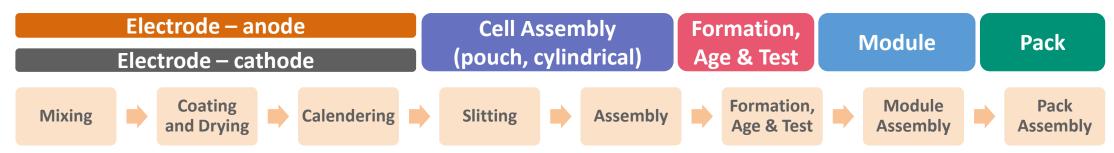




# **UK Battery Industrialisation Centre (UKBIC)**



- UK manufacturing research facility based in the Midlands
- Open to organisations looking to scale technology
- Access Giga-scale equipment to de-risk commercial investment
- Trial and validation at industrial scale, speed and quality
- Customers retain full ownership of their IP developed at UKBIC
- Delivering skills, training and knowledge transfer





# How we've helped customers





- Who is Ilika?
  - Developer of solid-state battery technology
- They wanted us to
  - Help them with their scale-up plans -
    - Project BUS100 (feasibility study)
    - Project SiSTEM (demonstration of Goliath solidstate battery cells)
- What they got by working with UKBIC
  - Superior performance of Ilika's Goliath batteries manufactured via an industrially scaled process
  - Access to Giga-scale equipment to de-risk commercial investment
  - Access to UKBIC's experience and expertise
  - Demonstration that the process and product developed on Ilika's pilot line can be transferred into an industrially relevant platform that can manufacture cells in commercial quantities



# **Excellence through collaboration**

# Tomography capabilities – CT Scanner: Strategic partnership between UKBIC and Waygate Technologies

Waygate (Model: VTX M 300/180)

#### **Enables UKBIC to:**

- Observe internal structure for damage
- Evaluate alignment, waviness, etc.
- Weld condition
- Missing components
- Misplaced tabs/too long/too short
- Shorted electrodes
- Damaged electrodes

Microfocus: 10 - 300 kV, ~  $10\mu m$  voxel size Nanofocus: 10 - 180 kV, ~  $3\mu m$  voxel size







# **Next Phase Of Development**



### £74.5m investment: UKBIC's enhanced capabilities



**Flexible Pilot Line (FPL)** will bridge the gap between existing kilogram scale demonstrator lines and our Industrial Scale-up Line (ISL)



**Battery Development Laboratory (BDL)** facilitates product characterisation of cells processed on our ISL and FPL



**Clean and Dry Zone:** Flexible 800m<sup>2</sup> space provides controlled conditions for equipment testing, temporary equipment installation



**Cell cycling capability:** Additional standalone cell cycling equipment for extended cell cycling – 192 channels for cylindrical cells and 96 channels for pouch cells







# Bridging the gap – industry needs

#### **UKBIC** Gigafactory **100s Kilograms** Scale Gram Kilogram **10s Kilograms** Kilotonne **Example:** mixing 15-40 litre >1000 litres 10 litre 250 litre TRL1 TRL2 TRL3 TRL4 TRL5 TRL6 TRL8 TRL7 TRL9 **Technology** Validation & Principles & Analytical Performance & Real world & readiness Explore Design & Model & Test & applications experiments requirements research performance testing demonstrate launch prototype Ability to conduct basic Equipment and knowledge Ability to de-risk product and Piloting equipment Grow UKs capable of manufacturing capable of manufacturing 100sbattery research and to commercial investment before gigafactory identify next generation 10s-100 cells, used in 1000 cells, used for product move to kilotonne scale. capacity to materials. early-stage product development, validation and Verification and validation the meet volume Ability to prove battery development and commercial activities. products are fit of scale/market. demands from Needs for process development, Proof of product scalability. validation activities. materials and components industry, e.g. **Industry** Facility which is capable of at gram scale and lower product quality, repeatability Proof of reproducibility and automotive. manufacturing several knowledge during scale-up. repeatability. costs. energy storage, needs Lead UK's early-stage Ability to innovate and learn Refinement of production different cell chemistries etc. materials and technology and formats. quickly on known equipment/ processes and systems Increase innovations. Product design capability technologies. integration. investment in and scalability, the UK's battery manufacturability, quality manufacturing knowledge of battery sector. manufacturing.

