

Advanced Industry 4.0

Assessment 1 – Report

MSc Industry 4.0 Advanced Manufacturing

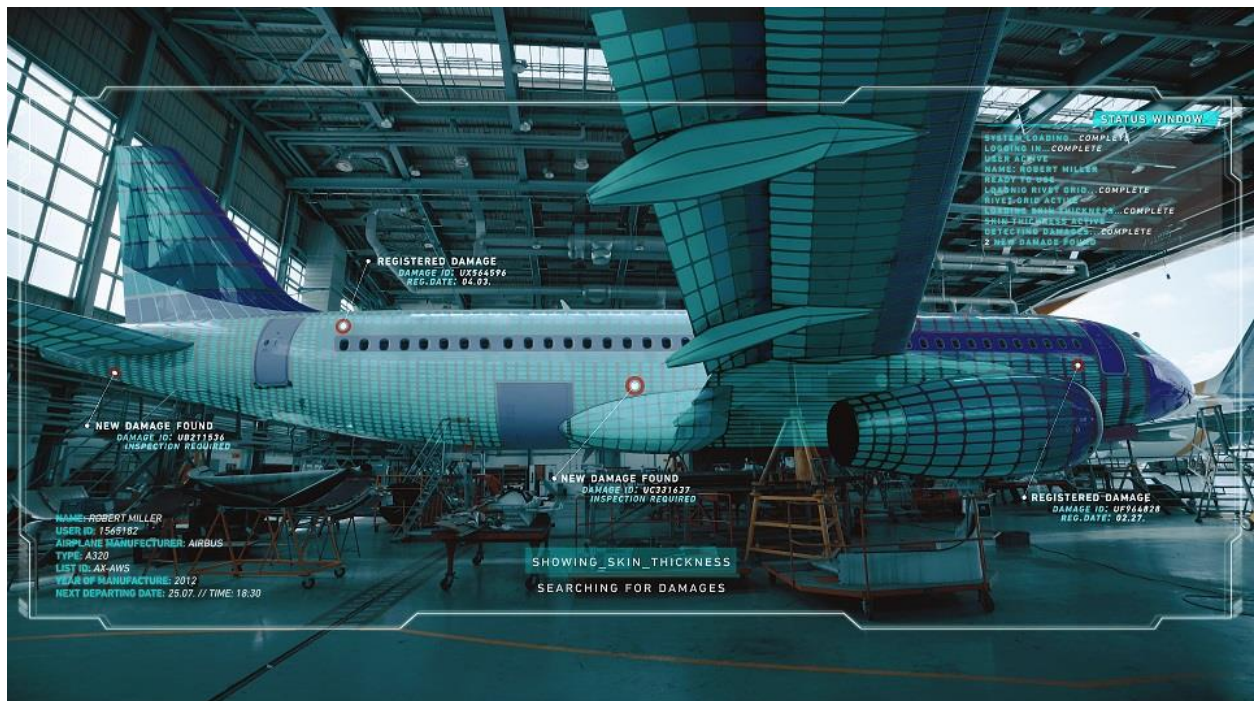
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Abstract

Most of the areas in SSGB remain analogue since the initial introduction, this means we have limited digital interaction through the operational phase. As stated in (Price, 2022) our business has seen a change in workload due to the pandemic of Covid-19 most contracts were either cancelled or delayed.

As contracts come back on-line there is a focus to work in a smarter way and utilize technologies seen in the industry 4.0 forum, by changing many of our processes in to digital the risks of quality escapes will reduce in-light of the constrained timescales to deliver.

We have already seen how technology in our sister facilities can improve efficiency and lower failures to quality standards. The integration of VR, AR, and mixed reality into the aircraft installation area was observed in this report, AR has played a key role in developing day to day work life changing how the processes and workload is carried out along with supporting remotely. As stated by (Pullein, 2019) there need to be a plan to move from reactive to proactive, the natural default for most is reactive by continuing to review data at the end of the day or the next morning does not help any form of improvement. If anything currently we have an ongoing loss in working time and the same mistakes can carry on in the build line or with any supplied parts.

Future contract wins as stated are required for to survive in this sector, (Donut, 2022) gives guidance on what customers are looking for when choosing a new supplier, these are business that concentrate on building trust, can show a feedback loop throughout the business demonstrating communication skills, teams that are prepared meeting the correct quality standards without asking and know the background of the customer they are supplying to.

Introduction

SSGB has a limited focus on VR, AR, and mixed reality, which limits many opportunities, the infancy of this technology frequently allows for the use of alternative analogue methods. The majority of operating procedures or manuals are written on paper and then converted into excel / word etc.

As stated by (Price, 2022), human intervention is needed to create and update paper, excel or powerpoint documents for planning, working instruction, tool control or inspections. These are all at the risk of having mistakes made in them whether this is non-eligible pens being used, untidy handwriting or using defective keyboards on laptops.

The image displays three documents from Safran, illustrating the use of paper-based forms in manufacturing.

