How to Calculate the True ROI of Warehouse Automation

5 Keys to Making a Case for Your Automation Project

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About the Author

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Troy has over 20 years of operations, logistics and supply chain experience. After serving as a Naval Aviation Maintenance Officer, he began a consulting career with Kurt Salmon Associates, founded XCD Performance Consulting, and served as a practice leader for two supply chain consulting firms.

Troy led successful e-commerce operations for iHerb.com and Hollar.com before joining OPEX. In his current role at OPEX, he helps customers and prospects identify challenges and meet operational goals with automated solutions. Troy is an adjunct professor at the University of San Diego and National University, where he teaches Operations and Supply Chain Management. He graduated from the University of Michigan with a bachelor's degree in Aerospace Engineering and from the University of San Diego with a master's degree in Supply Chain Management.

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Chapter 1

Introduction

Warehouse automation has long been a strategic initiative for companies that have warehouses and distribution centers (DC). COVID-19 has increased the urgency for automation as the need for laborers, worker safety and unpredictability in the supply chain have surged. While there is great potential for warehouse automation systems to bring significant benefits, that potential alone may not be enough to justify the cost. Understanding how to calculate the return on investment (ROI) of warehouse automation is essential. Far too often, projects are evaluated solely on the basis of simple payback periods of two or three years, net present value (NPV), internal rate of return (IRR), or other common methods; but there is more to ROI than spreadsheet calculations.

In this eBook, we will:

- Detail how to use each method of calculation

- Explore a broader view of ROI

- Discuss considerations that might not typically be factored into ROI calculations

- Explain how you can use ROI to build a strong business case for automating your facility
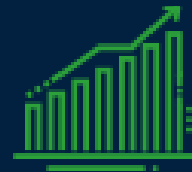
The warehouse automation market will reach the milestone of **$37.6B** by 2030, at a compound annual growth rate (CAGR) of **~10%** between 2021 and 2030.[1]

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[1] "Warehouse Automation Robots, Technologies, and Solutions Market, 2021-2030," Research and Markets, June 2021.
https://www.researchandmarkets.com/reports/5342799/warehouse-automation-robots-technologies-and

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Chapter 2

Making the Case for Warehouse Automation

Before attempting ROI calculations, it is helpful to know why you're calculating it in the first place. Occasionally, ROI does not matter. A CEO could be enthralled by a certain technology and therefore does not require the scrutiny of a business case. Alternatively, an automation decision can sometimes be viewed as a "no-brainer" because there are several clear financial and operational reasons to approve the project. All the potential stakeholders are on board and the budget is easily approved.

In most cases, the project approval process is significantly more involved. There are several other initiatives under consideration, and there is internal competition for the same funds. The CEO or Board of Directors seeks feedback from the executive team on the project. The CFO requires an ROI analysis and business case to justify the capital expense. Outside investors want to protect their promised return on capital.

Every company is different when it comes to new projects and initiatives. Start-ups that are flush with venture capital may be more open to taking risks. More established companies may have many different competing projects. For example, the Director of IT wants a new software upgrade. The Transportation Manager demands an increase to the fleet size. Purchasing needs to buy more inventory. R&D is looking for a budget increase to support the next big thing. Warehouse automation is just one of many initiatives competing for the same budget.

Understanding the internal competition and how your project stacks up is critical. It is essential to clarify the reasons people should care about automation. Will it improve customer service levels? Will it make employees' jobs easier? How will it impact the company's bottom line? ROI analyses help executives compare competing projects according to expected payback. Justifying the capital expense for automation will boost the likelihood of project approval.

Who is Responsible for Calculating ROI?

Short answer: Operations should take the lead on calculating ROI.

While Finance is comprised of analysts who routinely perform complex ROI calculations, they do not really have a stake in an automation project's approval. Because most financial analysts are not familiar with the nuances of operations, they also will not have knowledge of the more subtle benefits of automation, beyond what is clear in the financial calculations.

At the end of the day, most automation projects involve a full team effort. IT will need to build interfaces between the equipment controls and the warehouse management system (WMS) or enterprise resource planning (ERP) system. Various departments may be involved due to service level changes and new production expectations. As labor requirements change, even Human Resources may be impacted.

