INDUSTRIAL MACHINE VISION 2023:

THE FUTURE FOR MACHINE VISION LOOKS BRIGHT AND CLEAR

Machine vision productivity, quality, and visibility benefits drive global growth

INTERACT ANALYSIS | COGNEX

Executive Summary

The use of industrial machine vision is surging, with organizations looking for more ways to deploy the technology throughout their operations. However, few companies are using machine vision in all their potential applications and, with decision makers continually looking for ways to enhance productivity, quality, and traceability, there is huge scope for future growth.

Usage of machine vision is expected to grow by 37% - from 46% to 63% of potential applications over the next two years. There is clear evidence that demand for machine vision technology is strong and growing.

By exploring the current state of the global industrial machine vision market and looking at developing trends, how and why purchasing choices are made, the key benefits offered by industrial machine vision technology, and what the predictions are over the coming years, this whitepaper provides a basis for greater understanding of the machine vision market as it is now and its outlook for the future.

MACHINE VISION USAGE **EXPECTED TO GROW FROM 46% TO 63%** OF POTENTIAL APPLICATIONS

37%

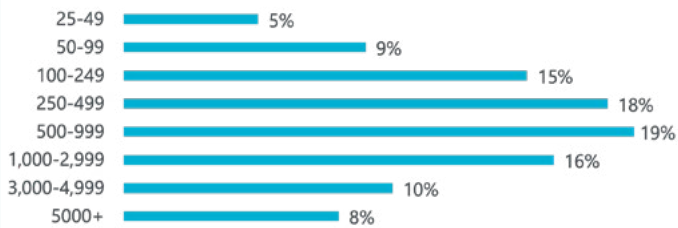**GROWTH IN APPLICATION USAGE OVER THE NEXT TWO YEARS**

Methodology

This whitepaper explores the outcomes of a survey carried out by Cognex and Sago among representatives and decision makers across 13 industry sectors about their usage, selection, and future plans for industrial machine vision technology. It combines this with expert research and insights from Interact Analysis to provide a comprehensive state of the market report for the industrial automation industry.

When it comes to responsibility for signing off on industrial machine vision solutions, the vast majority (82%) of respondents are the sole decision maker or ultimate decision maker, with the remainder participating in the decision-making process. One in five respondents (21%) are board members or C-level executives, while 37% are senior management, and 36% are mid-level management.
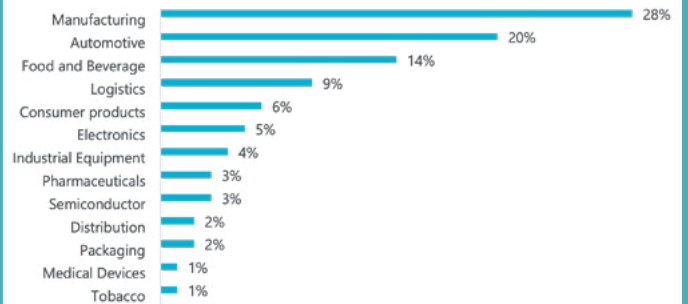
The data covers a broad spread of company sizes, from small businesses with 25-49 employees (5%) to companies with 5,000+ (8%). Responses were mostly concentrated in businesses with between 100 and 2,999 employees. Businesses surveyed represent 13 different industry sectors, with more than half in manufacturing (28%), automotive (20%), and food & beverage (14%). Over half (55%) of respondents represent manufacturing departments and 45% logistics & distribution operations, and respondents are spread across 3 regions: North America (US 20%/Mexico 17%), Asia-Pacific (China 17%/India 14%), and Europe (France 16%/Germany 15%).

Number of Employees

25-49	5%
50-99	9%
100-249	15%
250-499	18%
500-999	19%
1,000-2,999	16%
3,000-4,999	10%
5000+	8%

The research represents a broad range of company sizes

Industry

Manufacturing	28%
Automotive	20%
Food and Beverage	14%
Logistics	9%
Consumer products	6%
Electronics	5%
Industrial Equipment	4%
Pharmaceuticals	3%
Semiconductor	3%
Distribution	2%
Packaging	2%
Medical Devices	1%
Tobacco	1%

The manufacturing and automotive industries provide the largest numbers of respondents

Country

US	Mexico	China	France	Germany	India
20%	17%	17%	16%	15%	14%
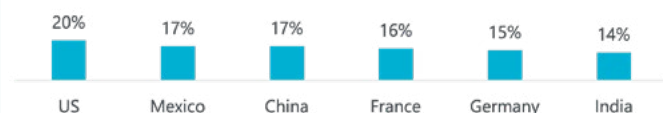
Respondents are evenly spread across six countries in three regions

The global machine vision market

Machine vision technology, or industrial machine vision, is a key element of modern automation systems and IIoT, using hardware and software to capture, process, and interpret visual information using cameras and processing algorithms to make intelligent decisions. It is used for automatic inspection, analysis, and guidance in a wide range of applications across various industries, with common uses including detecting defects/quality control, product sorting and tracking, positioning and measuring parts, and reading barcodes.

There is a lack of universal terminology when it comes to machine vision. According to the research, terminology used to describe machine vision varies among countries and regions. For example, the term 'machine vision' is widely used in the USA, India, and Germany. However, this term is used by only 8% of companies in France, where the preference is for 'vision sensors.' Machine vision and vision sensors are the two most widely used terms, but others include 'vision systems, 'industrial sensors,' 'computer vision,' 'visual inspection,' and 'smart cameras.'

