing solutions, could lead to ignorance of business objectives. This equilibrium is vital for maximizing productivity and effectiveness within warehouse operations.

This whitepaper delves into the contrasting approaches of global and local optimization metrics, starting from listing down such metrics for few warehouses. Furthermore, we will also highlight how Addverb's software helps you make this choice and achieve global objectives while addressing localized challenges.

The use of WMS is becoming more frequent in this modern era. As warehouses & Distribution Centers (DCs) become more automated and less reliant on human labor, and as that labor becomes harder to come by and more expensive, software that supports these operations is in high demand.

(McCrea, 2019)



MODERN WAREHOUSE

Key Functions

- Execute a higher volume of smaller transactions
- Handle and store a broader range of SKUs
- Offer extensive product and service customization
- Provide more value-added services
- Process a growing number of returns
- Accommodate an increasing number of international shipments

Key challenges



This increasing complexity places significant pressure on warehouse managers, who must optimize operations while managing constraints. The evolving warehousing landscape highlights the need for advanced technologies, including warehouse management systems, automation, & robotics, to maintain efficiency & competitiveness.

Global vs. Local Optimization

Supply chain management ensures that products reach customers in the right quantity, condition, and time while balancing quality and cost control. Traditionally, a central planner optimizes costs and demand, but modern supply chains have evolved into supply networks with multiple independent decision-makers.

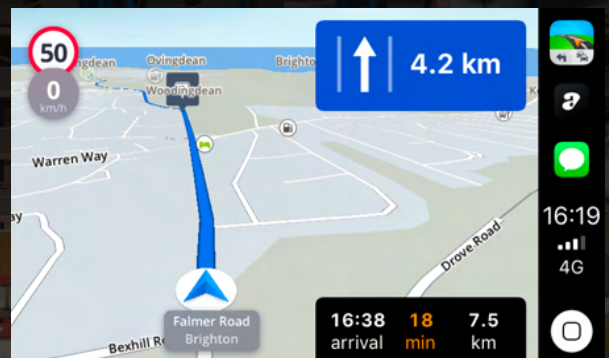
In real-world operations, interconnected suppliers operate with their own priorities and constraints. The supply network approach enhances efficiency by modeling interdependencies, identifying bottlenecks, and leveraging digital optimization. Unlike traditional supply chains, supply networks recognize conflicting objectives and information asymmetry, shifting the focus toward collaborative trade-offs that improve overall logistics performance.

This same principle applies to warehouse optimization, where software-driven decisions must align with the right North Star metric. While efficiency focuses on minimizing resource use, such as reducing travel time or maximizing equipment utilization, effectiveness ensures that these improvements contribute to higher-order business goals like order accuracy, fulfillment speed, and cost-to-serve.

With this in mind, warehouse optimization strategies can be divided into global optimization and local optimization, each differing in focus, objectives, and implementation.



Traffic signals in a town are example of **global optimization**, they seek overall smooth flow of traffic.



Individual car navigation is an example of **local optimisation**, it will find the shortest path to destination.



A 2022 report by McKinsey & Company highlights that large-scale e-commerce fulfillment centers, such as those operated by Amazon, prioritize end-to-end optimization over localized efficiency.

Global Optimization

A Holistic Approach

According to a survey by modern material handling institute, 70% of warehouses and distribution centers report significant technology gaps preventing them from capturing the benefits of data capture innovations.

Global optimization encompasses the synchronization of various processes within the warehouse to achieve maximum overall efficiency. This involves ensuring that every task, ranging from inventory movement to material handling and order processing, is executed cohesively, rather than in a disjointed manner. Research from Supply Chain Digital indicates that implementing a data-driven, AI-powered warehouse system can reduce order fulfillment time by as much as 40%. This reduction is achieved by optimizing material flows throughout the facility, ensuring that resources are utilized in the most effective way possible.



A leading eyewear brand used Addverb's Warehouse Execution System (WES) to streamline order fulfillment. This system provided real-time visibility, helping the company achieve over 98% next-day delivery. This demonstrates how effective software decisions can enhance efficiency.

Key elements of a global optimization strategy include:

Automated Task Allocation

Employing sophisticated algorithms to dynamically balance workloads among different zones or areas of the warehouse, ensuring that no single area becomes overburdened while others are underutilized.

