3 QUESTIONS TO EVALUATE

Warehouse automation for vertical space utilization

Demands of the new age consumer are spurring global retailers to explore modernized supply chain business models for customer retention

Retail strategies like same-day delivery, try-before-you-buy, BOSS/BOPIS, coupled with newer fulfillment formats like dark stores, micro-fulfillment, curbside pick-ups, in-store fulfillment are just some of the business models that have squeezed businesses between customer promises and margins. On the other hand, a growing labor scarcity continues to be a looming threat for the warehousing and supply chain industry. This twin-sided pressure has put retailers in a tight spot where they must take immediate decisions on their fulfillment automation strategy for staying competitive.

The goods-to-person (GTP) automation is one of the most popular innovation areas for fulfillment efficiency since decades. However, high CAPEX, legacy "fixed automation" systems such as AS/RS systems, Carousels, Vertical Lift Modules (VLMs), Automated Guided Vehicles (AGVs) etc., are falling short of future–proofing fulfillment operations in a world where critical operating parameters like SKU profiles, popularity classification, channel mix, and peak factors do not follow fixed rules anymore.

This is where Autonomous Mobile Robots (AMRs) offer a key advantage because their inherent flexible architecture can complement the real-time decision-making capabilities of cloud native software orchestration, which is crucial for building supply chains that are omnichannel, agile and future-proof.

In addition to flexibility, storage density through vertical space utilization has emerged as a critical parameter for evaluating fulfillment automation - a capability which multi-shuttle AS/RS systems have been traditionally good at. However, modern innovations in the AMR category have led to an emergence of Vertical AMRs (also known as shuttle AMRs) that provide an excellent combination of the flexibility of AMRs and the height utilization capabilities of multi-shuttles.

So, what should you keep in mind to evaluate different fulfillment automation technologies for vertical space utilization?

We have made it simple for you - just 3 questions to help you evaluate the right automation technology for the best utilization of vertical space with flexibility and without compromising throughput

1

Does it complement your future fulfillment needs?

Truly omnichannel supply chains are enabled by minimizing dependence on fixed A/B/C classifications and by always having all SKUs accessible by all channels. This can be possible only by a connected and agile supply chain network which is governed by cloud native and real time software orchestration capabilities, coupled with flexible automation like Vertical AMRs. Since the architecture of Vertical AMR systems enables the robots to autonomously navigate horizontally and vertically to every storage location, irrespective of aisle and height, the software orchestrator is enabled for maximizing inventory in motion and adapting to changing order profiles and channel mixes in real-time.
(Refer Figure 1)

