



# Warehousing 4.0

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# INTRODUCTION

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Warehousing, as a concept, goes back to biblical times, when farmers needed to store their produce that was beyond the daily market needs. Ackermann relates the story in the Book of Genesis (Chapter 14) where Joseph becomes a hero in Egypt for teaching them the concept of warehousing food surpluses for consumption during famines. Whether it be the Venetian trade routes or ones along the Silk Road, places of storage, usually as hubs, played an important role in the conduct of business.

As mentioned in Haksöz et al, cross-docking was an essential part of the old Silk Road where goods were never stored, but rather staged for short periods of time, at the hubs, waiting for the next caravan.

In essence, warehousing was a normal part of the supply system that took care of temporal imbalances of commodities traded. Fast forward to the current environment, warehousing is still an essential part of supply chain management but has become more sophisticated in function and capabilities demanded.

In general, warehousing serves the following functions (in no particular order of importance):

- a) Support supplies for production
- b) Storing parts to permit product flow, as in batch production
- c) Facilitate next stage consolidation of different products from different suppliers or different products from same supplier to fulfill internal or external customers in the supply chain
- d) Staging area for final packaging or finishing before shipment
- e) Supporting direct sales or MRO/after-sales service

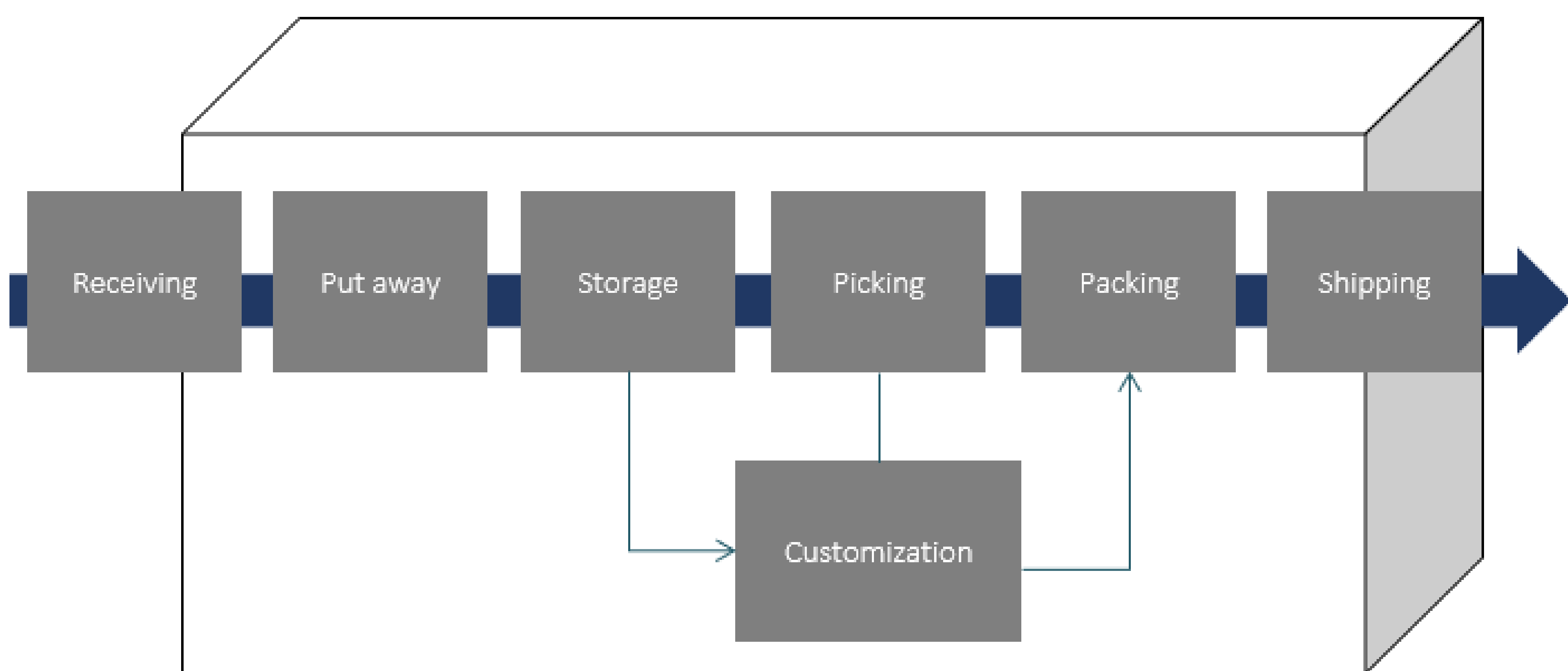
The various activities within the warehousing function include:

