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AMRC ADVANCED MANUFACTURING RESEARCH CENTRE / The University Of Sheffield.

ROLLS ROYCE

INDUSTRY X.0

INNOVATION CENTRE AT THE AMRC SMART FACTORY

SHEFFIELD

THE ROLE OF THE SMART FACTORY

SMART FACTORY IN ACTION

HOW YOU CAN USE THE SMART FACTORY

SHEFFIELD

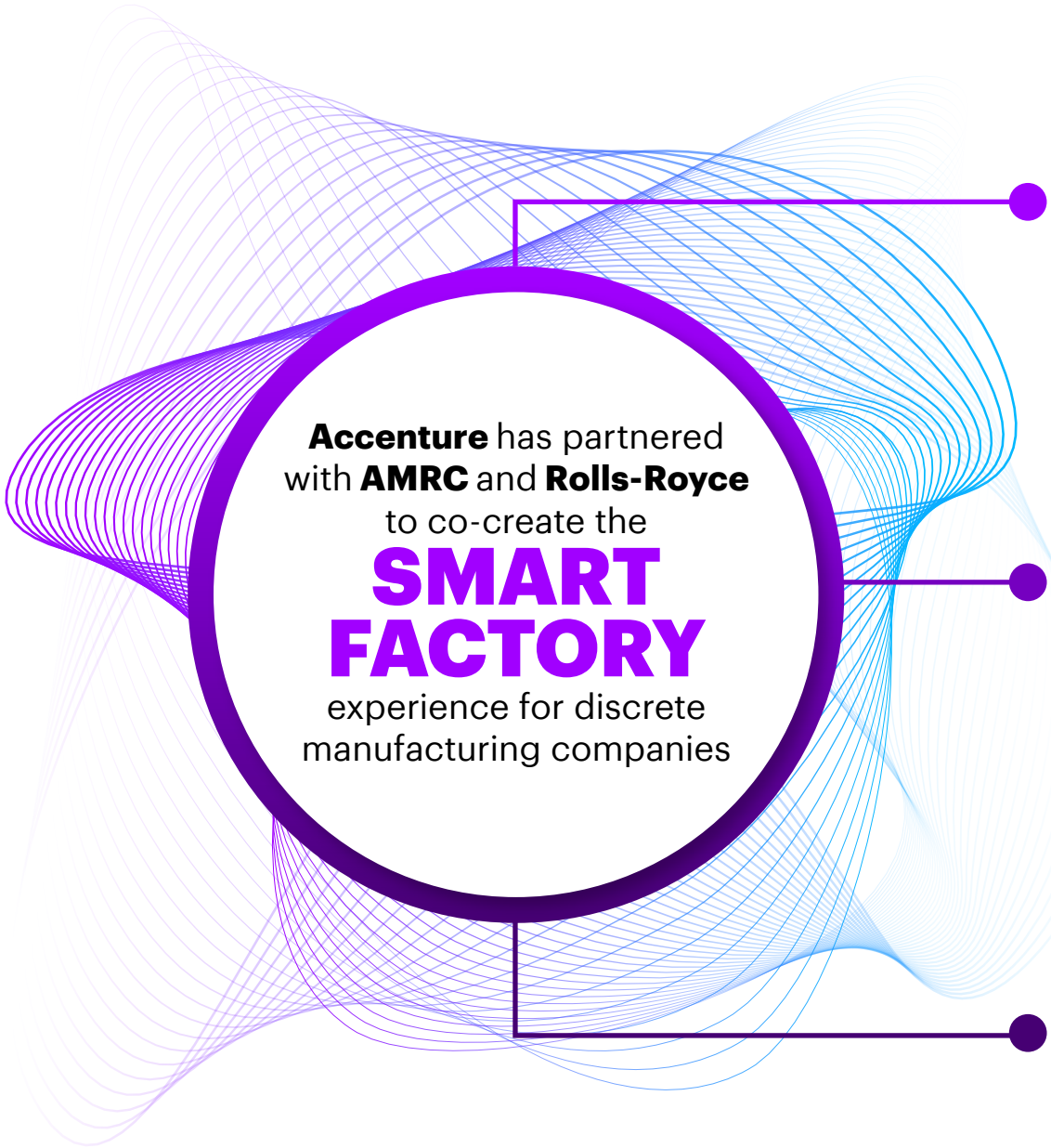
Traditional industries meet world leading technologies

Once at the heart of the British Steel Industry during the 20th century, **Sheffield** is now leading the way with cutting edge research, innovation for manufacturing. This has been led by the **AMRC** (Advanced Manufacturing Research Centre) which is a world-leading research and innovation centre and part of the High Value Manufacturing Catapult programme in the UK. The 650+ manufacturing professionals working at the AMRC are employed by the University of Sheffield.