A compelling business case based on ROI helps sell the project internally and build consensus among all potential stakeholders, bringing the project one step closer to approval.

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Chapter 4

What Should ROI Measure?

ROI begins with financial calculations, but there are also other factors to consider, many of which are not directly quantifiable. Combining both types of benefits can require some level of creativity.
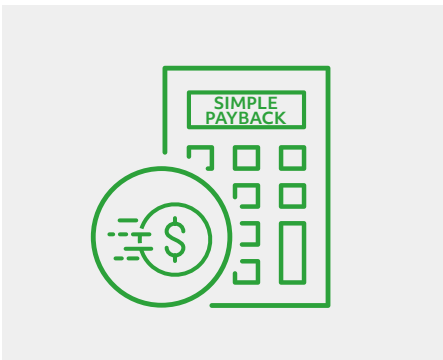
The most common ROI financial calculations are simple payback, net present value (NPV) and internal rate of return (IRR). The creative aspect involves quantifying factors that may seem to be more qualitative. For example, labor costs and savings are easy to calculate, but space savings from a goods-to-person system, financial benefits of improved service levels, and the impact on damage rates or order accuracy due to a decrease in human handling are much more difficult to quantify.

While these important factors may not be quantifiable, they should be considered as part of the approval process. If there are two projects with a similar ROI competing for budget approval, the project with the better overall business case (including all the qualitative improvements) should get the green light. That is why it's essential to measure every possible improvement and try to quantify factors that may not appear to be quantifiable. In fact, some of the qualitative improvements are just as important, if not more, than the actual ROI.

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The Three Methods of Calculating Financial ROI

1 Simple Payback

Simple payback can be used as a litmus test for the other two calculations. Simply divide the capital expense by the annual cash flow or savings. If the payback period is beyond the company's internal thresholds, then it most likely will not be worth the additional effort to perform the other two analyses. However, many companies impose payback periods that are significantly lower than the life of the equipment. For example, a two to three-year payback period is common, but many types of automation equipment will last over 10 years. For this reason, it's important not to dismiss a project because the payback period is slightly longer than the payback threshold. (See page 12 for calculations.)

2 Net Present Value

NPV is the most common financial calculation for determining ROI. Unlike simple payback, NPV recognizes the "time value of money" in its calculation by factoring in the cost of money (or hurdle rate) and taking into consideration multiple years of cash flows. By doing so, the NPV analysis provides the best feedback with regards to the overall benefit of the capital expenditure. The calculation will yield either a negative or positive dollar amount. A negative NPV indicates the investment will have a lower return than investing the funds at the hurdle rate. A positive NPV is considered a better financial investment and a better candidate for project approval. (See page 13 for calculations.)

3 Internal Rate of Return

IRR is similar to NPV because it also considers the cost of money and multi-year cash flows, but this method computes the "return" as a percentage. It's similar to what would appear on a personal financial investment statement that features retirement portfolios based on a monthly, annual, or 3, 5 and 10 year rates of return. The IRR is calculated where the NPV is equal to zero and will have a lower return than investing the funds at the hurdle rate. When multiple projects are competing for the same budget, the initiative with the highest NPV or IRR will most likely be the project that receives approval. (See page 14 for calculations.)

Time value of money

Both the NPV and IRR calculations are based on the time value of money concept: A dollar today is worth more than a dollar tomorrow. These methods use the cost of money — or the value of a future dollar — and the timeframe of the investment to calculate the present value of the project.

There are three concepts used in the NPV and IRR calculations to analyze capital expenditures:

- **Future value of the expense**, or the money value in the future if loaned or invested.

- **Present value**, or the cost of the project.

- **Required rate of return** (also known as the cost of capital or hurdle rate). This is the rate that a project should exceed to qualify for consideration. *How much better does the "internal" rate of return need to be than the hurdle rate?* That depends on the company's cost of capital and the number of competing projects. In addition, many companies set a higher hurdle rate for projects that are based on newer technologies.

