From Concept to Commercialisation: The European Perspective

Kris Wadrop
Platform Director, Industrial Biotechnology and Biorefining, CPI
Who are CPI?

CPI is a UK technology innovation centre and the process element of the Government’s High Value Manufacturing Catapult.

We use applied knowledge in science and engineering combined with state of the art facilities to enable our clients to develop, prove, prototype and scale-up the next generation of products and processes.
CPI works across a distinct set of technological areas that offer the largest potential impact on the future of UK and global manufacturing.
Services

- Product and Process Development
- Prototype, Demo and Scale-up
- Pilot Production
- Feedstock and Materials Investigation

- Manufacturability, Process Modelling and Simulation
- Process Economics and Evaluation
- Identification and Engagement of Key Collaborators
- Commercialisation Support and Incubator Space
Market Focus

- Healthcare
- Energy
- Materials and Chemicals
- Food and Drink
- Consumer Goods
- Personal Care
- Electronics
- Transportation
- Built Environment
High Value Manufacturing Catapult

A catalyst for growth and success in the UK

Seven UK-based centres for excellence, covering high value markets, and sharing expertise and knowledge to create a robust support network for advanced manufacturing in the UK.
Technology Readiness Levels (TRL)

9. Actual System proven through successful operations
8. Actual System completed and qualified through testing and demonstration
7. System prototype demonstration in an operational environment
6. System model or prototype demonstration in a relevant environment
5. Component validation in relevant environment
4. Component validation in laboratory environment
3. Analytical and experimental critical function and/or characteristic proof of concept
2. Technology concept and/or application formulated
1. Basic principles observed and reported
Technology Readiness Levels (TRL)

Technology Readiness Level 7-9
Industry and Companies

9
- Actual System proven through successful operations

8
- Actual System completed and qualified through testing and demonstration

7
- System prototype demonstration in an operational environment

Technology Readiness Level 1-3
Researchers and Inventors

3
- Analytical and experimental critical function and/or characteristic proof of concept

2
- Technology concept and/or application formulated

1
- Basic principles observed and reported
Technology Readiness Levels (TRL)

Technology Readiness Level 3-7 (Valley of Death)
CPI helps companies succeed where many otherwise fail

- **7**
  System prototype demonstration in an operational environment

- **6**
  System model or prototype demonstration in a relevant environment

- **5**
  Component validation in relevant environment

- **4**
  Component validation in laboratory environment

- **3**
  Analytical and experimental critical function and/or characteristic proof of concept
The CPI Process

- Integrate CPI assets and knowledge to create scalable products and processes that work
- Prove that the product or process will meet a market need
- Demonstrate the product or process across TRL 3 - 7
- Get the product or process ready for production; reducing risk and providing partners with confidence to invest
- Help clients understand their market environment and create options for their future
Summary of CPI

**Reduce risk** before investing large sums of money on new facilities by demonstrating and refining novel technologies.

**Proof of concept and process scale-up** showing that new concepts are feasible before approaching potential investors, stakeholders or funding programmes.

**Decrease the time to market** for a novel product or process by accessing proven demonstration assets and key expertise.
Facilities

Process Development
- Biolector (1ml) to 10 litre fermenters
- Downstream processing scale-down
- Analytical Capabilities

Pilot Facility
- 10 – 750 litre fermentation facilities
- