

# WHEN IN-PROCESS METROLOGY BRINGS SO MUCH TO ADVANCED MANUFACTURING, WHY IS IT NOT MORE WIDELY ACCEPTED IN UK INDUSTRY?



## EXPLORING

**WHAT DIRECTION IS AUTOMATION AND ROBOTICS HEADING IN AND HOW DOES THIS RELATE TO INDUSTRY 4.0?**

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**HOW WELL-UNDERSTOOD ARE THE BENEFITS OF PHOTOGRAMMETRY SYSTEMS WITHIN UK MANUFACTURING?**

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**WHAT ARE THE RISKS AND REWARDS AROUND DEPLOYING PHOTOGRAMMETRY SYSTEMS?**

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**HOW PHOTOGRAMMETRY SYSTEMS UNLOCK ADVANCED MANUFACTURING**

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This whitepaper summarises a round-table discussion between senior engineers working for leading UK aerospace and automotive organisations, as well as senior engineers from UK research centres.

It provides a comprehensive overview of the objectives, challenges and considerations from those working directly with robots and automation. It highlights the need for increased education of metrology and photogrammetry solutions, across sectors, to propel the industry forward to better align with the aspirations of Industry 4.0.

The round-table discussion was part of project ACCUFAS (Accurate and Flexible Automation Systems), a project focused on developing IONA technology to facilitate high accuracy robot control within the aerospace sector. The discussion was chaired by Insphere's Operations Manager, Phil Silk, at the AMRC Factory 2050 in November 2023.



# WHAT DIRECTION IS UK ROBOTICS AND AUTOMATION HEADING IN AND HOW DOES THIS RELATE TO INDUSTRY 4.0?

We asked the group:

- What automation and robotic related objectives does your factory have for the next 3-5 years?
- What does Industry 4.0 mean to your organisation?
- What is currently holding you back with your automation work?

As expected, there was a variation of answers across the sectors which sparked an interesting discussion...



## Aerospace

Amongst the group, it was agreed that achieving high accuracy automation is still a core focus for the aerospace sector. One engineer highlighted that in addition to this, a large emphasis was being made to standardise their automation so that technology remains consistent across multiple processes. Standardising their automation technology and/or having hardware that was re-configurable would lead to common platforms operators can master, eliminating the need for specialist individuals. This standardised hardware can then be viewed as a tool that provides flexibility and can be deployed across various tasks.

With a focus on having hardware that is re-configurable, this would benefit their organisation in variety of ways:

- Financial investment could be spread - having standardised hardware that was re-configurable and so can be deployed for multiple tasks this helps with the financial investment of hardware as it can be shared across multiple tasks/budgets
- Having a standardised toolbox for operators and engineers – operators will only have to learn one ‘tool box’ of hardware and apply the operational knowledge across multiple processes / systems.

This thinking was challenged at the table from an integrator’s perspective:

“Re-configurability can turn into a rabbit hole, where too much time is invested in making a tool re-configurable for too many tasks, when a focused approach is better.”

The point was agreed, but it was re-iterated that the objective behind standardising hardware / having hardware that was re-configurable was not to have one robot do everything, but to have common platforms (tools) that integrate with everything else.

## Automotive

Interestingly, the goals for this manufacturer were not around takt-time. Instead, their objectives are to improve build quality and strongly understood metrology to be a key enabler.

“The electrification of vehicles is driving a new build platform and architecture that is leading to improvements in build quality”.

An engineer from a UK research centre commented that build quality is rooted in accuracy, and a lot more needs to be done for companies that can't afford investment in high accuracy automation. Trackers are currently more widely used, but they are expensive and have their downfalls such as only being able to look at one point at once. Additionally, they often have a large amount of setup time making them unsuitable for serial production.

Their research centre was focussed on finding more affordable metrology systems that delivered more flexibility, so they could more effectively support the requirements for improving build quality in UK automotive manufacturing.

On the subject of Industry 4.0, it became clear it had different meaning to different manufactures as each were at different stages in their evolution. A Tier 2 supplier to the automotive and aerospace industry commented:

“Compared to other manufacturers, our automation is limited and old fashioned, we require significant transformation to align with what is commonly associated with the vision of Industry 4.0. We also struggle with a range of skills to internally develop automation systems”.

On the other end of the scale were the research centres who are very familiar with working in environments amongst the latest technology available to market. They were supporting factories which deployed AGVs and used AI. These research centres have skilled engineers who are able to develop and test technology that are at the cutting edge of manufacturing, like Insphere's IONA system, in challenging conditions and processes.

