2023 State of visual inspection

Survey report, March 2023

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Introduction and key findings

Introduction

Heavy industry is the backbone of our society, responsible for delivering reliable critical infrastructure ranging from electricity and natural gas to chemicals and fertilizers. To ensure reliability, organizations are tasked with maintaining infrastructure integrity – not a simple feat for complex, hazardous and often ageing infrastructure assets. As such, major efforts are being pursued by industrial companies to optimize the way assets are monitored and maintained.

Today, infrastructure such as transmission lines and gas storage tanks are typically monitored in a way that is extremely labor intensive, costly, complex, and often hazardous to perform, and therefore not conducted as frequently as they should. The result is that when failures do arise, they usually have wide implications, causing power outages, gas leaks, or fires, for example.

With organizations looking to make the switch to proactive, preventive maintenance, they are increasingly moving towards Industry 4.0 technologies to help them automate previously manual processes and optimize infrastructure integrity, safety and reliability. Technologies such as drones, robotics and Artificial Intelligence (AI)-powered software allow for automated visual infrastructure inspections at a pace, scale and accuracy level that humans alone cannot deliver using traditional visual inspection methods. Moreover, the failure of humans to detect faults in time can have far-reaching consequences, like catastrophic loss of life, billions of dollars in fines if a disaster impacts the environment, and billions of dollars in lost productivity and efficiency.

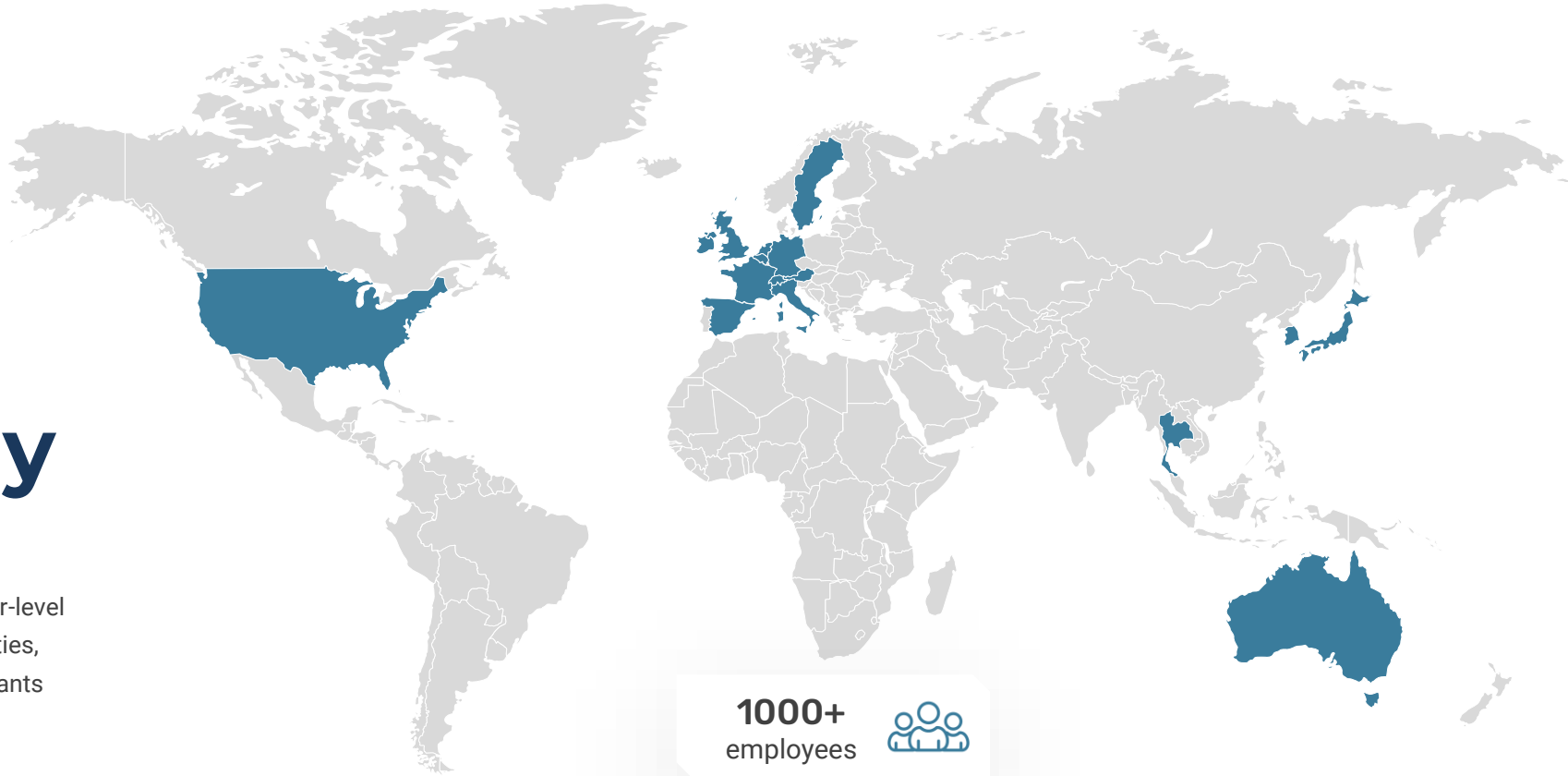
It's therefore no wonder that with industrial organizations increasingly expected to meet rising production, safety and ESG standards, the global Infrastructure Inspection Market has evolved significantly in the past few years and is expected to reach USD 3.78 billion by 2029.

This survey aims to shed some light on how visual inspections at industrial sites are conducted in the market today, by exploring factors like:

- How often inspections take place
- What kind of technologies are being used
- The level of automation that's being used
- Who is using visual data
- What opportunities exist for forward-thinking manufacturers to modernize outdated visual inspection technology so that they can remain competitive and profitable

Methodology

To get more insight into the current state of visual inspection, we commissioned a survey of 200 senior-level respondents from processing and distribution facilities, including power generation companies, chemical plants (e.g., fertilizers) and refineries.



This report was administered online by Global Surveyz Research, an independent global research firm. The survey is based on responses from full-time professionals (not contractors) responsible for inspections across Operations, Compliance, Reliability, Inspection and Safety departments in companies with 1,000+ employees across North America, EU (DE, NL, UK, IT, ES, Nordics), Australia, and APAC (TH, KR, JP). The respondents were recruited through a global B2B research panel and invited via email to complete the survey, with all responses collected during Q4 2022. The average amount of time spent on the survey was five minutes. The answers to the majority of the non-numerical questions were randomized, in order to prevent order bias in the answers.

Key findings

1 Most industrial companies have yet to implement Industry 4.0 technologies in their visual inspections

The survey revealed that the adoption of proven, advanced technologies such as drones, robotics and AI is surprisingly low. Although many industrial organizations today strive to upgrade their visual inspection to Industry 4.0 standards, 100% of respondents still rely on manned visual inspection, alongside SCADA (supervisory control and data acquisition) to oversee their site health, followed by 96% using IoT (Internet of Things) sensors (Figure 1).

However, the fact that a whopping 81% of respondents said they are not currently using drones for visual inspection but are “planning to start using them soon” (Figure 12), and 83% have indicated they’re not yet using AI but planning to start using it soon – is both shocking and encouraging at the same time, because although the vast majority of companies haven’t automated their visual inspection workflows yet, it seems the industry is at an inflection point that should see “a giant leap” for visual inspection once these technologies are integrated.

2 Site safety is the main driver for conducting visual inspection

98% of respondents said that “increasing site safety” is their main driver for visual inspections (Figure 5) – even beyond maintaining the reliability of their operations (66%) and regulation (29%).

Organizations strive to protect their employees from risk in any way possible – both by minimizing the need for hazardous manual inspections, and by properly maintaining their facilities to minimize large incidents such as gas leaks and explosions. This is undoubtedly one of the key motivators for automating visual inspection which were previously manual, to keep employees out of harm’s way and ensure infrastructure reliability.

Key findings

3 The most hazardous, risky assets aren't inspected as often as they should – posing a higher risk for failures with wide environmental and safety implications

The recent introduction of ESG (Environmental and Social Governance) in financial reports of industrial organizations is an important measure of how green, safe and sustainable they are. Meeting ESG goals has become a top priority for organizations around the world, with many setting ambitious environmental goals to reduce their carbon footprint. Yet, our survey revealed that organizations inspect assets such as tanks, pipelines, power lines and electric poles infrequently, at best.