Adaptive Task Prioritisation

Utilizing data analytics to continuously adjust storage locations in real-time, based on current demand patterns and inventory levels. This adaptability ensures that the most frequently picked items are easily accessible.

Seamless Coordination of Material Flows

Fostering effective communication and collaboration between manual and automated handling systems to prevent bottlenecks and improve overall process fluidity.

Local Optimization

The Micro-Level Approach

Conversely, local optimization targets improvements at the micro level, concentrating on specific warehouse functions such as the design of picking zones, storage layouts, and packing stations. This strategy can deliver quick boosts in efficiency and performance, but it may not always align with broader warehouse performance objectives and can lead to isolated gains that do not translate into overall success.



Most of the warehouse inefficiencies stem from ineffective location-based task management. This includes factors such as suboptimal picking paths, poorly configured storage areas, and inefficient robotic movements. While enhancing performance in specific areas can provide immediate benefits, if these improvements are not integrated into a comprehensive warehouse strategy, they can potentially create new bottlenecks and hinder overall operational flow.

Successful Local Optimizations include:

- **Optimized Picking Strategies:**

Implementing various picking methodologies such as batch picking, zone picking, or wave picking to streamline and expedite the picking process.

- **Dynamic Storage Allocation:**

Employing algorithms that adjust storage assignments based on SKU demand frequency, ensuring that rapidly moving items are conveniently located.

- **Localized AMR Routing:**

Utilizing advanced routing algorithms for Autonomous Mobile Robots (AMRs) to improve task execution in areas with high traffic, thus reducing delays and increasing throughput.

The Fallacy Of

Local Optimization without a Global Perspective

Local optimization, when taken as the sole focus of performance improvement, often presents a false sense of efficiency. While it may yield great results in isolated warehouse processes, it overlooks the broader perspective of system-wide coordination.

EXAMPLES WHERE LOCAL OPTIMIZATION MAY FALL SHORT:

PRODUCTION LINE EFFICIENCY

While a production line may be running at peak efficiency, bottlenecks in logistics or inventory management may undermine overall performance.

MAINTENANCE DOWNTIME

Minimal downtime in machinery is a positive KPI, but poor machine scheduling and ineffective utilization may still result in low output.

INVENTORY LEVELS

Perfectly balanced inventory levels may be maintained, but if raw materials are not used efficiently, there could be excess waste and higher operational costs.

This "illusion of efficiency" is why it is essential to integrate local optimizations into a global strategy. Without a holistic approach, warehouses may fail to realize the maximum potential of their operations.



In a study conducted with a leading apparel retailer, inefficiencies in the receiving function of warehouse were identified as a critical bottleneck in their supply chain. During an on-site evaluation of their primary distribution center, it was observed that the receiving dock experienced significant congestion. Upon inquiry, the warehouse manager reported a dock-to-stock time of 96 hours, a figure that was perceived as a benchmark within their operations. However, industry benchmarks indicate that 24 hours is the standard, 8 hours is above average, & a few hours is considered world-class. This discrepancy highlighted a key inefficiency in their operations, impacting inventory turnover & fulfilment speed. The case underscored the critical role of Warehouse Software System & automation.



While local optimization delivers short-term gains, it often creates systemic inefficiencies if not integrated into a global strategy.



A study by Deloitte (Deloitte Insights) indicates that over 55% of warehouses struggle with balancing local efficiency with global coordination, leading to operational disconnects.

- **Storage Efficiency vs. Throughput:**

A perfectly optimized storage system may cause delays if picking routes are not optimized concurrently.

- **AMR Utilization vs. Task Prioritization:**

If Autonomous Mobile Robots (AMRs) are optimized for local efficiency, they might not be available when needed for high-priority tasks elsewhere in the warehouse.

- **Conveyor System Speed vs. Dock Management:**

A high-speed conveyor that optimizes local throughput can create congestion at docking stations if unloading processes are not balanced.

