

FORRESTER®

The Total Economic Impact™ Of AutoStore

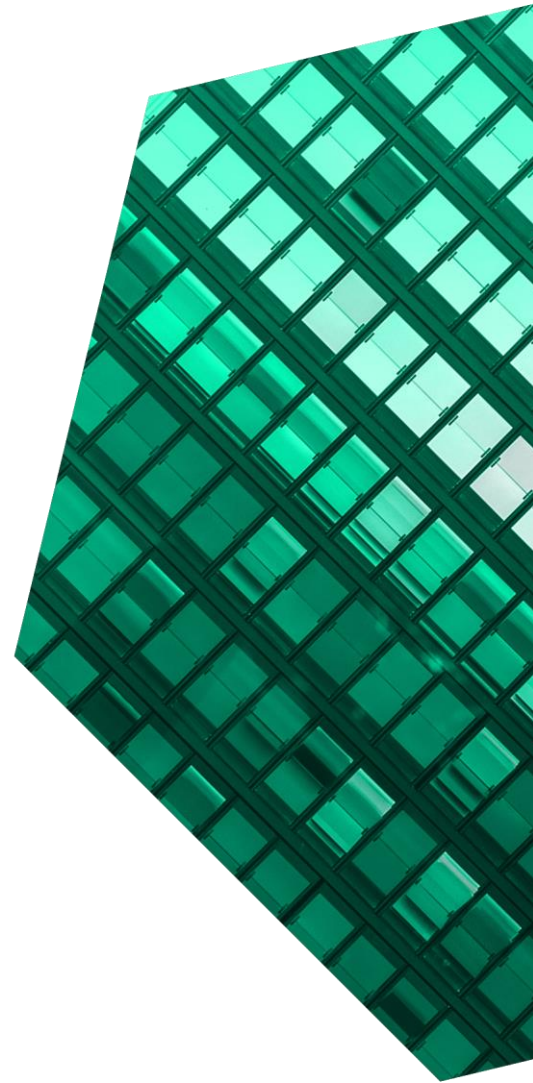
Cost Savings And Business Benefits
Enabled By AutoStore

DECEMBER 2023

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ABOUT FORRESTER CONSULTING

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Executive Summary

Traditional warehouses make prolific use of increasingly costly labor and prime real estate that is close to consumer markets. AutoStore's automated warehouse solution offers the potential to improve customer service with high-density storage and a smaller workforce while saving significant space and real estate costs.

[AutoStore](#) is an automated storage and retrieval system (AS/RS). In this system, warehouse goods are stored in bins and placed in a grid system. Robots then navigate above the grid to retrieve and deliver the bins to ports. AutoStore is implemented in industries such as — but not limited to — retail, e-commerce, grocery, industrials, healthcare, and third-party logistics (3PL).

AutoStore commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) enterprises may realize by deploying AutoStore.¹ The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of AutoStore on their organizations.

To better understand the benefits, costs, and risks associated with this investment, Forrester interviewed five representatives who have installed AutoStore in their organizations' warehouse. For the purposes of this study, Forrester aggregated the interviewees' experiences and combined the results into a single

Reduced storage footprint by

75%



KEY STATISTICS



Return on investment (ROI)
79%



Net present value (NPV)
\$5.32M

[composite organization](#) that is an e-commerce organization with an annual revenue of \$217 million, fashion and accessories for a total of 1.1 million orders per year.

Prior to using AutoStore, these interviewees noted that their organizations had a traditional warehouse setup, with standard shelving and manual radio-frequency-based picking or reach trucks. However, due to rising labor costs, limited scalability, and rising warehouse rents in Europe, there was a drive towards more efficient warehouse operations and flexibility.

After the investment in AutoStore's automated storage and retrieval system (AS/RS) solution, the interviewees experienced storage footprint savings and warehouse automation efficiencies, resulting in labor cost reductions, increased picking accuracy, and flexibility during peak-demand seasons.

KEY FINDINGS

Quantified benefits. Three-year, risk-adjusted present value (PV) quantified benefits for the composite organization include:

- **Warehouse footprint reduction, worth \$6.0 million over three years.** Warehouse space saving is a top priority for the composite organization when it considers AS/RS solutions, particularly in rapidly growing industries like e-commerce. AutoStore's high density ratio enables a reduction in storage footprint of 75% for the composite.
- **Labor cost savings, worth \$2.7 million over three years.** Rising labor costs are linked to the pressing concern of labor shortages. The composite organization looks for an alternative solution to looking for new talent to hire. By implementing AutoStore's AS/RS system, the composite realizes a 50% headcount saving of warehouse pickers.
- **Picking accuracy improvement, worth \$2.5 million over three years.** AutoStore allows a 99% reduction in picking errors for the composite organization, resulting in lower costs of returns.
- **Theft prevention costs, worth \$541,846 over three years.** The closed system design of AutoStore offers the composite organization higher security of stock as the bins are not reachable manually. Consequently, the composite organization realizes a cost reduction from stock shrinkage and theft.
- **Cost savings during peak seasons, worth \$414,754 over three years.** Previously, the composite organization hired extra temporary workers to prepare for an increased order level during peak periods. AutoStore's AS/RS system enables the composite to scale its operations during peak seasons without any further investment.

Unquantified benefits. Benefits that provide value for the composite organization but are not quantified in this study include:

- **Improved sustainability.** The AutoStore system uses minimal energy; the robots can carry out their tasks in the dark. The dense storage system also reduces the amount of concrete required for constructing bigger warehouses.
- **Reduced robot maintenance.** Compared to alternative AS/RS solutions, AutoStore robots necessitate only minimal maintenance, resulting in cost savings for the organization
- **Reliability.** The AutoStore system needs little downtime, increasing reliability, and it necessitates minimal preventive maintenance.
- **Inventory control.** AutoStore provides the composite with high inventory control since warehouse operations are automated and there is a reduced risk of manual error.

Costs. Three-year, risk-adjusted PV costs for the composite organization include:

- **Procurement and hardware costs.** The investment in hardware includes bins, robots, ports, and the installation of an aluminum grid, totaling \$4.8 million for the composite organization.
- **Up-front costs.** The total initial cost of internal planning, implementation, and up-front training amounts to \$1.1 million. This cost is comprised of expenses related to floor flattening, installing a compliant fire suppression system, power supply and lighting adjustments, software development, and the installation by the AutoStore implementation partner.
- **Ongoing costs.** The ongoing costs include yearly AutoStore operating expenses, AutoStore license fees, and an integrator maintenance package, totaling \$883,305.

