# Digitalisation of Rotomoulding

MANUFACTURING
INNOVATION FOR
REAL WORLD IMPACT


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# Digitalisation of Rotomoulding

- Industry 4.0 technologies - integrating digital systems, data analytics, robotics, and smart manufacturing
- Big data, AI-driven predictive analytics and digital twins can optimise process control, reduce cycle times, and improve product quality.
- Industrial robotics and virtual/augmented reality can enhance precision, safety, and operational efficiency.
- Advancements in materials, AI-enabled tooling, and innovative machine architectures are expanding the capabilities of rotational moulding.
- Overall, Industry 4.0 positions the sector for highly automated, sustainable, and high-value production, unlocking new markets and elevating product standards.

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# Digital Rotomoulding Virtual Reality Case Study

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# Rotomoulding at Queen's is changing...

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**AMIC is an industry led, open access manufacturing & engineering innovation centre, with state-of-the-art facilities and an expert engineering team, underpinned by academic excellence.**

- £100m collaborative, innovative powerhouse of advanced manufacturing
- Supporting economic growth and prosperity by creating high-quality jobs and increasing inward investment through high-value manufacturing innovation clusters
- Driving industrial transformation, paving the way for future technologies, and competing globally with a more sustainable focus.
- Our team is also growing rapidly (>75 staff) as we implement our ambitious vision with enhanced capability in digitalisation, design, and sustainability, and deliver real impact across the region.
- By 2050, it's estimated that AMIC will have contributed more than £1bn to the local economy, directly and indirectly created over 1,500 permanent jobs, and supported the training of 300 apprentices.

# Rotomoulding at Queen's

Rotational Moulding Area

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# AMIC LOCATIONS

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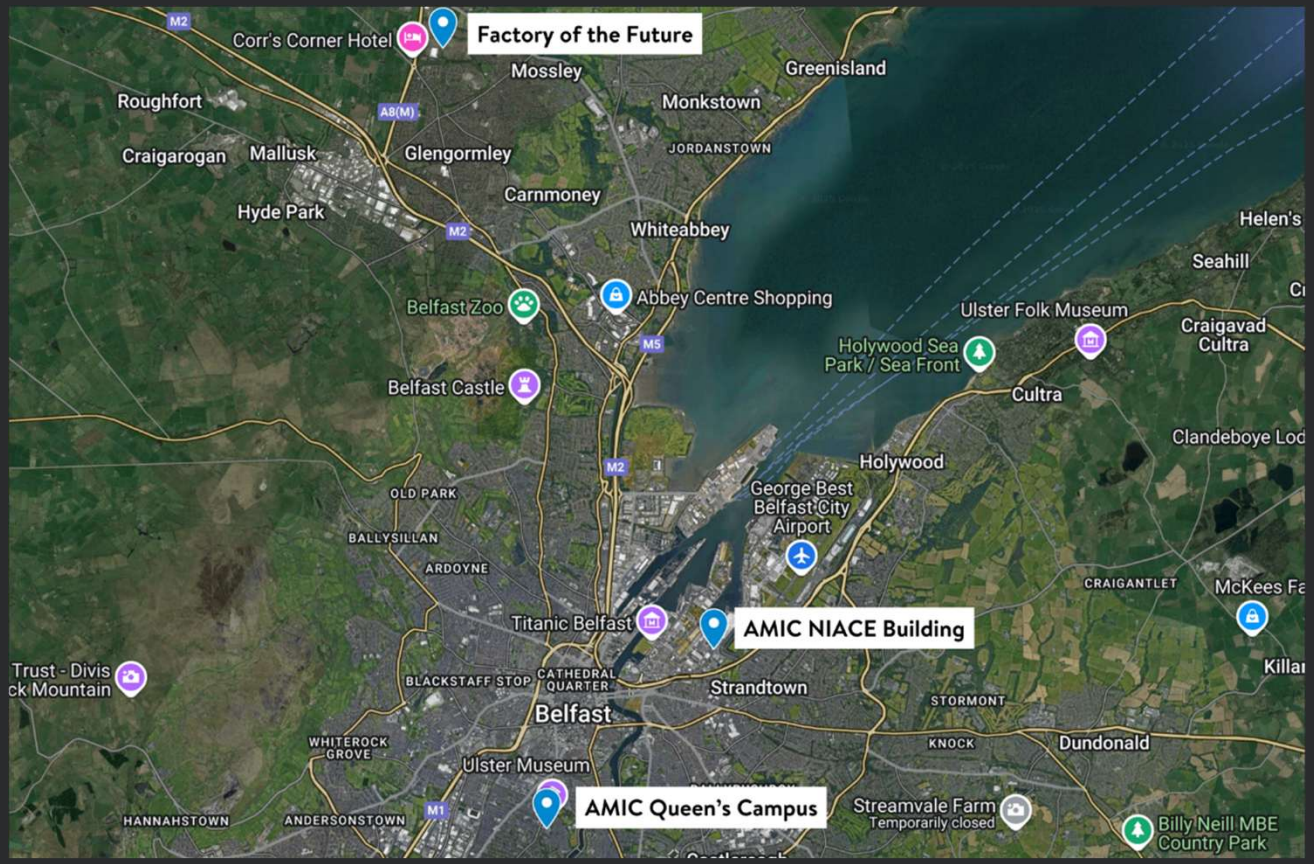

# AMIC'S STRATEGY

**1. Design centric approach:**

Compress the NPI cycle and accelerate tech to market

Energy, transport, infrastructure

**2. Decarbonise manufacturing:**

Design for low carbon & circularity, resource efficiency, carbon services, sustainable materials

**3. Drive innovation and competitiveness:**

Digital, automation, business models, skills

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# AMIC CAPABILITY AREAS




# DIGITAL FACTORY SCOPE

**Transformation of manufacturing through deployment of digital tools and techniques**

**The digital factory group takes a matrix approach combining digital tools and techniques with selected manufacturing process capability**

**Underpinned by UK leading research capability & regional strengths in AI & Cyber**

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# SUSTAINABLE POLYMERS & COMPOSITES