This poor frequency is likely these assets are difficult to access, may pose risk to employees, or may even require a total shut down for a proper inspection to take place. Leaving these hazardous assets unmonitored for long periods of time opens the possibility to failures going unnoticed and eventually turning into large scale failures such as fires, oil spills and gas leaks.

With organizations increasingly looking to go green, introducing innovation and automation into daily visual inspections can make inspection of hard-to-access infrastructure easier, effectively enabling organizations to implement preventive maintenance strategies and minimize failures.

4 Organizations are collecting masses of visual data, but not leveraging it fully due to non-optimal data management tools

Most industrial organizations collect a lot of visual data whether they are using drones or not. This data consists of images and video, but unlike binary data which is fairly quick to analyze, reviewing visual data can be incredibly time-consuming. And yet, a third of respondents (35%) are still using in-house developed analysis tools (Figure 15) which are typically not best-of-breed in the market, and only 12% indicated they use AI for automating data analysis and gleaning insights from the masses of data.

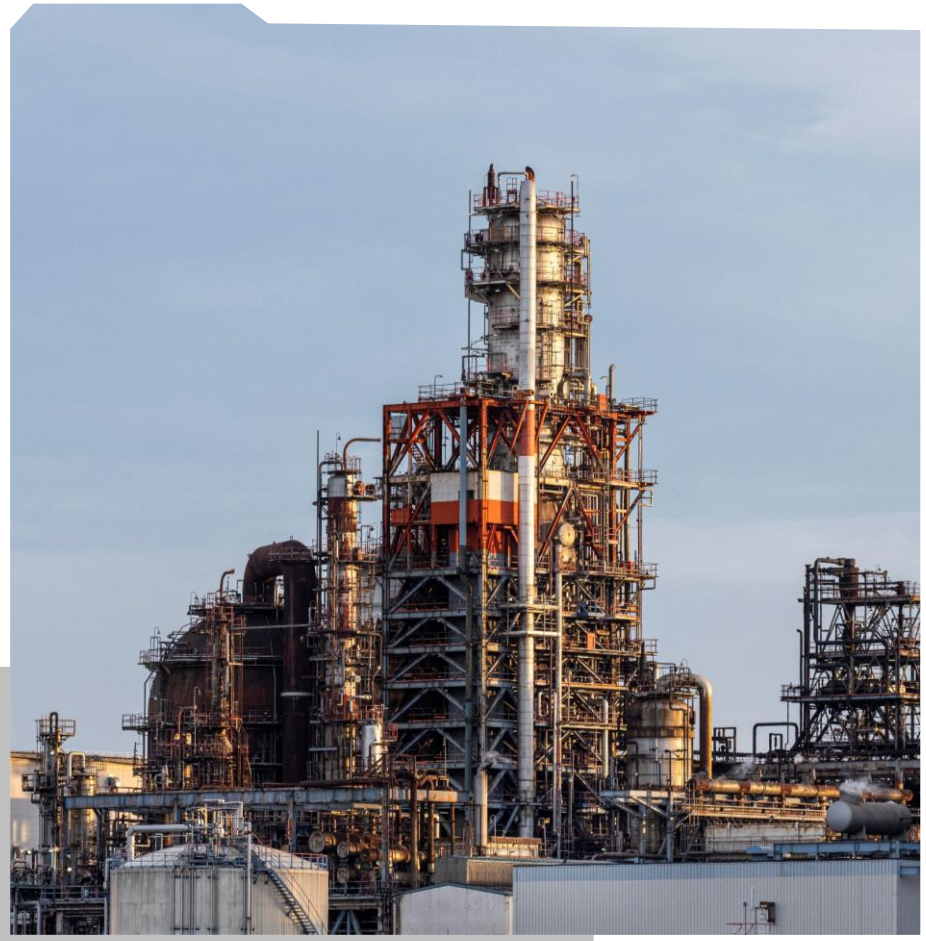
This is far from ideal, because non-optimal data management can result in relevant insights not reaching the right stakeholders, repairs not being performed in time, and in extreme cases – data not being analyzed at all.

By standardizing their tools and using more advanced cloud-based, AI-powered software for their data management, companies can monitor their site health with far greater speed, efficiency, and accuracy from anywhere, and allow all relevant stakeholders easy access to both the data itself as well as to the insights derived.

Key findings

5 The majority of companies have yet to achieve “true autonomy” of visual inspection

With only 14% of respondents currently using drones to conduct visual inspections (Figure 12) and only 30% automating both the collection and analysis of the data collected (Figure 17), there is a lot of potential for companies to use autonomous drones, robots and AI-powered software to improve efficiency of visual inspection. And while it’s true that most companies (94%) currently integrate a certain level of automation – most are still far from reaping the benefits of “true autonomy”, i.e., full, end-to-end automation of both the visual data collection as well as its management and analysis.



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Asset integrity and visual inspection

Technologies/methods used for promoting asset integrity and uninterrupted operations

As expected, 100% of respondents said they use both manned visual inspection and Scada to oversee their site health, followed by 96% using IoT sensors.

Surprisingly, although drones and AI are proven technologies, their adoption is low, **with only 12% indicating they are using AI or Machine Learning (ML), and only 16% are using drones for asset integrity purposes.**

The fact that 74% of the survey's respondents are NOT using drones or robotics yet (although they plan to use them in the future) means that industrial companies still haven't fully automated labor-intensive, costly and risky visual data workflows to streamline and increase the efficiencies of their visual inspection.

The good news is there is a huge opportunity to improve efficiency, safety and sustainability by harnessing readily available automation technologies.

Of the 16% of respondents who do use drones or robotics (Figure 2), there is a correlation between larger organization sizes and drone usage, presumably because it's a more highly-prioritized area of focus.

It's also interesting to note that Optical Gas Imaging (OGI) – widely used by both Oil & Gas facilities and utilities industries – is one of the leading technologies used (88%), reinforcing the high level of commitment by these organizations to reduce carbon emission and related environmental and safety risks.

*Question allowed more than one answer and as a result, percentages will add up to more than 100%

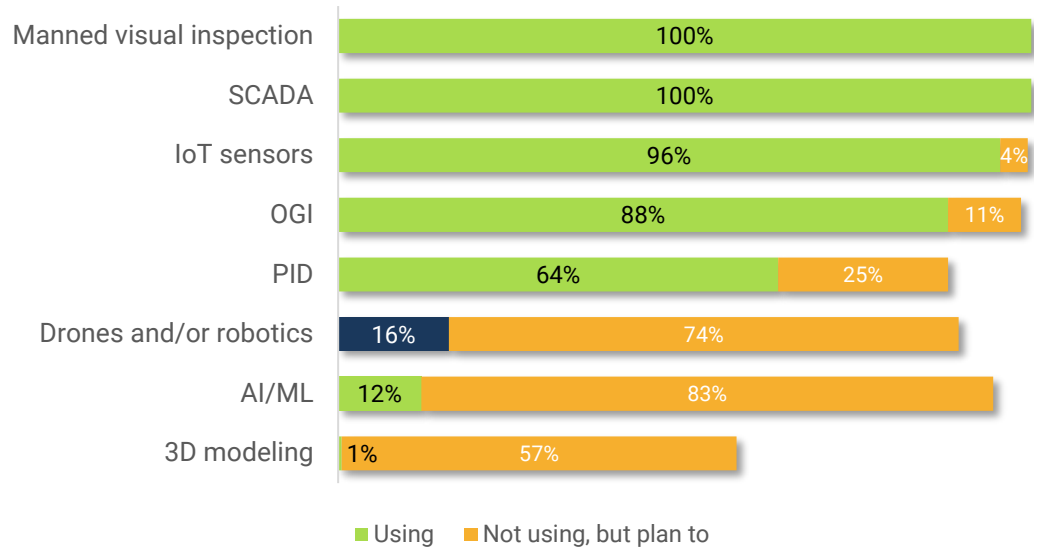

Figure 1: Technologies and methods used for promoting asset integrity and uninterrupted operations

Figure 2: Using drones, by company size

Preventive maintenance program

Part of guaranteeing asset integrity involves having a preventive maintenance program – performing regularly scheduled maintenance proactively in order to prevent failures and issues in the future.