- The representative interviews and financial analysis found that a composite organization experiences benefits of \$12.05 million over three years versus costs of \$6.73 million, adding up to a net present value (NPV) of \$5.32 million with a payback time of 18 months and an ROI of 79%.²



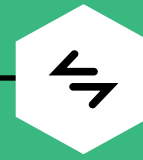
ROI
79%



BENEFITS PV
\$12.05M

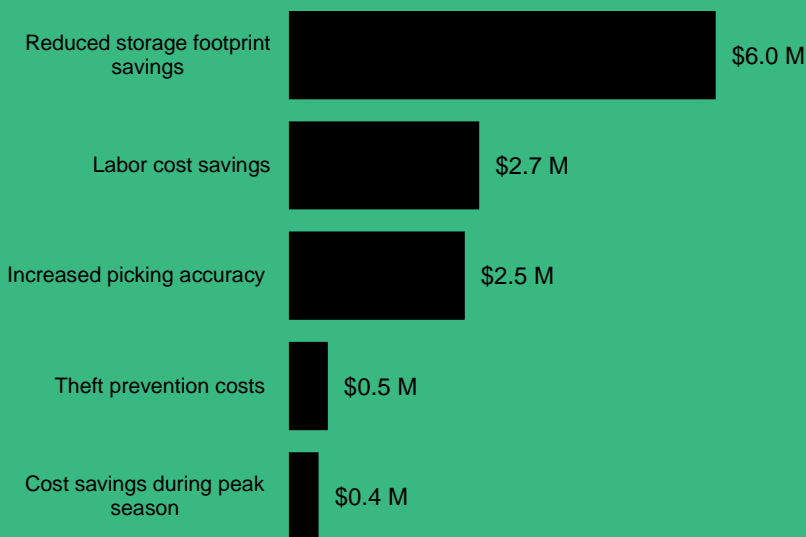


NPV
\$5.32M



PAYBACK
18 months

Benefits (Three-Year)



The biggest category represents cost savings from a reduced storage footprint requirement.

AutoStore's AS/RS warehouse solution enables a 50% headcount reduction.

The risk of theft within the AutoStore system is reduced to 0.1%.

“AutoStore has many advantages, such as speed, reliability, and warehouse footprint utilization. At the end of the day, it’s all about cost per transaction.”

— Chief technology officer, e-commerce

TEI FRAMEWORK AND METHODOLOGY

From the information provided in the interviews, Forrester constructed a Total Economic Impact™ framework for those organizations considering an investment in AutoStore.

The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision. Forrester took a multistep approach to evaluate the impact that AutoStore can have on an organization.

DISCLOSURES

Readers should be aware of the following:

This study is commissioned by AutoStore and delivered by Forrester Consulting. It is not meant to be used as a competitive analysis.

Forrester makes no assumptions as to the potential ROI that other organizations will receive. Forrester strongly advises that readers use their own estimates within the framework provided in the study to determine the appropriateness of an investment in AutoStore.

AutoStore reviewed and provided feedback to Forrester, but Forrester maintains editorial control over the study and its findings and does not accept changes to the study that contradict Forrester's findings or obscure the meaning of the study.

AutoStore provided the customer names for the interviews but did not participate in the interviews.



DUE DILIGENCE

Interviewed AutoStore stakeholders and Forrester analysts to gather data relative to AutoStore.



INTERVIEWS

Interviewed five representatives at organizations using AutoStore to obtain data with respect to costs, benefits, and risks.



COMPOSITE ORGANIZATION

Designed a composite organization based on characteristics of the interviewees' organizations.



FINANCIAL MODEL FRAMEWORK

Constructed a financial model representative of the interviews using the TEI methodology and risk-adjusted the financial model based on issues and concerns of the interviewees.



CASE STUDY

Employed four fundamental elements of TEI in modeling the investment impact: benefits, costs, flexibility, and risks. Given the increasing sophistication of ROI analyses related to IT investments, Forrester's TEI methodology provides a complete picture of the total economic impact of purchase decisions. Please see Appendix A for additional information on the TEI methodology.

The AutoStore Customer Journey

Drivers leading to the AutoStore investment

Interviews						
Role	Industry	Region	2022 Revenue	Type Of Items To Distribute	Average Number Of Orders Per Day	Percentage Of Picking With AutoStore
International business development lead	Medical technology 3PL	Germany	\$312 million (€288 million)	Medical devices	41,000	50%
Chief technology officer	E-commerce	Sweden	\$633 million (€583 million)	Fashion, lifestyle	22,000	90%
Chief operating officer	E-commerce	UK	\$2.6 billion (€2.4 billion)	Beauty, nutrition	325,000	40%
Head of management and planning	3PL	Germany	\$5.4 billion (€5.0 billion)	Fashion	38,000	50%
Head of global spare parts management and logistics	Manufacturer	Switzerland	\$130 million (€120 million)	Spare parts	100	90%

KEY CHALLENGES

Before investing in AutoStore, the interviewees' organizations had traditional warehouses, which were labor-intensive with limited shelving that was designed for human access and required a large amount of storage space. The interviewees noted that their organizations struggled with common challenges, including:

- Increasing labor costs and shortages.** The interviewees noted concerns about rising labor costs. Due to the recent macroeconomic trends in the labor market, it has become increasingly difficult to attract new workers. Relying on variable seasonal workers was problematic as well, due to growing competition for work. The international business development lead at a medical technology 3PL stated: "Labor costs started to increase and [labor] shortages became an issue. Nearly 40% of our workers come from [a country outside of where our facilities are located] due to the tremendous labor shortages within Germany and the Netherlands."

"We kept patching and building out different areas, because we ran out of space all the time."

Chief technology officer, e-commerce

- Warehouse capacity shortages.** All interviewees stated that their organizations had outgrown their storage capacity due to business growth. Because of warehouse shortages, it was challenging to fit more capacity into a smaller footprint. Some of the interviewees' organizations were based in urban areas and had more difficulties finding sufficient warehouse capacity because of this. The head of global spare parts management and logistics at a manufacturing organization stated, "[We kept] moving from one warehouse to another one as we needed more space."

- **Limited scalability and flexibility in traditional warehouses.** The interviewees faced limited scalability and flexibility due to storage restrictions. During peak periods, existing warehouses would reach maximum capacity, making it difficult to store additional stock efficiently. Companies had to rent extra warehouse space, incurring costs, and increasing transportation expenses.
- **Increasing cost of real estate.** In terms of the warehouse location, the interviewees mentioned the importance of close geographical proximity to their customers. Consequently, the costs of their European warehouses increased in price per square meter.