Achieving the Right Balance with Warehouse Software

Warehouse Management System



Inbound

- ASN invoice
- Quality Check
- Put away



Inventory

- Cycle count
- Bin to bin
- Replenishment



Outbound

- Order management
- Wave/waveless planning
- Picking / consolidation / dispatch



Integration

- ERP
- OMS
- TMS
- Dock & yard management



Reporting

- Dashboard
- Productivity
- Labour Efficiency

Warehouse Execution System



ASRS

- Put away optimisation
- Retrieval workload balancing
- Compaction Storage Optimisation



Conveyors

- Routing optimisation
- Divert request & confirmation
- Exception routing



Picking

- Pick path optimisation
- Multi-modularity picking lights/voice GTP/scanners
- Bin picking



Sortation

- Automated put wall consolidation
- Dynamic order assignment
- Sortation Optimisation



Orchestration

- Integrates different automation subsystems
- Reporting & operational analysis
- Error handling and recovery

Fleet Management System



Fleet Manager

- Health management
- Mission Management
- Operational Control



Path Planner

- Obstacle avoidance
- Dynamic path planning & assignment
- Load balancing



Task Manager

- Task control dashboard
- Task status management
- Reporting analytics



Battery Manager

- Opportunistic charging
- Optimised charge cycle management
- Battery health



Stimulation Stat.

- Average vs peak demand simulation
- Operational training module
- Throughput & efficiency calculation

Warehouse Control System



Devices Integration

- Communication & translation layer
- Device/MHE agnostic
- Error handling & reporting



Sensing & Scanning

- PLCs
- Scanners
- Sensors



Devices

- Shuttles
- Lifts
- RGVs
- Automated Put wall sortation
- PTL/PBV
- Printers



Connecting Layers

- Bluetooth
- Socket connection
- OPC protocol
- REST API based integration

ACHIEVING THE RIGHT BALANCE:



According to Harvard Business Review, "While (artificial intelligence) AI will radically alter how work gets done and who does it, the technology's larger impact will be in complementing and augmenting human capabilities, not replacing them."

To ensure both global and local optimization, Addverb's software suite integrates real-time intelligence, predictive analytics, and automation coordination. This enables:

Seamless Warehouse Synchronization

Ensuring localized improvements align with broader efficiency goals.

Real-Time Optimization

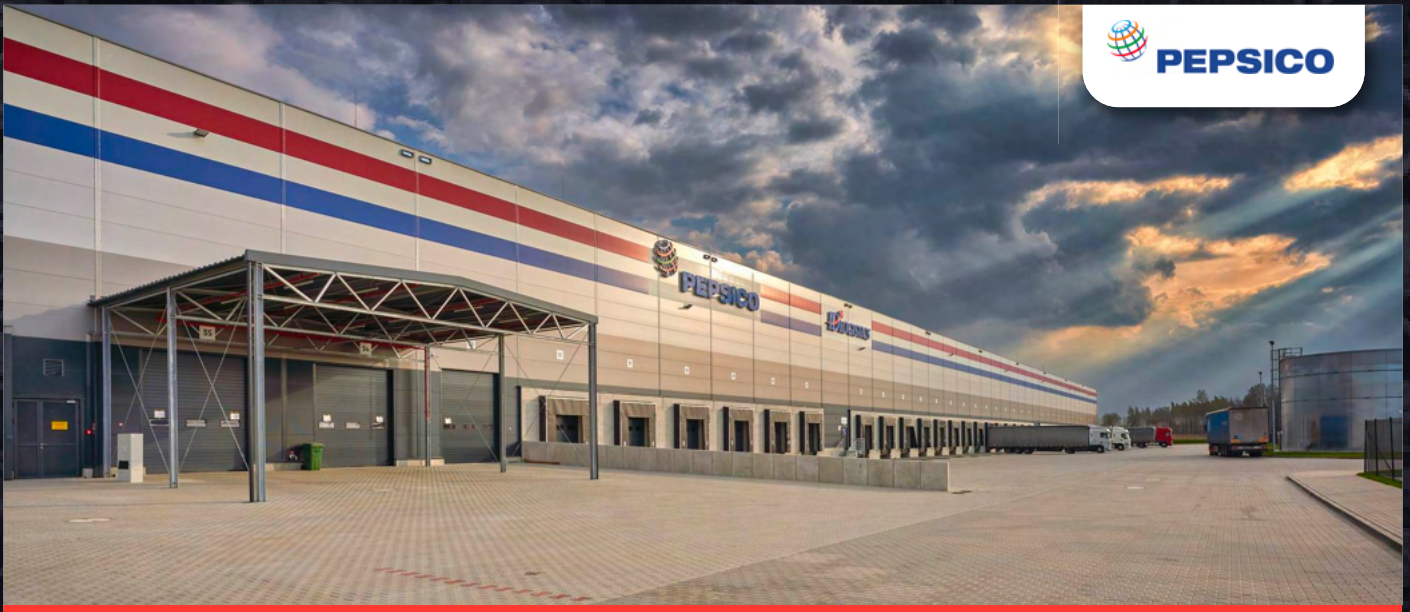
Using AI-driven analytics to adjust operations dynamically.