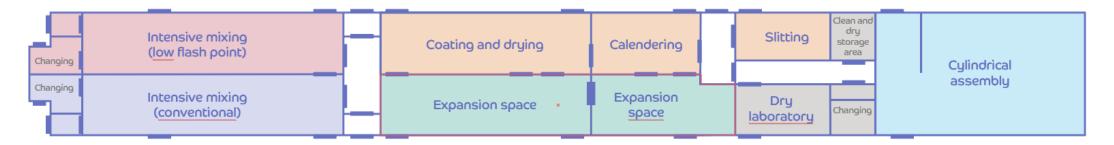
Phase 2



# What does the FPL provide?

- Offers all developers early access
- Secure material air lock access points which protect customer IP
- Flexible approach for developing electrodes
- Low cost, efficient and quick turnarounds
- Lower quantity material entry requirements
- Access to new, high-tech manufacturing line
- Opportunity to watch the early commissioning stage of the line
- Scale-up from lab to production environment









# **Lessons Learned**



# Mixing challenge: slurry viscosity matching

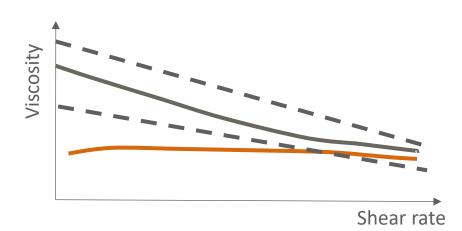
#### What we did

- Trials at three scales of mixing and developed a thorough understanding of influential factors on slurry rheology at each stage of scale-up
- Through experimentation, key slurry rheological properties were identified and modified

#### **Lesson learned**

- Slurry behaviour changes from small-scale to large-scale mix irregularly!
- UKBIC understands the factors that influence slurry rheology and can adapt the process to suit different scales of mixing and chemistries

### **Slurry Viscosity Matching**

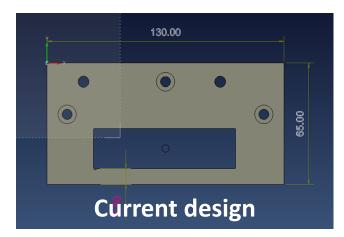


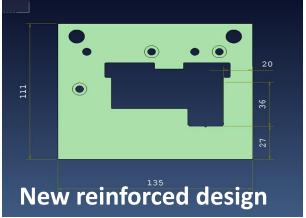
Target Viscosity RangeInitial Cathode SlurryModified Cathode Slurry

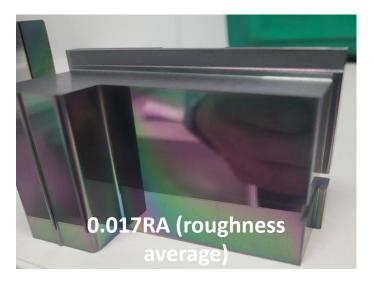


### **PHASE 4 Notching Die Design**

- UK reverse engineered design
  - Improved design
    - Fixed punch with kicking leg (OEM floating punch lack of control)
    - Increased surface area of die (strength)
    - Reduced pillar amount for control
    - Quick change of internals
    - Improved surface finish (.017Ra)
  - Reduced maintenance downtime
  - Reduced cost of replacement parts (punch and die)
  - Increased strength in cutting die (surface area increased)
  - Overall tool life increased
  - UKBIC team working with three UK suppliers to modify and improve the cutting performance







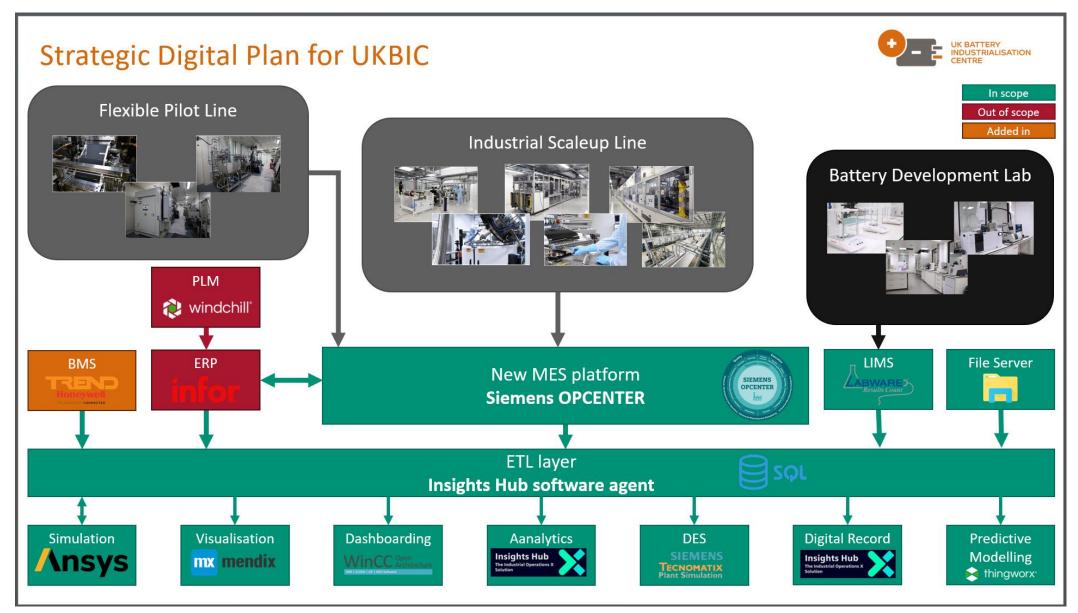




# UKBIC's New Digital Landscape

# **UKBICs New Digital Landscape**









# Thank you!



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