There is a clear need for consensus when it comes to describing and naming machine vision technology, as the current approach adds complexity to a buying process companies are already finding complicated, and makes global conversations about the market more difficult.

Terminology Used to Describe Machine Vision

- Smart Cameras: 8%
- Machine Vision: 22%
- Visual Inspection: 9%
- Vision Sensors 20%
- Computer Vision: 13%
- Vision Systems: 15%
- Industrial Sensors: 13%
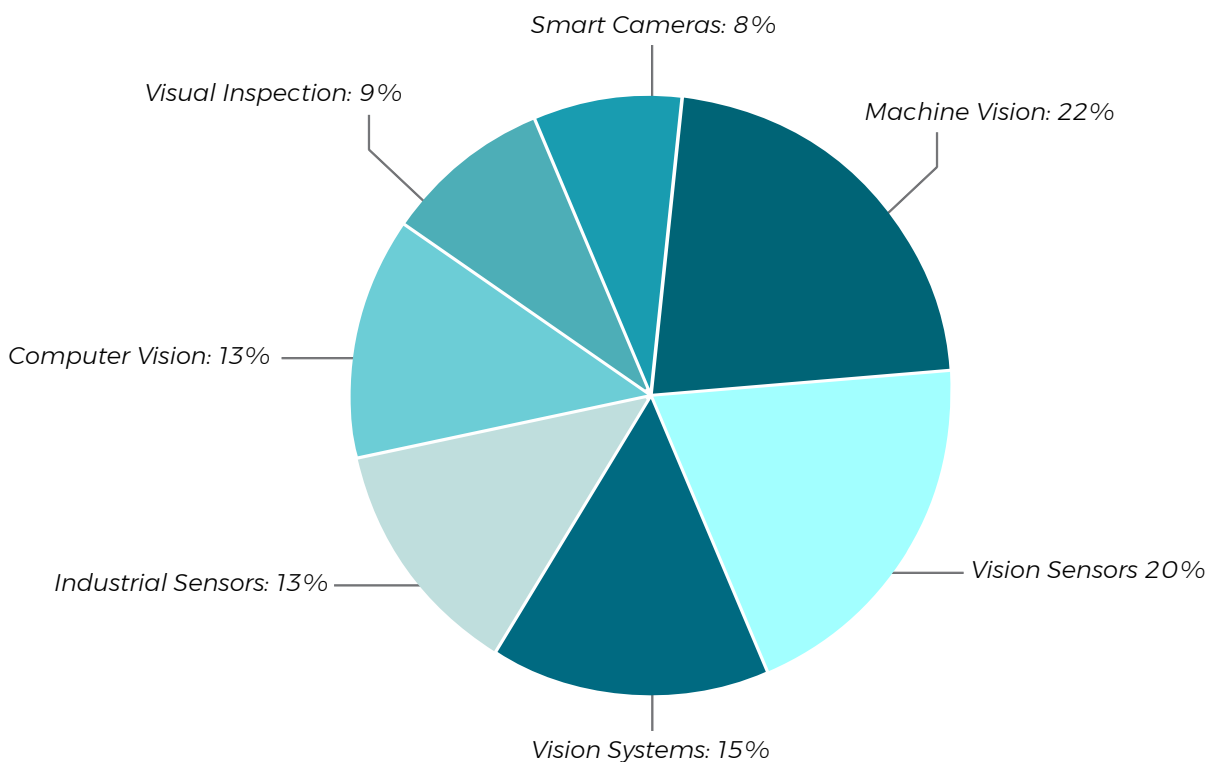
BASE: Use machine vision technology N=667

Q1A. Which of the following terms best describes the technology used to provide image/sensor-based automatic inspection and analysis for such applications as quality inspection, process control, and robot guidance.

Companies across industry sectors are embracing machine vision

A booming and rapidly advancing technology, machine vision is used widely across a range of different manufacturing and industrial applications, and usage of machine vision in relevant processes is very high.
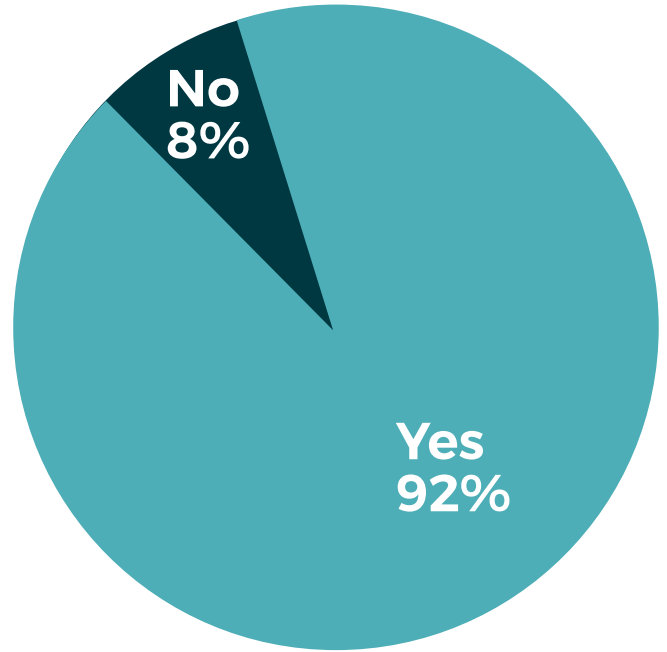
Of those who are using machine vision, 45% are using it in either all or most of their relevant processes, while just 25% are only using machine vision technology in a limited capacity.