Numbers You'll Need

Capital expense:

Cost of the project, including equipment, installation, freight, taxes, and future maintenance/ software license fees.

Depreciation and amortization costs may also be included.

Cash flows (savings) generated by the investment.

Cost of capital (rate of return or hurdle rate). This is usually the rate a company pays its long-term investors.

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Cash Flow Considerations

The next step is to calculate cash flow for the project over the timeframe of the analysis, typically three to five years. Some cash flows may increase over time, such as labor costs due to inflation or other wage increases. In these situations, the ROI should be higher for future years due to the higher costs.

In automation projects, there are three cash flow categories to consider: Labor, space, and increased revenue.

Labor savings

For labor savings, the typical method is to calculate the difference in productivity levels using loaded (or fringe) wage rates. By comparing the current situation to a future state with automation, the difference is the annual cash flow. However, there are a few typically overlooked labor-related costs to include. If automation results in lower headcount, factor in all costs associated with a worker, such as retention, training, liability costs due to disability or lawsuits, and reliability costs, such as sickness, injury, tardiness, and consistency. It is important to look beyond the wage component to fully burden the labor cost.

Online sales have skyrocketed since the beginning of the pandemic, putting new strain on workers who unload trucks, sort inventory, and pack boxes for an average wage of about $23.05 an hour.[2]

[2] "Warehousing and Storage: NAICS 493," US Bureau of Labor Statistics, September 29, 2021. https://www.bls.gov/iag/tgs/iag493.htm

Space savings

All goods-to-person automated storage and retrieval system (ASRS) solutions maximize cubic storage in a facility, often dramatically improving storage density when compared to conventional solutions, such as static shelving or carton flow racks.

Additionally, space is expensive when factoring in rent, utilities and other costs associated with maintaining property. Further, by better utilizing existing space, your company may be able to defer near-term capital expenses for expansions or the addition of facilities to the supply chain network. The business may also generate additional revenue by subleasing space or releasing it back to the landlord. It is essential to consider all potential savings areas in ROI calculations.

Increased revenue

Finally, remember to factor in potential revenue boosts due to increased service levels. Increasing shipping speed and order accuracy can boost competitive advantage and dramatically reduce the number of customer service complaints and refunds. Satisfied customers and five-star reviews both affect cash flow and can be included in your ROI calculation. The greater the cash flow, the better the payback, NPV and IRR will be, along with the likelihood of project approval.

Prologis Research estimates the need for an incremental **125M square feet** of logistics space or more each year through **2025** in the US and Europe alone as a result of substantial ecommerce and efulfillment demand.[3]

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[3] "Forever Altered: The Future of Logistics Real Estate Demand," Prologis, March 9, 2021.
https://www.prologis.com/news-research/global-insights/forever-altered-future-logistics-real-estate-demand

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Chapter 7

Doing the Math

Here's an example to demonstrate exactly how the calculations are done.

A company is considering a $3,000,000 automation investment on a goods-to-person picking system with the following factors:

COST OF AUTOMATION	BENEFITS	SAVINGS	RATE OF RETURN
$3M	Space utilization/Storage Lower labor costs	$1.3M/year	(Hurdle Rate) 8%

Simple payback

The focus of the payback analysis is on the time required from the project to return the original investment. To do the calculation, divide the capital expense by the annual cash flow or savings.

In this example, the investment is $3,000,000 and the savings are $1,300,000 per year, which is a 2.31 year payback.

$$\frac{\$3,000,000}{\$1,300,000/year} = 2.31 \text{ years}$$

While payback period thresholds vary by company, the true measure is whether the payback period is less than the life of the equipment. Here, the payback is within the threshold of the three-year equipment life.

It is important to remember that most companies set payback thresholds much shorter than the actual life of the equipment, which means this method would not reveal the true financial benefit of automation. NPV and/or IRR may reveal a project to be beneficial, even at a higher payback period.

Net present value

Considered by many to be the true indicator of a project's financial benefit, NPV considers the time value of money and cost of capital.