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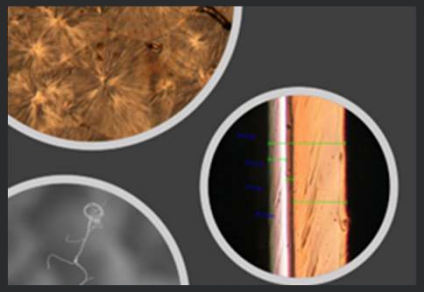
# Sustainable Polymers & Composites

**Moulding & Extrusion**

- Rotational moulding
- Injection moulding & over moulding
- Extrusion; sheet, tube
- Compounding



**Materials characterisation**

- Lab analysis
- Coupon make and test
- Sample preparation

**Cost-Effective Manufacture of composites**

- Thermoplastic Composites
- Complex Fibre Architectures
- Automated Deposition & Preforming

**Sustainability**

- Bio-Derived Composites
- Bio- Derived Polymers
- Circular Supply Chain

**SUSTAINABLE POLYMERS & COMPOSITES**

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# Sustainable Polymers & Composites

Sustainability

High-rate/ Cost-effective Manufacturing

Digital Integration

## Materials

- Thermoset & Thermoplastic composites
- High-performance and commodity polymers
- Bio-derived materials

## Processes

- Automated gantry with modular heads for dry fibre placement, ALM, tooling
- Thermoforming and overmoulding
- Autoclave assisted resin infusion with high temp/pressure
- RTM
- 3D weaving
- Multi-axis preforming
- Injection moulding
- Rotational Moulding
- Modular extrusion lines for novel compounding & EOL recycling

## Testing and Validation

- Dual robotic NDT, CT scanning,
- Mechanical/thermal/ environmental testing- Coupon to sub-element level
- Process/structural simulation

## Applications

- Large aerostructures
- Cabin Interiors
- Defence, Space, Automotive, Marine and Medical,
- Storage tank liners,
- Packaging sheets, tubes,

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# Rotational Moulding

- Over 35 years of expertise in rotational moulding technologies and materials.
- Recognised as a Global Centre of Excellence in rotational moulding innovation.
- Portfolio of patents demonstrating leadership in innovation, research and development.
- Industrial-scale manufacturing capabilities using both gas oven and direct electric rotational moulding systems.
- Advanced material testing infrastructure, including pulverisation and characterisation equipment.
- Ability to analyse, optimise, and innovate with materials for enhanced performance and quality.

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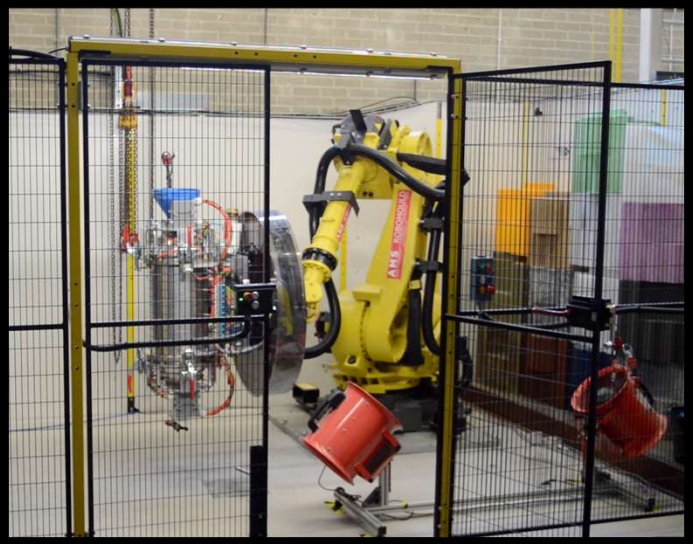
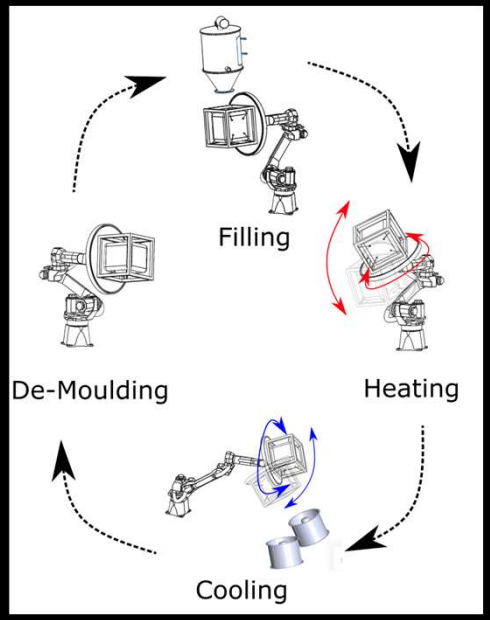
# Rotational Moulding Investments
# New AMS Robomould 700