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This survey revealed that **92% of respondents are using machine vision technology**

Currently using Machine Vision

No
8%

Yes
92%

The research shows the vast majority of companies are utilizing machine vision

With both smaller and larger companies predicting their machine vision usage will rise by 37% to cover 63% of their relevant processes in two years' time, the global market is expanding quickly as businesses embrace the technology. However, there's plenty of room for growth: almost 8 out of 10 manufacturers identified processes that could benefit from the addition of machine vision technology.

Increased usage over the coming years is largely expected to come from applying machine vision technology to processes which are currently carried out using other methods (such as manual inspection or barcode scanning).

Looking in depth at the industrial robots segment, a key application for machine vision, research by market intelligence specialist Interact Analysis shows the market for machine vision hardware used with industrial robots was worth an estimated $947 million in 2022. The market is predicted to reach $1.6 billion by 2027, growing at a compound annual rate of 11.3%.
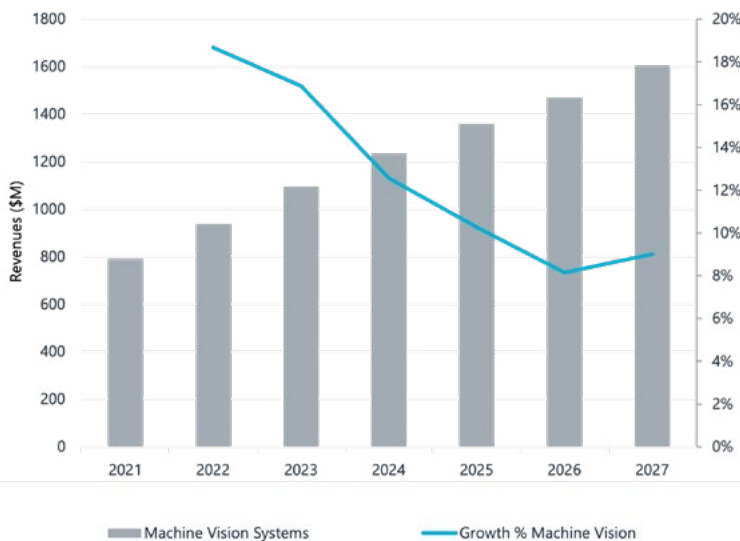
The proportion of industrial robots equipped with machine vision is expected to grow over the next 5 years with the highest attachment rates likely to be in delta robots employed in pick and place or sorting operations.

The number of picking robots sold is expected to be 10x higher in 2030 than it is in 2023. This growth will have a positive impact on the machine vision market, increasing demand, especially for 3D systems.

Revenue ($M) and Annual Growth in Machine Vision for Industrial Robots

Legend: Machine Vision Systems — Growth % Machine Vision

Machine vision use in industrial robots is forecast to climb steadily through to 2027

8 in 10

MANUFACTURERS IDENTIFIED PROCESSES THAT COULD **BENEFIT FROM MACHINE VISION TECHNOLOGY**

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The market for machine vision in industrial robots is expected to **grow to $1.6 billion by 2027**, representing a predicted compound **annual growth rate of 11.3%.**

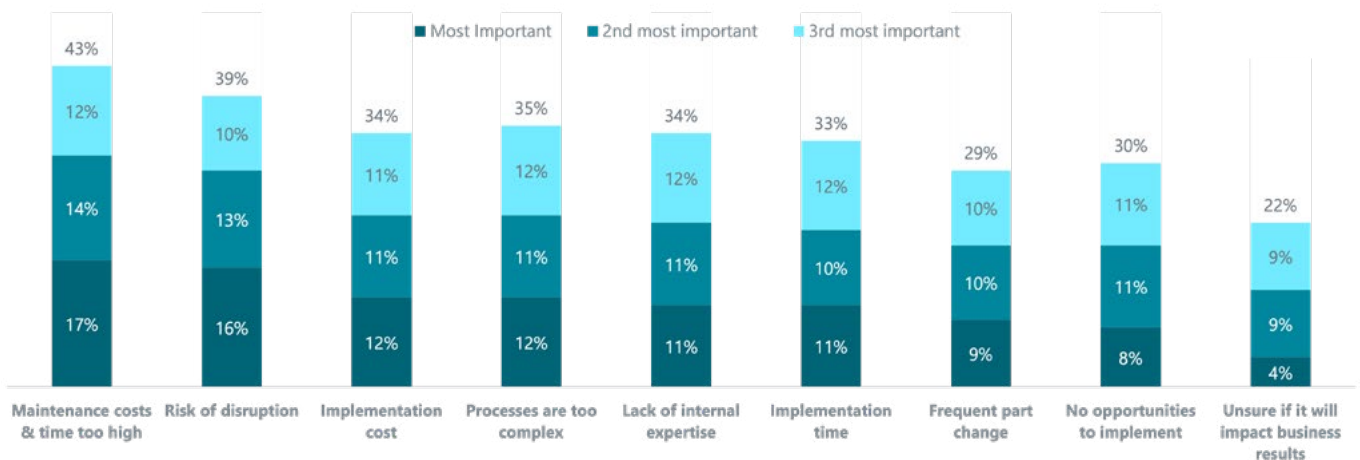ACCORDING TO MARKET INTELLIGENCE SPECIALIST **INTERACT ANALYSIS**

Ongoing support and advice could address machine vision barriers to growth

While most companies are using machine vision to some degree, over half are using it only in some or limited ways. Survey respondents cited maintenance costs and complexity, risks of disruption, upfront costs, and lack of expertise as obstacles preventing more widespread adoption.