> The AMRC bridges the gap between academia and commercial implementation by providing a safe sandpit environment for ideas to thrive. Airbus, BAE Systems, Boeing, McLaren and Rolls-Royce are just a few of the success stories.

The **AMRC Factory 2050** is located on the grounds of what was once Sheffield Airport and was opened in 2017. It is part of the growth story of the AMRC. Accenture has co-invested with the AMRC in the development of Accenture Industry X.0 Innovation Centre at the AMRC Smart Factory. This is a real factory environment, which is now demonstrating the very best integrated digital technologies. We invite you to come and see it for yourself and understand how the **Accenture Industry X.0** and AMRC team can help you accelerate the adoption of Digital solutions for manufacturing.

The smart factory partnership



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Accenture, a leading technology consultancy, is ready to support the accelerated change needed in the manufacturing Industry. By navigating disruptive technologies and using our industry knowledge we are transforming manufacturers to become a digital enterprise. Accenture has been ranked first in the HFS Top 10 Manufacturing Service Providers 2019 report. Being referred to as “a consulting powerhouse with industry X.0 vision and strong investment commitment in manufacturing.”

AMRC / The University Of Sheffield.

The University of Sheffield Advanced Manufacturing Research centre (AMRC) specialises in carrying out world-leading research into advanced machining and manufacturing digitisation for aerospace, automotive, pharma and other high-value manufacturing sectors. The partnership between industry and academia has become a model for research centres worldwide. Their 100-plus industrial partners range from global giants like Airbus, BAE Systems, Boeing, GKN, McLaren and Rolls-Royce to small companies.