On the other hand, the fixed nature of multi-shuttle storage systems, featuring in-built aisle rails for carrier shuttle movement, normally restricts horizontal and vertical shuttle roaming. (Refer Figure 2). Hence, Multi-shuttle systems can be slower to adapt to dynamic SKU popularity and changing channel mix compared to Vertical AMRs. Though multi-shuttle systems can adapt to changing units per line or lines per order, they work well in situations with stable SKU pareto curves and pre-defined channel mixes.
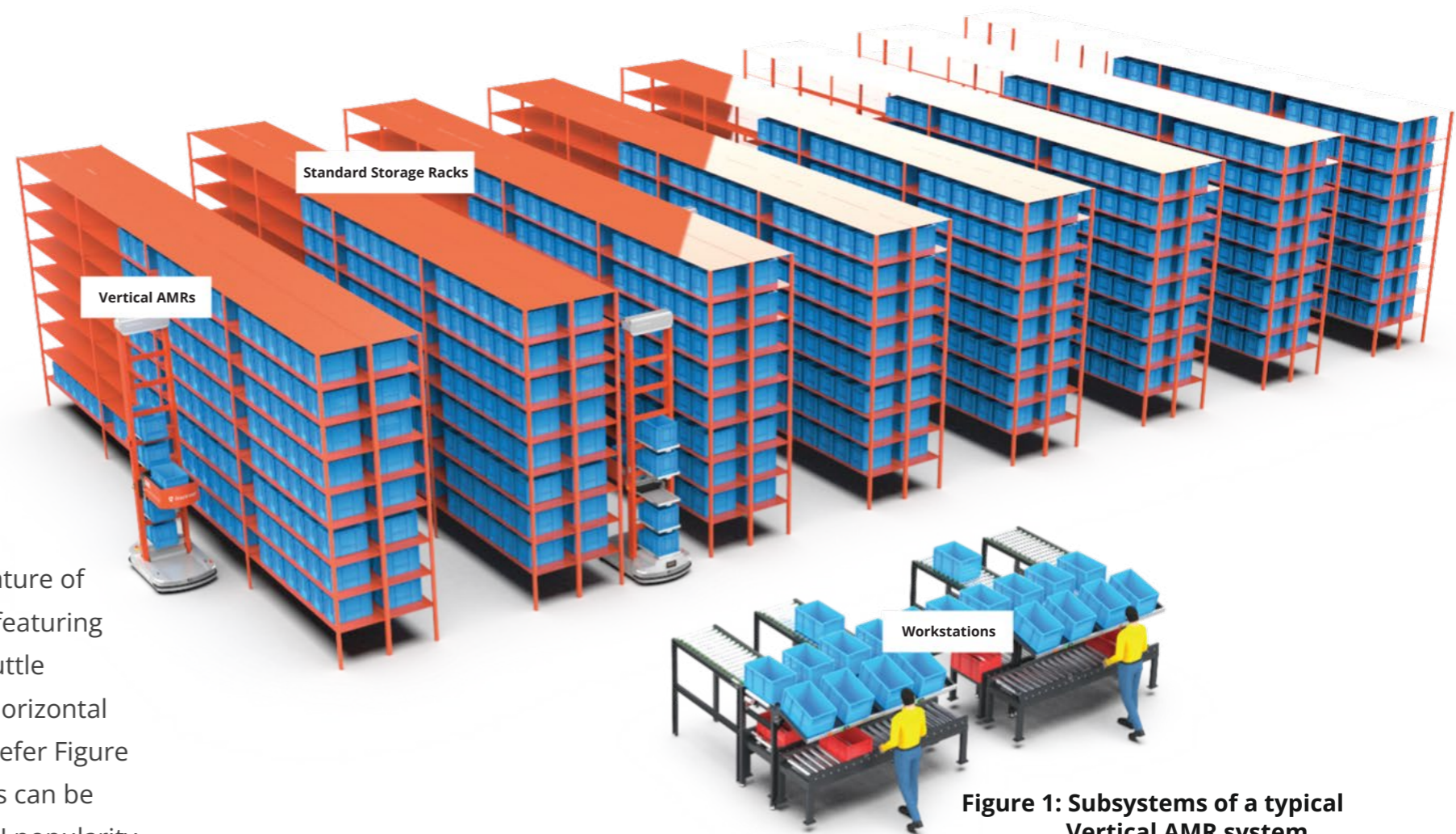