**Conventional Machinery – Ferry Upgraded**

**Direct Electrical – AMS Robomould**

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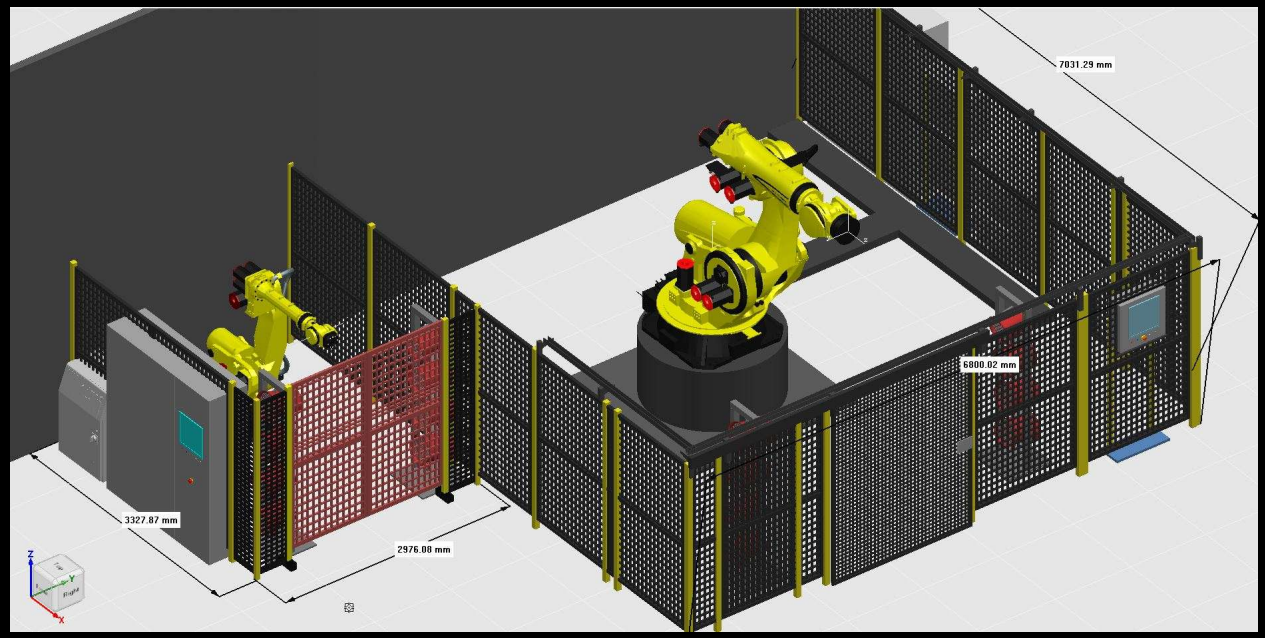
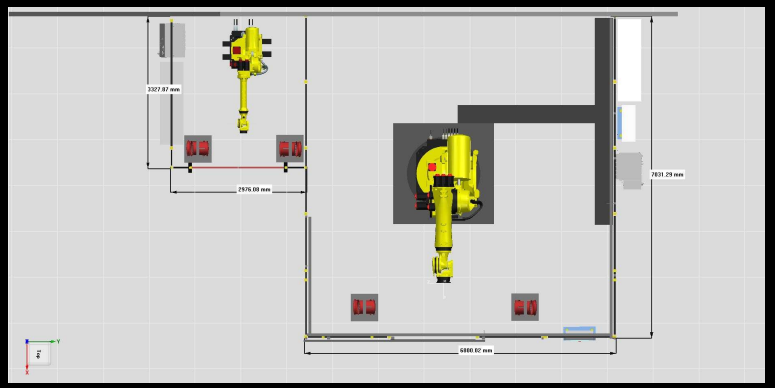
# Rotational Moulding Investments
# New AMS Robomould 700



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# New Rotomoulding Investments - Conventional Machine Digital Upgrade

- Digital Ready
- Complete Upgrade
- Completely new Electronics / re-wiring / hardware / software
- Increased efficiency – oven / burner / cooling bay

- Example of what can be done to a traditional conventional rotational moulding machine

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# Pilot Line Facilities

**Extrusion:** Eight single screw extruders and downstream equipment to produce 3-layer blown film and 5-layer tube, sheet & cast film (250mm and 400mm dies).


**Compounding and formulation:** Four twin screw compounders, fitted with low density material feeder and nano-material handling / loading.

**Material Characterisation :** Full suite of physical, thermal, rheological, optical, aging, and spectroscopic equipment

**Injection Moulding:** Three industry-scale IM (35, 50, 200 tonne) capable of high temperature processing

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**Rotational Moulding:** Four full industry-scale conventional and electrically heated machines with robotic control

**Thermoforming and Overmoulding:** One industry-scale 800 tonne press capable of high temperature processing

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# Characterisation

Independent testing service for the polymer and composite industry

Our recent investment in facilities includes physical, thermal, rheological, optical, aging, and spectroscopic properties which identify the characteristics of materials

All testing is carried out in accordance with International Testing Standards

- Physical testing: Tensile, flexural, shear, compression, impact, density and hardness
- Thermal analysis: DSC, DMA, TMA, and TGA
- Rheological analysis: Melt flow rate, capillary and oscillatory rheology
- Optical Analysis: Microscopy and colour
- Aging: Weathering and conditioning
- Spectroscopic analysis: Infrared spectroscopy

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# ADDRESSING SKILLS CHALLENGES

AMIC is set to address the future technology and skills challenges faced by the region's manufacturing sector.

Queen's is working collaboratively with partners under the Employability & Skills Pillar of City Deal to enable a constant pipeline of talent to support the growth created by the BRCD investments and ensure that the right skills are available within the region to support emerging job opportunities.

Learning factory environment complementing existing sectoral skills provision.

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# Digital Rotomoulding VR Case Study

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# Digital Rotomoulding VR Case Study

1. Aims and Objectives
2. VR Process
3. Manufacturing cell walkthrough
4. Collaboration
5. Benefits
6. VR versus reality
7. Conclusion

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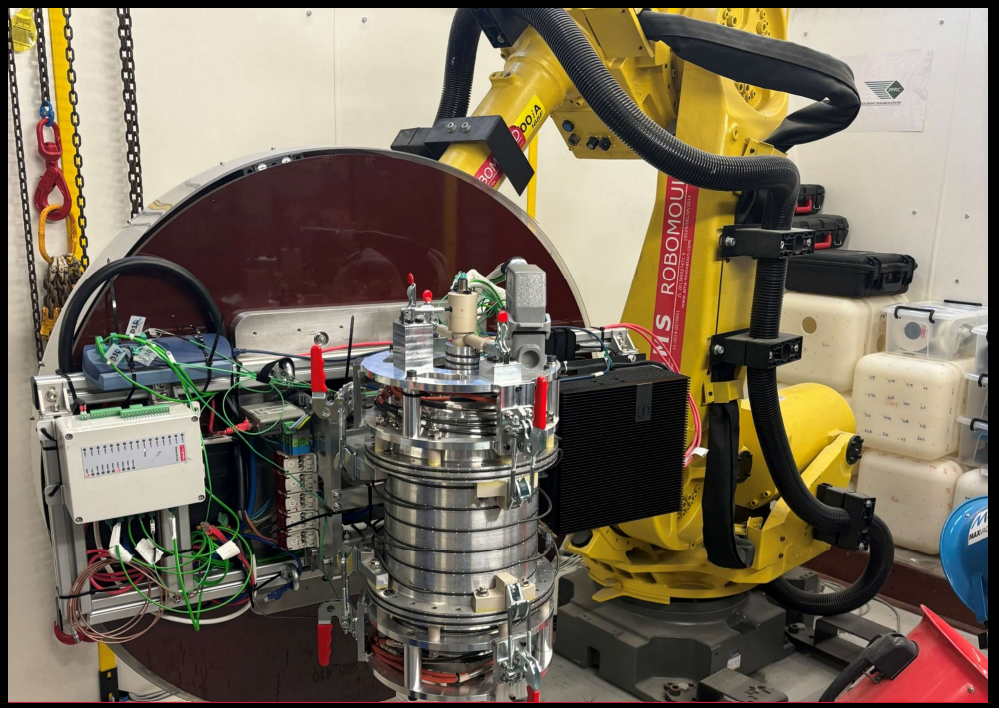
# Aims and Objectives