Top Left: Technical Drawing
Part Number: NAS1802-9-36
Description: SCREW HEAD
The drawing shows a technical illustration of a screw head with various dimensions and callouts. It includes a table for 'Tools Required' and 'Target Stock'.

Top Right: PRODUCTION BUILD TRAVELLER
Centre Shroud (F29J50 series)
Project: Optima 757-400
Customer: United Airlines
Unit Serial: 701220922-90134
The table lists specific requirements and build instructions for various components, including items like 'Items detailed on BOM Kitting list' and 'Items detailed on BOM Kitting list'.

Bottom Left: PRODUCT INSPECTION REPORT
Part Number: NAS1802-9-36
Description: SCREW HEAD
The report is a table with columns for 'Inspection Item', 'Inspection Method', 'Inspection Result', and 'Inspection Date'. It contains handwritten entries for various inspection points.

Because our process's drive the use of paper documents which are the hand written as above, these can be misread meaning that corrective actions can be signed off inadvertently. This is where quality escapes can happen, at this point we have to understand if the mistake is genuine or people have simply not taken care. If this is the case that people have not taken care we find ourselves in a negative culture that will, something that is not easy to undo. (Stover, 2022) provides the top three cultures within this pattern, employee animosity, hustle culture & poor communication. This is not an environment that at team can work or develop themselves, process or methods they work in.

The methods of industry 4.0 can transform a business giving that it is done right, (Yvanovich, 2017) states that the number 1 concern is cybersecurity. As software programs enter the factory they are run through business servers that will be connected to sensitive information, this could either be designs, financial or personal data therefore we have to be understanding of what blockers will be

inplace. Essentially removing paper document where hand filling is required is the way forward for our business in many different ways. (GOV.UK, 2019) provides help of how to collaborate & share data safely, this can then be used by analytics tools where data can be pulled into dashboards, these dashboard can be created using Python scripts.

To ensure seamless communication for building, installation, and ongoing maintenance, digital systems must be used. Within our current inspection gates there is the option to use ipads rather than hand written paper sheets. This means the inspections can be carried out quicker and have less likely mistakes in the descriptions for the operators to rework and the quality team to sign off.

To provide customers with what they have requested developments have to be applied, when we have enhanced our tools the benefits soon become apparent. Tools like 8D, 5whys or other route cause analysis tool as shown by (Kanbanize, 2023), give us the methods to show that customer concerns can be reduced and reports with containments, corrective actions are in place along with investigations showing how these will sustain and are not just a sticking plaster. These can also be linked to APQP where lessons learnt are feed back into the design phase of new products.

We can reduce the NVA elements of the business by incorporating VR, AR, and mixed reality systems into the installation phase. The goal would be to use these systems to boost our current efficiency of 55% (which is considered poor in the business world carrying nva) to 80%.

This report will focus around the below,

- Aircraft Installation – As described by (Price, 2022), SSGB supply fully build suites to our customers, however these cannot be directly fitted into the aircraft. Once delivered our on-site team disassemble these into a modular format so they can enter the aircraft and then be reassembled. The main issues are by using this method we are causing our customers delays as we are disassembling on the aircraft wing, instead of this we would like to conform the finished product prior to assembly. This is where we need to use additive manufacturing in the form of 3D printing and AR for the assembly phase on the aircraft which will not be carried out by the same team in the original factory. The assembly process will be carried out by teams that are not familiar to the product, they will see several different types of suites and aircraft over several months.

Main Content

As described above the current process is not simple and can cause damage and issues when reassembling in addition we can find that the in-experienced on wing team can miss read the build

documents or become confused with other product types. The installation time for the overall build can be improved, any issues are raised there is a knock on effect throughout not just the installation. The installation of the suites are needed to support the galley installs, these areas require the most time due to a high amount of electrical features being installed, air-conditioning units, ovens, life head end units and passing connection wires.

As we release the suites from the operational line we can use several gauges to understand if the mating points and aircraft fitment points will align at the assembly point in the aircraft. A quick way of checking hole alignments would be the use of 1-2-1's made out of kydex. In the past some of these have been developed by 3rd parties which come at a significant cost, as these are normal not high volume more than likely 1 off's this also pushes the price of these being purchased. At present 3D printers are being looked at so we can bring this work in house, once in house these can be manufactured at a fraction of the cost. (H.Amelia, 2021) describes how parts can be manufactured at a low cost and without the need for additional molds using an additive manufacturing method.

With these 3D parts in place we can look to change the tools in the environment that may no longer be required. As these 3D parts are introduced a 5S approach can be taken (Toolbox, 2023) shows where we need to clean up the workflow, a process of red tagging and removing unused tools also help foreign object debris another form of quality escape that is not good for the business.

AR has already been developed by several other aircraft suppliers for not just suites but most processes where rework, assembly or the sign off of work is required.

(TWI, 2022) explains how the VR system would support the visual assembly, operator and customers could use a VR headset to see how the product will be built and finished into the aircraft cabin. At this point if early enough the VR system can be loaded with options, these could be to change colors or feature changes like décor, door handles, cupboard design, trim shapes or where company logos will be embossed. These choices provide the customers with a clear picture of what will be received and aligned the team of how the product should look once finished.