Although upfront cost is a factor, it is not the most significant obstacle, in part because the ROI is sufficiently high: improving quality control and reducing costly stoppages immediately delivers both hard cost savings and soft value benefits.

To address some of these barriers, machine vision providers should emphasize partnership and ongoing support for clients, rather than a purely transactional relationship. This should include both the initial integration process, and ongoing maintenance and upkeep.

Obstacles in Using or Expanding Machine Vision Technology

Legend: ■ Most Important ■ 2nd most important ■ 3rd most important

Obstacle	Most Important	2nd most important	3rd most important	Total
Maintenance costs & time too high	17%	14%	12%	43%
Risk of disruption	16%	13%	10%	39%
Implementation cost	12%	11%	11%	34%
Processes are too complex	12%	11%	12%	35%
Lack of internal expertise	11%	11%	12%	34%
Implementation time	11%	10%	12%	33%
Frequent part change	9%	10%	10%	29%
No opportunities to implement	8%	11%	11%	30%
Unsure if it will impact business results	4%	9%	9%	22%

Maintenance, skills/knowledge gaps and concerns about downtime are all key obstacles to adoption of machine vision technology

> "Although upfront cost is a factor, **it is not** the most significant obstacle to adopting machine vision technology.

Machine vision information, support, and guidance may be crucial to adoption

There is overwhelming consensus (94%) among decision makers that organizations would benefit from seeing the potential applications of machine vision. Therefore, there is significant scope for wider information sharing about the benefits and potential applications of solutions.

Ongoing support will play a key role in the future, as 93% of respondents agree or strongly agree their

organizations would benefit from ongoing support and service for the machine vision technology they already have in place. Additionally, 80% of those questioned said their company needs guidance and support integrating machine vision with existing systems and 75% want guidance in measuring the impact of machine vision. Greater understanding of how to get the most out of machine vision, on developing metrics and analyzing

their overall impact, and greater support and service will all help to drive the market.

There is also considerable potential for improving and updating solutions in place across industry sectors, as 86% of those polled agree or strongly agree the machine vision technology at their organization could be improved or updated.

Maintenance of machine vision technology split across many roles

Ongoing maintenance of machine vision typically falls to mechanical/controls engineers, vision engineers, and maintenance technicians (16-20% for each role across bar code reading/scanning, vision sensors, and vision systems).

As the chart below demonstrates, quality engineers are more involved in the maintenance of vision sensors

and vision systems than they are for bar code scanners. IT engineers (10-12% across all three categories – bar code reading/scanning, vision sensors, and vision systems) also bear some responsibility, as do automation engineers (primarily for bar code reading scanners - 13%). Logistics & distribution technicians, and machine operators & technicians occasionally have responsibility for maintenance.

Responsible for Maintaining Machine Vision Products & Services

	Bar Code Reading/Scanning	Vision Sensor	Vision System
Mechanical/Controls Engineers	17%	20%	17%
Vision Engineers	19%	17%	16%
Maintenance Technicians	17%	17%	16%
Quality Engineers	8%	14%	13%
IT	12%	10%	11%
Automation Engineers	13%	10%	8%
Logistics & Distribution Technician	9%	8%	10%
Machine Operators & Technicians	5%	5%	8%
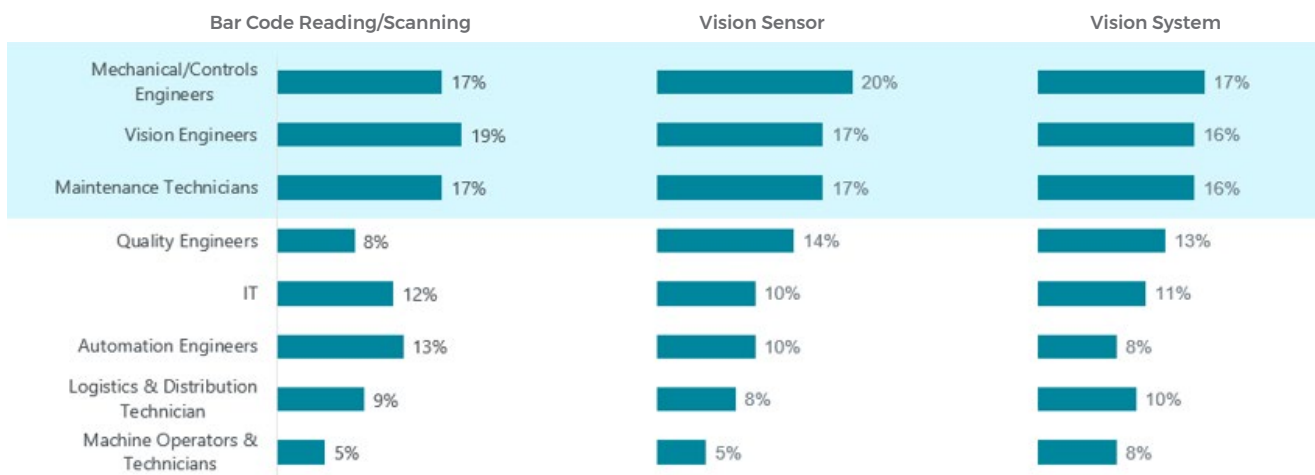
BASE: ALL RESPONDENTS N=723
Q9b. What function is ["is" IF USAGE=1 YES, "would be" IF USAGE=2 NO] primarily responsible for the maintenance/update of these Machine Vision products of services?