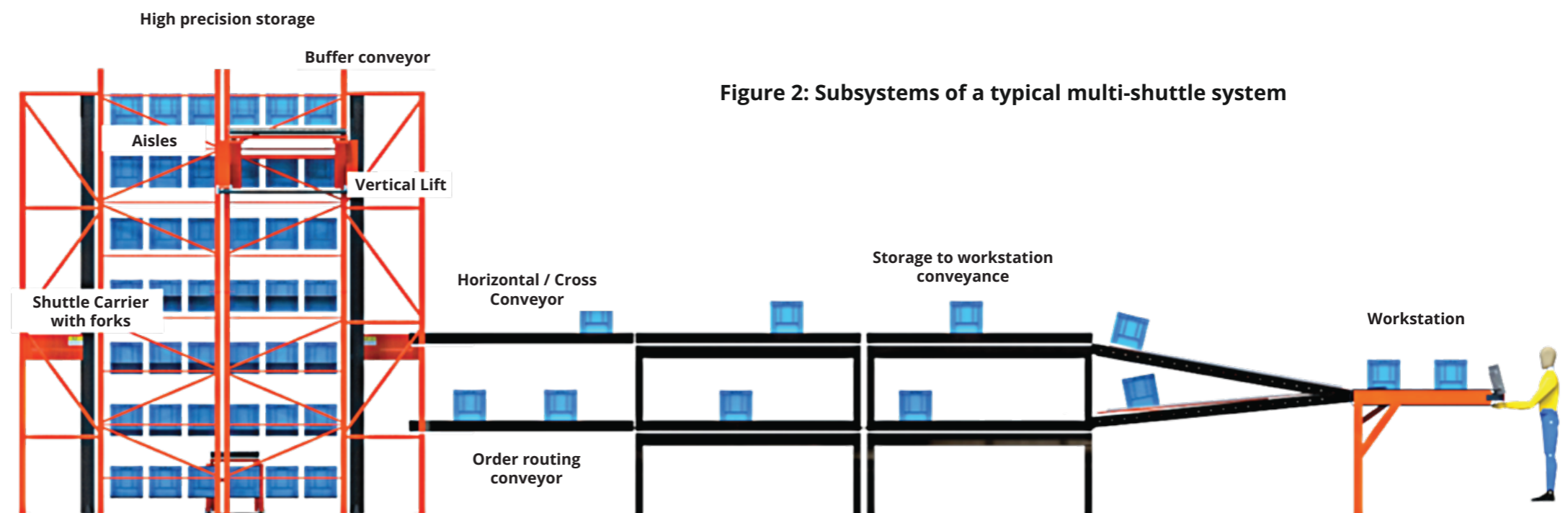**Figure 1: Subsystems of a typical Vertical AMR system**

Figure 2: Subsystems of a typical multi-shuttle system

2

Does it balance high storage density with high throughput?

Multi-shuttle AS/RS systems can deliver a very high throughput because they have an inherent advantage of high shuttle speeds of ~4m/s and they obviate carrier charging times through busbar-powered fixed rails. On the other hand, cube AS/RS systems can offer some of the highest storage densities by eliminating aisles. However, the high throughput and storage density come at the cost of reduced storage bin flexibility and, in the case of cube AS/RS systems, at the cost of order preparation times due to 'bin digging'. Bin digging can result in a reduction in effective storage due to space needed for partially picked orders and bin re-arrangements.

As industrial real estate costs hit record highs, a compromise on warehouse storage density or flexibility for high throughput is not something retailers or multi-retailer 3rd party logistics (3PL) players would ever want to make. The need for storage efficiency is amplified amidst the ongoing disruptions in global trade and logistics that is driving the need for onshoring "safety stock" inventory. This is resulting in a surge in space take-up by 3PLs and e-commerce players, especially for bolstering urban logistics with faster delivery times. As of June 2020, asking industrial rents in the US had averaged 6.8% annual growth and this trend is expected to continue in 2021-22, as per CBRE. Similar trends are predicted by CBRE in the EMEA region, thus establishing the increased premiums on floor space and the value of cube utilization in global fulfillment nodes.

Vertical AMRs play a great balancing role between throughput and flexible space utilization. They can reach heights of up to ~35 feet with telescopic mechanisms (without the use of mezzanines or vertical transportation lifts), handle variable dimensions of totes and / or cartons and even manipulate inventory with irregular form factors through forklift mechanisms.

INCREASED PREMIUM ON SPACE HAS MADE **EFFECTIVE CUBIC UTILIZATION** A CRITICAL FACTOR

By combining the storage density capabilities of multi-shuttle and cube AS/RS systems without compromising on throughput and flexibility, they present an interesting choice for future-proof GTP automation, especially in the sweet spot of micro fulfillment facilities and other fulfillment nodes which are set up in existing urban retail facilities (dark stores / back store fulfillment etc.). Refer Figure 3.

Figure 3: Comparison of throughput and storage performance of the most common fulfillment technologies for vertical height utilization

	Vertical AMR system	Mobile Shelf AMR system	Cube Storage shuttle systems	Multi-shuttle systems
Throughput/sq.ft.	**High** (Independent of order profiles, no order prep times)	**Low-Medium** (Dependent on picks per face optimization; high area utilization)	**High** (Dependent on pre-defined order profiles & order prep times)	**High** (Dependent on pre-defined order profiles)
Storage/sq.ft.	**High** (All locations available for active inventory)	**Low** (Limited height utilization)	**Very High** (But reservations needed for bin digging)	**High**
Storage flexibility	**High**	**Very High**	**Low**	**Medium**
Flexibility to adapt to order profile changes	**High** (All bots access all locations)	**High** (All bots access all locations)	**Low** (Needs bin digging & additional order prep time)	**Medium** (Limited aisle roaming, needs defined A/B/C classifications)

3

Does it enable ease of expansion & maintenance and workplace safety?