100% of survey respondents confirmed their organizations' dedication to a preventive maintenance program (Figure 4), validating the importance of proactive (vs. reactive) maintenance. In addition, when asked "Is visual inspection part of the preventive maintenance program implemented for your site critical assets?" – 100% of respondents answered yes (Figure 5). Once again, this is testament to how important visual inspection is for industrial companies to prevent major failures and ensure safety and reliability

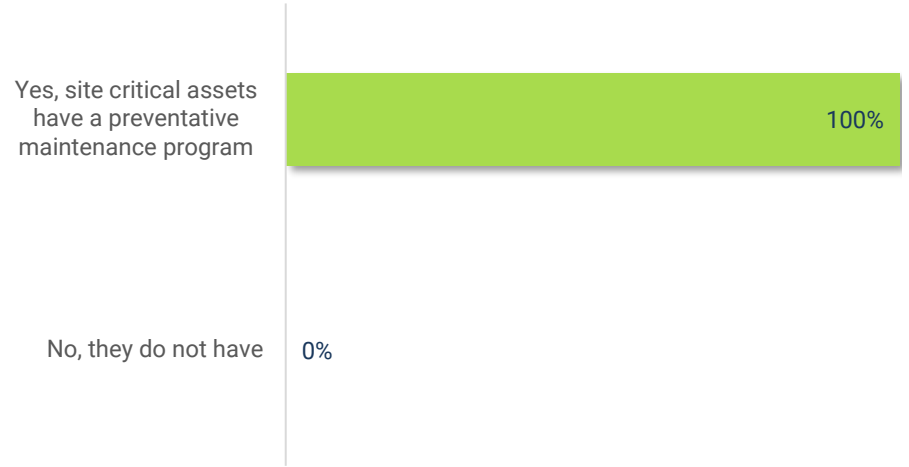

Figure 3: Preventive maintenance program on site critical assets

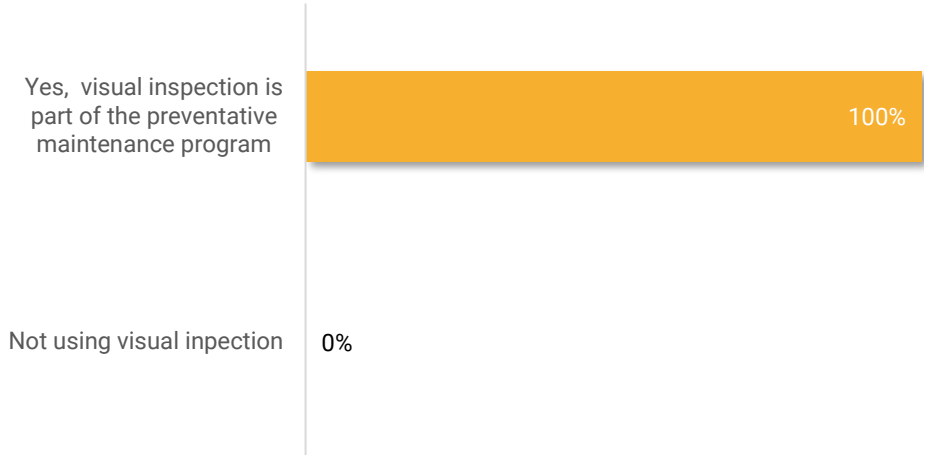

Figure 4: Use of visual inspection in preventive maintenance program

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Visual inspections today

Drivers for conducting visual inspection

Unsurprisingly, respondents chose “increase site safety” as their main driver for conducting visual inspections – with 98% of respondents affirming the importance of safety in their day-to-day operations (Figure 5).

Organizations strive to protect their employees from risk in any way possible by minimizing the need for high-risk work (which is sometimes the case with manual inspections), and properly maintaining their facilities to minimize large incidents such as gas leaks and explosions.

This is undoubtedly one of the key motivators for automating visual inspections (which were previously manual) – to both optimize and increase inspection frequency and quality, and thereby reduce the risk of infrastructure failures.

*Percentages do not add up to 100% due to rounding up of numbers

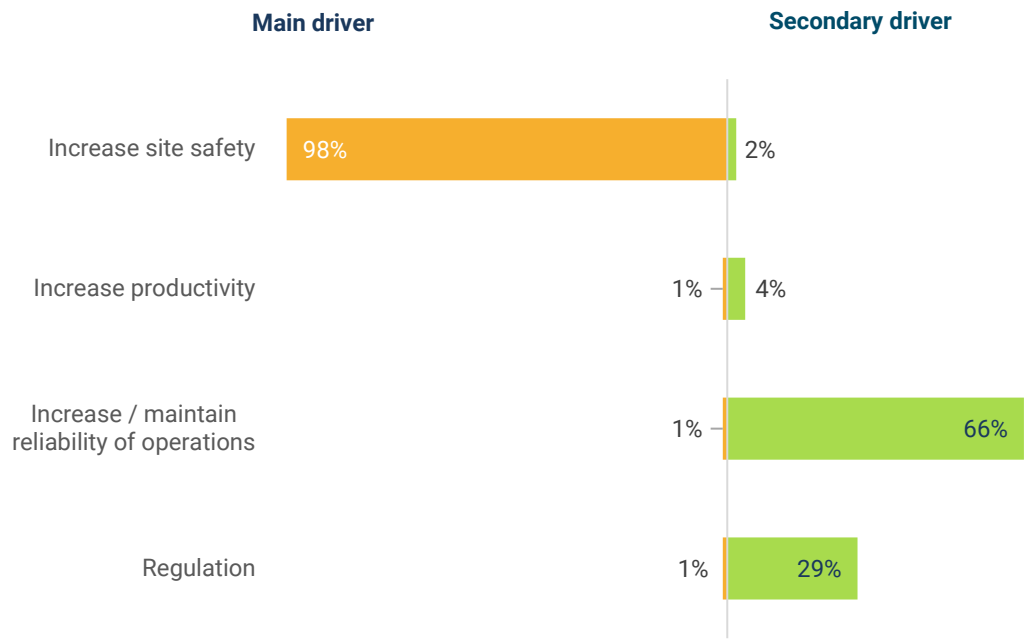

Figure 5: Drivers for conducting visual inspection

Inspected infrastructure by industry

Respondents in the energy industry indicated that the top inspected infrastructures are torch towers (97%), processing units (81%), chimneys (70%), and rooftops (50%). For the power and utilities, substations (98%), generators (97%), processing units (66%), and rooftops (24%) are the most inspected infrastructure.

The assets inspected the least, such as tanks (5%), pipelines (2%), power lines (0%) and electric poles (0%), are (predictably) the assets which are hardest to inspect – either because they pose a higher risk to employees, or they require a total shut down for a proper inspection, or simply because they are geographically spread too far apart. This is problematic because it's often these assets that could potentially cause the biggest problems or the most damage if they break down or if something goes wrong.

Combined with the growing trend of reducing carbon footprints and meet ESG goals, it is critical to inspect all assets on a regular basis to minimize large-scale failures. **By leaving tanks or power lines unmonitored for long periods of time, organizations risk environmental catastrophe such as forest fires and large emission leaks.**

With ESG goals a top priority for these organizations, there is increasing motivation to look to innovation and automation tools (like robots and autonomous drones) to make the inspection of hard-to-access critical infrastructure assets easier and therefore prevent more mishaps.

*Question allowed more than one answer and as a result, percentages will add up to more than 100%