Companies give responsibility for machine vision maintenance to in-house engineers and technicians
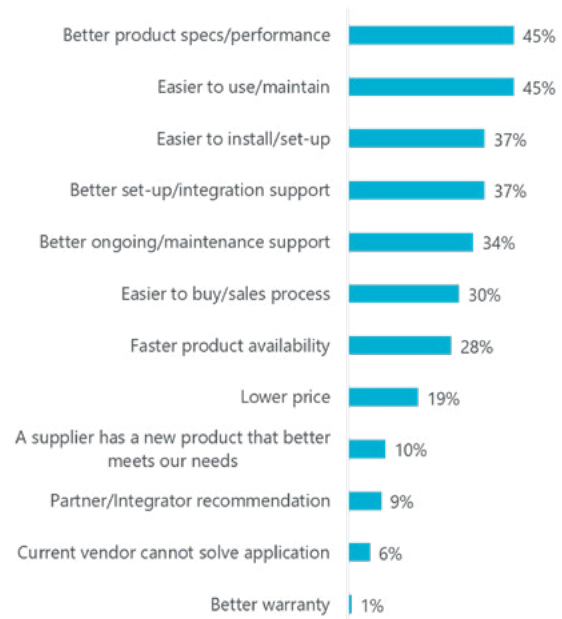
Industrial machine vision selected on ease of use, performance, and support services

Better product specifications/product performance and the ongoing ease of use/ease of maintenance of machine vision technology are the top two reasons for switching machine vision vendor for 45% of customers.

This focus on ease of use, ongoing maintenance, and upkeep ties in with other highly rated factors, all associated with support from vendors. These include ease of installation/set-up (37%), better set-up/integration support (37%), and better ongoing/maintenance support (34%). Skills gaps within the workforce mean companies are looking for machines that are easy to use, maintain, and set up, and having support with that process is important. Also of note is the priority given to products being easier to buy/having an easy sales process (30%) and fast availability (28%), while price (19%) is much less important than the quality of the service offered.

Top 3 Reasons for Switching Machine Vision Vendor

Reason	%
Better product specs/performance	45%
Easier to use/maintain	45%
Easier to install/set-up	37%
Better set-up/integration support	37%
Better ongoing/maintenance support	34%
Easier to buy/sales process	30%
Faster product availability	28%
Lower price	19%
A supplier has a new product that better meets our needs	10%
Partner/Integrator recommendation	9%
Current vendor cannot solve application	6%
Better warranty	1%

BASE: USE MACHINE VISION TECHNOLOGY N=667
Q19. What would be the top 3 reasons to switch from existing machine vision vendor relationship? (Select top 3)

Performance, ease of use, and support all rated highly for machine vision vendor switching considerations
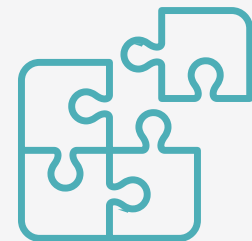
for switching machine vision vendor:
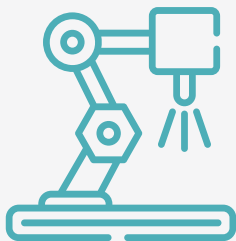
Better product specs and performance
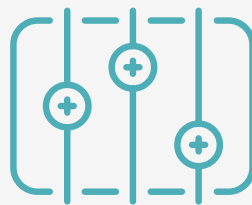
Easier to use and maintain

Easier to install and set up

Providing continuous support to customers is central to removing the key barriers to machine vision adoption, which are: skills/knowledge gaps regarding the implementation and ongoing operation of technology, and concerns around downtime and maintenance.

