LANDING AI | Association for Advancing Automation

2020 State of AI-Based Machine Vision

High confidence, growing adoption and many challenges – trends and insights based on a survey of 110 companies

Artificial Intelligence is transforming every industry, and manufacturing is no exception.

Of the many use cases in manufacturing, visual inspection—a task that involves using human eye or machine vision to verify if a product is free of defects or if parts are correctly assembled—is well-suited for AI. According to a study by McKinsey & Company, AI-powered quality inspection can increase productivity by up to 50% and defect detection rates by up to 90% compared to manual inspection.

Given these benefits, have businesses started using AI in visual inspections? If so, what is the level of adoption, and what are the challenges? These questions and more drove Landing AI, an industrial AI company, and the Association for Advancing Automation to launch this survey on the state of AI-based machine vision.

The survey polled 110 companies from the manufacturing and machine vision industry with both multiple and single choice questions. Respondents who took the survey perform a variety of roles and include C-suite executives, automation engineers and plant managers. One main takeaway is that businesses have high confidence in the effectiveness of AI, and a growing number of companies are already using deep learning-based machine vision for automated visual inspection.

In this report, we will highlight four key findings, detail those discoveries, and provide analysis.

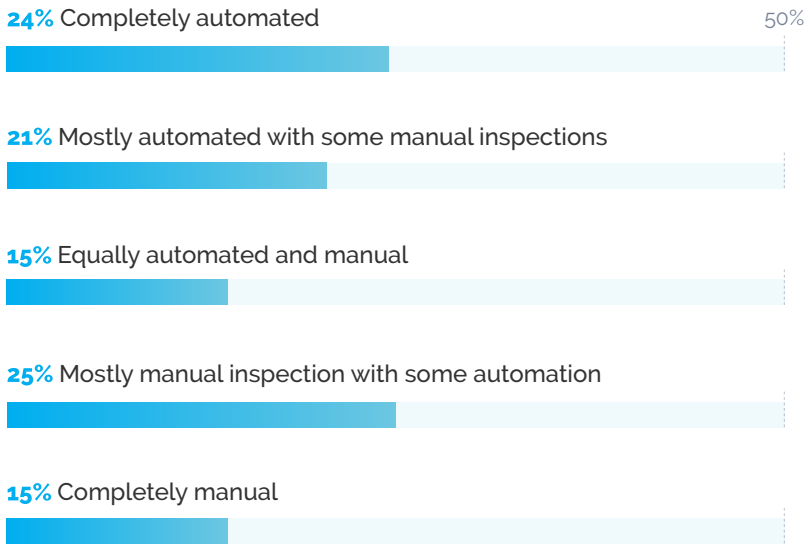
Key Finding 1

In a heavily automated sector, manual inspection is still playing an important role with 40% saying their inspection is either completely or mostly manual.

Although historically done by human workers, many visual-inspection tasks on modern assembly lines have been automated using traditional rule-based machine vision. The survey reflects this trend where more than 60% said they use automation in some form, while 40% said their visual-inspection process is either completely or mostly manual.

Automated inspection overcomes many of the limitations of manual inspection systems. In manufacturing, visual inspection errors often take one of two forms. The first is missing an existing defect. The second is the incorrect identification of a defect. Misses lead to a loss in quality while incorrect identifications result in unnecessary production costs and overall waste.

How is your company currently conducting visual inspections?



These errors are often traced back to the undependability of human vision alone, imprecision of eyesight, and cost of labor.