SOLUTION REQUIREMENTS

The interviewees' organizations searched for a solution that could:

- **Optimize space.** The primary motivation identified by the interviewees was footprint savings. Their objective was to expand storage capacity and increase storage density to optimize the utilization of warehouse cubic meters. Many of the interviewees revealed that their organizations' warehouses were not effectively utilizing the full ceiling height, resulting in unused space.
- **Increased reliability.** The interviewees noted their organizations desired to improve their systems' uptime, picking accuracy, stock accuracy, and product security. By minimizing system downtime and reducing maintenance requirements, an automated storage system like AutoStore ensured a higher level of reliability. Additionally, the interviewees' organizations looked for advanced tracking and monitoring to enhance picking and stock accuracy, leading to improved order fulfillment. Strengthening product security measures, such as implementing access controls and surveillance systems, was also a requirement.
- **Reduce labor costs.** Due to rising labor costs and labor shortages, reducing the reliance on manual labor was paramount for the interviewees' organizations. AutoStore's automated storage and retrieval system (AS/RS) reduced the need for manual labor, increased the throughput performance, and improved picking accuracy. The interviewees unanimously stated that an automated warehouse solution was a must-have to realize competitive advantages.
- **Increased picking accuracy.** In a traditional warehouse with shelving, the interviewees noted their picking accuracy was not optimal. For example, cases occurred where items were not in place as marked in the system, had fallen off a shelf, or were stolen. That caused wrongly picked items and unsatisfied customers, which brought additional costs of returns.
- **Flexibility and scalability.** These were crucial factors considered for choosing AutoStore's AS/RS. During high-demand periods, the system needed to be capable of handling peak order volumes without compromising efficiency. The interviewees' organizations required a flexible system with the ability to easily scale the storage capacity as business needs evolved.
- **Operational costs and sustainability.** The interviewees noted the need for an AS/RS solution that was energy efficient and did not compromise their organizations' sustainability footprint.
- **Enhanced integration.** The interviewees noted their organizations not only sought an AS/RS system with a small learning curve for operational staff, but also desired a system that integrated seamlessly with their other existing software and logistics systems. The international business development lead at medical technology 3PL emphasized the need for a user-friendly system to avoid employee turnover. Ideally, new hires

should be able to quickly grasp and utilize the system after a short training period.

“Even before COVID-19, labor costs and the square meter price for our warehouses kept increasing.”

International business development lead, medical technology 3PL

COMPOSITE ORGANIZATION

Based on the interviews, Forrester constructed a TEI framework, a composite company, and an ROI analysis that illustrates the areas financially affected. The composite organization is representative of the five interviewees, and it is used to present the aggregate financial analysis in the next section. The composite organization has the following characteristics:

Description of composite. The composite organization is an e-commerce company that operates locally and ships goods worldwide and has an annual revenue of \$270 million. Specializing in the distribution of lifestyle goods, such as fashion, beauty, and home products, the company caters to a diverse customer base. With an average order value of \$198, customers are inclined to make multiple or higher-value purchases. The company has a consistent annual growth rate of 10%, reflecting its ability to adapt to a dynamic e-commerce landscape.

Deployment characteristics. The composite organization’s warehouse is situated in a rural industrial area adjacent to a major city, conveniently located along a highway. The warehouse operates

with a workforce of 50 employees, divided into two shifts per day; each shift consists of 25 employees. During these shifts, the staff is further divided into two categories: 20 individuals dedicated to picking and packing tasks, while the remaining five are engineers present on-site.

In relation to storage, the warehouse spans an area of 10,000 square meters. It employs a combination of AutoStore’s AS/RS and traditional shelving systems. Around 70% of the goods are stored within the AutoStore system, while the remaining 30% are stored on traditional shelves. This includes flammable liquids (e.g., perfumes), clothes hanging on racks, and long items.

The warehouse has the capability to pick and pack 3,000 orders per day by conducting 10,000 daily picks. This indicates an average of 3.3 picks per order.

The AutoStore system has a height of eight meters and consists of 40,000 bins, providing sufficient storage space for the goods. There are 10 ports connected to the automated storage system and each port is managed by one employee. The AutoStore system is also supported by 40 robots that operate on the grid. These robots assist in the movement of goods within the AutoStore, ensuring efficient retrieval and storage.

Key Assumptions

- **Global e-commerce (Apparel and Beauty)**
- **\$217 million in revenue**
- **50 warehouse employees**
- **1.1 million annual orders**
- **107,000 sq ft of warehouse**

Analysis Of Benefits

■ Quantified benefit data as applied to the composite

Total Benefits						
Ref.	Benefit	Year 1	Year 2	Year 3	Total	Present Value
Atr	Reduced storage footprint savings	\$2,128,400	\$2,394,450	\$2,660,500	\$7,183,350	\$5,912,666
Btr	Labor cost savings	\$810,000	\$1,125,360	\$1,358,100	\$3,293,460	\$2,686,774
Ctr	Increased picking accuracy	\$913,140	\$1,004,471	\$1,104,904	\$3,022,514	\$2,490,398
Dtr	Theft prevention costs	\$198,677	\$218,544	\$240,399	\$657,620	\$541,846
Etr	Cost savings during peak season	\$159,460	\$167,110	\$175,270	\$501,840	\$414,754
	Total benefits (risk-adjusted)	\$4,209,677	\$4,909,935	\$5,539,172	\$14,658,784	\$12,046,438

REDUCED STORAGE FOOTPRINT SAVINGS

Evidence and data. The interviewees explained that when their organizations looked at AS/RS providers, warehouse space saving or space maximization was a business priority, particularly in rapidly growing industries, such as e-commerce.

- For the interviewees, the largest cost saving was the storage footprint savings. Since the interviewees' organizations required large warehouses with over 53,000 square feet in regions near their customers, the rental costs tended to be above the European average.³ The international business development lead at a medical technology 3PL noted: "[With AutoStore], we can put more inventory into the same warehouse. We can double the amount of the space for storage, which has a significant impact on the square meter cost saving."
- Because of the storage savings, the chief technology officer at an e-commerce company stated that their organization avoided costs from moving to a larger warehouse. The interviewee explained, "[Implementing AutoStore] has

avoided the need for us to move and to build new warehouses for additional storage space."

- Several interviewees mentioned that AutoStore's high-density ratio made warehouse space usage more efficient. The chief operating officer at an e-commerce company explained: "One of the key features of an AutoStore is that it offers cubic storage. It's a master of space. You operate in 75% percent less space than you would have done in a manual facility." The head of global spare parts management and logistics at a manufacturing company further explained the benefits of cubic storage on space utilization, "Inventory utilization is our main benefit, especially in terms of cubic meters rather than square meters."

Modeling and assumptions. For the composite organization, Forrester assumes the following:

- The warehouse storage footprint required for a manual picking solution for the composite is 420,000 square feet.

“Our main benefit is to maximize the usage of our current warehouse. By implementing AutoStore, we have avoided moving to a larger warehouse and building new warehouses.”

Chief technology officer, e-commerce

- By implementing AutoStore, the warehouse storage footprint requirement is reduced to 107,000 square feet.
- The rental storage costs are \$8 per square foot in Year 1. Assuming a 10% price increase per year, this cost increases to \$9 in Year 2 and \$10 in Year 3.