Boosting productivity and quality come out as top machine vision benefits

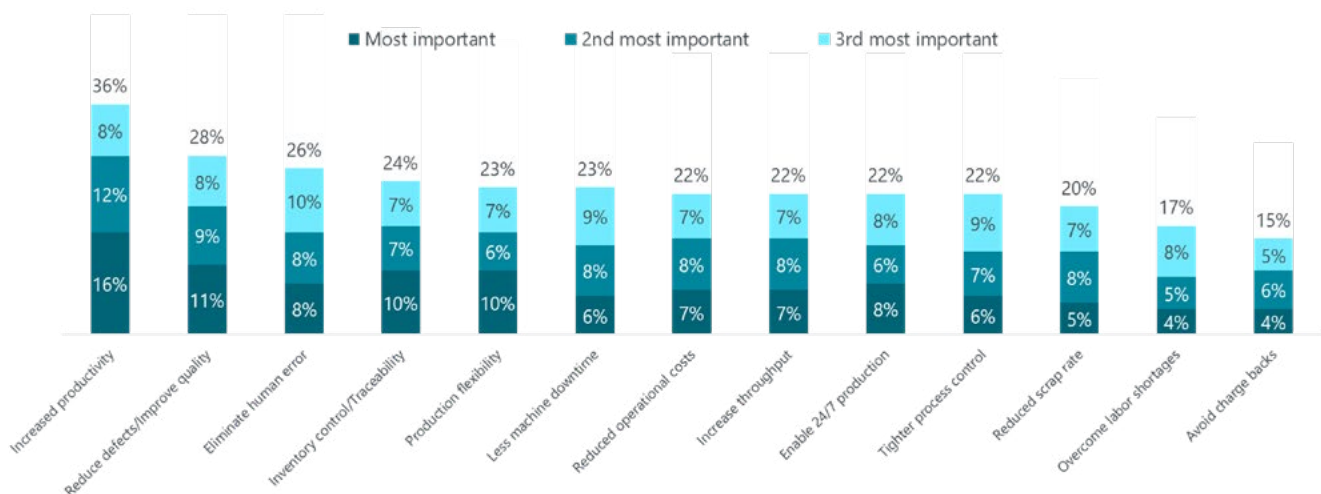**Increased productivity is the most important benefit of investing in a machine vision product** (selected as a top three benefit by 36% of those questioned). This was followed by reducing defects/improving quality (28%) and eliminating human error (26%), demonstrating the critical improvements to accuracy across a range of applications and processes that machine vision offers.

Given the spread of responses across a wide range of different benefits, it is clear industrial machine vision technology is providing companies with an array of advantages, many of which cover improving efficiency (productivity, throughput, 24/7 production), enhancing quality (reduced scrap rate, human error), and visibility (traceability, tighter process control). Interestingly, overcoming labor shortages was far less important to respondents when it comes to benefits obtained through the use of machine vision, demonstrating the benefits of machine vision technology are not perceived to be replacing, but rather enhancing, employees' work.

Most Important Benefits of Machine Vision Technology

■ Most important   ■ 2nd most important   ■ 3rd most important

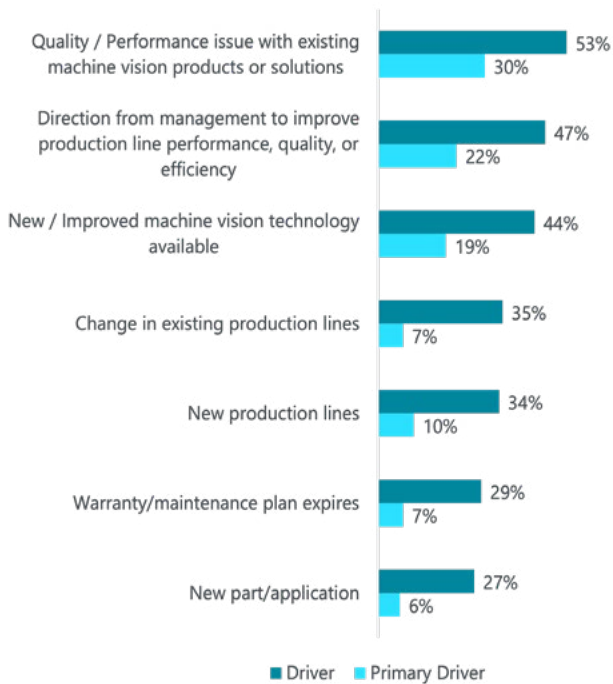| Benefit	Most important	2nd most important	3rd most important	Total
Increased productivity	16%	12%	8%	36%
Reduce defects/improve quality	11%	9%	8%	28%
Eliminate human error	8%	8%	10%	26%
Inventory control/Traceability	10%	7%	7%	24%
Production flexibility	10%	6%	7%	23%
Less machine downtime	6%	8%	9%	23%
Reduced operational costs	7%	8%	7%	22%
Increase throughput	7%	8%	7%	22%
Enable 24/7 production	8%	8%	8%	22%
Tighter process control	6%	7%	9%	22%
Reduced scrap rate	5%	8%	7%	20%
Overcome labor shortages	4%	5%	8%	17%
Avoid charge backs	4%	6%	5%	15%

BASE: ALL RESPONDENTS N=723

Q7. Which of the following benefits, if any, would the use / expanded use of Machine vision (including barcode reading, vision sensors, and vision systems) have on your organization?

*Productivity, improved quality, traceability and flexibility are perceived as top benefits of machine vision*

What are the key reasons behind selecting machine vision technology?

Triggers for Investing in Machine Vision

Trigger	Driver	Primary Driver
Quality / Performance issue with existing machine vision products or solutions	53%	30%
Direction from management to improve production line performance, quality, or efficiency	47%	22%
New / Improved machine vision technology available	44%	19%
Change in existing production lines	35%	7%
New production lines	34%	10%
Warranty/maintenance plan expires	29%	7%
New part/application	27%	6%