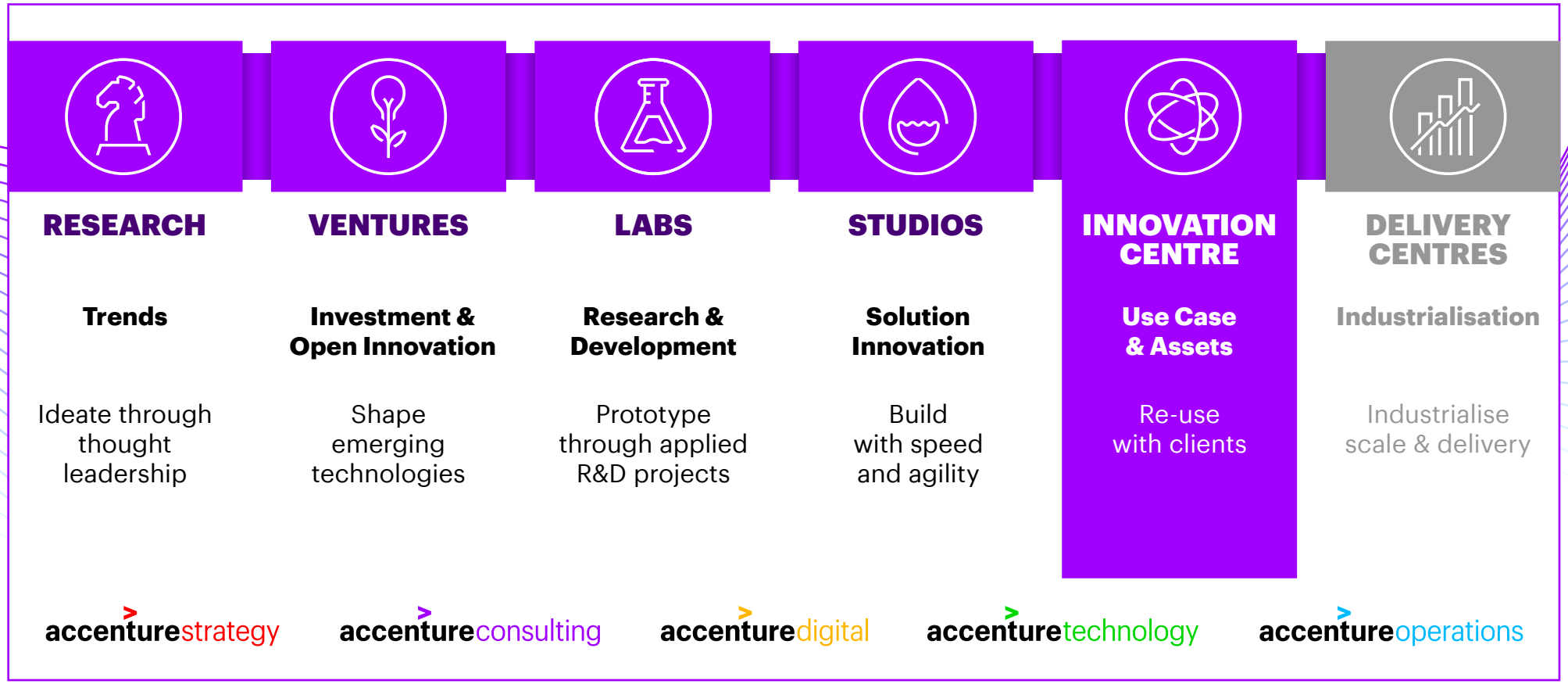
ROLLS ROYCE

Rolls-Royce is one of the world’s leading industrial technology companies. Rolls-Royce has customers in more than 150 countries, comprising more than 400 airlines and leasing customers, 160 armed forces, 70 navies, and more than 5,000 power and nuclear customers. In 2018, Rolls-Royce invested £1.4 billion on research and development. They are a major partner of the AMRC and currently influence the deployment of IT and Operational Technology solutions at the Smart Factory.

Innovation closes the gap between today and Industry X.0

Innovation is in our DNA, and we bring it to our clients through our innovation architecture.

The Industry X.0 Innovation Center at the AMRC Smart Factory is part of the global Industry X.0 Innovation Network and complements capabilities integrating Research, Ventures, Labs and Studios.



“This facility and **Industrial Strategy Challenge Funding** will help to accelerate the UK to a stronger industrial future. Investment such as this is crucial to help industry change how they conceive, design, engineer, manufacture and operate products and services with digital technology.”

Olly Benzecry
Accenture UKI Country Managing Director

AMRC and Accenture joint value propositon

AMRC ADVANCED MANUFACTURING RESEARCH CENTRE / The University Of Sheffield.

- Engineering and manufacturing expertise
- University and research offerings
- Process and method improvement
- State of the art equipment
- Membership model with IP and learnings from others

SMART FACTORY

- A world leading Manufacturing Capability
- Reducing risk and time to value

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- Industry Knowledge
- Leaders in digital and disruptive technologies
- Delivery at speed and scale
- Technology agnostic Lab environment at the AMRC
- Technology and business integration capabilities

Raise efficiency

Raise flexibility

Cost of poor quality

Reduce lead time

Improve transparency

Reduce inventory

Reduce machine down time

Reduce aftersales maintenance costs

The work undertaken for the Made Smarter Review found that the positive impact of faster innovation and adoption of Industrial Digital Technologies could be as much as **£455 billion** for UK manufacturing over the next decade.

Source: **Made Smarter. Review 2017**

THE ROLE OF THE SMART FACTORY

Provides a fully operational representative manufacturing environment which creates a Digital Thread of data across key technologies such as **PLM**, **ERP**, **MES**, **IoT** and **Analytics** capabilities leveraging **Cloud** and **On-Premise OT** and **IT** software.

SMART FACTORY

Co-create solutions with our clients

Demonstrate solutions and their application in a real world situation

De-risk new technology, by providing a test facility prior to deployment

Act as an **open innovation 'sandpit'** to promote new solutions

Provide a **Learning Factory** to promote skills development

SMART FACTORY IN ACTION

Visitors will experience the integration of digital technologies in a real factory setting