- Navico Group do not have experience with robotics or roto-moulding
- Help stakeholders visualise this new technology
- Improve confidence in cost model and labour time
- Help to make data driven decisions for equipment selection
- Enable early engagement of  manufacturing engineers



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# The VR Process

- Options considered for equipment suppliers, level of automation and factory footprint
- Manufacturing cell modelled in SolidWorks
- Keyshot used to create life-like renders
- Transferred to Meta Quest 2 headset using Steam VR and eDrawings
- Real life open space set aside to use VR with boundaries set

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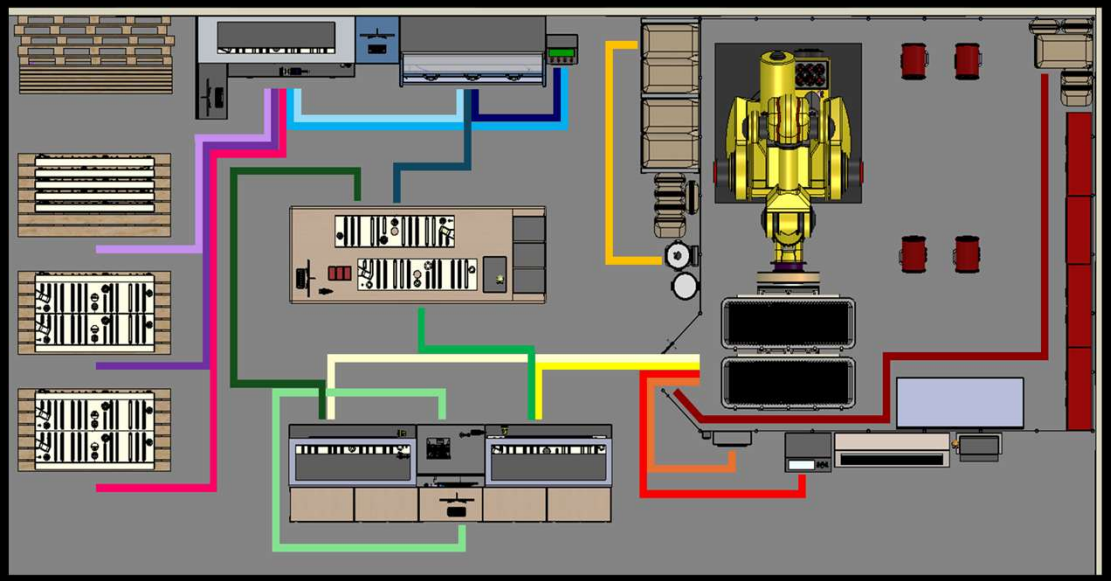
# Cell Timings



- Corner to Gate- **12.95** Sec
- Dock Control to Gate- **7.95** Sec
- Screen Control to Gate- **5.95** Sec
- Material to Scales- **5.51** Sec
- Tool to Bench 1- **5.21** Sec
- Tool to Bench 2- **6.82** Sec
- Laptop to Storage- **11.10** Sec
- Bench 1 to Build 1- **4.72** Sec
- Bench 2 to Build 2- **11.81** Sec
- Build 2 to Vacuum- **5.26** Sec
- Vacuum to Controller- **3.86** Sec
- Controller to EOL- **6.60** Sec
- Vacuum to EOL- **4.82** Sec
- EOL to Pallet 1- **6.99** Sec
- EOL to Pallet 2- **8.24** Sec
- EOL to Pallet 3- **10.58** Sec

- VR used to step through the assemble process and validate MOST timings
- Confidence in labour times and equipment required
- Quantified data to decide on the level of automations. Eg labour saving vs investment
- Penguins were placed around the cell
  - Tutorial for using VR
  - help identify hard to reach areas

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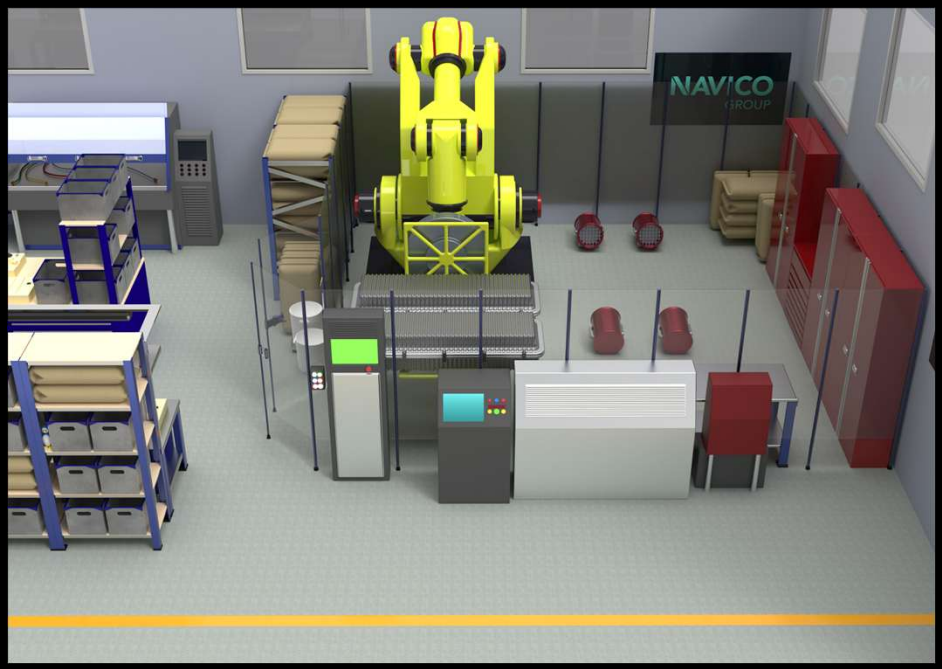
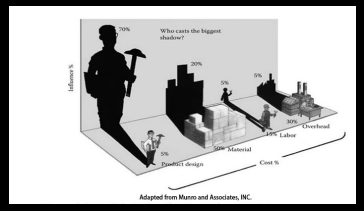
# Collaboration