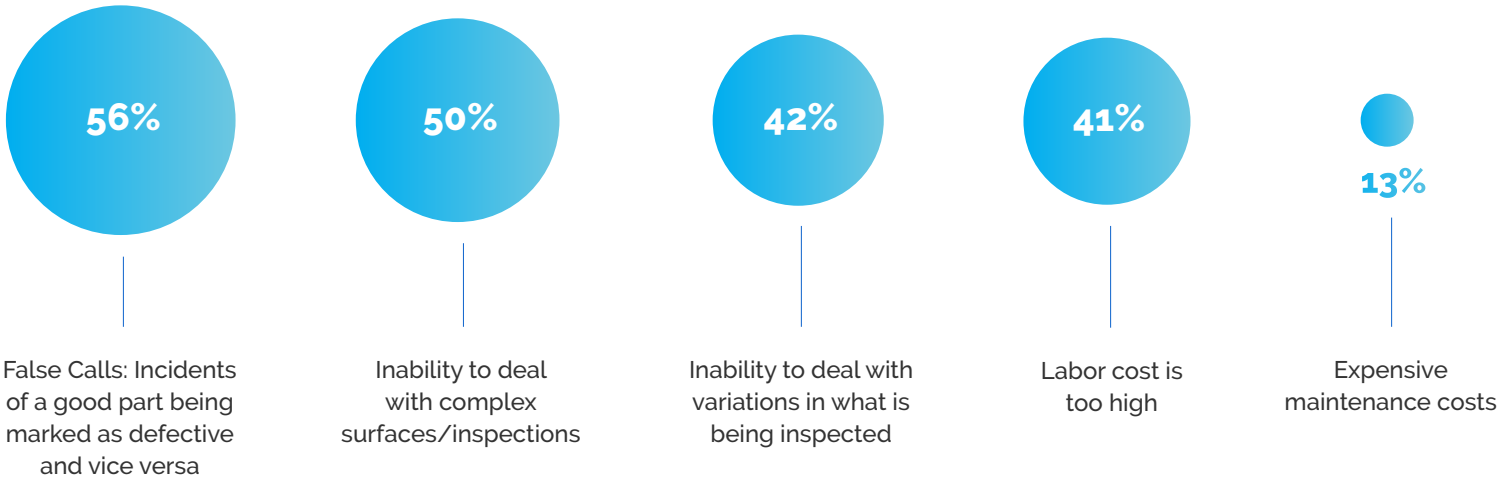
In response to the question about the main issue with the current visual inspection method, respondents said their top complaints are false calls (56%), which are incidents of a good part being marked as defective and vice versa, the inability to deal with complex surfaces (50%), and the inability to deal with variations in what is being inspected (42%).

20-30%

Error rates of 20% to 30% are frequently reported across multiple types of manual inspection tasks.

— Sandia National Laboratories

What are the main issues with your current visual inspection method?



Key Finding 2

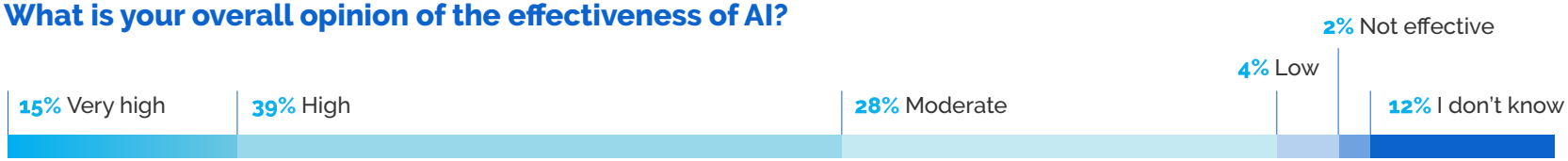
The confidence level of businesses regarding AI effectiveness is high with 26% saying they are already using AI for visual inspection.

To face the growing challenges with quality issues and product customization, companies are utilizing AI to turbocharge their visual inspection projects. The survey showed that 26% of respondents are already using AI while 41% say they plan to in the future.

Of those who are using AI, improved accuracy is the top benefit (62%), followed by being able to automate inspection tasks that had to be performed manually (48%). AI was also cited as particularly effective in dealing with variations in products being inspected (45%).

Many companies see AI as the tool for increasing the value of their inspection processes. Survey respondents showed a high degree of confidence in the effectiveness of AI, with 55% of respondents saying their overall opinion on the effectiveness of AI is either high or very high. Just 5.5% rated AI's effectiveness as low or not effective.

What is your overall opinion of the effectiveness of AI?



47%

Since the start of the pandemic, 47% of AI investments were unchanged, and 30% of organizations actually planned to increase such investments.

— Gartner

"With more AI solutions taking hold in manufacturing, vision-inspection solutions have had the most widespread adoption," says Robert Huschka from the Association for Advancing Automation. "The system **far surpasses human vision in quality and quantity measurements** because of speed, accuracy, and repeatability."

What are the main benefits from using AI-powered solutions?