Scalability and Adaptability

Allowing warehouses to evolve with changing demands.

By leveraging these advanced capabilities, Addverb enables warehouses to achieve a harmonious balance between local efficiencies and global optimization.

Approach for Business Metrics through real-life CASE STUDIES



PepsiCo planned to build its largest automated warehouse in India to manage end-to-end inventory flow within a constrained 36,000 sq. ft. footprint. The primary challenge was to enable high-volume case picking, mixed-SKU (rainbow) pallet formation, and efficient space utilization, while moving away from manual processes. Addverb implemented a hybrid automation solution featuring crane-based ASRS for slow movers and a multi-level Mother-Child shuttle system for fast movers powered by Warehouse Execution System, Concinity. The warehouse is built to achieve a system throughput of 300 pallets per hour, with 32 rainbow pallets (600 cases) formed hourly through 60 grabs across seven pick lines. With 9,000 pallet positions across 2,000 bays and an average inventory retention of less than seven days, the site supports 248 pallet movements per hour.

LOCAL METRICS

- Turn table cycle time
- Crane speed
- Mother-child Shuttle retrieval time
- Picker accuracy
- Aisle congestion rate
- Pick-to-light response lag
- Manual intervention frequency

GLOBAL METRICS

- Overall storage density
- Rainbow picking efficiency
- Inventory turnover
- System throughput
- Order batching cycle time
- SKU-wise velocity dispersion
- Dock turnaround synchronization



Volvo sought to improve parts availability anytime, anywhere, prompting VE Commercial Vehicles Limited (VECV) to expand the VE Parts Distribution Centre (VEPDC) for better traceability, accuracy, and order-to-delivery times, enhancing customer satisfaction and operational efficiency. Addverb implemented an automation solution with an ASRS featuring three stacker cranes, 5,700 pallet positions, and 630 ground positions, supporting 15–21 days of inventory and 60 order pickings per hour. The Multi-Level Shuttle System (MLS - Medius) managed six days of inventory with 23,040 tote positions and 100 buffer positions. An integrated conveyor system and Warehouse Control System (WCS) optimized storage and synchronized operations. The result was a 60% increase in daily order lines, from 6,000 to 10,000, with four Goods-to-Person (GTP) stations handling 15 order totes at once. Key gains included 131 pallets per hour (ASRS), 983 totes per hour (MLS), and 414 order lines per hour, improving dispatch accuracy, reducing truck turnaround time, and boosting productivity.