Somewhere in the middle sat the representatives from the automotive sector who explained,

**“ Whilst our robots are repeatable and to date have achieved the production rate we required, as we try to meet higher build quality expectations and develop more flexible processes in line with Industry 4.0 it is clear standard robots offerings alone cannot help us reach these goals. We are looking for new technology to improve robot flexibility and accuracy enable us to advance our manufacturing processes”.**

## SUMMARY

Disparate systems and legacy automation equipment and/or integration practices that were once fit for purpose are becoming the bottleneck for enabling manufacturers to advance their manufacturing processes. Industry 4.0 has varying meaning per manufacturer and sector based on where they are in their factory transformation, but it has been established that in-process metrology is an enabler for advancing automation. Build-quality is directly linked to accuracy and this is fundamental to both aerospace and automotive industries strategy in the next 5 years.



# HOW WELL-UNDERSTOOD ARE PHOTOGRAMMETRY SYSTEMS WITHIN UK MANUFACTURING?

We asked the group:

- Would you say there is widespread knowledge of photogrammetry systems within your organisations?

The discussion was kicked off by an observation from an engineer from a research centre stating,

“Metrology and photogrammetry systems aren’t so widely understood so sometimes there can be a lack of trust between operator and metrologist – particularly within the automotive sector.”

A representative from aerospace manufacturing agreed it was similar within his sector also,

**“**  
**Accurate robotics is still a dark art. Many operators do not care about metrology, they often need more context or understanding of what the data means to them and the process before they get on board. An organisation does not need wide-spread knowledge of photogrammetry to see the benefits – just a key pool of people.”**

A tier 2 supplier to both automotive and aerospace sectors also agreed,

“There does not need to be widespread knowledge of photogrammetry. Shopfloor production just need to have a basic understanding and understand the ‘why’ it is being used.”

A third engineer based in another research centre made an interesting observation that was,

“The UK has a lower knowledge of photogrammetry and metrology compared to other European countries. For example, in Germany you can get an

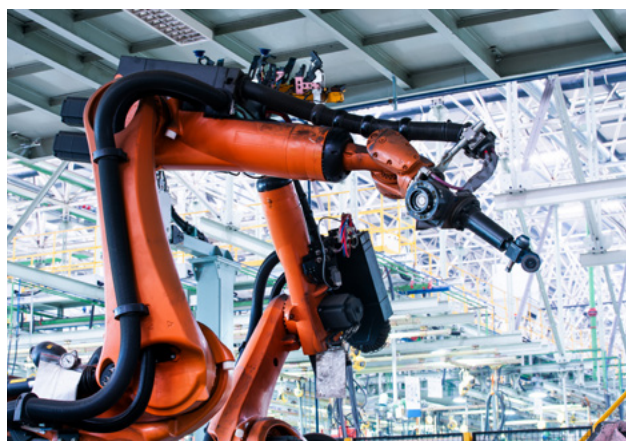
undergraduate degree or masters in Metrology, but you can’t in the UK.”

With Germany’s high reputation for engineering quality, we fact checked this statement, and found a foundation degree in metrology at Coventry University to be the highest-level qualification available in the UK. Germany offers both degrees and masters at Technische Universität Braunschweig in metrology and measurement technology.

It led the group to question, is there a direct correlation between education in metrology and reputation for high-quality engineering, or is this purely coincidence?

An aerospace engineer continued,

“Often, operators do not understand the complexity of a robot, their accuracies and how they integrate with manufacturing systems. This results in only marginal gains and operators being heavily involved in the commissioning and running of automations.”



Automation (in particular cobots) is becoming more accessible, enabling more processes to be automated. Cobots often require little or no guarding and have an easier online programming methods. Whilst this opens the door for many manufacturers, they often face issues when implementing flexible processes, as the accuracy is not up to a required specification, yet this is often not well understood.

Engineering and operator knowledge of automation is behind what is needed for manufacturers to adopt advanced technology. If there is a knowledge gap in metrology, how are manufacturers going to know they have an accuracy issue, to then understand that photogrammetry systems could solve it?

Typically, it takes a significant amount of resource to identify and solve an accuracy issue. It can also involve an acceptance of scrapped or sacrificial test parts with post-production measurement. The ideal solution is one that enables manufacturers to measure and correct errors in process. For example, a closed-loop photogrammetry system, like IONA, can resolve errors instantaneously.