When calculating NPV, first calculate the present value, which is the sum of the future values (or the cash flow savings) divided by 1+ the hurdle rate. For each period beyond the first year, the hurdle rate is squared or cubed. This calculation is available in Excel. Since NPV considers both the hurdle rate and the time periods (or the time value of money), the future values become less valuable. To calculate NPV for five years, calculate two more periods of present value than shown here.

$$\text{Present Value} = \frac{\text{Future value}_1}{1+i} + \frac{\text{Future value}_2}{(1+i)^2} + \frac{\text{Future value}_3}{(1+i)^3}$$

(i = hurdle rate)

$$\text{Present Value} = \frac{\$1{,}300{,}000}{1.08} + \frac{\$1{,}300{,}000}{(1.08)^2} + \frac{\$1{,}300{,}000}{(1.08)^3} = \$3{,}350{,}000$$

Net Present Value = \$3,350,000 - \$3,000,000 = **\$350,000**

NPV is greater than "\$0", so it should be accepted

In the example, the NPV is \$350,000, which is greater than zero, so this investment is better than the 8% rate of return hurdle. The project would yield an additional \$350,000 in three years versus investing the funds at 8%.

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Internal rate of return

The IRR is the interest rate where the NPV equals zero. The IRR calculation reveals gross savings over a period, so it may be the preferred method of comparing the return rate for various investments or projects.

Source: https://www.thecalculatorsite.com/finance/calculators/irr-calculator.php
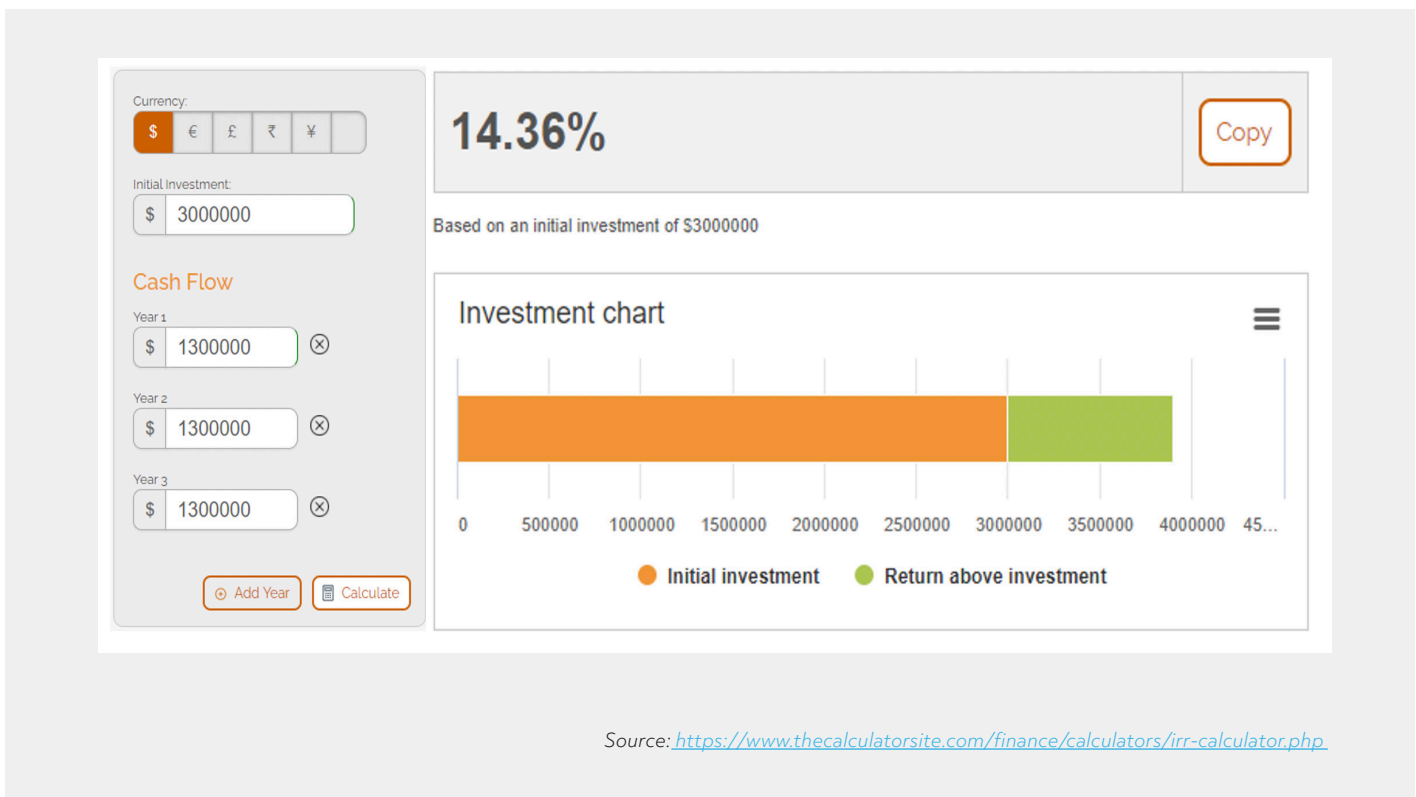
In this example, the IRR for the automation project is 14.36%. Since the hurdle rate is 8%, the project should be accepted.