- i) Receiving of goods
- ii) Compactly and efficiently storing of goods
- iii) Inventory management of goods stored

- iv) Order fulfillment, including picking, final processing and preparing shipment
- v) Loading of finished goods to be shipped onto transportation modes, be they on pallets or in containers to be carried in trucks, boats, ships, trains etc.

\*See Figure 1 for visual representation

Figure 1.



Final transportation and delivering of goods to customer may or may not be part of the warehousing function, and may belong to the logistics service but they are part of the services (including the warehousing part) offered by distribution companies.

Warehousing as a business operates in several ways: as private warehousing controlled by one owner/manufacturer for their own goods or as public warehousing where the owner services several customers either via long-term leases or short-term contracts.

Even households have started to use warehousing services during times of transition between locating in different cities/countries or between renters.

# CURRENT STATUS IN THE U.S.

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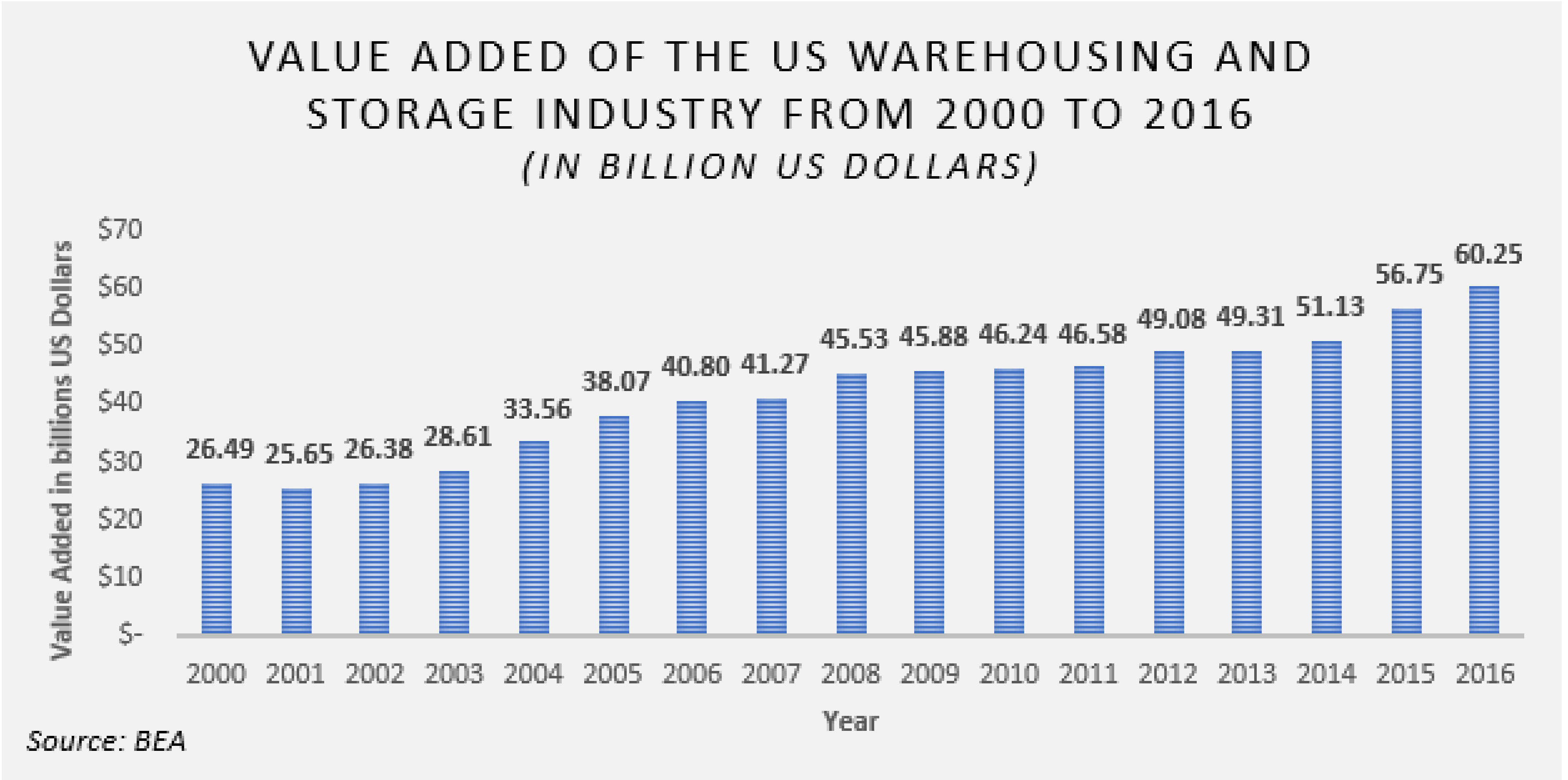
Warehousing and storage in the United States is currently a \$24 billion industry employing over 800,000 people plus another \$9 billion and 110,000 employees handle order fulfillment in this major industry. General warehousing accounts for about 55 percent of industry revenue; refrigerated warehousing for 15 percent.