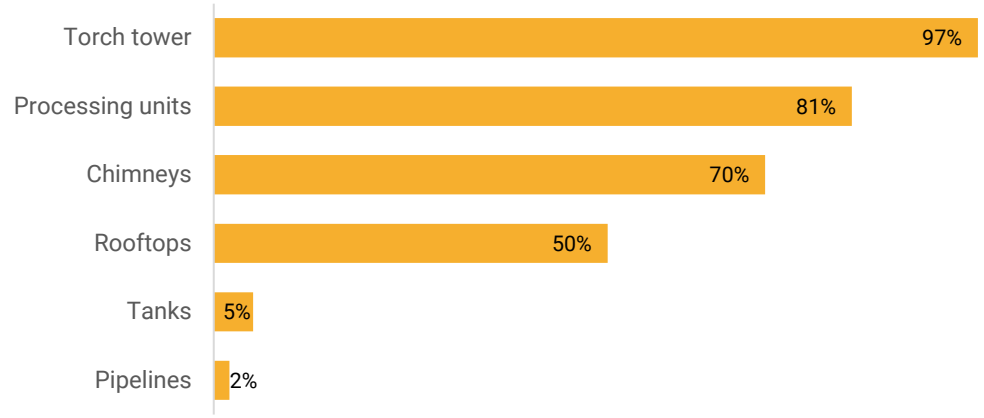

Figure 6: Inspected infrastructure, energy & utilities

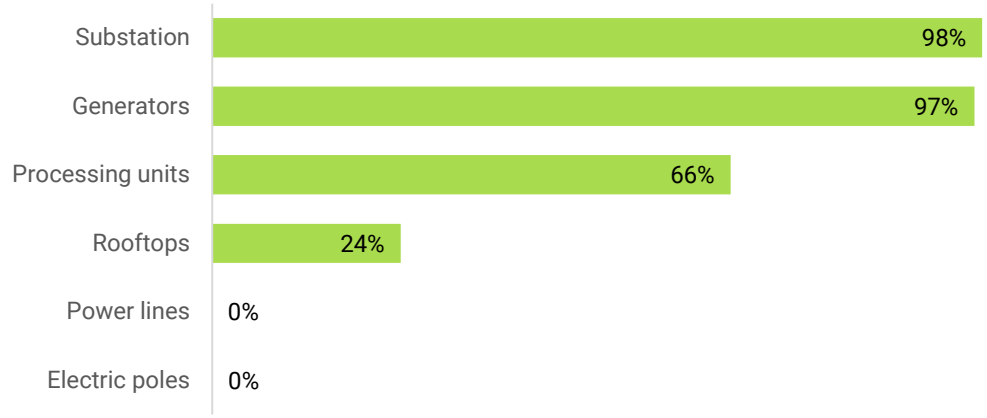

Figure 7: Inspected infrastructure, industrials

Number of inspectors conducting daily inspection activities

Visual inspection is an extremely labor-intensive task, with respondents indicating that on average, they have **41.7 inspectors conducting daily inspection activities in a single site.**

Only 2% of respondents say they have an average of 11-20 inspectors conducting daily inspections.

Since visual inspections are often time-consuming and risky , the fact that so many inspectors are required to conduct daily inspections suggests **a massive conflict for respondents, who indicated that safety is a top priority for their organizations (Figure 1).**

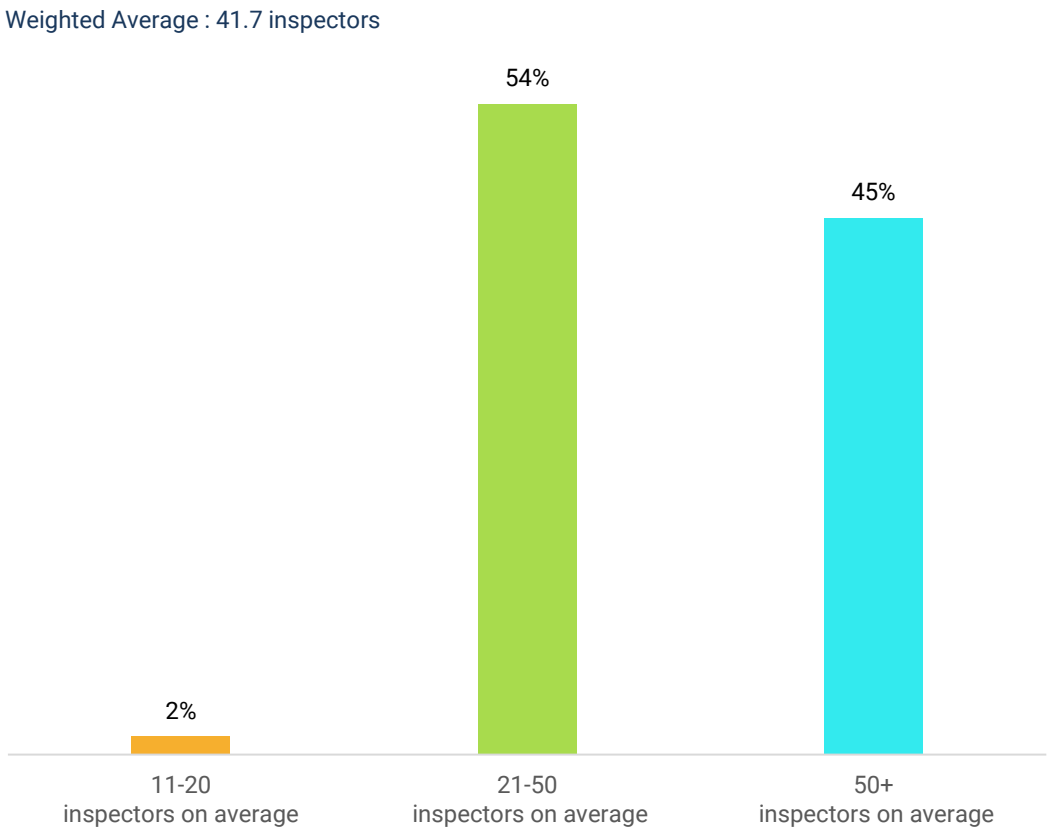

Figure 8: Number of inspectors conducting daily inspection activities

*Percentages do not add up to 100% due to rounding up of numbers

Frequency of visual inspection activities

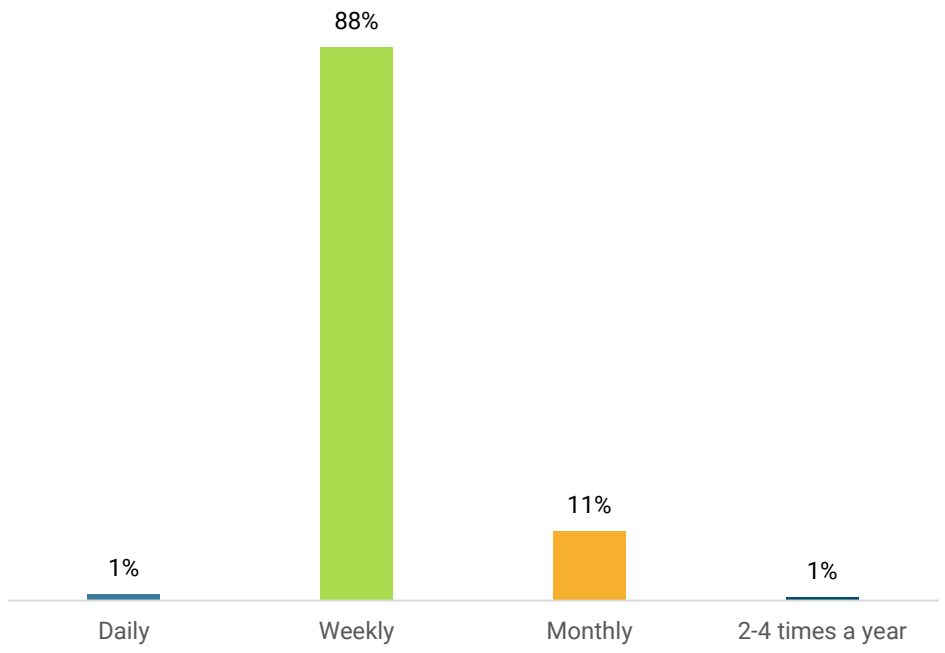

Figure 9: Frequency of visual inspection activities

Only 1% of respondents said their organization performs daily visual inspections, while 88% said visual inspections are conducted only on a weekly basis.

12% said they conduct visual inspections monthly, or even less frequently, which isn't surprising given how labor-intensive inspections can be (see fig. 8).

The fact that 88% are running weekly inspections speaks to how important it is for industrial facilities to maintain infrastructure health and prevent potential incidents and downtime.

Automating inspections can reduce costs and increase efficiencies, making it possible to boost their frequency, thereby reducing the potential for any mishaps even more.

*Percentages do not add up to 100% due to rounding up of numbers

Visual inspection: percentage done in-house vs. outsourcing

Since frequent visual infrastructure inspection is so critical to guaranteeing asset integrity, uninterrupted operations and safety, it isn't practical to rely solely on outsourcing.

So, predictably, when asked what percentage of visual inspections are conducted in-house, i.e., by employed inspectors vs. outsourced (i.e., service provider) – **all respondents reported conducting at least part of their visual inspections using their own resources in-house.**

91% conduct 50% or more of visual inspection in-house while only 9% outsource more than 50% of the work.

The fact that the majority of respondents (91%) conduct more than half of visual inspection in-house, paired with the fact that 88% of companies conduct visual inspections weekly (as we saw on the previous page) – **is a resounding confirmation of just how much time and effort companies routinely invest in inspecting their assets and infrastructure.**

As companies look for ways to improve efficiencies, they should explore new technologies designed to improve visual inspection workflows.