■ Driver   ■ Primary Driver

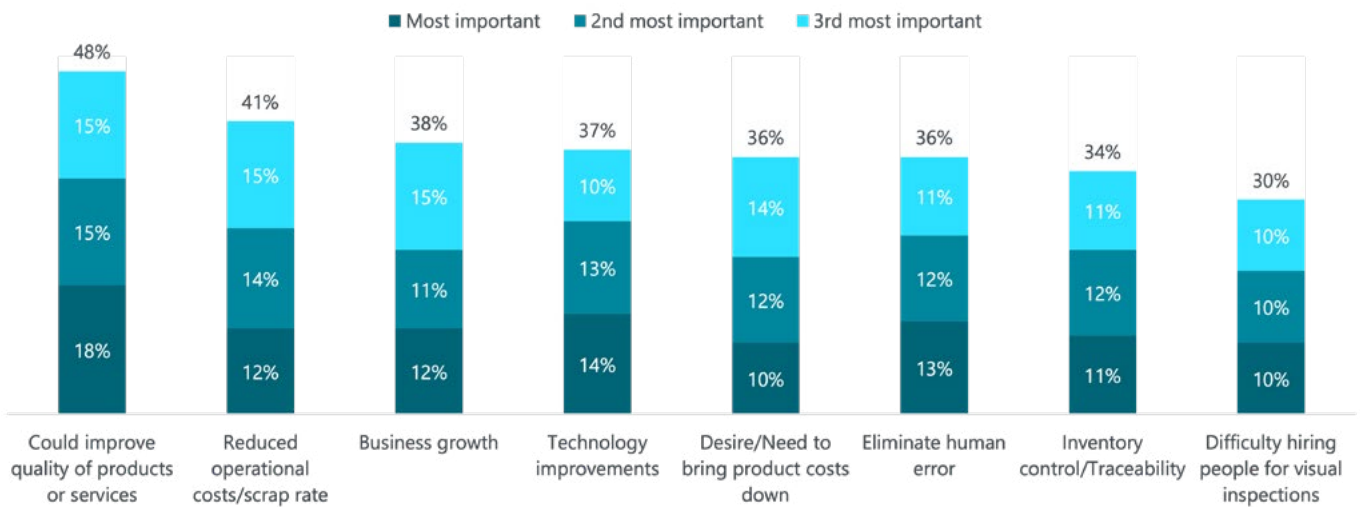*Quality issues, performance improvements and new tech are all driving purchasing decisions*

One of the primary drivers of investment is getting better performance out of existing machine vision systems, with the availability of new/improved machine vision solutions acting as a trigger for 44% of companies purchasing machine vision solutions, and 53% driven by problems with existing technology. Few respondents say they would invest in new technology just for changes such as a new part or application or their warranty ending.

44%

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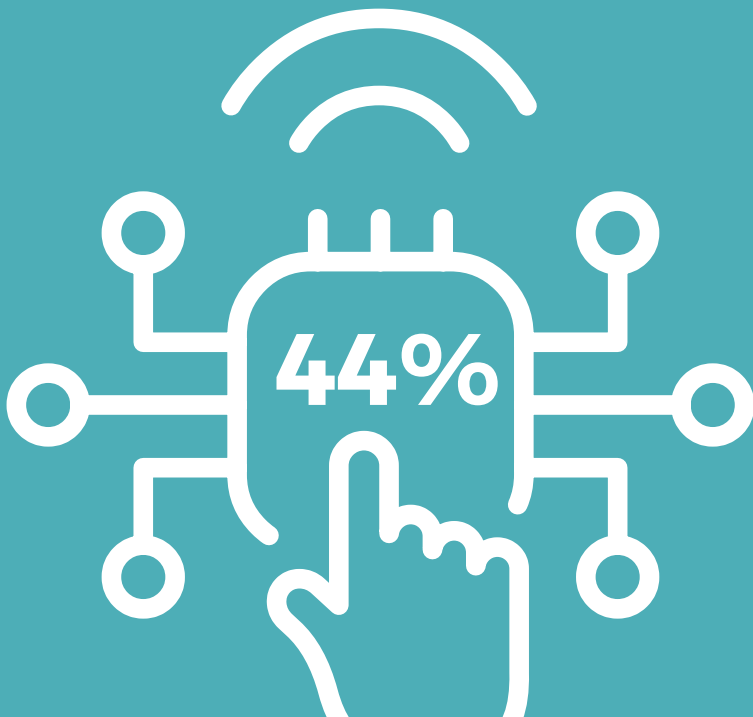
The availability of new and improved machine vision technology is **a trigger for 44% of companies purchasing machine vision solutions.**

Once again, potential quality improvements and cost reductions are motivators for those looking to add machine vision to a new process. Technological improvements also rated highly with respondents, demonstrating the importance of new features and benefits, while at the other end of the scale labor and skills shortages aren't strong incentives for adding machine vision to a new process.

Triggers for Adding Machine Vision to New Processes

Legend: ■ Most important ■ 2nd most important ■ 3rd most important

Category	Most important	2nd most important	3rd most important	Total
Could improve quality of products or services	18%	15%	15%	48%
Reduced operational costs/scrap rate	12%	14%	15%	41%
Business growth	12%	11%	15%	38%
Technology improvements	14%	13%	10%	37%
Desire/Need to bring product costs down	10%	12%	14%	36%
Eliminate human error	13%	12%	11%	36%
Inventory control/Traceability	11%	12%	11%	34%
Difficulty hiring people for visual inspections	10%	10%	10%	30%

Machine vision purchases are often influenced by reducing costs or improving quality

AI integration can meet machine vision customers' needs

As machine vision matures it is becoming more advanced and user friendly. AI is accelerating this process, paving the way for simplified products and improved user experience. Machine learning systems enhanced with AI technology can offer specific advantages over traditional machine vision for companies that are seeking accurate, repeatable results but have little machine vision experience and limited resources for highly trained engineers.