Risks. The value of this benefit can vary across organizations due to differences in:

- The size of the organization and order volume. Smaller organizations may realize less footprint savings.
- The warehouse location. Warehouse rental costs across Europe differ. The chief operating officer at an e-commerce organization stated that their warehouse is in the United Kingdom with close proximity to an airport. Hence, the organization pays a premium warehouse rental price, whereas the head of global spare parts management and logistics at a manufacturing company explained that the organization’s warehouse is in rural Germany, thus the company pays an average European warehouse rental price.

Results. To account for these risks, Forrester adjusted this benefit downward by 15%, yielding a three-year, risk-adjusted total PV (discounted at 10%) of \$6.0 million.

Reduced Storage Footprint Savings					
Ref.	Metric	Source	Year 1	Year 2	Year 3
A1	Warehouse storage footprint (sq ft) needed with a manual picking solution	Interviews	420,000	420,000	420,000
A2	Size AutoStore warehouse storage footprint (sq ft)	Interviews	107,000	107,000	107,000
A3	Rental price per sq ft	Interviews	\$8	\$9	\$10
At	Reduced storage footprint savings	(A1-A2)*A3	\$2,504,000	\$2,817,000	\$3,130,000
	Risk adjustment	↓15%			
Atr	Reduced storage footprint savings (risk-adjusted)		\$2,128,400	\$2,394,450	\$2,660,500
Three-year total: \$7,183,350			Three-year present value: \$5,912,666		

LABOR COST SAVINGS

Evidence and data. The interviewees noted that labor shortages were a challenge, increasing labor costs for their organizations. Most of the interviewees' organizations had to rely on variable seasonal workers, which became increasingly problematic due to increased competition for their work.

- All interviewees reported a reduction in operational costs following the implementation of the AutoStore system. This decrease was primarily attributed to the reduction in labor expenses, which varied among the interviewees from 20% to 40%.
- The chief operating officer at an e-commerce organization noted, "By implementing AutoStore, we realized a 50% headcount reduction." Consequently, this interviewee's e-commerce organization now has the capability to process the entire order volume with half of the previous labor requirements. The interviewee further stated, "AutoStore takes risk out of the business, especially since labor shortages are pushing labor costs up." The chief technology officer at an e-commerce echoed: "We were no longer competing with your rival warehouses in the vicinity for the same labor. We have grown 20% to 50% per year in revenue when operating AutoStore, so we have grown in head count but not the same pace as without AutoStore."
- The international business development lead at a medical technology 3PL stated that they previously required 60 pickers to fulfill orders in their 20,000-square-meter warehouse. By implementing AutoStore, they reduced the number of pickers by 50% but were required to employ ten additional employees with a technical background, e.g., engineers, to manage the system. Overall, the international business development lead noted their medical technology 3PL achieved a 33% reduction in overall headcount.

- The interviewees mentioned that labor costs were reduced due to the speed of throughput. The chief operating officer at an e-commerce noted: "Speed of throughput is a key attribute of the AutoStore. By this I mean the capability to receive a unit and pick it much faster than a human could do it."

Modeling and assumptions. For the composite organization, Forrester assumes the following:

- The composite organization's warehouse employs both warehouse pickers and technical staff and/or engineers.
- The composite reduces its picker headcount by 50% following the AutoStore investment. The technical staff of five remains the same.
- Pickers have a fully burdened annual salary of \$45,000. Engineers have a fully burdened annual salary of \$112,000.

Risks. The value of this benefit can vary across organizations due to differences in:

- The burdened annual salary for both pickers and engineers, which is subject to significant variation based on the location of the warehouse.
- The number of extra engineers and technical staff required, as these personnel have a higher annual burdened salary.
- The size, complexity, and processes of an organization, which will affect the headcount reduction rate.
- The size of items distributed. Large items cannot be stored in AutoStore bins. If an organization distributes large items, there might be a necessity to employ additional pickers to manage the traditional shelving.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of \$2.7 million.

Labor Cost Savings					
Ref.	Metric	Source	Year 1	Year 2	Year 3
B1	Manual warehouse FTEs (picking, packing, putaway)	Interviews	40	44	48
B2	Warehouse picker fully burdend annual salary	Interviews	\$45,000	47,200	49,500
B3	Manual warehouse FTEs (technical staff)	Interviews	5	6	6
B4	Technical staff/ engineers fully burdend annual salary	Interviews	\$112,000	\$117,600	\$123,000
B5	Manual warehouse FTEs costs (pre AutoStore)	$(B1*B2)+(B3*B4)$	\$2,360,000	\$2,782,400	\$3,114,000
B6	AutoStore warehouse FTEs (picking, putaway)	Interviews	20	20	20
B7	AutoStore warehouse FTEs (engineers)	Interviews	5	5	5
B8	AutoStore warehouse FTE costs	$(B6*B2)+(B7*B4)$	\$1,460,000	\$1,532,000	\$1,605,000
Bt	Labor cost savings	B5-B8	\$900,000	\$1,250,400	\$1,509,000
	Risk adjustment	↓10%			
Btr	Labor cost savings (risk-adjusted)		\$810,000	\$1,125,360	\$1,358,100
Three-year total: \$3,293,460			Three-year present value: \$2,686,774		

INCREASED PICKING ACCURACY

Evidence and data. Interviewees noted that the reduction of the number of picking errors benefited interviewees' organizations by reducing the costs incurred for returns of wrong goods. Picking errors, such as selecting the wrong item, led to dissatisfied customers and additional costs associated with restocking and reshipping. The reduction of picking errors saved the interviewees' organizations money and enhanced their reputation.

- The chief operating officer at an e-commerce explained that the AutoStore is a "closed system." The interviewee stated, "The items cannot move; you cannot get into an AutoStore." Previously, goods fell off the shelves or were misplaced. The AutoStore system reduced the risk of picking errors for all interviewees' organizations.
- All interviewees reported improvements in their picking accuracy. The international business development lead at a medical technology 3PL stated, "If the inbound process is executed accurately, it is impossible to [pick incorrectly] with an AutoStore." The interviewee further reported an enhancement picking accuracy from 98% to 99.5%. The chief operating officer at an e-commerce company affirmed that their picking accuracy improved "by a factor of five."
- Given the improved picking accuracy, the interviewees from various e-commerce organizations realized immediate cost savings in the return process. The chief operating officer at an e-commerce confirmed that by "basically eliminating manual picking errors," their organization experienced lower costs of returns, which included the labor and time of processing and restocking.
- Since implementing AutoStore, two of the interviewees noted their organizations realized efficiencies in their put-away process. The chief technology officer at an e-commerce organization explained, "Our put-away process is now faster

as it's automatically stored in the designated bin location, making items readily available for sale upon order placement, ensuring immediate availability."

"The AutoStore has made us a preferred service provider in the e-commerce industry, aligned to our obsession of putting the end customer first [and] delivering our promises, on time, every time."