- *"The cell is very large; can we remove tables and make some paths between tables smaller?"*
- *"It flows very well and is very easy to understand the process."*
- *"As the tanks are so large, would it make more sense to make people move to the tanks, rather than the tanks move?"*
- *"Could we use adjustable tables? It will make it easier for different operators."*
- *" It's very tight around the robot tools, could this space be adapted?"*
- *"If we start including automation throughout the cell, could this be incorporated?"*




**Decisions early in the design process cast the longest shadow**

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# Benefits


**Factory footprint**

*Quantified and optimised with confidence*

**Equipment selection**

*Helps make data driven decisions with labour time and capital investment*

**Ergonomics**

*Manufacturing engineers can engage in a more meaningful way earlier and have greater impact*

**Collaborative**

*Global teams can study the model in real time*

**Communication tool**

*Easier for engineers to communicate their vision to stake holders*

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# VR versus Reality

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# Cell Updates and Revision

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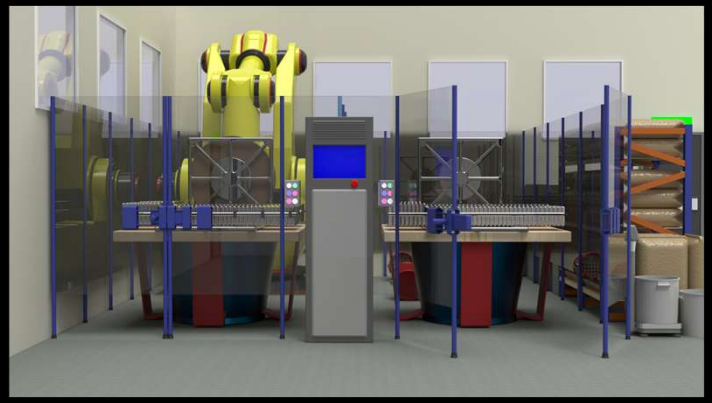
# Cell Updates and Revision



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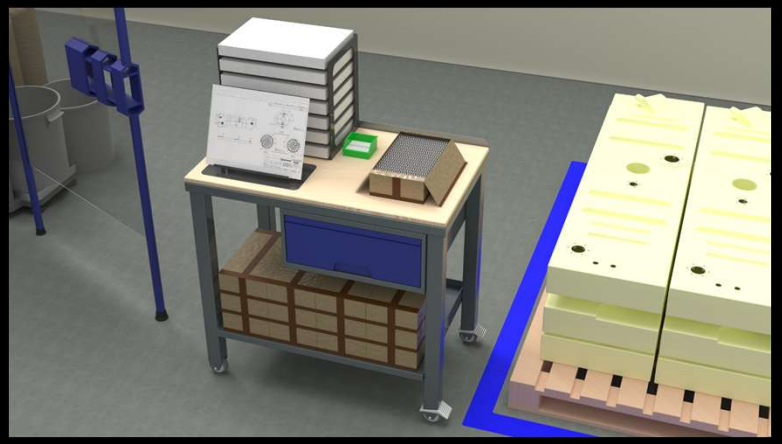
# VR versus Reality



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# VR versus Reality

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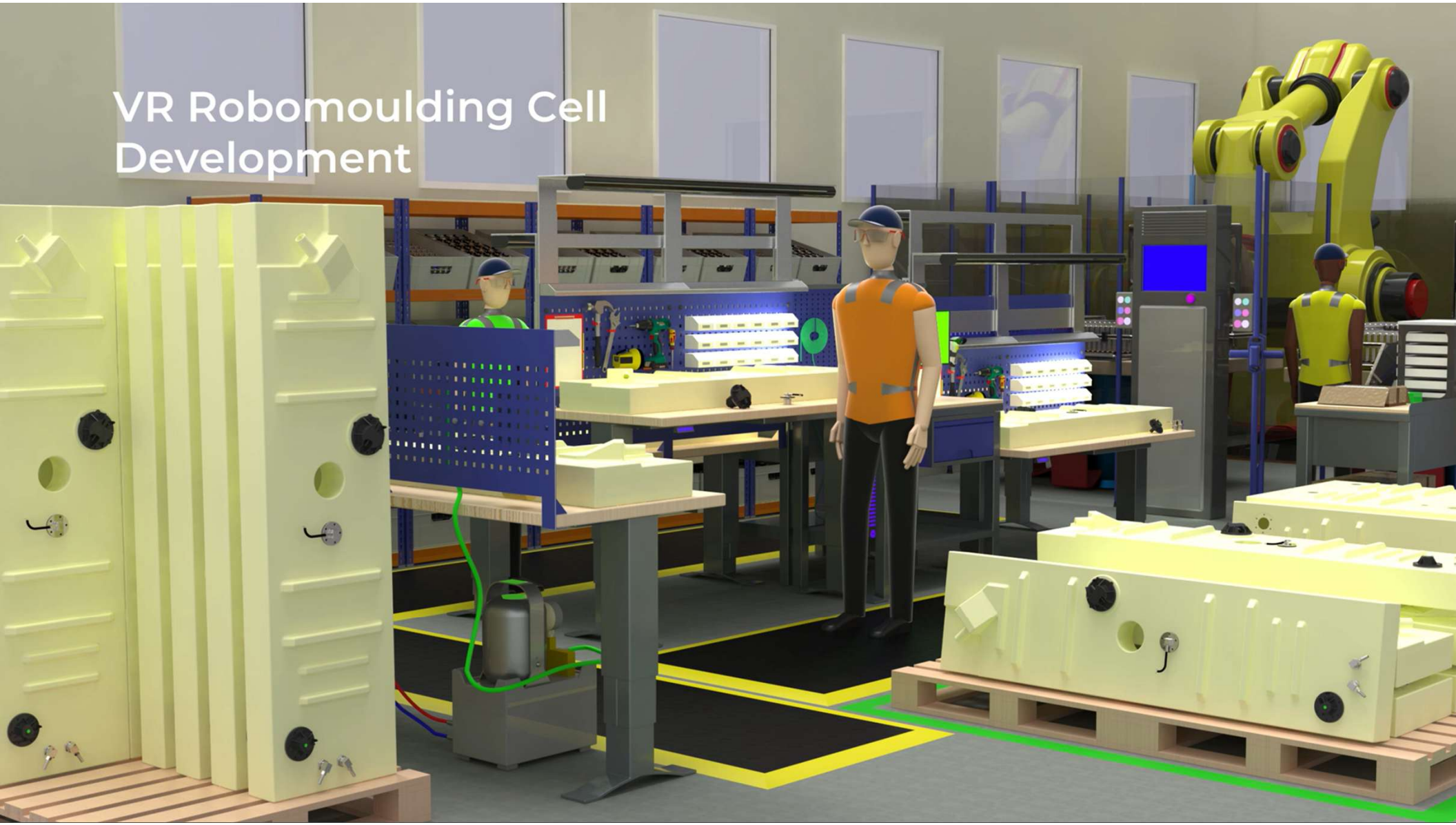
VR Robomoulding Cell
Development