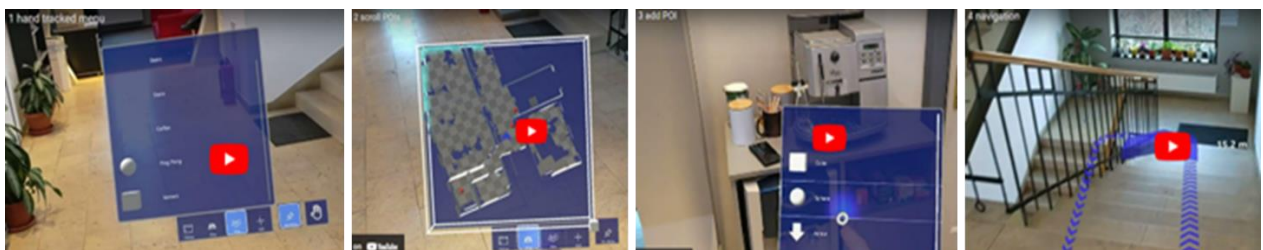
(TWI, 2022) also explains how the AR system would support the build up from modulation to full suite level, the AR overlapping reality with model data would allow an operator to rebuild the suite knowing the same level of detail as an initial inspector in the build factory. Most systems also have a function by where an external support can be requested and joined via the system allowing a remote person to support seeing visually in tandem the process and items in front of the operator that require clarity.

(365, 2023) shows what AR can give us with regards to helping through the process of installing suites on an aircraft, the main is bridging the gaps by using physical and digital worlds.

The main elements is to have an overarching view of tools, processes and parts in a virtual world when looking at the physical place of where these components are going. With these combined everything is in the vision of where you are looking, there is no requirements for any additional books or paperwork.



(ALL, 2022) provides a brief overlay of how the software can be easily developed using the HoloLens 2. POI's or key characteristics against a catia model can provide alignment analysis which can be used to develop hand tracked menus by installation pieces. This Bluetooth-enabled technology has an integrated IoT system that allows reports to be auto-populated and saved for evidence when mating parts are correctly connected.



Implementation Methodology

(Article, 2022) emphasises that integrating the HoloLens 2 is relatively simple because it was developed by Microsoft and runs in tandem with Windows 10. The connection is made via wifi, which will load the software package that includes iris setup for individual users onto the HoloLens 2. The air tap gesture is a part of the software that allows the operator to hold, release, and resize objects. This part of the software package also includes a training package. In SSGB we used model data from Catia V5 that would support the aircraft installation via paper documents, with the HoloLens 2 the files can be exported into either an fbx or obj format this then can be uploaded into a Unity app and opened on the HoloLens 2.

Background Research

The above-mentioned reality system has dominated other sectors however (Research, 2021) discusses how this is still in its infancy with regards to the aerospace and defense industry, automatic is still the largest industry where this is being used. (Research, 2021) also share that the market value of AR is a staggering \$38.56billion and set to achieve a forecast high of \$597.54billion by 2030, this shows that other industries are clearly keen to adopt this technology into their businesses.

(Hoey, 2018) also discusses the use of Internet of Things (IoT) devices which can wirelessly connect to the internet servers quickly and safely move recordings, in one of our challenges this would be the movement of defects that have been recorded not to the required standards on an iPad. When inspecting products with an iPad items could be photo'd and drop downs added with defect codes. With this (Harrison, 2022) highlights how pivot software can sort defects into batches, cause codes, quantities and even identify the operator, at the same time digital graphs can be created. With this we can look to create where the biggest failures are and start a plan to address them, this design is preferred in companies as it can be focused on by small teams with them pulling on support teams as and when.

Conclusion

According to a survey (Uzialko, 2022) due to the integration of digital technologies, companies were able to work through the financial impacts of the economy down size in the past two years. With AR only just being used within our industry there will still be a lot to learn, like any the sooner this is understood and used our product install team will benefit. As other aircraft installers have used this already there is less fear as we won't be the first, simple step by step integration will allow us to target the low hanging fruit as we understand the technology. When teams have seen the AR systems working many operators have suggested not only this working in the main build lines and install team but using this as an opportunity for training of new staff, apprentices or a method of upskilling for modifications / extreme developments.

Industry 4.0 as previously stated, is not cheap no developments are, we have to understand why we need these improvements prior to laying out huge expense. (Upcounsel, 2022) provide positive reasons of why we would move forward with the improvements, upskill of knowledge, product creation, product design, testing abilities and prototyping phases will all move new product forward.

We must also keep in mind that Industry 4.0 is not the end of the road, (Kunovski, 2021) demonstrates that there is already a clear path to Industry 5.0 and how this will fit as another

revolution. We would like to see machines in Industry 5.0 that can perform multiple, complex tasks without the need for human intervention thus integrating with AR to install product on aircraft.

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