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AI Machine Vision in the Automotive Industry

Benchmark Report

FOREWORD

Machine Vision and AI: An Unbeatable Team

The world of artificial intelligence (AI) doesn't stand still, and that's certainly true when we look at the machine vision landscape today, with new offerings powered by deep learning AI. The findings of this new report from Zebra Technologies also help us to understand why industries like automotive manufacturing need better visual inspection solutions. Industry and societal demands won't be met with the current hard to train, difficult to use and unreliable tools that too many are still using.

It's my hope that this report will encourage all players and stakeholders in the automotive and machine vision industries to consider the outstanding capabilities AI-powered machine vision affords us today and work together to keep the UK's automotive manufacturing industry at the forefront of innovation.

Allan Anderson,

Chairman, UK Industrial Vision Association (UKIVA)

INTRODUCTION

Automotive original equipment manufacturers (OEMs) and their suppliers have the opportunity to elevate the role of the machine vision engineer, with modern machine vision solutions that leverage artificial intelligence (AI) such as deep learning. These new solutions are transforming machine vision applications with new levels of speed, accuracy, and the ability to handle complexity. Machine vision engineers are thinking and acting more like data and AI specialists with powerful tools to deliver new capabilities and efficiencies. But there are still many in the industry who are unaware of this new range of AI-powered machine vision systems or have not yet understood how they can improve inspection and measurement processes. It's important that manufacturers and suppliers in the UK and Germany understand how AI machine vision can help them overcome challenges they're facing with machine vision, such as hardware and software compatibility, financial costs, procurement times, maintenance, interoperability, and training.

To gain insights into the industry's AI maturity levels and top challenges, Censuswide surveyed 500 (250 in the UK and 250 in Germany) business owners, C-level executives, heads, directors, vice presidents, managers and engineers from automotive OEMs, tier 1 and tier 2 suppliers with revenues ranging from under 50 million GBP/58 million EUR to more than five billion GBP/5.9 billion EUR in June 2023. This report summarises some of the key highlights related to their views on current machine vision use, optical character recognition (OCR) challenges, AI maturity levels and future automation plans. Figures shown are the overall results for all respondents across the sample. These occasionally differ from an average across different categories due to different relative category sizes.

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WHAT ARE OEMs AND SUPPLIERS CURRENTLY USING MACHINE VISION FOR?

With the focus on compliance, safety, efficiency, sustainability, and the move toward hybrid and electric vehicles, the need for better quality/end of line inspection, traceability of parts across the supply chain, measurement, presence/absence, metrology and porosity inspection is more important than ever. The right combination of hardware and software leveraging AI deep learning can enhance these machine vision applications, including for more complex use cases. This table below shows how OEMs and suppliers apply their current machine vision solutions.

Quality/end of line inspection	Average	OEM	Tier 1	Tier 2
Germany	34.66%	36%	40%	21.74%
UK	36%	40.80%	32.50%	28.89%

Traceability of parts	Average	OEM	Tier 1	Tier 2
Germany	31.87%	38.40%	23.75%	28.26%
UK	33.60%	40%	32.50%	17.78%

Gauging & measurement	Average	OEM	Tier 1	Tier 2
Germany	29.88%	35.20%	23.75%	26.79%
UK	34%	37.60%	28.75%	33.33%

Presence/ absence checks	Average	OEM	Tier 1	Tier 2
Germany	29.48%	34.40%	23.75%	26.09%
UK	29.60%	33.60%	23.75%	28.89%

Metrology (measurement)	Average	OEM	Tier 1	Tier 2
Germany	27.09%	23.20%	33.75%	26.09%
UK	29.60%	28%	35%	24.44%

Porosity inspection	Average	OEM	Tier 1	Tier 2
Germany	27.09%	23.20%	28.75%	34.78%
UK	29.60%	29.60%	28.75%	31.11%

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WHAT ARE THE CHALLENGES OF USING OPTICAL CHARACTER RECOGNITION TOOLS?