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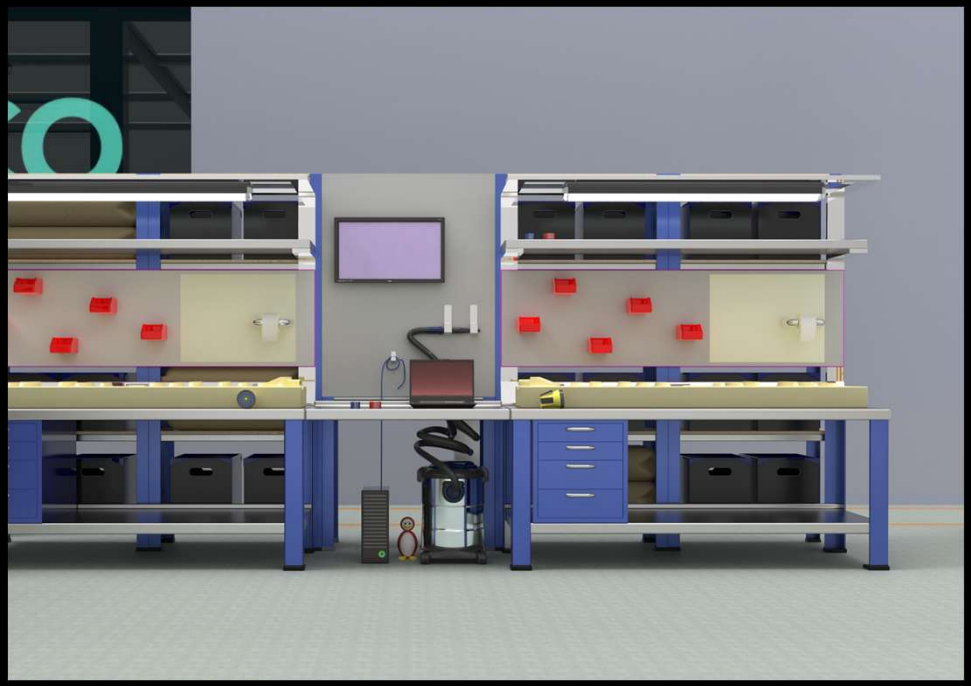
# Observations

- VR is not a toy; it's another data point to help make decisions
- We have been able to consider labour time, capital investment and factory footprint
- Collaboration globally and across department is easier
- Easier to communicate technical details with stakeholders
- The next step on in VR journey is operator training



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# Future Steps

- Continued refinement of layout
- The cell will be refined and modified using VR software
- Different cell designs can be compared by operators conducting test runs
- Development of the most efficient and ergonomic processes considering multiple factors
- Consider integrating training using VR simulations
- This can be linked to AR simulations during the onsite assembly
- Can be shared with other manufacturing sites across the Navico Group