Chief operating officer, e-commerce

Modeling and assumptions. For the composite organization, Forrester assumes the following:

- The composite has an order volume of 1,095,000 in Year 1 with an annual increase of 10% due to the organization's business growth.
- Prior to the AutoStore investment, the manual picking error rate was 3%.
- The average cost per return is \$33.
- The percentage of picking with AutoStore is 90%.
- By implementing AutoStore, the picking error rate is reduced by 99%.

Risks. The value of this benefit can vary across organizations due to differences in:

- The order volume and changes in the yearly order volume.
- The manual picking error rate prior to introducing AutoStore AS/SR.

- The type of distributed items, as large and fragile items have higher return costs, such as in the case of the interviewed medical technology 3PL.

Results. To account for these risks, Forrester adjusted this benefit downward by 15%, yielding a three-year, risk-adjusted total PV of \$2.5 million.

Increased Picking Accuracy					
Ref.	Metric	Source	Year 1	Year 2	Year 3
C1	Total order volume	Interviews	\$1,095,000	\$1,204,500	\$1,324,950
C2	Manual picking errors	Interviews	3%	3%	3%
C3	Returns due to picking errors	C1*C2	\$32,850	\$36,135	\$39,749
C4	Cost of error	Interviews	\$33	\$33	\$33
C5	Manual total cost of picking errors	C3*C4	1,084,050	1,192,455	1,311,701
C6	Percentage of picking with AutoStore	Interviews	90%	90%	90%
C7	Total order volume picked with AutoStore	C1*C6	\$985,500	\$1,084,050	\$1,192,455
C8	Error reduction with AutoStore	Interviews	99%	99%	99%
C9	AutoStore returns due to errors	C2*(1-C8)*C7	296	325	358
C10	AutoStore total cost of errors	C4*C9	\$9,768	\$10,725	\$11,814
Ct	Increased picking accuracy	C5-C10	\$1,074,282	\$1,181,730	\$1,299,887
	Risk adjustment	↓15%			
Ctr	Increased picking accuracy (risk-adjusted)		\$913,140	\$1,004,471	\$1,104,904
Three-year total: \$3,022,514			Three-year present value: \$2,490,398		

THEFT PREVENTION COSTS

Evidence and data. The interviewees shared that the AutoStore system reduced the risk of theft in their warehouses. The bins were not manually accessible, increasing inventory security.

- The chief operating officer at an e-commerce highlighted the benefit that AutoStore was a closed system unlike traditional shelving. The interviewee stated: “Once [an item] is in the AutoStore, it cannot move. You cannot get into the AutoStore, preventing theft.”
- The chief operating officer at an e-commerce elaborated on the problem of inventory shrinkage, which refers to missing inventory that may have been stolen by outside parties or employees, damaged, or simply lost. By introducing AutoStore, this interviewee realized complete stock shrinkage prevention.

Modeling and assumptions. For the composite organization, Forrester assumes the following:

- A stock volume of 2,956,500 in Year 1, which increases by 10% in both subsequent years since the composite is expanding its business operations.

- A yearly stock shrinkage rate of 0.30% due to theft.

“In any facility, theft can happen. With AutoStore, your stock is inside a secure system; you can’t access the stock manually.”

Chief operating officer, e-commerce

- The average item value is \$28.
- Risks.** The value of this benefit can vary across organizations due to differences in:
- The stock volume and the average item value.
 - A risk of theft remains during the inbound process.

Results. To account for these risks, Forrester adjusted this benefit downward by 20%, yielding a three-year, risk-adjusted total PV of \$541,846.

Theft Prevention Costs						
Ref.	Metric	Source	Year 1	Year 2	Year 3	
D1	Warehouse yearly stock volume	Interviews	2,956,500	3,252,150	3,577,365	
D2	Average value per article	Interviews	\$28	\$28	\$28	
D3	Manual warehouse setup: Stock shrinkage (%) resulting from warehouse theft	Interviews	0.30%	0.30%	0.30%	
D4	Manual warehouse setup: Total stock shrinkage resulting from warehouse theft	D1*D3	8,870	9,756	10,732	
Dt	Theft prevention costs	D2*D4	\$248,346	\$273,181	\$300,499	
	Risk adjustment	↓20%				
Dtr	Theft prevention costs (risk-adjusted)		\$198,677	\$218,544	\$240,399	
Three-year total: \$ 657,620			Three-year present value: \$ 541,846			

COST SAVINGS DURING PEAK SEASON

Evidence and data. The interviewees from e-commerce organizations noted that they used to face logistical challenges during peak seasons. Prior to investing in AutoStore, they had to recruit additional warehouse workers to adequately prepare for an increased level of order volumes before and during Black Friday, Christmas, Singles' Day, and Valentine's Day. The employment of temporary workers resulted in increased expenses, thereby reducing the operating margin of their respective organizations.

- The chief operating officer at an e-commerce stated that the organization required a preparation of eight to 12 weeks per peak period where additional pickers had to be hired. The chief technology officer at an e-commerce reported similar preparation time for an annual peak period that lasts approximately three weeks.
- Several interviewees highlighted the scalability benefit when implementing an AutoStore system. The head of management and planning at a 3PL organization explained that they could expand their storage capacity and warehouse fulfillment operations while the system was running. This was particularly beneficial during peak seasons, when organizations faced an increased order level and their throughput requirement changed. The chief operating officer at an e-commerce stated, "We can simply add robots and ports."
- The chief operating officer at an e-commerce echoed the advantage of adding robots during peak periods or with general growth. The interviewee stated: "[With AutoStore], we address our peak periods by temporarily adding extra robots. We continue our business as usual." This interviewee explained that prior to peak seasons, their permanent workers restocked the bins to increase the overall inventory in preparation for the increased order level.

- The chief operating officer at an e-commerce stated that AutoStore enabled their organization

"The AutoStore provides us with the ability to switch from picking to order to picking in batches. This is important during high-velocity periods, as this allows us to manage spikes in order unit and volumes more cost effectively and much faster."

Title, industry Chief operating officer, e-commerce

to swiftly change its fulfillment strategy to increase the throughput during peak season. The interviewee explained, "During peak times, we must switch from pick-to-order to pick-to-batch."

Modeling and assumptions. For the composite organization, Forrester assumes the following.

- Prior to the AutoStore investment, the composite requires a total of eight weeks per year to prepare for peak seasons.
- A total of 25 temporary workers are employed to run a third shift during the eight-week preparation period per year.
- The average fully burdened weekly salary per temporary worker is \$938 in Year 1, which increases by 10% to \$983 per week in Year 2, and to \$1,031 per week in Year 3 due to an increase in labor costs.

Risks. The value of this benefit can vary across organizations due to differences in:

- Seasonal demand, which differs across organizations and industries.
- Insufficient ports, which pose a risk of inadequate outbound flow from the AutoStore system to meet

the demand during the organization’s peak period.

Results. To account for these risks, Forrester adjusted this benefit downward by 15%, yielding a three-year, risk-adjusted total PV of \$414,754.