Vertical AMRs and Multi-shuttle technologies can be broken into two broad categories of sub-systems:

1) **Inventory storage**
2) **Inventory moving (AMRs in case of Vertical AMR system and Shuttle Carriers in case of Multi-shuttle systems)**

The autonomous mobile robots in the Vertical AMR technology encapsulate a power supply, a vertical conveyance mechanism, a ground navigation mechanism, and an inbuilt load handling carrier with telescopic forks, all of which is on board the bot itself. (Refer figure 4) This effectively relieves the inventory storage system of all moving parts, making it akin to standard racks that are devoid of electrically powered busbars or high precision rails found in multi-shuttles and related technologies.

The low complexity in the inventory storage of Vertical AMR systems enables a faster installation time and easier field expansion due to the low setup time of the racks. Maintenance is primarily restricted to the AMRs because the inventory storage does not have in-built moving parts. The AMRs themselves can be individually isolated for preventive and breakdown maintenance, without aisle downtimes and are easy to induct in a new field. This gives Vertical AMR systems an edge in terms of installation times, maintenance, and expansion.

Another significant impact of Vertical AMR inventory storage systems is the comparatively low risk of fires originating within the racking structure itself due to the absence of electrically powered components. Fires within the dense vertical inventory storages can be hard to access hence powered busbars and moving parts in the racking can attract high insurance costs. Overall, fire safety is a critical factor in choosing an automation technology that must be holistically evaluated from the lens of local regulations and should consider the height of storage, cost, and suitability of different fire suppression systems as well as levels of flammable inventory in the fulfillment center.

Figure 4: A comparison of component locations in Vertical AMR and Multi-shuttle systems

	Vertical AMR system	Multi-shuttle systems
Vertical Lift	Onboard AMR	Within Storage
Power supply	Onboard AMR	Within Storage
Horizontal navigation / conveyance	Onboard AMR	Within Storage
Buffer conveyance	Onboard AMR	Within Storage
Telescopic fork	Onboard AMR	Onboard Multi-shuttle carrier

Vertically Mobile Lift

Power Supply (Battery)

Ground Navigation Module

Figure 5: Components of a V-AMR bot

Get started with GreyOrange

GreyOrange is the leading omnichannel fulfillment platform that gives companies choice, flexibility, and resilience in driving digital supply chain transformations. The GreyOrange fulfillment platform gets the right product to the right person at the right time. GreyOrange gives organizations a competitive advantage by increasing productivity, empowering growth, and scale, mitigating labor challenges, reducing risk, and getting to market faster while also creating better experiences for customers and employees.

The **GreyOrange Fulfillment Platform** orchestrates data, resources, and processes in real time. With 99.9% accuracy up to 5x faster, this platform is designed to manage a large and wide variety of inventory. Shoppers can choose from millions of items, order what they want, all in one place, and have it delivered the next day or faster. The platform stores and retrieves inventory, bringing it to team members and guiding the process of picking and packing orders. Team members enjoy an enhanced work environment, greater safety, and the opportunity to upskill through working with technology.

GreyOrange Vertical AMR solution, the Ranger™ TTP (Tote-To-Person) is leading the innovation in flexible automation by developing a hybrid multi-robot field where oversized or overweight inventory can be stored on mobile storage units under vertical tote/carton racking. This hybrid storage can be serviced by different types of Goods-to-Person AMRs on the same instance of GreyMatter – the brain of the GreyOrange Fulfillment Platform.

Next Steps

What **works for you** works for us

Have a Deeper Conversation
Let's set up a call or virtual conference to explore more specifically how we can help you achieve your goals

Connect Us
Introduce our experts to those on your team who might want to know more

Show Us Your Site
We'll come to your DC to evaluate how you can improve operations with us

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