For instance, by integrating AI with machine vision for analysis of defects, inspection systems can be trained to distinguish between acceptable and unacceptable anomalies, detect flaws that have not been identified before, and even pinpoint the causes of quality control issues, all while operating with greater consistency and speed than manual inspections. Furthermore, advances in AI have made technology that previously needed machine vision experts accessible to, and easily operated by, maintenance technicians.

Machine vision systems with AI integration appear poised to appeal to customers looking to change vendors. AI promises to address three of the most frequently mentioned factors in vendor switching: better performance (cited by 45% of respondents), easier use and maintenance (also 45%), and easier installation and set up (37%). The research demonstrates improving quality and reducing costs are the benefits most sought by machine vision customers, while technological advancements and new features/applications are significant reasons for investment. This indicates we will see rapid adoption of AI over the next two years.

With demonstrated capabilities that address some of the biggest concerns faced by machine vision customers, AI technology is ideally positioned to play a significant role in the future of machine vision.

> " Machine learning technology can offer **specific advantages** over traditional machine vision for companies that are seeking **accurate, repeatable results.**

Global future looks bright for machine vision

The key benefits cited by organizations for investment in machine vision solutions were given as:

- **Improving quality**
- **Productivity/Cost cutting**
- **Traceability**

Companies are aware of the significant benefits machine vision can offer to their bottom line and their reputation. They are looking for new ways to apply it to their operations and processes.

**When <u>selecting machine vision solutions</u>, companies want:**

- **Performance**
- **Ease of use/maintenance**
- **Ongoing customer support**

Labor market shortages and cost rate relatively low as drivers for investment.

The availability and capabilities of AI and 3D vision technology will continue to grow, delivering many of the benefits and features customers are seeking from machine vision technology.

Demand for machine vision is predicted to continue growing as new features are added and it is applied by more companies to a wider range of applications. As part of the move towards more intelligent, digitized and advanced IIoT manufacturing and logistics solutions, machine vision technology is providing new opportunities for productivity and efficiency.

The future for machine vision looks bright and clear.
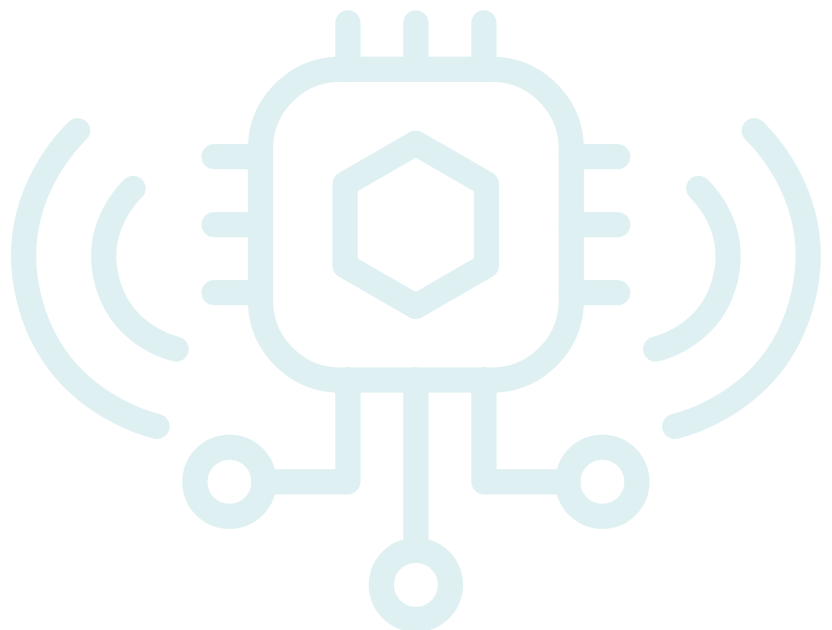
About Cognex Corporation

Cognex Corporation invents and commercializes technologies that address some of the most critical manufacturing and distribution challenges. We are a leading global provider of machine vision products and solutions that improve efficiency and quality in high-growth-potential businesses across attractive industrial end markets. Our solutions blend physical products and software to capture and analyze visual information, allowing for the automation of manufacturing and distribution tasks for customers worldwide. Machine vision products are used to automate the manufacturing or distribution and tracking of discrete items, such as mobile phones, electric vehicle batteries and e-commerce packages, by locating, identifying, inspecting, and measuring them. Machine vision is important for applications in which human vision is inadequate to meet requirements for size, accuracy, or speed, or in instances where substantial cost savings or quality improvements are maintained.

Cognex is the world's leader in the machine vision industry, having shipped more than 4 million image-based products, representing over $10 billion in cumulative revenue, since the company's founding in 1981. Headquartered in Natick, Massachusetts, USA, Cognex has offices and distributors located throughout the Americas, Europe, and Asia. For details, visit **cognex.com**

About Interact Analysis

With over 200 years of combined experience, Interact Analysis is the market intelligence authority for global supply chain automation. Our research covers the entire automation value chain – from the technology used to automate factory production, through inventory storage and distribution channels, to the transportation of the finished goods. The world's leading companies trust us to surface robust insights and opportunities for technology-driven growth. To learn more, visit **www.InteractAnalysis.com**