Cost Savings During Peak Season					
Ref.	Metric	Source	Year 1	Year 2	Year 3
E1	Number of weeks to prepare for peak season	Interviews	8	8	8
E2	Manual warehouse setup: Number of temporary workers needed for a third shift	Interviews	25	25	25
E3	Temporary staff fully burdened weekly salary	Interviews	\$938	\$983	\$1,031
Et	Cost savings during peak season	$E1 * E2 * E3$	\$187,600	\$196,600	\$206,200
	Risk adjustment	↓15%			
Etr	Cost savings during peak season (risk-adjusted)		\$159,460	\$167,110	\$175,270
Three-year total: \$501,840			Three-year present value: \$414,754		

UNQUANTIFIED BENEFITS

Interviewees mentioned the following additional benefits that their organizations experienced but were not able to quantify:

- **Improved sustainability.** Various interviewees discussed the improved sustainability of their organizations after installing the AutoStore. Not only did the AutoStore robots require a low amount of energy, but the dense storage of the system allowed them to use less concrete for storing the same number of goods. The chief operating officer at an e-commerce organization said: “The AutoStore itself is comparatively energy efficient; 10 robots operating 24 hours use less energy than a hairdryer for 20 minutes. Furthermore, the AutoStore system does not need lighting or heating in the winter to operate.”

- **Reliability.** The chief operating officer at an e-commerce stated: “The AutoStore uptime is 99.6%. AutoStore doesn’t sleep or need food. The only thing it needs from time to time is to plan preventative maintenance, but that is part of that 0.04 percentage of uptime itself.”
- **Inventory control.** Several interviewees noted that AutoStore provided them with high inventory control, since warehouse operations were automated and there was a reduced manual touch. Additionally, their AutoStore introduced a higher accuracy in shipment.

“Sustainability was an important factor for us when we selected our AS/RS solution, because we have commitments to our customers and our stakeholders to manage our impact.”

Chief operating officer, e-commerce

- **Reduced robot maintenance.** The chief operating officer at an e-commerce noted the low maintenance of the AutoStore robots: “The robots diagnose themselves; they have the ability to correct a software deficiency as they are doing their day-to-day jobs.” This interviewee has seen that when a robot identifies a failure, it brings itself to the side of the grid and can be taken off by a member of the technical staff. The chief operating officer also stressed: “When you take a robot off the grid, it doesn’t paralyze the grid as with other AS/RS solutions.”

FLEXIBILITY

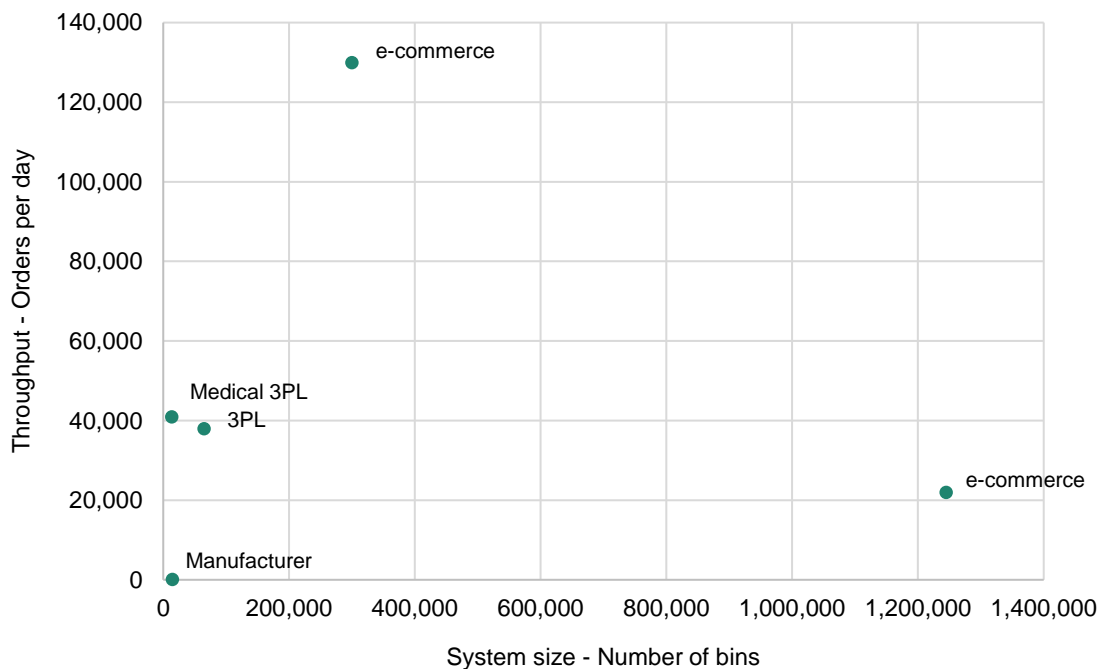
The value of flexibility is unique to each customer. There are several scenarios in which a customer might implement AutoStore and later realize additional uses and business opportunities, including:

- **Refrigerated item storage.** The AutoStore system showed the ability to operate in a space that served as a large refrigerator for goods that have specific temperature needs. There were no people required in the dense system and bins were transported to the ports where pickers could work in normal temperatures. The chief operating officer at an e-commerce noted: “I can have a refrigerated attribute to the AutoStore if I’ve got a client that needs items with certain temperature requirements, which is then segregated away from all the other categories itself.”
- **System flexibility.** All interviewees mentioned that the AutoStore system can be easily integrated into existing warehouses with low and high ceilings, and it’s easy to expand the capacity, while adding robots, picking stations,

and bin locations. The size and set up of the AutoStore systems varied between the interviewed organizations. The head of global spare parts at a manufacturing organization mentioned having 25,840 bins served by 30 robots, while the chief technology officer at an e-commerce stated having 1.3 million bins with 1,243 robots across their three AutoStore systems.

Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in [Appendix A](#)).

Throughput x System Size



Analysis Of Costs

■ Quantified cost data as applied to the composite

Total Costs							
Ref.	Cost	Initial	Year 1	Year 2	Year 3	Total	Present Value
Ftr	Total procurement costs - hardware	\$4,763,000	\$0	\$0	\$0	\$4,763,000	\$4,763,000
Gtr	Upfront costs	\$1,081,960	\$0	\$0	\$0	\$1,081,960	\$1,081,960
Htr	Ongoing costs	\$0	\$355,190	\$355,190	\$355,190	\$1,065,570	\$883,305
	Total costs (risk-adjusted)	\$5,844,960	\$355,190	\$355,190	\$355,190	\$6,910,530	\$6,728,265

TOTAL PROCUREMENT COSTS – HARDWARE

Evidence and data. The procurement costs varied among the interviewees’ organizations, depending on the order volume and the size and composition of the AutoStore system. The number of robots ranged between 10 and 1,245, the number of bins varied between 25,840 and 1,240,000, and the number of ports fluctuated between 3 and 290. The hardware costs, which included bins, robots, ports, and the grid system, ranged between \$1.6 million to \$23 million.