Selecting the right ROI method for your project

There is no single method that is better than the others; it all depends on the project, audience and available budget. If the project is a large capital expense, or if there is a great deal of competition for budget, use all three methods to demonstrate the best possible ROI.

1 Start with the **simple payback** method. If the payback period is too long, either abandon the project or negotiate to reduce the capital expense.

2 If the payback period is less than the actual life of the equipment (not the self-imposed payback threshold), next calculate **IRR**. The payback threshold may be negotiable, so it's important to think beyond the simple payback method. For example, most executives would approve a project with a 25% IRR, even if it had a simple payback of four years.

3 Finally, using **NPV** reveals the gross savings, which may be a better way than percentages to evaluate competing projects. While an investment that has a 40% IRR may only yield $50,000, a project that has a 25% IRR could produce $500,000 in return. Approval will ultimately be determined by available budget, but the greater amount of savings would generally be most appealing to an executive team.

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Chapter 8

Additional Factors to Include in the Business Case

After calculating the financial ROI, it's time to factor in the qualitative factors that are just as important, but difficult to calculate as cash flow. When building a comprehensive business case, some of these factors can essentially make or break the final decision on project approval.

Service levels: Automating not only increases productivity, but also boosts capacity and the speed of processing, sometimes by 10x or higher. This increase leads to faster order processing times, which ultimately translates to faster customer delivery.

Order profiles & product characteristics: The automation under consideration may have a strong financial ROI but is not suited for your company's order or product types. This could limit the products you can process using the equipment and reduce potential savings.

Building specifications: Ask some basic questions up front. Is there space available for the equipment or will process flows need to be redesigned? How can the new automation be integrated with existing processes?

Technology: Most automation requires some form of integration with other systems, such as ERP, WMS or WCS/WES. The ability to effectively integrate and communicate with these systems is critical and can sometimes require significant effort.

Human factor: Consider the level of expertise in operating highly automated equipment. Are supervisors, managers and maintenance team members tech-savvy or will they require extensive training? What level of support will the equipment vendor provide?

Prestige: Does your company want to be viewed as a technology leader? Are you looking for additional funding from investors? Prestige may be a powerful tool to leverage in the approval process.

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Chapter 9

Are You Ready?

Whether you are considering co-bots, goods-to-person, robot picking or any combination of automated warehouse solutions, the investment is highly unlikely to get approval without a solid business case and ROI calculation.

To recap, here are the five keys to calculating automation ROI.

1 Identifying the challenges driving automation and calculating ROI are the keys to project approval.

2 Understand your company's investment environment and competing projects, and calculate the ROI *before* going to Finance.

3 Start with the simple payback method, then expand to NPV and IRR to present the strongest possible case.

4 Consider the impact of both quantitative and qualitative factors.

5 Select a partner with a solid track record of guiding similar companies through successful automation deployments.

By working with industry experts who understand the current financial, business and IT challenges, have successfully delivered projects in environments similar to yours, and offer modern equipment, you'll be more likely to secure leadership buy-in and smooth the way to automation deployment.

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About OPEX

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