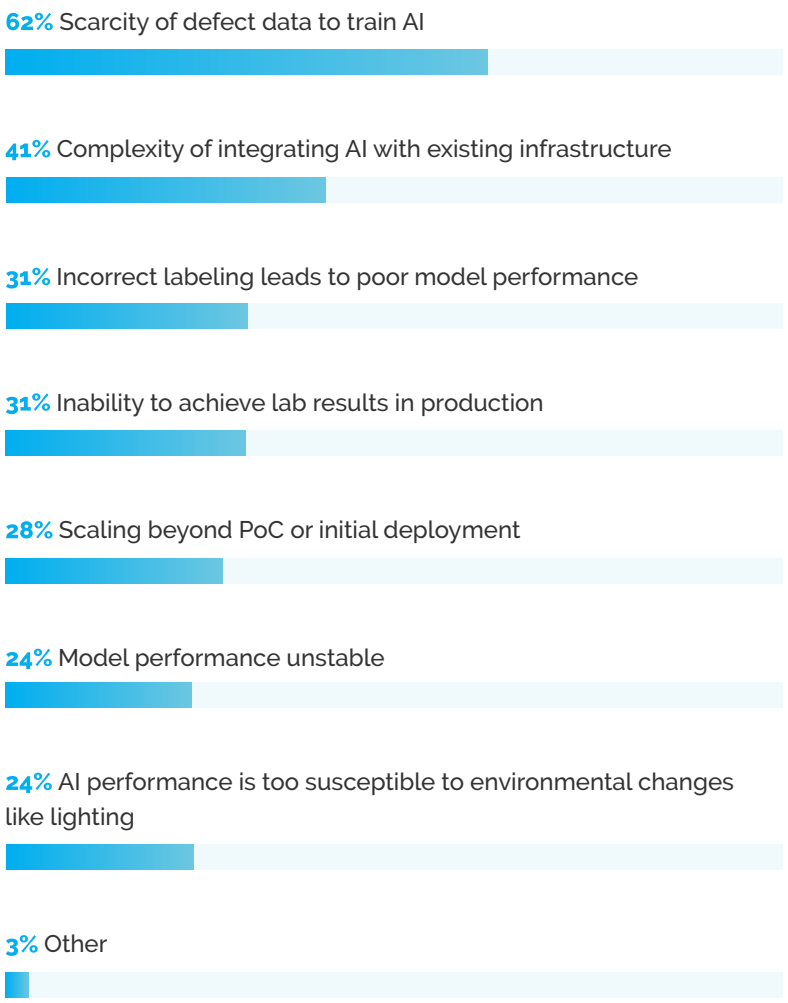
Key Finding 3

When it comes to using AI, scarcity of data, complexity of integrating AI within existing infrastructure, and the inability to achieve lab results in production are the top three challenges.

The survey also showed some of the barriers that companies face in deploying AI solutions. Some cited the high cost of AI solutions as well as the difficulties in collecting data to train machine-learning algorithms. Of those surveyed, 62% were concerned about the scarcity of critical data.

> "Machine vision AI tasks are model and data dependent," wrote one respondent. "Curating such a process and collecting sufficient data is always a tedious task and has been the main reason for not using an AI model so far."

What are the main challenges your company faces with AI-powered solutions?



Companies were also concerned about scalability as solutions moved out of pilot programs, with 27% saying they struggled when moving from proof-of-concept to initial deployment. And, 31% said they were unable to mirror the lab results in their production processes.

Customers of AI systems also want to be assured that what they are purchasing will evolve as the technology improves.

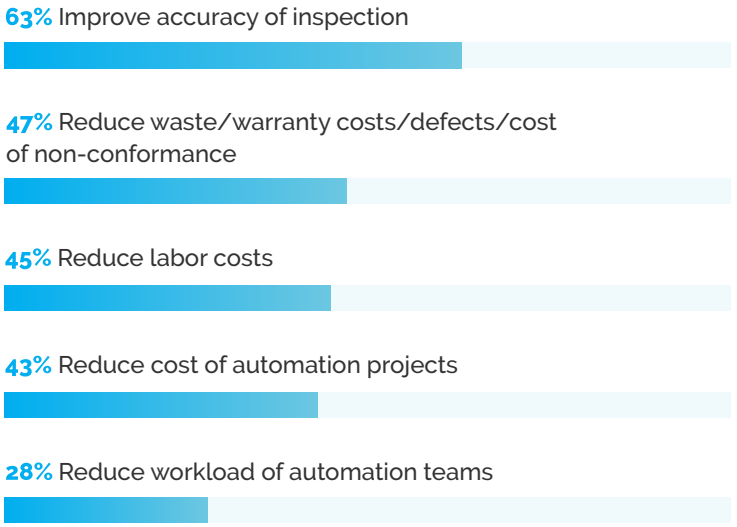
"Any AI/deep learning system purchased for the plant needs to have the flexibility to run third-party equipment/software, expand, upgrade, and modify without investing a large amount of money in additional or new equipment," wrote one respondent. "I do not want to purchase something that is outdated in six months."