DIGITAL THREAD

SMART FACTORY HUB

Welcome area providing context for the Smart Factory

SUPPLIER

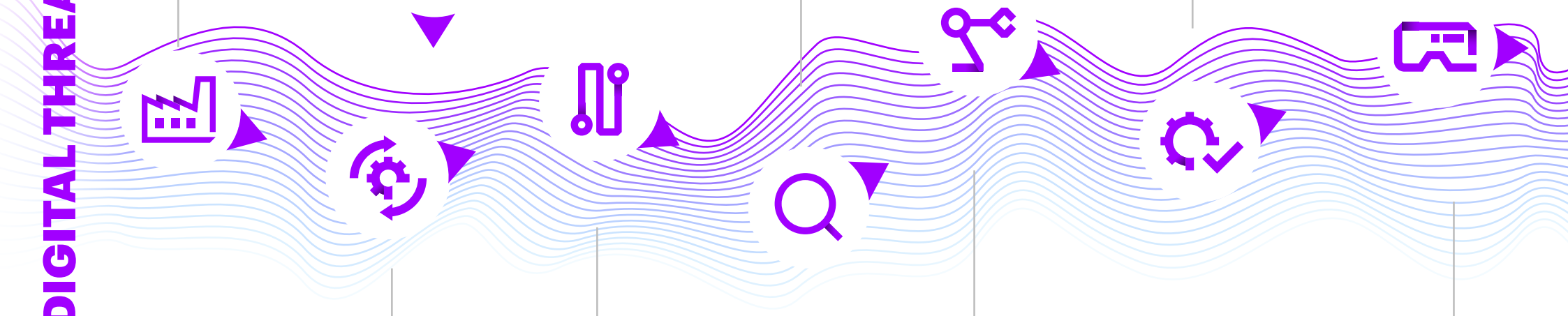
Access real-time visibility of order status/parts tracking

PARTS INSPECTION

Using camera inspection technology to provide contactless inspection

KITTING

Demonstrate interaction within the Smart Factory: management of parts visibility and identification, and augmented kitting process



SIMULATION

Modeling different factory conditions to optimise layout and performance

FLEXIBLE FACTORY

Modular floor for quick and easy reconfiguration between workloads

MACHINING

Industry 4.0 solutions used in the manufacturing process

ASSEMBLY

Augment assembly using cobots, laser projection, AR and video assembly techniques

Smart Factory Hub

Are you ready to experience a Smart Factory?

Your Smart Factory experience begins at the Smart Factory Hub, an area used for defining your specific challenges, discussing relevant research and exploring real-world examples.

We will illustrate the integration of manufacturing and digital technologies that are deployed as part of the Smart factory, and are able to deep dive into specific areas as needed.

Whilst providing an overview of the Smart Factory journey, we will explain how typical business challenges are overcome using the Smart Factory technology backbone and digital thread.

From here, we take a tour of the operational Smart Factory cells where key processes such as simulation, parts inspection, machining, kitting and assembly take place.

Following the shop floor tour, we reconvene to explore how what you have seen can be used to solve business problems, and discuss how we co-create practical ideas and solutions to take forward.

Simulation

Simulate factory scenarios

Simulation is a powerful tool that enables understanding of how different scenarios will affect key KPIs such as OEE and On Time Delivery and Overall Equipment Effectiveness. Manufacturing facility layouts are modelled to simulate business processes to evaluate system performance, optimise resources and perform what-if scenario testing. The ratio of human vs. automated workforce can be simulated and adjusted, to define the best conditions for each production scenario.

Key functionality

- Detailed end to end impact of process automation or change
- Simulation of anticipated future production scenarios to define best factory layout and configuration
- Understanding of how a flexible workforce could be deployed across multiple lines or cells dependent on each demand scenario

Flexible factory

Fully configurable factory floor

Simulation coupled with a flexible factory floor allows for quick rearrangement of machining and assemble to maximise operational efficiency while improving demand driven agility. Reconfiguration accommodates for fluctuations in order demand, while improving OEE.

Key functionality

- Layout can quickly be reconfigured to allow for multiple and new products, reducing space requirements and capital spend on duplicated machinery
- Drives production flexibility from informed intelligent facility planning

Parts inspection

Automated video inspection, optimised delivery

The automated visual inspection cell uses a digital imaging technique with machine learning to capture data regarding visual features which are of significance to the conformity of a component. The system identifies the features which are flagged to an inspector for further investigation.

Digital inspection could be used at any part of the supply chain where a controlled imaging acquisition system can be put in place, from individual parts to final assembled product.

The automated process captures, analyses and disseminates high volumes of inspection data in a managed and useful way. The data acquired could be used to correlate component visual feature verification with occurrences in upstream processes and operations.

By reducing the component quantity requiring manual visual inspection, significant gains in capacity and productivity can be achieved.

Accenture have integrated the automated visual inspection cell with the Smart Factory infrastructure, enabling product conformance visibility and tracking of items against work orders as inspected.