Modeling and assumptions. For the composite organization, Forrester assumes the following:

- The investment in bins totals \$955,200.

- The robots, the ports, and the aluminum grid system amount to an investment of \$3.4 million.

“What we signed up for and what we purchased was as per expectations with the ability to scale further as we understood the technology better.”

Chief operating officer, e-commerce

“The capex cost presented a risk, but we conducted thorough analysis with help of the AutoStore implementation partner to mitigate the risks.”

Head of global spare parts and logistics, manufacturing industry

Risks. Risks that could impact the magnitude of this cost include the following:

- The hardware costs may vary depending on the size of the order, i.e., the size of the system. The price per unit decreases with a larger order.
- The inflation rate has an impact on procurement costs and can vary over time.

Results. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV (discounted at 10%) of \$4.8 million.

Total Procurement Costs - Hardware						
Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
F1	Bins	Interviews	\$960,000			
F2	Robots + ports + aluminum grid	Interviews	\$3,370,000			
Ft	Total procurement costs - hardware	F1+F2	\$4,330,000	\$0	\$0	\$0
	Risk adjustment	↑10%				
Ftr	Total procurement costs - hardware (risk-adjusted)		\$4,763,000	\$0	\$0	\$0
Three-year total: \$4,763,000			Three-year present value: \$4,763,000			

UPFRONT COSTS

Evidence and data. Interviewees noted that installing an AutoStore system required thorough planning and preparation. The interviewees explained that their organizations’ warehouses required floor flattening, the installation of a fire suppression system, power supply and lighting adjustments, and the implementation of up-front software.

- The chief technology officer at an e-commerce stated that the AutoStore project took approximately one year to complete, as this was a relatively large project. The implementation process, supported by AutoStore, involved a full-time external consultant and an internal steering committee consisting of five individuals within the organization. Each committee member dedicated approximately 20 hours per week, accounting for half of their total work time over the course of one year.
- Prior to installing the AutoStore, the chief operating officer at an e-commerce noted that their company conducted an initial analysis, including system calculations. They collaborated with an AutoStore integration partner, who developed a plan for the AutoStore system and its IT solutions. After reviewing the AutoStore partner’s quote, they finalized the project scope and engaged in construction. The AutoStore

implementation partner installed and configured the AutoStore system, integrating it with existing IT infrastructure. Thorough testing and training followed to ensure functionality and employee proficiency. The goal was to enhance efficiency and productivity with the AutoStore system.

- The head of management and planning at a 3PL told Forrester that they assigned an internal team to develop an implementation plan together with the AutoStore implementation partner. As an outcome, there were some requirements regarding the floor flatness and the installation of a supplementary fire suppression system that was specific to AutoStore’s AS/RS system.
- Regarding the floor-flattening requirements, the head of management and planning at a 3PL organization further elaborated: “Ground preparation is a vital step that requires attention and precision. Flattening the floor with additional measures is necessary for integrating an AutoStore system, but it can be a costly and time-consuming process. Costs range from [\$2.50 to \$10.00 per square foot], and the timeframe can be extended if additional flattening is needed. For instance, a [48,000-square-foot warehouse] can take three weeks to complete.”
- Four out of the five interviewees mentioned that they had to install a supplementary fire

suppression system that met the specific needs of an AutoStore facility. This was due to the dense nature of the AutoStore. The head of management and planning at a 3PL explained that this regulation measure added complexity and cost to the building preparation process.

- The chief technology officer at an e-commerce stated that training super users was crucial to avoid quality and process issues. Super users, i.e., the engineers, were assigned to a control tower and received up-front guidance and training by the AutoStore implementation partner. The duration of the training was approximately one week. The interviewees mentioned that warehouse pickers learned on the go and up-front training was not necessary.

Modeling and assumptions. For the composite organization, Forrester assumes the following:

- A team of five internal employees, the internal steering committee, are involved in planning the AutoStore implementation.
- Each internal employee dedicates 20 hours per week for a period of six months (48 weeks).
- The average fully burdened hourly salary of an employee within the steering committee is \$51. The composite organization must prepare a 107,000-square-foot warehouse for the AutoStore installation, which generates floor flattening costs of \$109,000, installation costs of \$109,000, fire suppression system costs of \$271,000, power supply and lightning costs of \$130,000, and up-front software development costs of \$109,000. The total implementation costs amount to \$728,000.
- There are a total of five super users who receive 40 hours of up-front training.
- The average fully burdened hourly salary of an engineer is \$54.

Risks. Risks that could impact the magnitude of this cost include the following:

- Additional fire suppression installation requirements and adjustments.
- Additional floor-flattening measures and adjustments.
- The construction of a false ceiling for fire suppression or with the creation of a mezzanine.
- The complexity of integrating the AutoStore software with other logistics IT systems.
- Additional compliance costs because of local regulations (e.g., Occupational Safety and Health Administration [OSHA] guidelines, fire codes, transportation and logistics regulations, local building codes).

Results. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV of \$1.1 million.

Upfront Costs						
Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
G1	Number of internal employees involved in planning (internal steering committee)	Interviews	5			
G2	Hours per week per employee involved in internal planning	Interviews	20			
G3	Length of internal planning (in weeks)	Interviews	48			
G4	Internal planning staff hourly salary	Interviews	\$51			
G5	Internal planning costs	$G1 \times G2 \times G3 \times G4$	\$244,800			
G6	Floor flattening costs	Interviews	\$109,000			
G7	Installation costs	Interviews	\$109,000			
G8	Fire suppression system	Interviews	\$271,000			
G9	Power supply and lighting	Interviews	\$130,000			
G10	Upfront software development	Interviews	\$109,000			
G11	Implementation costs	$G6 + G7 + G8 + G9 + G10$	\$728,000			
G12	Number of super user (engineers) to receive upfront training	Interviews	5			
G13	Hours per super user (engineers) for upfront training	Interviews	40			
G14	Engineer hourly salary	Interviews	\$54			
G15	Upfront training costs	$G12 \times G13 \times G14$	\$10,800			
Gt	Upfront costs	$G5 + G11 + G15$	\$983,600	\$0	\$0	\$0
	Risk adjustment	↑10%				
Gtr	Upfront costs (risk-adjusted)		\$1,081,960	\$0	\$0	\$0
Three-year total: \$1,081,960			Three-year present value: \$1,081,960			

ONGOING COSTS

Evidence and data. All interviewees noted that ongoing costs consist of yearly operating expenses, the AutoStore license fees, as well as an integrator maintenance package. The latter costs varied, depending on the scope of maintenance service provided.