14%

As of January 2019, 14% of automotive OEMs have delivered AI implementations at scale.

— Capgemini

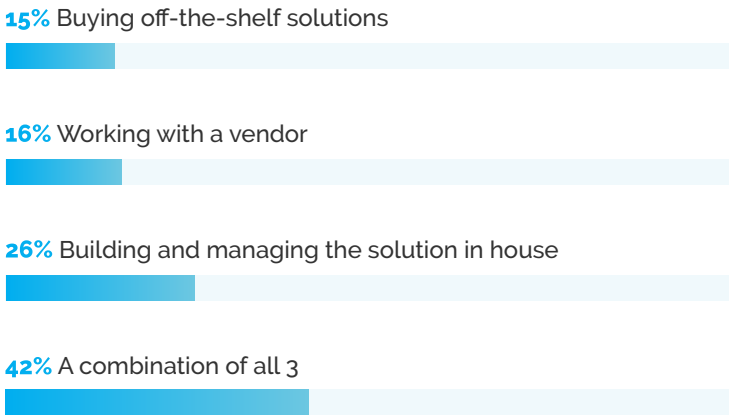
What are your primary business goals?



Key Finding 4

Most businesses prefer to have ownership of AI projects either by developing in house or working with a vendor.

If your company were to adopt AI-powered visual inspection solutions, what would be the preferred ways to achieve this?



Figures may not add up to 100% due to rounding.

It's clear that businesses are ready to embrace solutions that maximize productivity and business results. More than 26% of businesses wanted to build and manage their vision solutions in house, while only 15% said they would buy off-the-shelf solutions. The most popular approach, however, is a hybrid mode where 41% said they want to build and manage their vision solutions in house while working with a vendor.

A hybrid approach reflects many companies' needs and challenges. On one hand, due to IP and security concerns, many companies prefer to develop and manage solutions in house. On the other hand, with shortages in the AI talent pool, it may not be realistic for many enterprises—especially small- and medium-sized businesses—to build their own AI vision-inspection systems.

20%

Deep learning-based, machine vision techniques in smart manufacturing will see an annual growth rate of 20% between 2017 and 2023.

— ABI Research

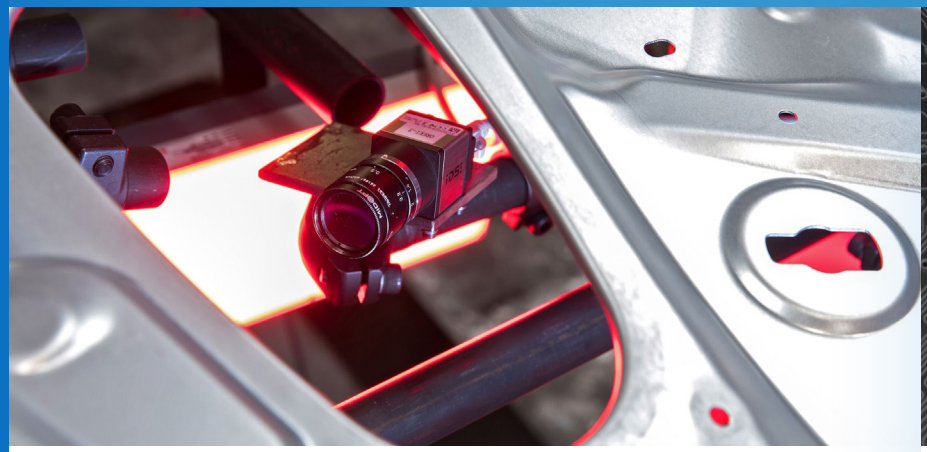
In a recent report, Gartner wrote, "AI is starting to deliver on its potential, and its benefits for businesses are becoming a reality."