The final comment which was widely agreed upon by the group on was the observation that start-ups are generally more forward-thinking and often earlier adopters of photogrammetry systems and in-process metrology. They haven't been conditioned into the traditional ways of manufacturing and are more open to seeing and learning the benefits a photogrammetry system can bring to their manufacturing process.

**“ Often, operators do not understand the complexity of a robot, their accuracies and how they integrate with manufacturing systems. This results in only marginal gains and operators being heavily involved in the commissioning and running of automations.”**

#### SUMMARY

The group agreed that in general there is a low understanding of metrology and photogrammetry systems within the UK, and because of this, often manufacturers don't even realise they need it to solve their manufacturing problems. Photogrammetry systems can bring huge value to manufacturers who invest in the technology and expertise, including improvements to build quality, time saving benefits and waste reduction.



# WHAT ARE THE RISKS AND REWARDS AROUND DEPLOYING PHOTOGRAMMETRY SYSTEMS?

We asked the group:

- What do you see being the biggest risk with photogrammetry system?
- What do you see being the biggest opportunity with photogrammetry system?

The conversation surrounding risk of deploying a photogrammetry system began around the up-front costs. One research centre representative commented that,

“Photogrammetry sensors often have a low cost, however often require high skills / knowledge to integrate them into a turnkey production system. This prevents most manufacturers from adopting photogrammetry solutions as the deployment and maintenance knowledge is not internally available.”

It was agreed that the cost of a fully integrated system, plus lack of understanding posed a huge perceived risk, but perhaps again if there was more knowledge surrounding them, this perceived risk would be mitigated.

“Unions are often a shopfloor blocker and new technology is seen to take jobs in automotive industry” commented one engineer which was also agreed amongst the group. Photogrammetry is often seen as such a technology and as it removed a verification process often conducted by operators.

For these risks, the group agreed with the counter argument made by one member of the group,

“The biggest value drain I see is continuing to use traditional probing and spike alignment methods to datum the parts, often costing days of valuable operator time. A lot of production systems are still operator led, meaning they require an operator to touch up the process at every stage. A shift to automation led system with the use of

photogrammetry can unlock opportunities to improve quality, get manufacturing right first time, save time, reduce waste and close the loop, but the link between these benefits and types of process is often not linked.”

The conversation moved on to when is the right time to set up a photogrammetry system as another member of the group stated that,

**“ New cells being set up should have photogrammetry systems included in the blueprint, it is the set-up of the cell that makes the difference in build quality”**

It was agreed by the group that this would be the ideal – but also recognised this isn’t always reality.

“A turnkey photogrammetry system can be deployed at any point to enhance robot performance and flexibility” stated another engineer.

A Tier 2 supplier re-affirmed,

“A flexible photogrammetry system would greatly benefit our applications centre. The automation we have is old fashioned, but we are now looking in focus more on high end automation and industry 4.0, and a system like IONA would unlock these capabilities for us.”

## SUMMARY

Proving the ROI in deploying a photogrammetry system is challenging – especially with few systems on the market and the technology being new.

However, to those with an understanding of metrology and photogrammetry, the opportunities vastly outweigh the risks. Yet again, lack of widespread understanding and knowledge appeared in this group discussion to be a big blocker creating higher perception of risks around cost of deploying a photogrammetry system.

# CONCLUSION

## HOW PHOTOGRAMMETRY SYSTEMS UNLOCK ADVANCED MANUFACTURING



Photogrammetry systems such as IONA, are unlocking advanced manufacturing processes.

Robots are accurate, but with increased expectations in build quality, a drive to be more sustainable by reducing waste, time-saving targets, tighter accuracy tolerances, a need to get manufacturing right first time, they are not accurate or intelligent enough to meet the demands of today.



**Photogrammetry systems improve robot performance by unlocking:**

- Higher robot accuracy
- Move measure correct (MMC) processes
- Faster alignment processes
- Digital twin verification



**Enabling manufacturers to:**

- Get manufacturing right first time (RFT)
- Operate flexibly
- Improve build quality
- Reduce waste
- Save both setup and cycle time
- Have better process controls
- Deliver a resilient manufacturing

Wherever a manufacturer is on the Industry 4.0 journey, a photogrammetry system will provide value. Find out more by visiting: [www.insphere ltd.com](http://www.insphere ltd.com).

## CONTACT US

Get in touch with us here to discuss your manufacturing requirements and discover how IONA can unlock the potential for flexible automation.

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