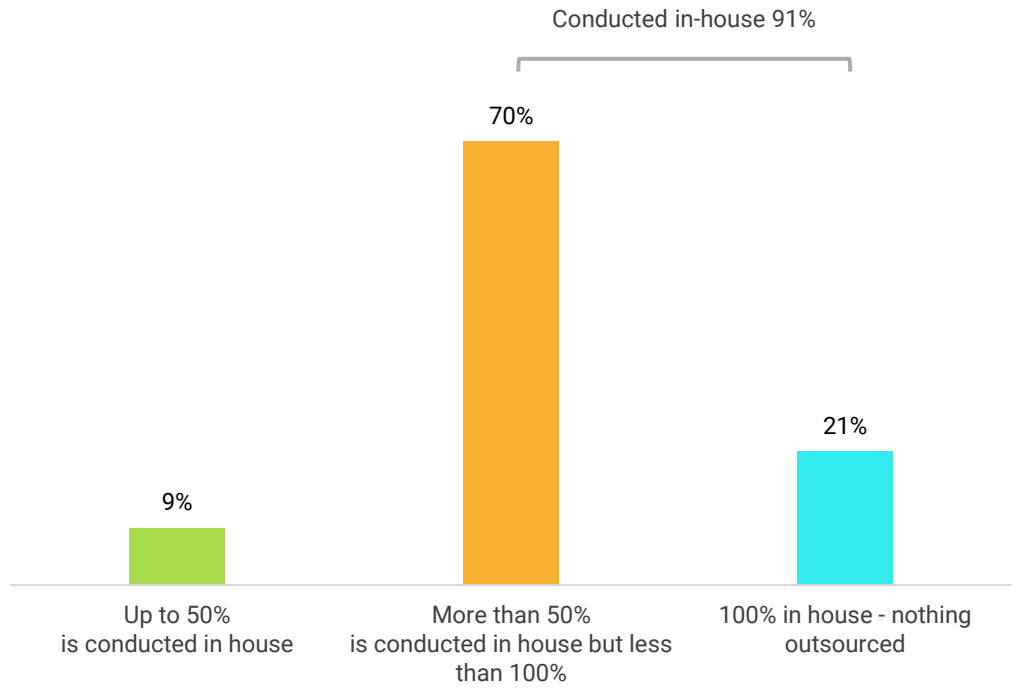

Figure 10: Visual inspection - percentage done in-house vs. outsourcing

Main challenge in conducting more visual inspections

The majority of respondents (74%) indicated that their main challenges in conducting more visual inspections are related to a lack of budget and/or resources.

This suggests that their current visual inspection technology and/or processes aren't optimal or cost-effective. This is something they could potentially solve through automation, as it would eliminate the need for manual, labor-intensive inspections, improve the frequency and reliability of the visual data collected, and provide insights that could improve the reliability and productivity of their sites.

21% of respondents said that their main challenge was the fact that visual inspections are not prioritized highly enough in their company, and the remaining 5% of respondents said that their main challenge is a lack of knowledge/training.

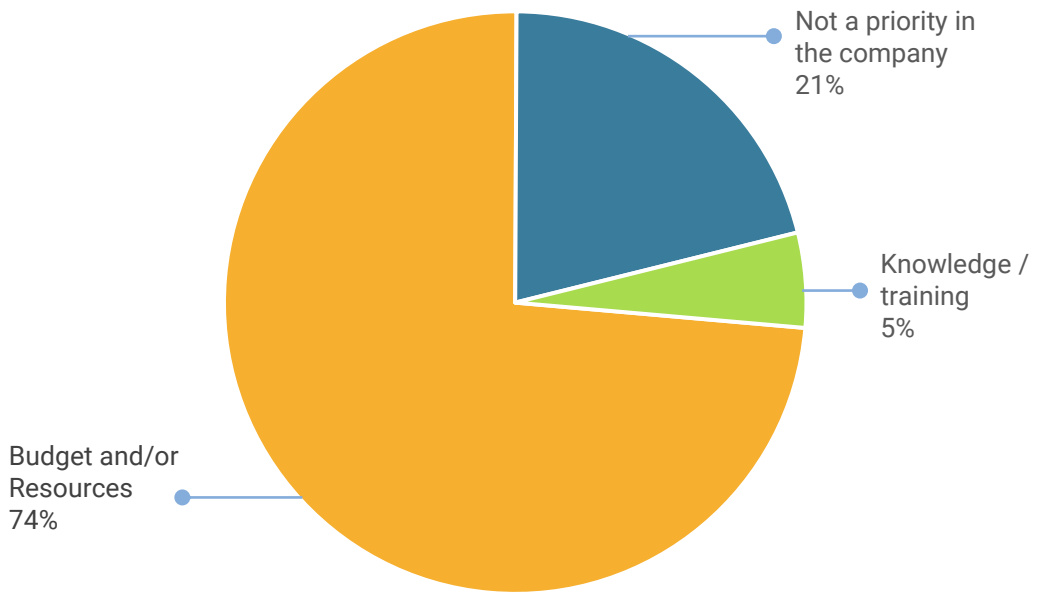

Figure 11: Main challenge in conducting more visual inspections

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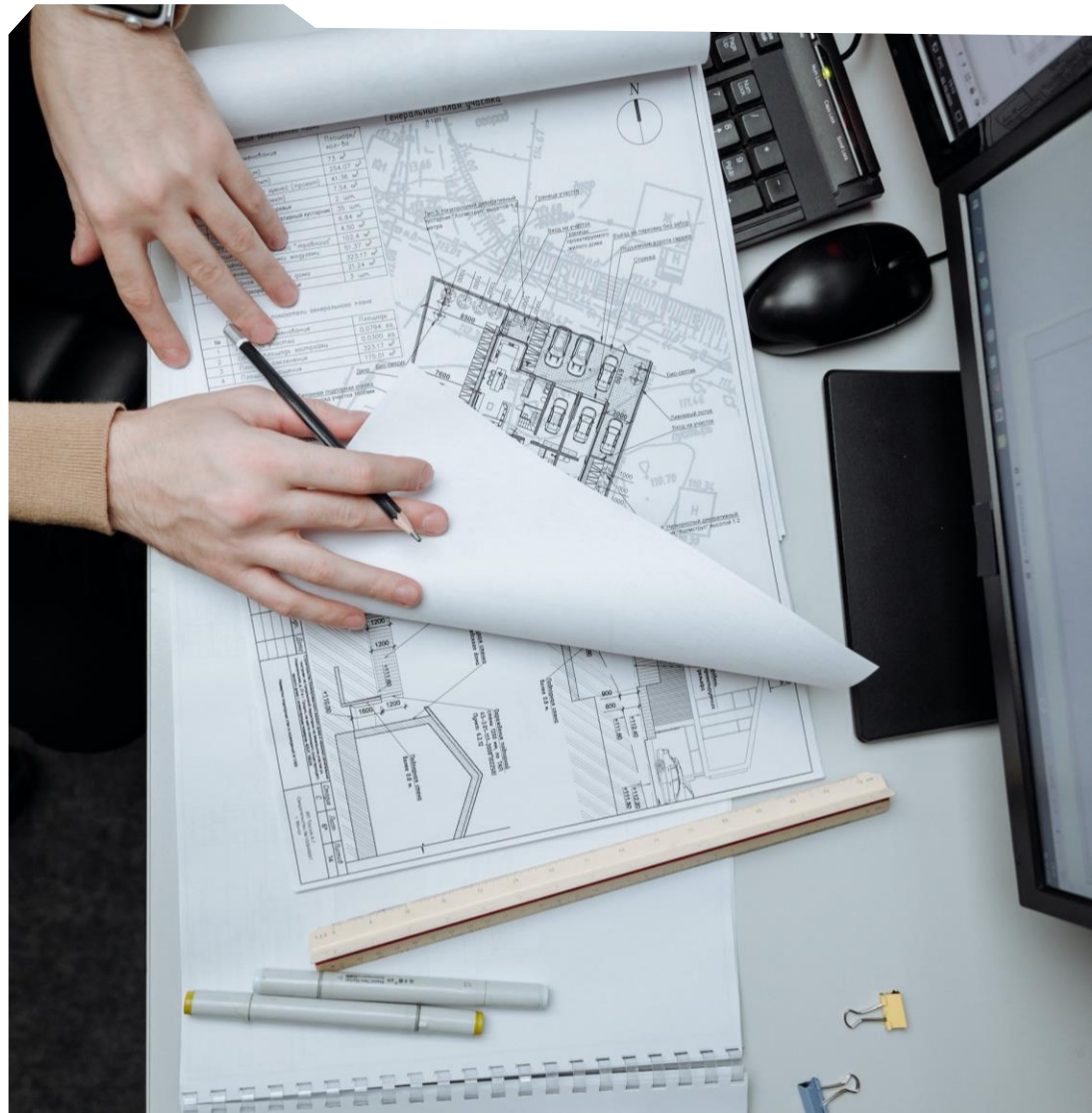

Visual inspection technologies and digitalization

Use of drones for visual inspection

When asked about their level of drone usage, a whopping 81% of respondents said they are not currently using drones for visual inspections but are planning to start using them soon.