Key functionality

- Consistent and reliable inspection process resolves issues of capacity bottlenecks
- Reduction in waste due to increased consistency and accuracy
- Integrates data from MES, PLM, and Analytics for root cause analysis and continuous improvement

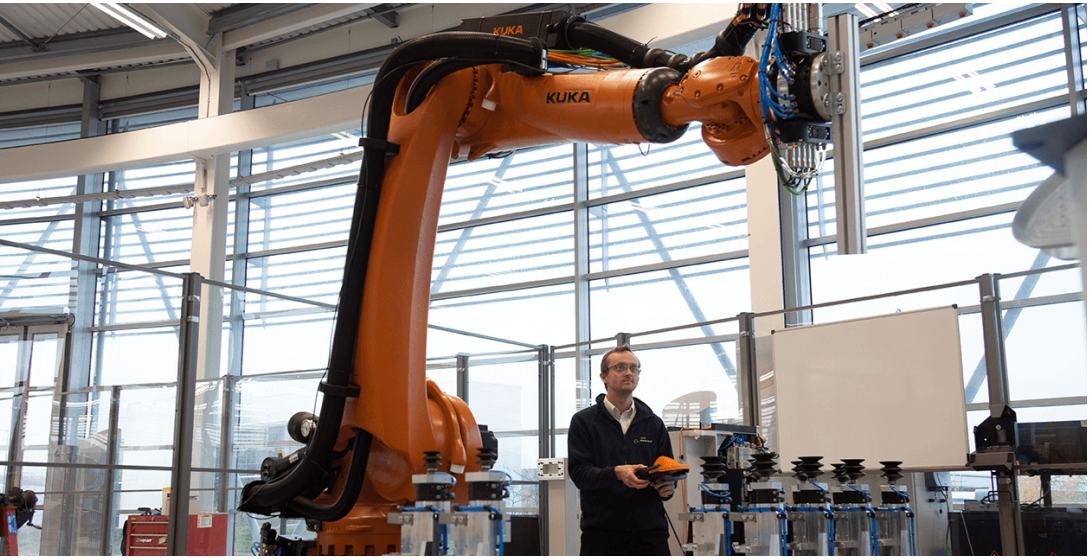
Smart machining

Using a Digital Twin of the cell to optimise the machining process

The machining cell showcases the use of advanced fixturing techniques to improve manufacturing efficiency, from which a Digital Twin is created.

The Digital Twin provides real time performance data and value from the entire manufacturing process, creating customisable and user friendly digital dashboards and reporting to enable intelligent decision making and analysis.

Further enhancement using machine learning and artificial intelligence can be added to predict equipment failure and provide predictive maintenance platform to enable prioritisation of data insights and actions. The Digital Twin also allows the engineer to become safely and fully immersed in the machining process, using VR enabling them to follow closely the step by step process and understand how issues affecting the environment and overall performance can be resolved.



Key functionality

- Real time access to production information and failure prediction
- Enables intelligent, data driven decision making through creation of a Digital Twin and predicative maintenance platform
- Ongoing improvement through the use of data science, AI and Machine learning to optimise OEE
- Compare real-time information to expected performance using Discrete Event Simulation (DES) to ensure continuous machine availability

Smart kitting

Intelligent Kitting process

Smart Kitting is showcased in AMRCs cost-effective AR driven kitting cell. Fully integrated with the MES, the pick-by-light system enables the user to find and locate parts quickly and efficiently.

As soon as a work order is accepted into the kitting cell, the technician is told which shelf and specific box/area is required and where each of the parts are with the storage facility.

The interactive storage facility uses lighting to highlight each part location to enable fast, efficient, error free collection. This solution can be reconfigured quickly and easily based on either the type/volume of work being undertaken. Findings from the associated analytics can then be used to make the kitting process more effective.

Accenture have enabled the solution to be fully integrated with the MES to ensure seamless end to end production and assemble.