Many of the applications listed above—end of line inspection, traceability of parts, presence/absence— could require OCR. OCR isn't a new technology. It's been around for a long time and is a familiar tool for reading serial numbers, lot numbers, and vehicle identification numbers (VINs), for example, to ensure the correct components and parts are in the right place at the right time for the right model of vehicle. However, the problems using OCR are also familiar. They need a lot of training time, can be unstable when faced with a change in environment, and don't handle complex use cases well. Many existing OCR tools require OEMs and suppliers to invest a lot of time into setting up an application. These conventional OCR tools are strong under perfect conditions, but often struggle to read obscure and damaged characters, engraved and embossed formats, characters on reflective and curved surfaces, or changing and harsh lighting conditions, as seen below.

This table highlights the main challenges faced when using OCR:

OCR Challenges	Training time needed		Stability of the tool		Does not handle complex use cases well	
Average	43.6%	43.43%	38.4%	40.64%	33.6%	36.25%
OEM	50.4%	43.2%	47.2%	45.6%	39.2%	36.8%
Tier 1	41.25%	45%	23.75%	33.75%	30%	37.50%
Tier 2	28.89%	41.3%	40%	39.13%	24.44%	32.61%

UK Germany

OCR Challenges	Not easy to use		Not using/NA		No challenges	
Average	32.8%	31.87%	0.8%	1.99%	1.2%	0.8%
OEM	36.8%	27.2%	1.6%	2.4%	2.4%	1.6%
Tier 1	33.75%	41.25%	0%	1.25%	0%	0%
Tier 2	20%	28.26%	0%	2.17%	0%	0%

UK Germany

However, the latest OCR tools now come with a powerful type of AI called deep learning, which uses a neural network that mimics the human brain. These newer tools deliver very high accuracy straight out-of-the-box and work on both GPU and CPU. They can handle complex use cases, eliminate training time, ensure stability and are easy to use, even for a non-expert. Deep learning OCR tools don't require an engineer to have any deep learning training or machine vision expertise. Deep learning OCR comes with a ready-to-use neural network that is pre-trained using thousands of different image samples. This enables the user to create a robust OCR application in just a few simple steps. Deep learning OCR can offer a 'deep learning everywhere' experience for industrial imaging professionals whether on desktop PCs – Windows, Linux or Linux ARM – on Android handheld devices, and on Zebra's own smart cameras.

IS AI BEING USED IN MACHINE VISION PROJECTS?

In an environment where there are more demands than ever before, OEMs and suppliers have the opportunity to use technology – including AI – to help get the job done. The cognitive load and volume of data and distractions impacting a range of professionals—from front-line workers to people leaders to data scientists—have never been higher. AI capabilities help make work more meaningful, empowering workers to focus on the biggest areas of impact to the business. Today's AI-powered machine vision tools come with 'drag and drop' user interfaces, readymade tools and libraries, and flow-chart approaches to creating solutions, with support from experienced machine vision technology partners who can provide the advice, data quality and labelling guidance needed.

The automotive industry can leverage AI to enhance and automate machine vision applications and make data-driven decisions that optimally serve their own customers while also helping improve worker satisfaction. Transforming current 'systems of record' into 'systems of reality' is the only way to attain the level of enterprise intelligence businesses need to improve the speed and effectiveness of every workflow and create a perfectly orchestrated supply chain that can achieve frictionless fulfilment from the factory to the customer. AI will play an important part in this transformation.

Deep learning OCR is one tool among many software tools now available, helping engineers to think and act like data and AI specialists and transforming machine vision applications with AI. Machine vision software powered by deep learning is an exceptional solution for surface inspection, inspection of raw materials with naturally occurring variations, textile inspection, classification, segmentation, feature and anomaly detection.

This table shows how AI is being used in machine vision projects today.