This is encouraging, because drones can dramatically reduce the time it would otherwise take to collect data from visual inspections, while increasing safety and efficiency.

Of the 6% of respondents with an in-house drone program, 17% are working in companies with 5K+ workers while only 4% are in companies with less than 5K workers. This reinforces the notion that larger companies most likely have more budget and resources to invest in an in-house drone program.

Looking at the 8% who outsource most of their drone activity by region, APAC is the biggest outsourcer (14%), followed by the EU (10%), and North America (4%).

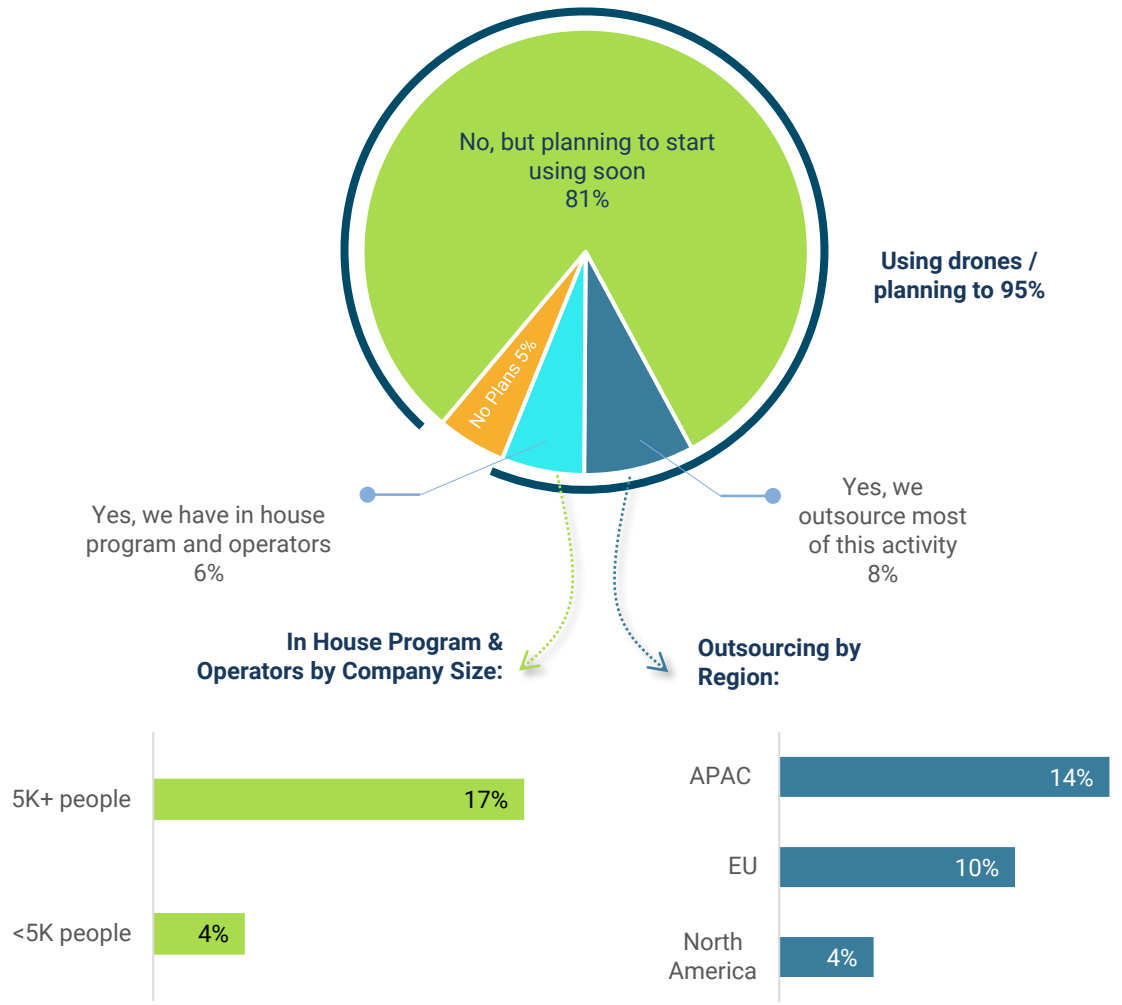

Figure 12: Use of drones for visual inspection

Use of robots for visual inspection

When asked about their use of robots for visual inspection, a staggering 71% of respondents said they have no plans to use robots, while 29% are planning to start using them soon.

The use of robots is still in relative infancy and its adoption rate is still low, especially compared to the usage of drones (95% of survey respondents are using drones or are planning to do so soon, Figure 12).

Yet true automation of the visual inspection processes can only really be achieved by integrating autonomous robots, including autonomous drones. For visual inspections of certain assets, robots provide a unique view from the ground up – unlike drones, which provide an aerial view.

For organizations looking to fully automate visual inspections of all of their assets – robots will play a key role in filling in the gaps where drones cannot.

It's clear that automating data collection using autonomous robots is becoming an increasingly essential aspect of the visual inspection process. So, it will be interesting to see how the increased efficiency of the 29% of companies who plan to start using them soon will impact the 71% who don't currently plan to start integrating robots into their visual inspection process (Figure 13).

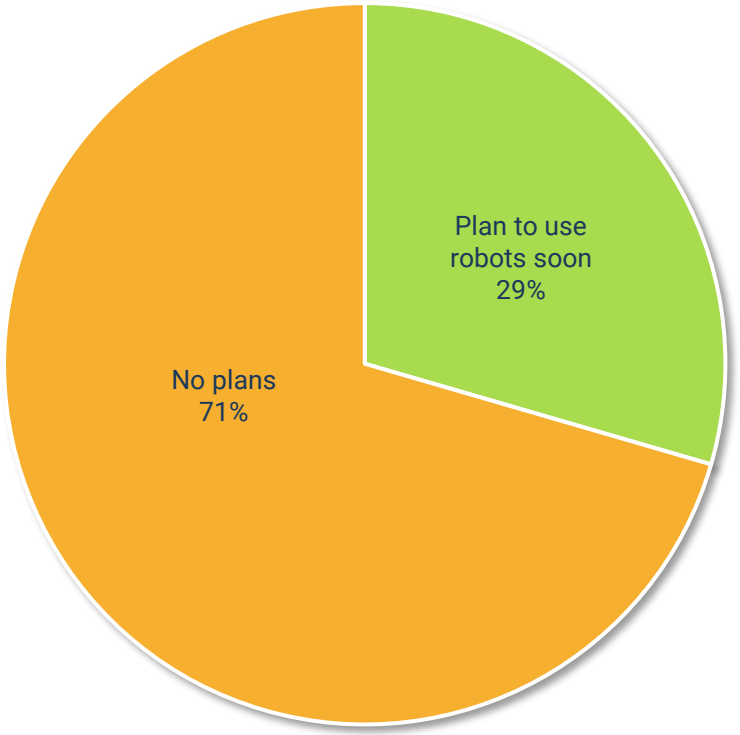

Figure 13: Use of robots for visual inspection

Visual data management & analysis

Most industrial companies collect a lot of visual data whether they are using drones or not. The main stakeholders leveraging visual inspection (Figure 16) are the inspection professionals themselves (99%), followed by maintenance (95%), and reliability (86%).

The majority of respondents (89%) store their visual data in dedicated software with a centralized data warehouse (Figure 14), while 11% are still storing that data on a shared drive.

Unlike binary data which can be processed easily to glean quick insights, the masses of visual data collected consist of images and video, making it very time consuming to sift through and review. To analyze this visual data, 64% of respondents are using third-party software (Figure 15) and 35% are using in-house software. It is encouraging to see that only 1% said they process their visual data completely manually.