Key functionality

- Reduction in kitting errors
- Flexible configuration
- Removes unnecessary worker movement and manual handing
- Easy reconfiguration enables shelving to be re-used for different parts and products based on demand quickly and easily

Assembly

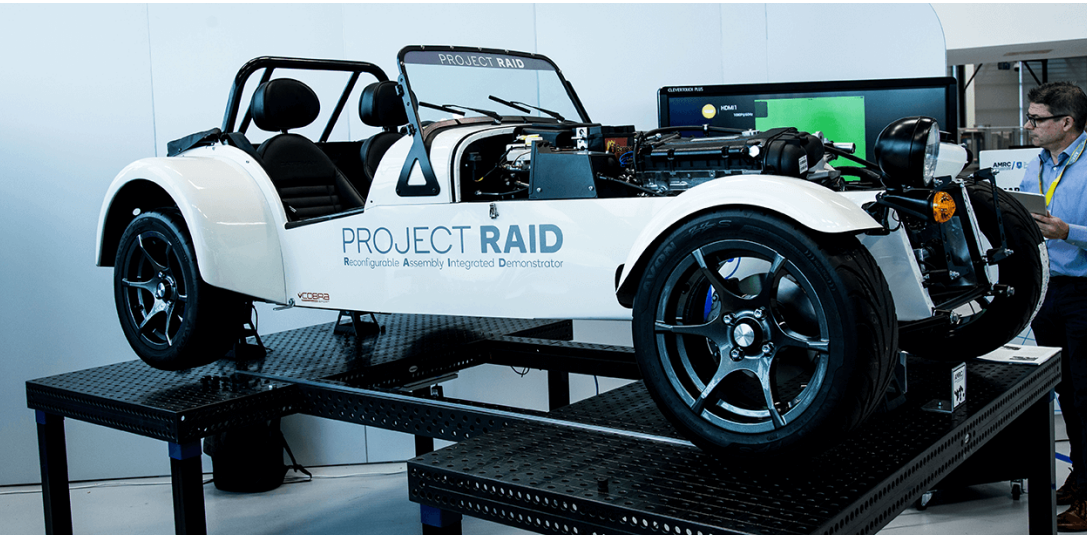
Digitally supported Assembly for the Connected Worker

The Smart assembly cell showcases the how digital technologies are used to support and optimise the assembly process. The fully integrated end to end Smart factory infrastructure enables work orders to be accessed through-out.

Once kitting is completed, the As-Built-BoM is generated to create a single view of the engineering needs.

Skill level appropriate assembly instructions are created which can also capture the training needs and development of workers. Work instructions delivered through augmented technologies and Cobots are used for assisted assembly.

Smart Tools which are automatically adjusted to pre-defined parameters associated with the work order are used in order to optimise assembly routines and avoid errors.



Key functionality

- The Integration of smart tooling removes the opportunity/ chance of human error and provides the ready to use equipment, reducing assembly time
- Digitalised and Immersive work instructions reduce time taken to complete task
- Increased Right First Time by eliminated errors

HOW YOU CAN USE THE SMART FACTORY

There are a variety of different services provided at the Smart Factory ready for you to see.

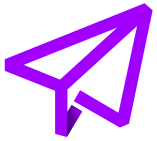
Get in touch at **amrc@accenture.com** to find out more.

INITIAL VISIT

Come and visit us for a half or full-day at the Smart Factory. We will inspire you with cutting edge technologies and begin to unravel your industrial problem.

CO-CREATION

We host facilitated ideation and design thinking workshops to co-develop innovative industrial solutions.



SMART FACTORY SANDPIT

The ‘sandpit’ is a risk-free development environment that allows for rapid prototyping and proving the value of digital manufacturing solutions. Digital solutions can be configured, tested and developed using it.

TECHNOLOGY PARTNERS

The Smart Factory is supported by a large number of relevant technology partners, providing the perfect opportunity to understand, develop and test drive different solutions.

LEARNING FACTORY

We provide structured training in high-demand skills that will benefit from the practical experience at the Smart Factory with Accenture and the AMRC.

About Accenture

Accenture is a leading global professional services company, providing a broad range of services and solutions in strategy, consulting, digital, technology and operations. Combining unmatched experience and specialized skills across more than 40 industries and all business functions—underpinned by the world's largest delivery network—Accenture works at the intersection of business and technology to help clients improve their performance and create sustainable value for their stakeholders. With 492,000 people serving clients in more than 120 countries, Accenture drives innovation to improve the way the world works and lives.

Visit us at **www.accenture.com**.

About Industry X.0

Accenture's perspective on, and method for, the digital reinvention of industry. We help clients use advanced technologies to reinvent products, services and business models from design and engineering to manufacturing and support, to supply chain management and logistics, to drive higher efficiency and new enterprise-wide growth.
For this, our IX.0 organization specializes in product and service development and operations, engineering digitization, and digital production and operations.