Almost 10,000 U.S. businesses take part in this industry, organizing and directing the flow of hundreds of millions of dollars’ worth of merchandise per year. The 20 largest companies control less than 30 percent of the market. The industry is highly labor-intensive: average annual revenue per employee being \$30,000.

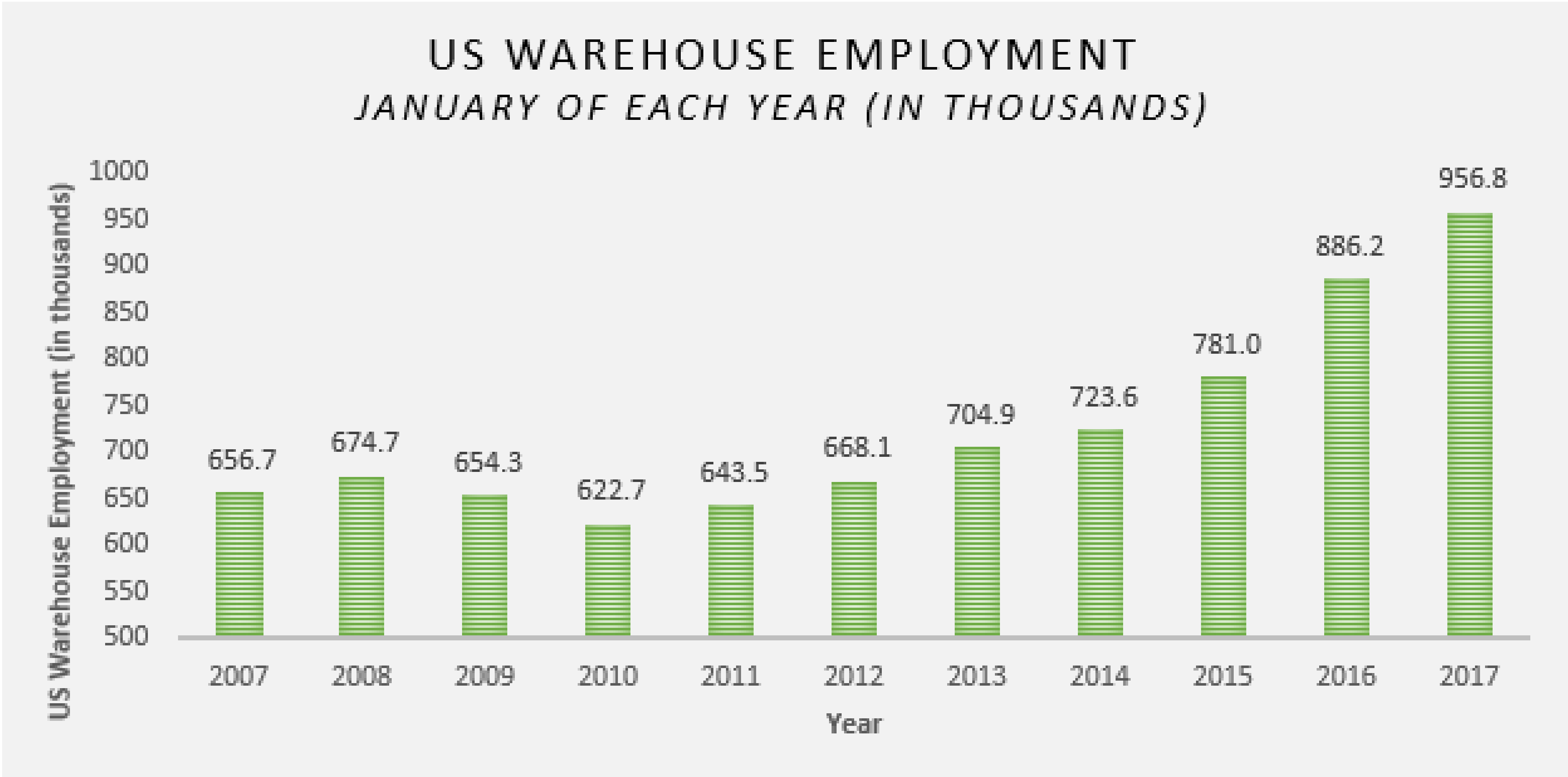
## 2017 Q1 BREAK DOWN IN THE U.S

Property Use	Total Stock (sq. ft.)	Total Vacancy	Total Availability	YTD Net Absorption (sq. ft.)	YTD Construction Deliveries (sq. ft.)	Under Construction (sq. ft.)	Q1 2017 Avg. Rent
Warehouse & Distribution	9,281,914,801	5.5%	8.1%	51,233,828	43,953,894	190,785,901	\$ 5.23
Manufacturing	3,196,473,421	4.9%	6.6%	7,053,341	2,059,913	15,862,396	\$ 5.20
Special Purpose	68,734,194	3.4%	5.1%	129,803	115,415	73,000	\$ 11.30
Totals	12,547,122,416	5.3%	7.7%	58,416,972	46,129,222	206,721,297	\$ 5.25

KEY FIGURES & BASIC STATISTICS - USA



KEY FIGURES & BASIC STATISTICS - USA



Warehousing management has transitioned slowly but surely from a manual clip board operating environment to automation at different nodes within the warehouse and across the network. Over the last few decades, warehousing has been impacted by the adoption of technological improvements to optimize operations and improve inventory management performance:

- Warehousing management software (WMS), moving it from being paper-based to software based.
- Bar-coding technology and radio frequency identification (RFID)
- Voice-recognition technology
- Use of automated storage-retrieval system (AS/RS), and robotics

Historical data indicates growth in warehousing needs with limited availability and increase in construction.

## FUTURE MAJOR TRENDS

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Technology is leading to faster processing, cheaper storage and faster internet connectivity. It has opened up opportunities in smaller and cheaper components, wireless connectivity leading to Internet of Things, cloud computing, and big data analytics. These technological advancements have led to shared economies with exponential scales like Uber and AirBnB type models.