Not using, but would like to know more	Average	OEM	Tier 1	Tier 2
Germany	15.94%	16.8%	16.25%	13.04%
UK	14.8%	12%	15%	22.22%

Not using, and don't see use/relevance	Average	OEM	Tier 1	Tier 2
Germany	34.26%	29.6%	35%	45.65%
UK	24%	26.4%	18.75%	26.67%

Using and satisfied with performance	Average	OEM	Tier 1	Tier 2
Germany	24.7%	28%	21.25%	21.74%
UK	38.4%	37.6%	43.75%	31.11%

Using, but think it could be working better/doing more	Average	OEM	Tier 1	Tier 2
Germany	18.73%	20.8%	18.75%	13.04%
UK	17.6%	18.4%	18.75%	13.33%

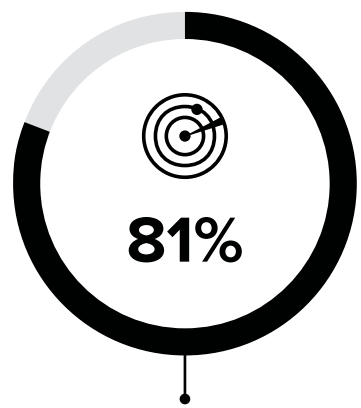
Currently looking to procure	Average	OEM	Tier 1	Tier 2
Germany	5.98%	4%	8.75%	6.52%
UK	4.8%	4.8%	3.75%	6.67%

None of the above	Average	OEM	Tier 1	Tier 2
Germany	0.4%	0.8%	0%	0%
UK	0.4%	0.8%	0%	0%

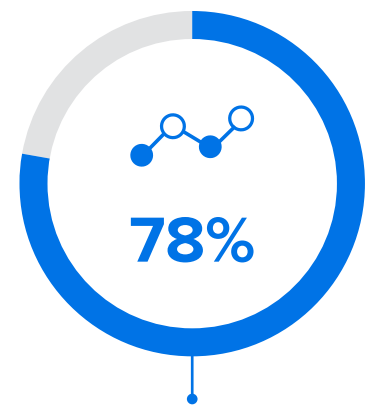
Fifty-six percent of automotive business leaders in the UK and 43% in Germany are currently using some form of AI such as deep learning in their machine vision projects. An average of 20% in both the UK and Germany say they are not using any AI but would like to know more or are currently looking to procure. The data also shows that when it comes to AI in machine vision projects, there is room for improvement. Of those using AI, 18% in the UK and 19% in Germany say their AI could be working better or doing more. Of concern is the 24% in the UK and 34% in Germany who say they are not using any form of AI. The figures suggest an educational and innovation gap to close between those who are informed and growing their AI machine vision maturity versus those who do not see the value. There is a need to understand and address barriers to AI adoption if organisations are to remain competitive and efficient.

WILL VISUAL INSPECTION BE AUTOMATED WITH MACHINE VISION IN THE FUTURE?

Zebra's Automotive Vision Study revealed that globally, 81% of automotive decision-makers say they could better meet business objectives if their organisations made more investments in technology (e.g. machine vision, machine learning, advanced data analytics) while 78% believe their organisation needs to be more innovative to remain competitive in the automotive industry. However, eight in ten (78%) agree their organisations struggle to keep up with the speed of technological innovation. Increased automation, including automation of visual inspection using machine vision, can unlock greater accuracy, speed, compliance, and safety. It also means front-line engineers can hand over inspection tasks to machine vision, leaving them more time for other valuable and needed workflows. The same study found that 24% are using machine vision today, with 44% planning to use it by 2027. That's a significant 83% increase. A 70% jump was also seen between current (27%) and future use (46%) of machine learning.



of automotive decision-makers say they could better meet business objectives if their organisations made more investments in technology



believe their organisation needs to be more innovative to remain competitive in the automotive industry

The table below outlines what UK and German OEMs and suppliers are thinking when it comes to automating visual inspection using machine vision over the next five years.