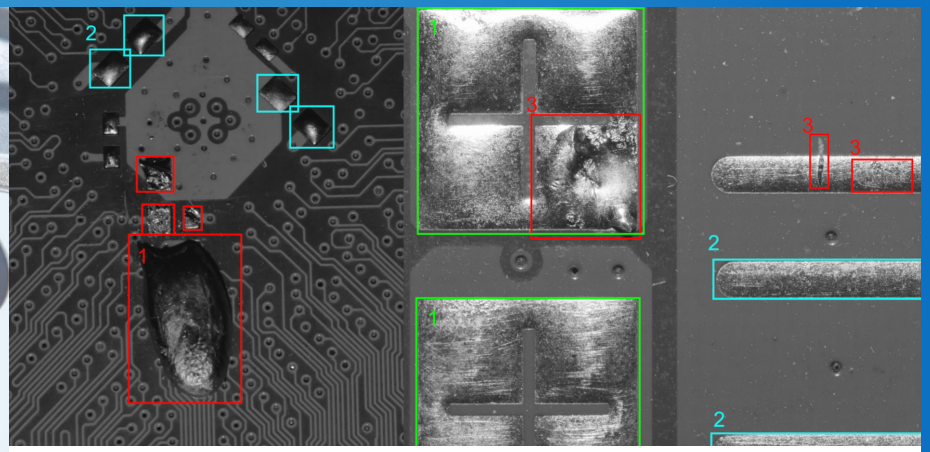
This holds true for AI-based machine vision. As the survey shows, those early adopters who implemented AI have already begun reaping benefits that include improved accuracy, flexibility and reduced cost. While our survey reinforces the emergence of AI within the manufacturing sector, widespread adoption is still a long way away. Successfully deploying and scaling AI-based solutions on a factory floor requires deep knowledge and expertise from both AI experts and domain experts. A strong partnership and collaboration between the two groups will unleash great potential and move the industry forward.

"Conventional machine-vision technology remains popular in the manufacturing factory, due to its proven repeatability, reliability, and stability. However, the emergence of deep-learning technologies opens the possibility of expanded capabilities and flexibility, leading to more cost-efficiency and higher production yield. Deep learning technologies offer so much potential that deep learning-based, machine vision techniques in smart manufacturing will see an annual growth rate of 20% between 2017 and 2023, with a revenue that will reach US $34 billion by 2023."

— ABI Research

Manufacturing companies in different sectors are already leveraging AI-based machine vision to perform visual inspection. Here are some examples:





Audi is a pioneer in using AI-based vision for visual inspection.

The company uses a deep learning-based system that recognizes and marks cracks in sheet metal parts at a plant in Ingolstadt, Germany. The software, according to the company, can detect the finest cracks in sheet metal with the utmost precision and reliably marks the spot. To develop this system, the Audi team spent months training the artificial neural network with several million test images from seven presses at Audi's Ingolstadt plant and from several Volkswagen plants. Commenting on this remarkable achievement, Frank Loydl, Chief Information Officer at AUDI AG, said "**artificial intelligence and machine learning are key technologies for the future at Audi.**"

— Audi MediaCenter

Landing AI has been working with companies from different manufacturing sectors to solve various kinds of visual inspection problems using AI.

With Landing AI's end-to-end visual inspection platform, **a global steel manufacturer was able to improve AI model accuracy from 76% to 93% on 38 defect classes in only 2 weeks**. This enabled more accurate detection of steel defects. In another case, a leading global compressor manufacturer was able to automate leak detection using an AI-based visual solution co-developed by Landing AI and the company. To identify leaky compressors, cameras were set up in front of glass water tanks where compressors were submerged one at a time. The cameras then captured and sent visuals to a deep learning-based system to detect and analyze the emergence of any air bubble leaks, thereby indicating a leaky or defective compressor.

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About Landing AI and The Association for Advancing Automation

Landing AI, a company founded by renowned AI expert Andrew Ng, provides an end-to-end AI platform specifically designed for industrial customers to build, deploy and manage AI-powered visual inspection solutions. The Association for Advancing Automation is a global trade association that represents more than 1,250 in the robotics, machine vision, motion control, and automation industries.