What is shared economy and what does it mean for Warehousing?

The Sharing or Peer Economy arises from the possibility of faster and cheaper computing with access to big data, thus creating platform technologies where the traditional models of assets are shared vs owned. In past, businesses have tolerated the lower capacity utilization of assets that they own.



Revolutionary new business models in the shared economy have been globally proven by companies like Uber and Airbnb, leading to developing trust between the asset provider and the customer. Uber and Airbnb provides the independent platform technology that creates the network of buyers and sellers.

These companies were able to succeed as they:

- Developed sophisticated platform to play the role of the bridging the market for the asset deployed
- Attract a large number of participants on both sides of the market (i.e. buyers and sellers); these roles can change in the context of a transaction i.e. buyers can become sellers and vice versa
- Provide ease of use along with search and matching algorithms per user needs
- Opportunity to complete a transaction with safety and reliability with a click of a button
- But most important: build trust based on a review system, providing a platform for both buyers' and sellers' evaluations that the future market can use for its decision making process

As the need for warehouse increases, the static planning and Capex approach of traditional business model would lead to more investment while the warehouse operations would operate at an average of 70% utilization.

With the technology growth that has enabled business models like Uber and Airbnb, clearly, warehousing space is an asset that can take advantage of the shared economy and unlock the potential for unused capacity of space in existing warehouses.



# TECHNOLOGY IS HERE TO STAY

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Cloud computing, big data analytics, and machine learning have kicked off platform technology and Amazon is one of the key players in the supply chain domain. Warehousing is starting to emerge with platforms like Warehouse Exchange (<https://www.warehouseexchange.com/>) creating a market for unused warehouse capacity. Sellers can describe capacity available with all its defining configuration characteristics such as space available, storage type (bulk/pallet/full case/split case etc.), and storage layout (open, racking, dedicated rooms, secured rooms, refrigerated etc.) to attract buyers. The shared economy is here to stay and so are the platform technologies that enable it.

Several exciting and emerging trends will change the mature warehousing industry. For example, let's consider Industry 4.0/Internet of Things (IoT). Industry 4.0 is a catchall name being given to all things digital in the manufacturing world, including digitization and automation of products and processes.

The key revolution here is in the design of all equipment, machines and products with sensors built in that can communicate amongst themselves seamlessly via the Internet. The design principles that underlie this transformation include:

- i) Interoperability
- ii) Information transparency
- iii) Decentralized and intelligent (using artificial intelligence) autonomous decision-making
- iv) Decision-support for human beings where autonomous decision making is not possible or advisable.

While Industry 4.0 refers to connecting everything involved in a manufacturing environment, IoT refers to connecting everything involved with human systems, be they household appliances, transportation equipment, healthcare devices etc. An example of this is Amazon's Alexa, which is internet-connected and can support the owner to query the internet, place purchase orders, etc. Mobile capabilities, prospect of mass customization, predictive analytics and deep learning (e.g. IBM's Watson), cloud computing and 3-D printing have all provided the opportunity to radically disrupt existing supply chains and business models.

Warehousing 4.0 will need to innovate warehousing-related technologies as well as warehousing management to adapt to this world of IoT and Industry 4.0, both as part of the evolving manufacturing supply chain systems as well as for the “digital consumer” warehousing needs.

It is clear that warehouses are key assets in the new shared economy. Opportunities await those who can intelligently adopt the mentioned technology trends above and apply them to 21st century business applications.



# REFERENCES

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[1] Kenneth B. Ackerman, **Practical Handbook of Warehousing**, Chapman & Hall (Materials Management/Logistics Series) 4th Edition, Springer Science + Business Media Dordrecht, 1997

[2] Çağrı Haksöz, Sridhar Seshadri, Ananth V. Iyer, **Managing Supply Chains on the Silk Road: Strategy, Performance, and Risk**, CRC Press, Taylor and Francis, 2011