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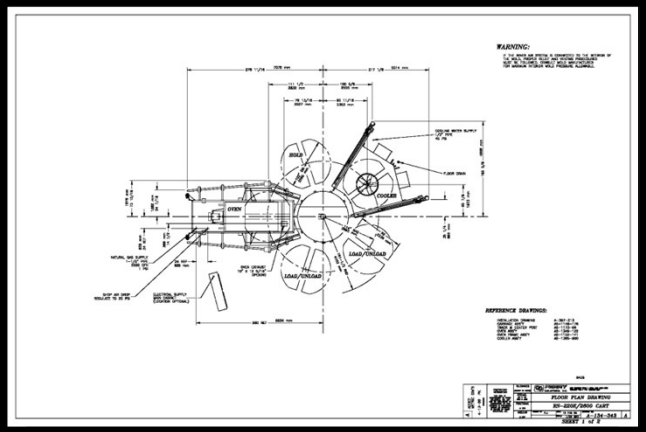
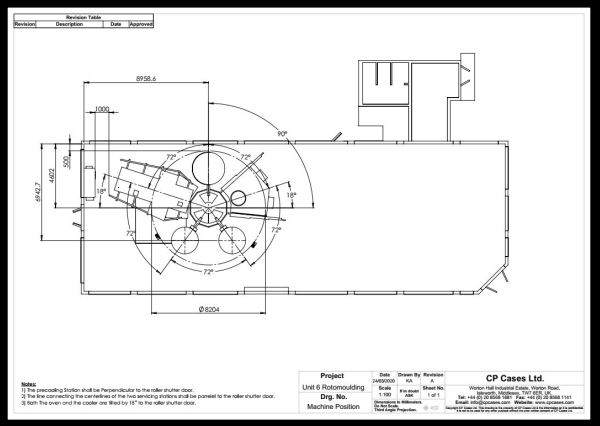
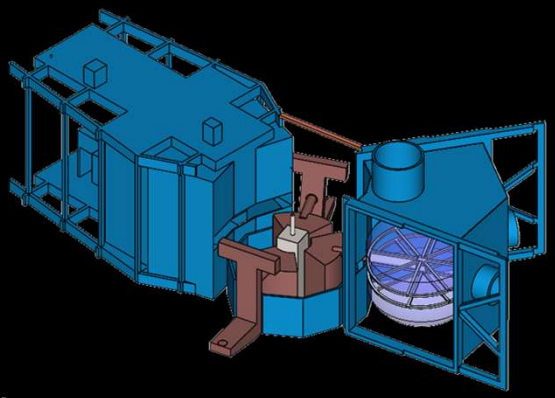
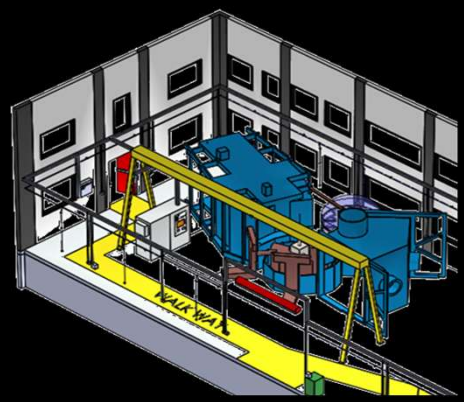
# Collaboration



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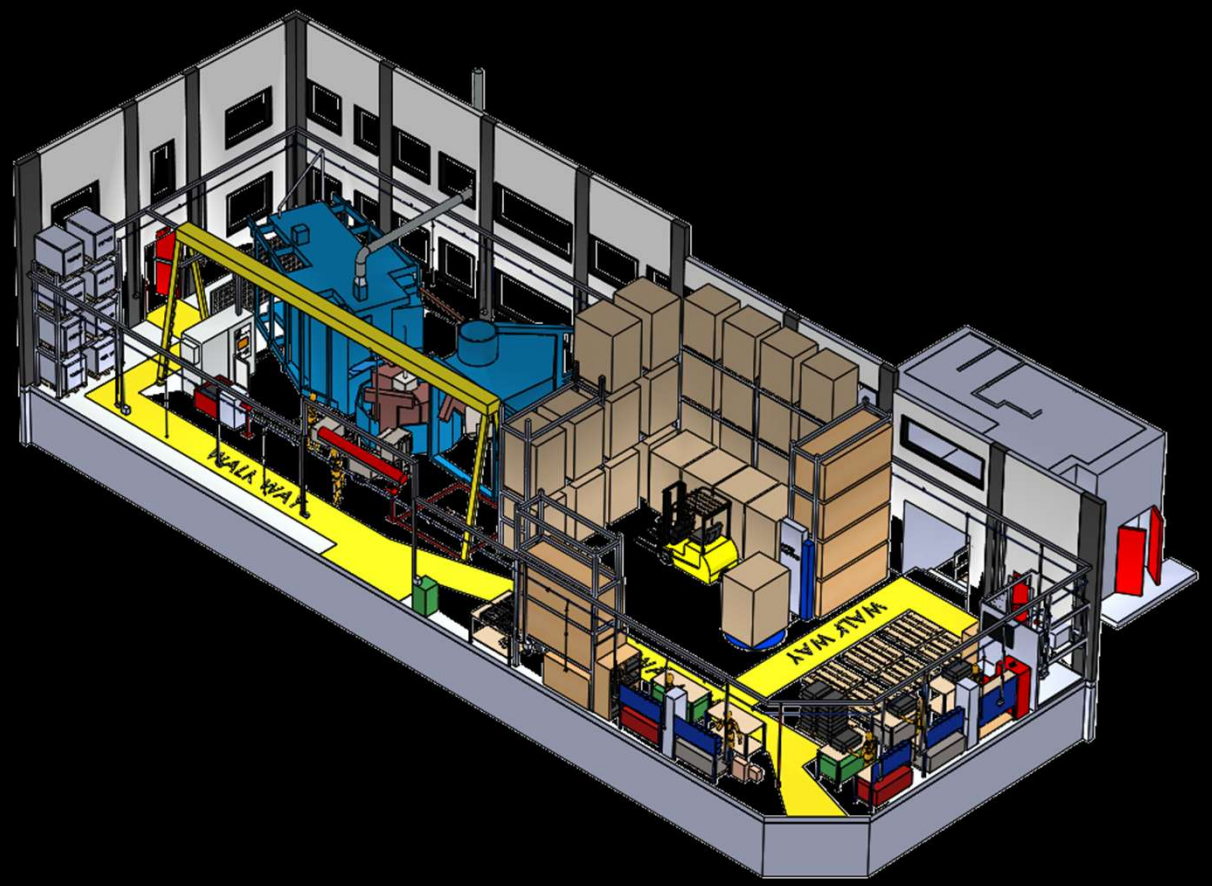