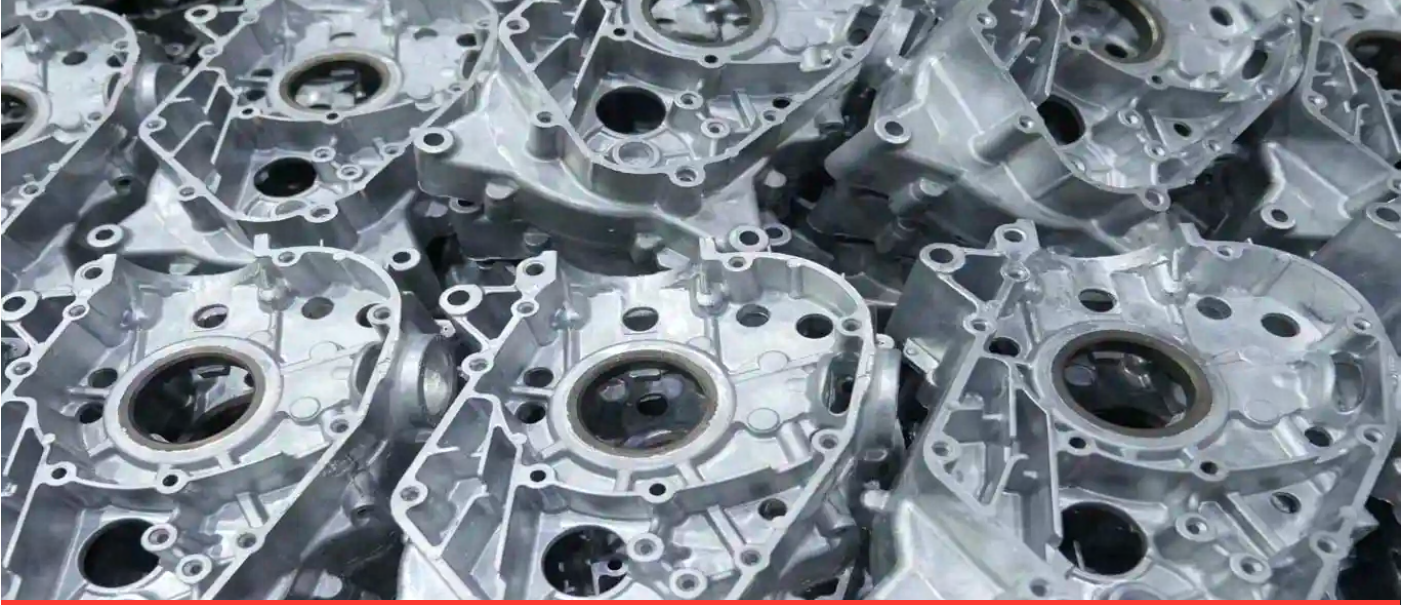
LOCAL METRICS

- Order line starvation at GTP slot
- Tote decanting time
- Crane/shuttle utilization/reliability (MTBF/MTTR)
- Worker agility at picking station and decanting station
- Fast mover retrieval time
- Pick path overlap
- Manual repick rate
- Slotting accuracy
- Station dwell time

GLOBAL METRICS

- Order closure time
- Inventory storage density/turnover
- Overall picking throughput
- Inventory accuracy
- Order fulfillment cost
- Energy usage per order
- Cycle count frequency
- Automation system uptime

AUTO COMPONENTS PLAYER



A leading aluminium die-casting manufacturer in Chennai, faced material handling and storage inefficiencies due to reliance on forklifts for moving semi-finished (SFG) and finished goods (FG), leading to bottlenecks, errors, and safety risks. To resolve this, the company implemented Automated Storage and Retrieval Systems (ASRS) and Autonomous Mobile Robots (AMRs) in phases. Initially, 30 AMRs automated pallet movement, with more to follow. A WIP ASRS with 2,070 pallet positions was set up for SFG, and an FG ASRS with 1,240 pallet positions for FG, both using vertical storage and automated cranes. This automation significantly improved efficiency, reduced manual effort, and boosted throughput processing 42 pallets/hour in the FG ASRS, 54 pallets/hour in the WIP ASRS, and up to 94 filled pallets/hour with the AMR-Dynamo1000.

LOCAL METRICS

- Dynamo movement reduction (based on optimized park spots)
- Worker idle time in casting cells and machine shops
- Crane/Dynamo utilization & reliability
- Zone congestion frequency
- Pallet staging delay
- Manual intervention incidents
- Pick error rate
- AMR battery swap rate

GLOBAL METRICS

- Order lead time
- Storage capacity
- Overall site throughput in terms of WIP casting and machined boxes output
- Energy consumption per move
- Equipment downtime
- Average inventory age
- Carbon footprint per pallet moved
- Cost per order fulfilled

Add Intelligence to your warehouse

- **One system, multiple faces**

Addverb's software suite offers a comprehensive solution for warehouse, distribution, & manufacturing companies by consolidating their WMS, WES, WCS, and Fleet management operations onto a unified platform. This centralized approach streamlines processes, improves operational efficiency, and enhances visibility and control over the entire supply chain. With Addverb's software suite, organizations can effectively manage and optimize their warehouse, automation systems, and fleet of mobile robots, leading to improved productivity & streamlined operations.