For the majority of stakeholders consuming visual data including inspection, maintenance, reliability, health & safety and operations – gaining insights from data collected is critical to perform their jobs efficiently. Without a dedicated software to sift through and organize the mass quantities of visual data collected, it is akin to searching for a needle in a haystack to locate a specific image or video. Only then can data be analyzed and shared with the stakeholders who need it. **For stakeholders who need to find the information they need, a sophisticated data management platform is needed, as is an automated analysis software to generating operations-related insights quickly.**

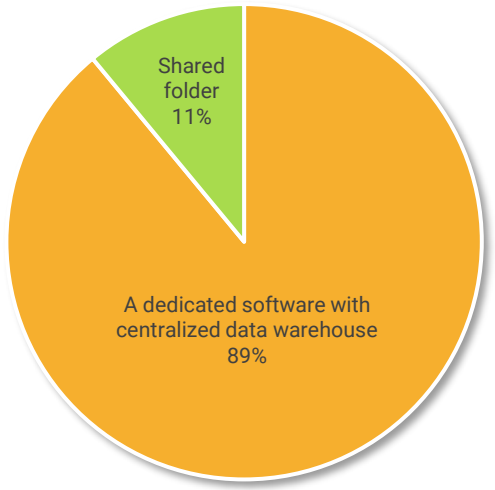

Figure 14: Visual data storage location

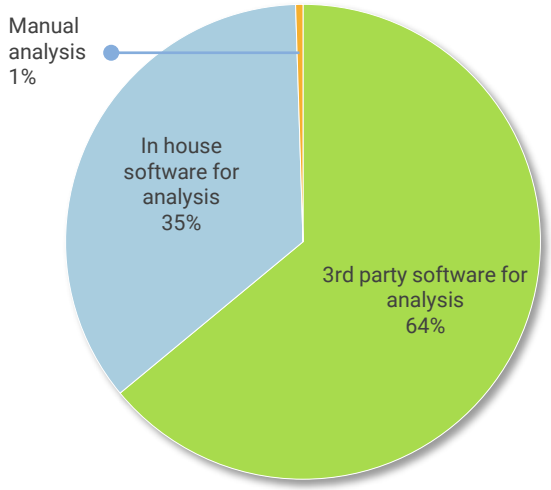

Figure 15: Visual data analyzing software/tools

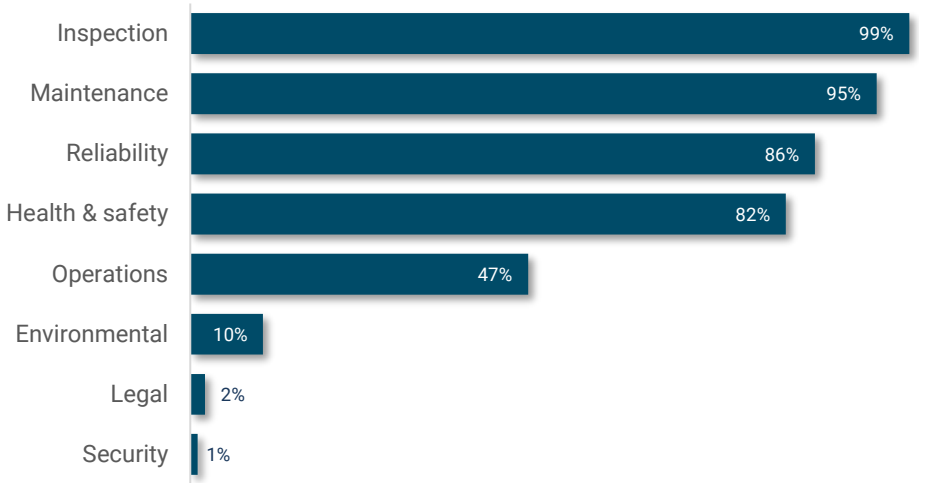

Figure 16: Main internal stakeholders leveraging visual inspection

Automated visual inspection

When asked whether they have automated visual inspection, 60% of respondents said they are automating their data analysis only, and 30% said they have automated both the collection and analysis of the data collected.

This shows that **the majority of companies have yet to achieve "true automation", whereby the entire visual inspection process is automated, i.e., data collection is automated using autonomous robots and drones, and data management and analysis are automated using AI-powered software.**

This could be an indication that there's a gap in perception between what companies think constitutes "fully automated", and what is actually involved in fully automated visual inspections.

While it's true that most companies (94%) currently integrate a certain level of automation – and the remaining 6% who don't are planning to start automating their processes shortly – most are still far from reaping the benefits of true autonomy, i.e., full cycle automation, from data collection through to data analysis.