- The operating expenses were costs that the interviewees’ organizations incurred by operating the AutoStore system. They were calculated as 3% of the capital expenditure (capex) costs, i.e., the AutoStore hardware per year.
- The AutoStore license costs varied depending on the size of the interviewees’ organizations’ system.
- The interviewees described that they concluded a service package agreement with their local AutoStore partners. The scope of the services included varied. While the chief operating officer at an e-commerce organization stated that their service package “include[d] spare parts for the AutoStore system,” the international business development lead at a 3PL organization

confirmed that their service package comprised of system maintenance only.

Modeling and assumptions. For the composite organization, Forrester assumes the following:

- The yearly operating expenses of the AutoStore are 3% of the capex costs.
- The license cost amounts to \$43,000 per year.
- The integrator maintenance package totals \$150,000 per year.

Risks. Risks that could impact the magnitude of this cost include the following:

- The size of the AutoStore system and the initial capex costs.
- The integrator costs may vary based on the organization’s warehouse location.
- Variability of costs of local partner services.

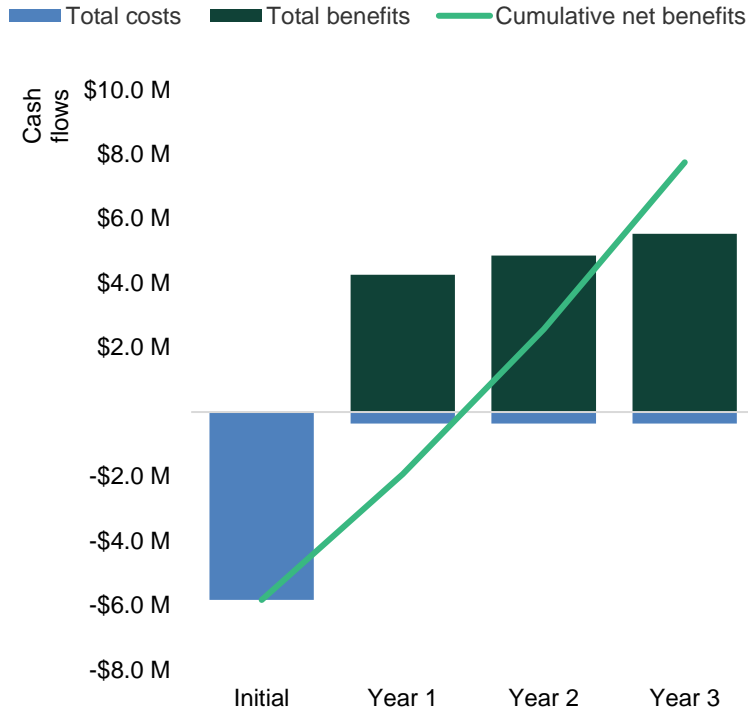
Results. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV of \$883,305.

Ongoing Costs						
Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
H1	AutoStore operating expenses (3% of hardware cost)	0.03*Ft		\$129,900	\$129,900	\$129,900
H2	AutoStore license fees	Interviews		\$43,000	\$43,000	\$43,000
H3	Integrator maintenance package	Interviews		\$150,000	\$150,000	\$150,000
Ht	Ongoing costs	H1+H2+H3		\$322,900	\$322,900	\$322,900
	Risk adjustment	↑10%				
Htr	Ongoing costs (risk-adjusted)			\$355,190	\$355,190	\$355,190
Three-year total: \$1,065,570			Three-year present value: \$883,305			

Financial Summary

CONSOLIDATED THREE-YEAR RISK-ADJUSTED METRICS

Cash Flow Chart (Risk-Adjusted)



The financial results calculated in the Benefits and Costs sections can be used to determine the ROI, NPV, and payback period for the composite organization's investment. Forrester assumes a yearly discount rate of 10% for this analysis.

These risk-adjusted ROI, NPV, and payback period values are determined by applying risk-adjustment factors to the unadjusted results in each Benefit and Cost section.

Cash Flow Analysis (Risk-Adjusted Estimates)

	Initial	Year 1	Year 2	Year 3	Total	Present Value
Total costs	(\$5,844,960)	(\$355,190)	(\$355,190)	(\$355,190)	(\$6,910,530)	(\$6,728,265)
Total benefits	\$0	\$4,209,677	\$4,909,935	\$5,539,172	\$14,658,784	\$12,046,438
Net benefits	(\$5,844,960)	\$3,854,487	\$4,554,745	\$5,183,982	\$7,748,254	\$5,318,173
ROI						79%
Payback period (months)						18.0

Appendix A: Total Economic Impact

Total Economic Impact is a methodology developed by Forrester Research that enhances a company's technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

TOTAL ECONOMIC IMPACT APPROACH

Benefits represent the value delivered to the business by the product. The TEI methodology places equal weight on the measure of benefits and the measure of costs, allowing for a full examination of the effect of the technology on the entire organization.

Costs consider all expenses necessary to deliver the proposed value, or benefits, of the product. The cost category within TEI captures incremental costs over the existing environment for ongoing costs associated with the solution.

Flexibility represents the strategic value that can be obtained for some future additional investment building on top of the initial investment already made. Having the ability to capture that benefit has a PV that can be estimated.

Risks measure the uncertainty of benefit and cost estimates given: 1) the likelihood that estimates will meet original projections and 2) the likelihood that estimates will be tracked over time. TEI risk factors are based on "triangular distribution."

The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1 that are not discounted. All other cash flows are discounted using the discount rate at the end of the year. PV calculations are calculated for each total cost and benefit estimate. NPV calculations in the summary tables are the sum of the initial investment and the discounted cash flows in each year. Sums and present value calculations of the Total Benefits, Total Costs, and Cash Flow tables may not exactly add up, as some rounding may occur.



PRESENT VALUE (PV)

The present or current value of (discounted) cost and benefit estimates given at an interest rate (the discount rate). The PV of costs and benefits feed into the total NPV of cash flows.



NET PRESENT VALUE (NPV)

The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). A positive project NPV normally indicates that the investment should be made unless other projects have higher NPVs.



RETURN ON INVESTMENT (ROI)

A project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits less costs) by costs.



DISCOUNT RATE

The interest rate used in cash flow analysis to take into account the time value of money. Organizations typically use discount rates between 8% and 16%.



PAYBACK PERIOD

The breakeven point for an investment. This is the point in time at which net benefits (benefits minus costs) equal initial investment or cost.

Appendix B: Supplemental Material (Optional; delete if not using)

Related Forrester Research

“Defining The Online Marketing Suite,” Forrester Research, Inc., October 17, 2007.

Online Resources

More information about computer animation is available at [www.link.com].

Appendix C: Endnotes

¹ Total Economic Impact is a methodology developed by Forrester Research that enhances a company’s technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

² On average, AutoStore users typically calculate the return on investment (ROI) of the AutoStore investment over a 10-year period.

³ Source: “[Annual prime headline rent cost for warehouses over 5,000 square meters in selected European cities from 2021 to 2022, by city](#),” Statista, August 30, 2023.

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