- **Single platform or A la carte**

Addverb's automation software is an AI-driven and feature-rich solution that serves as the backbone for streamlining the entire operation of clients. It caters to a wide range of scenarios, including greenfield and brownfield operations, providing the flexibility to centralize the entire operation or selectively integrate specific modules to create a highly configurable platform. With 100% integration agnosticism, elasticity, and versatility, Addverb's software platform is intuitive, modern, easy-to-use, and easy-to-train on.

- **One platform multiple layers**

Addverb's software platform combines the latest modern layers for WMS, WES, WCS, and Fleet Management, providing clients with the capability to seamlessly integrate their existing hardware or software requirements with our platform. The software suite offers a feature-rich and interoperable solution, enabling you to configure, simulate, optimize, and analyse your warehouse operations. With Addverb's single-platform software, you can digitize your entire warehouse to meet market demand and scale as required, leveraging advanced functionalities and ensuring a streamlined and efficient operation.



How

Addverb's Software Suite

Enables Global Optimization

Addverb's software suite provides a comprehensive solution that optimizes warehouse operations both globally and locally. Key features include:



According to world class warehousing and material handling, maintaining healthy storage utilization helps to enforce healthy inventory management. In our early work with Honda, the company's warehouse space utilization was more than 98 %. When it came time to implement a new warehouse management system, the warehouses were so full that there was no room to move product to create the space needed to relabel and reconfigure racking to accommodate the new system.

- **End-to-End Integration:**

Addverb's suite, including Optimus WMS, Concinity WES, Mobinity WCS, and Movect FMS, ensures seamless coordination across all warehouse functions. This integration enables the system to optimize global metrics such as turnaround times and storage utilization.

- **Real-Time Updates:**

Addverb's software offers near real-time operational updates, enabling managers to quickly identify and address bottlenecks, ensuring smooth warehouse operations.

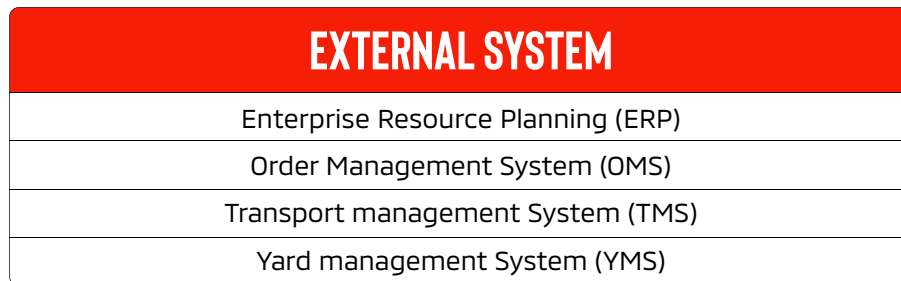
- **Task Management and Scheduling:**

By utilizing priority-driven scheduling, Addverb's software ensures optimized task allocation. Movect FMS, for example, ensures that robots are assigned tasks based on overall warehouse needs rather than focusing on individual performance metrics.