% Automation	UK				Germany			
	Average	OEM	Tier 1	Tier 2	Average	OEM	Tier 1	Tier 2
0%	0.80%	0.80%	1.25%	0.00%	3.19%	3.20%	1.25%	6.52%
1-10%	2.40%	1.60%	2.50%	4.44%	8.76%	9.60%	6.25%	10.87%
11-20%	2.80%	1.60%	6.25%	0.00%	10.36%	8.80%	16.25%	4.35%
21-30%	11.60%	11.20%	13.75%	8.89%	10.76%	11.20%	11.25%	8.70%
31-40%	21.60%	27.20%	13.75%	20.00%	18.73%	17.60%	16.25%	26.09%
41-50%	28.00%	36.80%	21.25%	15.56%	19.12%	25.60%	11.25%	15.22%
51-60%	17.20%	16.80%	16.25%	20.00%	17.13%	14.40%	18.75%	21.74%
61-70%	5.20%	3.20%	8.75%	4.44%	6.37%	6.40%	7.50%	4.35%
71-80%	4.80%	0.80%	10.00%	6.67%	5.18%	3.20%	10.00%	2.17%
81-90%	4.00%	0.00%	5.00%	13.33%	0.40%	0.00%	1.25%	0.00%
91-100%	1.60%	0.00%	1.25%	6.67%	0.00%	0.00%	0.00%	0.00%

This table shows a big difference among UK organisations. Twenty-one percent of OEM respondents in the UK plan to automate more than half of their visual inspection activities using machine vision, compared to 41% of tier 1 and 51% of tier 2 suppliers. It could suggest that quality and compliance requirements and the need to meet demand set down by OEMs is driving suppliers to embrace greater machine vision automation. Labour hiring challenges may also be a factor. In Germany, things are more evenly spread across the industry, with 24% of OEMs, 38% of tier 1 and 28% of tier 2 all aiming to automate more than half of visual inspection activities using machine vision. However, the gap between ambitious automation targets and AI machine vision adoption is apparent, despite the many challenges these organisations continue to face with conventional machine vision and OCR tools. This gap needs to be closed if OEMs and suppliers are to meet their goals and overcome current machine vision frustrations.

About Zebra Technologies Machine Vision Portfolio

Zebra provides an expansive ecosystem of machine vision products and fixed industrial scanners. Users can scale up and across portfolios with ease by adding on complimentary hardware or a software licence. Our flexible machine vision portfolio grows with your business, so you can effortlessly leverage vision technology to boost yields, lower costs, and enhance regulatory compliance. Modular machine vision and fixed scanning components let you right-fit your solution—and growth. Zebra's hardware portfolio features fixed industrial scanners, smart cameras and sensors, frame grabbers, vision controllers, the Indio I/O card and AltiZ 3D sensor, and machine vision cameras.

Our intuitive software is easier to use, and our systems require less hardware to implement. The Zebra Aurora suite of industrial automation software enables users of all experience levels to solve their track-and-trace and vision inspection needs. Experienced users will appreciate how easy it is to develop, refine and customise jobs, while first-time users can take advantage of interactive, step-by-step guidance to develop powerful applications for a wide range of industries.

Adapting an existing automation system? Our portfolio interoperates widely with third-party components so you can drive down time to install, acquire and deploy your vision. Zebra is an automation leader who understands how to protect your business, today and beyond. Our interoperable automation portfolio is enhanced by our extensive partner network, and Zebra OneCare offers 24/7 expert support, while product designs adhere to and adapt with industry standards to future-proof your investments.

Interoperable Flexibility:

Enjoy broad capabilities and user-friendly interfaces optimized for Zebra hardware, and easily integrated with a range of cameras, vision controllers and third-party systems.

Deep Learning + 3D Vision Expertise:

Our 3D tools identify hard-to-see, low-contrast features that are otherwise undetectable, and deep learning capabilities help solve problems far too complex for traditional machine vision algorithms.

Reduced Training Time:

Our intuitive software is backed by online training and support platforms for on-demand guidance, so users have options at their disposal to become proficient developers of vision applications.

Are you ready to benchmark your machine vision and AI maturity levels?

Get in touch with Zebra's specialist machine vision team today to take the next step forward.