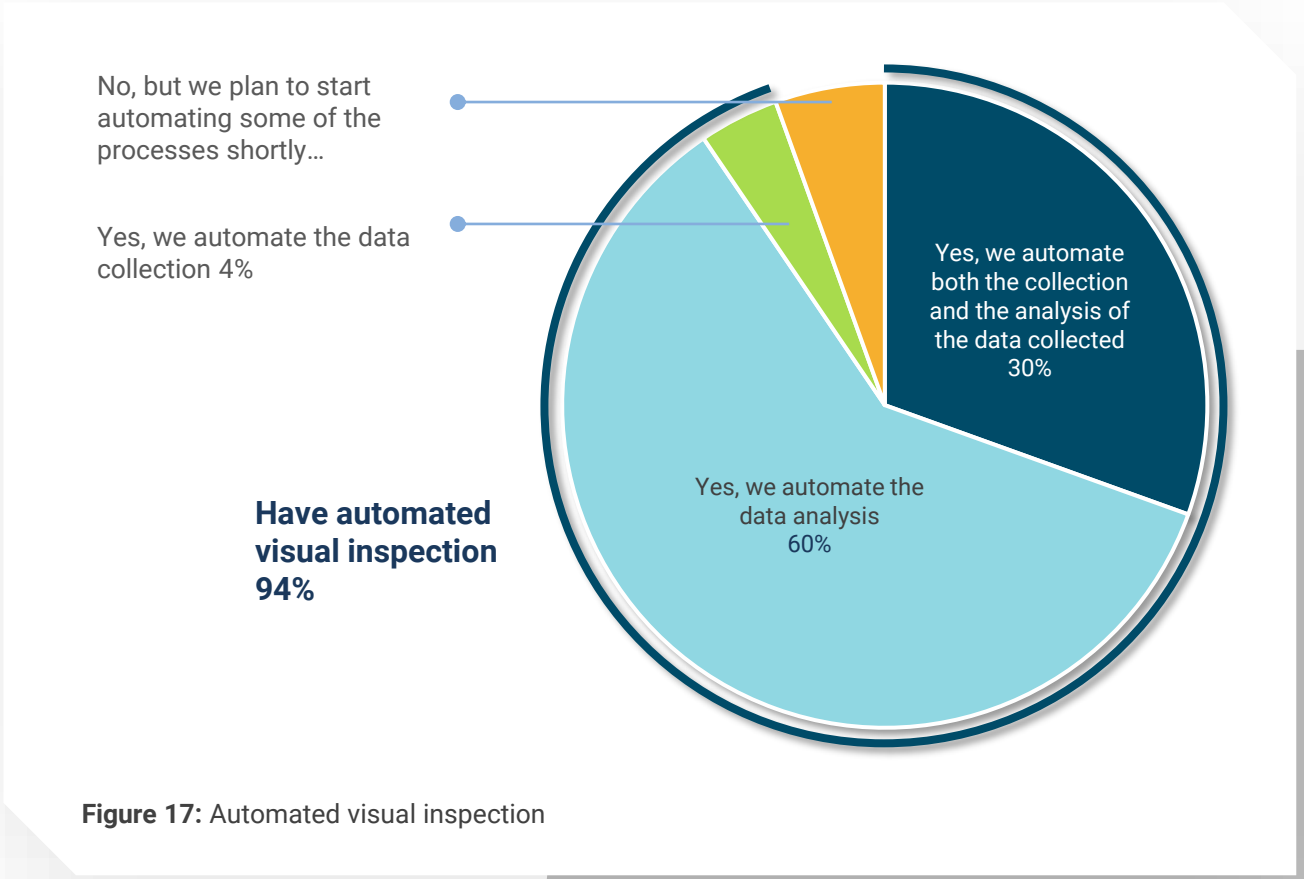

Figure 17: Automated visual inspection

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Demographics

Country, industry, and infrastructure

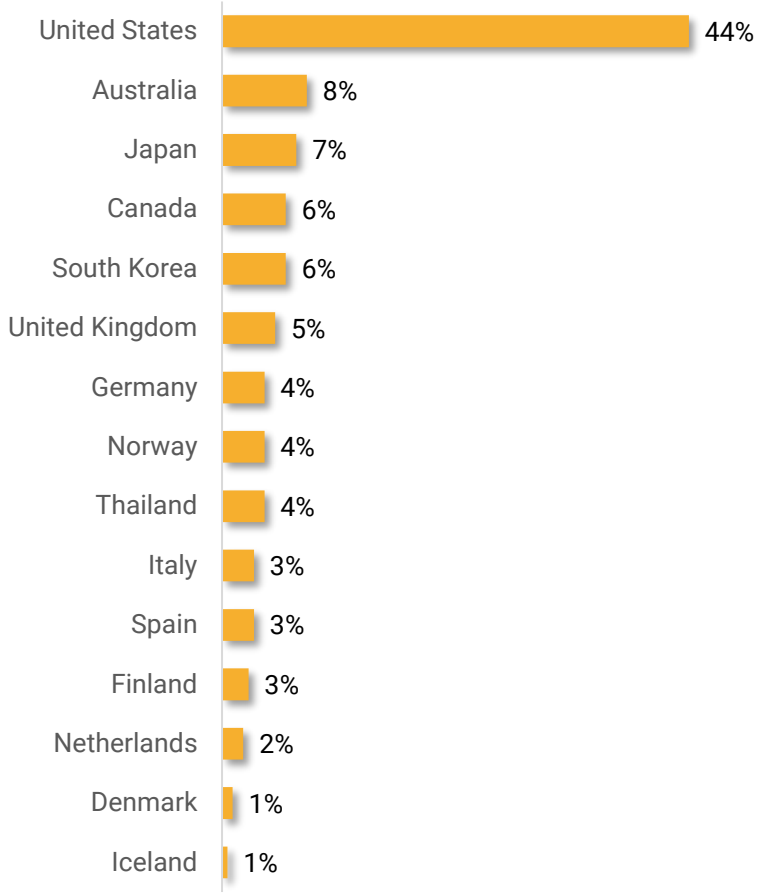

Figure 18: Country

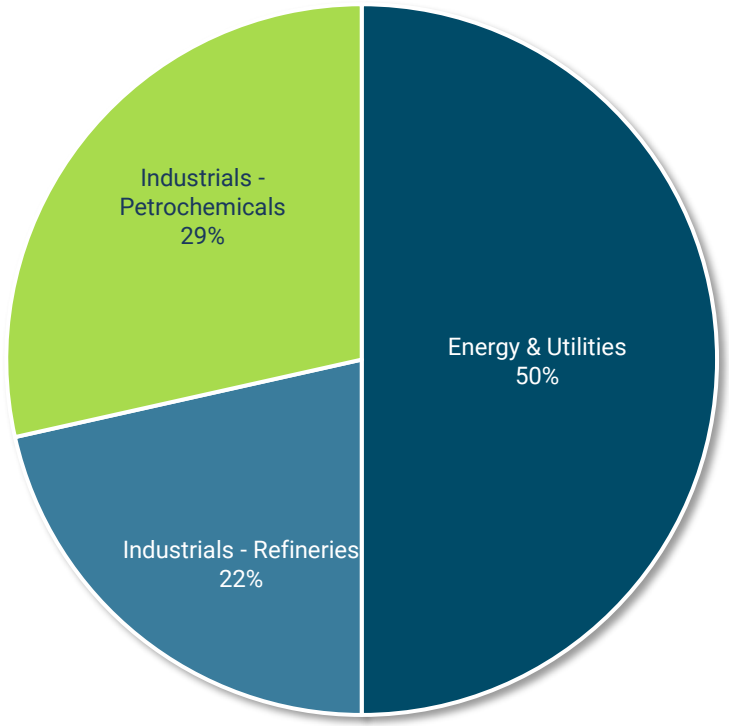

Figure 19: Industry

Company size, department, and seniority

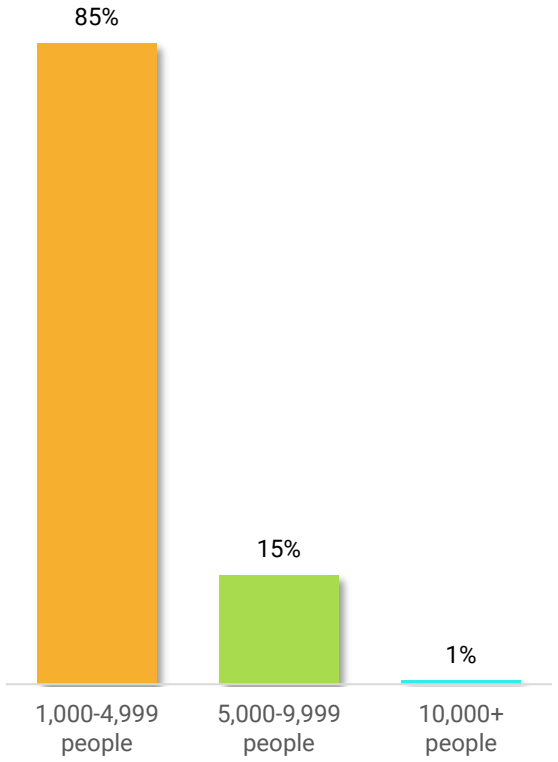

Figure 21: Company size

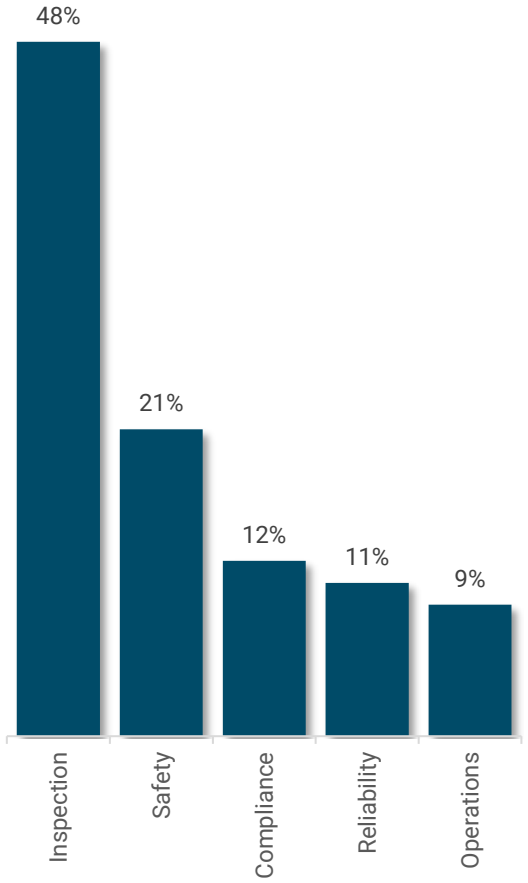

Figure 22: Department

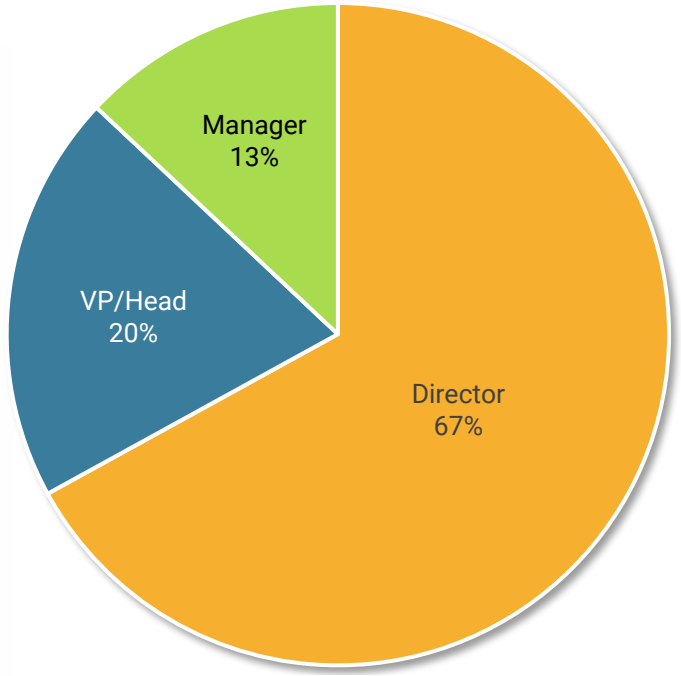

Figure 23: Seniority

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About Percepto

Percepto is the leading autonomous inspection and monitoring solution provider, revolutionizing how industrial sites monitor and inspect their critical infrastructure and assets.

Listed in TIME magazine's 100 Best Inventions of 2021, Percepto's AIM software fully automates visual data workflows from capture to insight, leveraging the Percepto Air drone-in-a-box portfolio and Percepto Air Max OGI – the only autonomous gas detection solution on the market – alongside other robots and visual sensors. Using advanced machine-learning and AI, Percepto AIM provides an end-to-end autonomous inspection and monitoring solution, designed to increase safety, sustainability and productivity.

Percepto's solutions are trusted by Fortune 500 customers on six continents including Koch Industries, Delek US and Siemens Energy.

Talk to An Inspection Automation Expert

For more information, please visit us:

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