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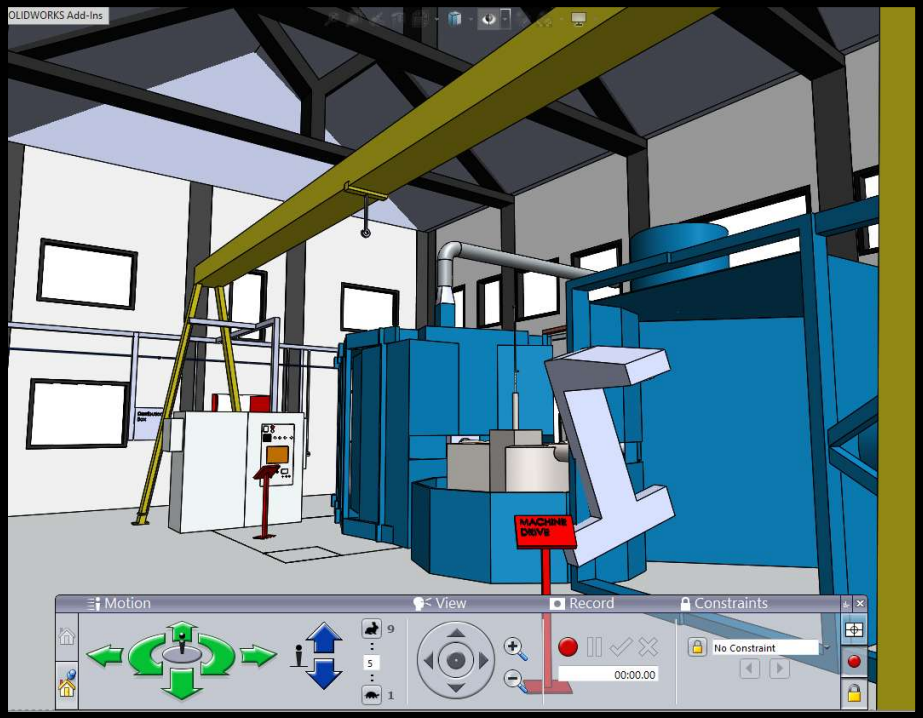


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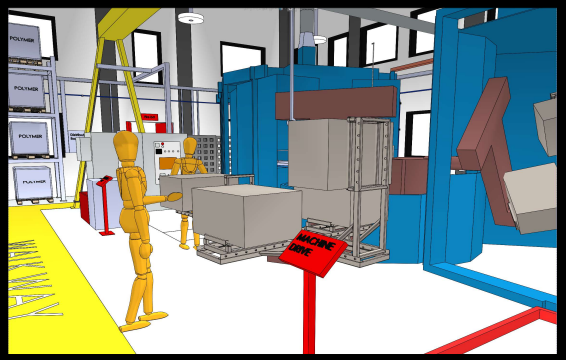


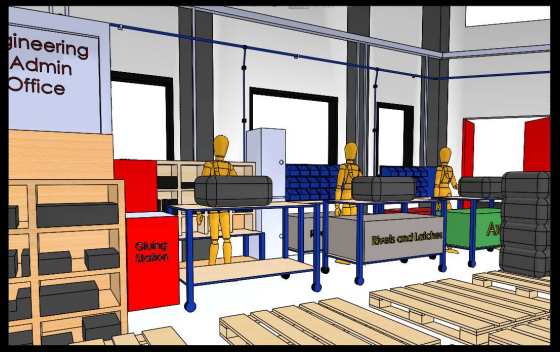



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The financial gain of using VR in virtual layout planning is dependent on the complexity of the project, the cost of the physical change and the expertise and knowledge of the planning team.

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# Benefits of Virtual Reality

- VR helps ‘visualise’ and bridges the gap between project’s stakeholders
- VR allows a ‘common view’ and better understanding which accelerates the decision-making processes.
- Better ease of getting opinions and ideas from all levels of engineering and management
- VR increases knowledge and understanding for cross functional teams at early stages of the project
- In addition to the enhancement of quantitative measures, qualitative measures such as factory safety, ergonomics and operator preferences can be assessed

- Virtual planning boosts the level of knowledge at the planning stage - in any design process, the designers have the largest freedom of choice at the very early stages whilst the cost of change is still negligible. However, the knowledge and experience the designer has is relatively low at this stage.

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# WAYS OF WORKING WITH US

## How you can engage:

### Collaborative R+D

AMIC assists companies with grant applications for funding to support working together on a defined project (opportunity to also involve other partners)

- e.g. funding through UKRI/Innovate UK, Horizon Europe, Invest NI

### Consultancy and technical services

Industry accesses engineer support and technical input for short term projects/activities

### Training and continued professional development services

Company may pay for specific training to be developed or participate in a training programme offered by AMIC

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### Direct industry funded R+D

Industry pays directly for engineer time/other resources deployed on projects defined by the company

### Lab / technical / equipment services

Includes access to analysis, testing, processing as determined by the company

### AMIC membership

Enables a company to build a strategic relationship with AMIC by paying ahead for resource to work on its projects and develop shared activity with other members.

*This is just one way of working with AMIC and not necessary for engagement. Contact amic@qub.ac.uk for details

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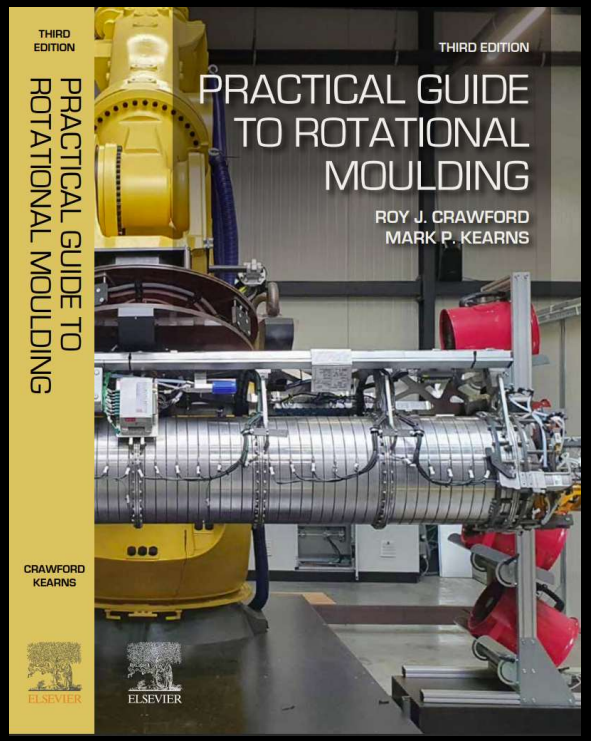
Many thanks for your attention:

Mark Kearns (m.kearns@qub.ac.uk)
Senior Technology Lead (Polymer Processing)
Sustainable Polymers & Composites
Advanced Manufacturing Innovation Centre
Queen's University Belfast

Association of Rotational Moulders (ARM) 50 Years - Spring 2026 Meeting
Queen's University Belfast, NI June 9-12 2026

Tour of AMIC Factory of the Future June 11

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