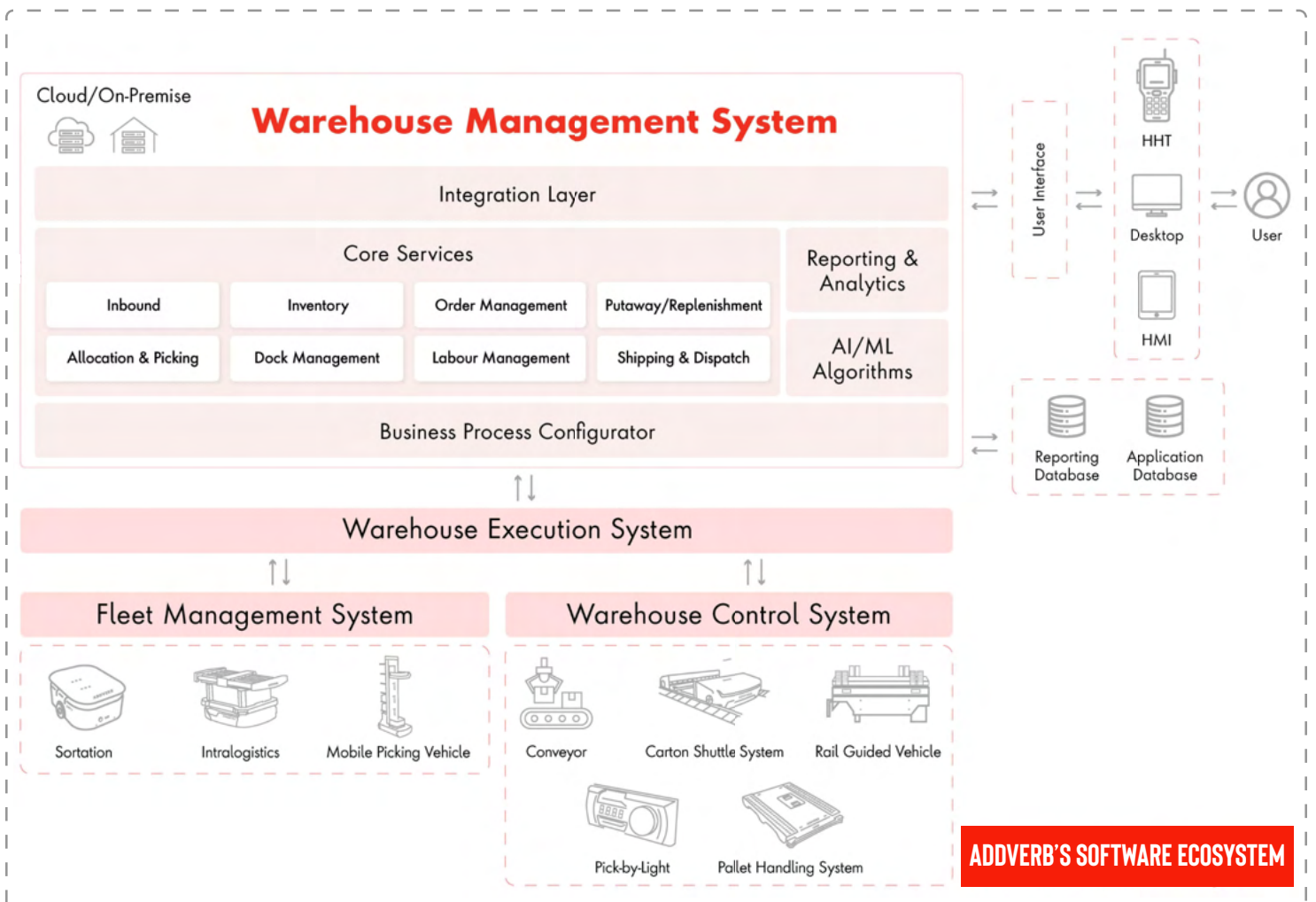
- **Scalability:**

Addverb's software solutions are scalable, which means they can adapt to the evolving needs of warehouses, making it easier to integrate new technologies and processes as they become available.

Addverb's approach goes beyond individual KPIs to enhance overall operational performance. By focusing on optimizing global metrics and integrating both local and global strategies, Addverb's software suite ensures that warehouses operate at peak efficiency.



↕ API Integration ↕



CONCLUSION

Global and local optimization must work in tandem to maximize warehouse efficiency. While local optimizations enhance specific processes, they must align with global strategies to prevent operational bottlenecks. Addverb's software suite ensures that warehouses maintain this critical balance, enabling seamless integration across all operational levels.

Global and location optimization are two sides of the same coin. While local optimization targets specific areas for improvement, global optimization ensures that all warehouse processes are aligned for maximum efficiency. Addverb's software suite plays a crucial role in bridging the gap between these two approaches, ensuring seamless coordination and integration across all warehouse functions.

By leveraging a combination of WMS, WES, and FMS, warehouses can achieve a comprehensive optimization strategy that drives overall efficiency, reduces costs, and enhances throughput. This holistic approach positions warehouses to not only meet current demands but also adapt to future challenges, ensuring sustained success in a dynamic market.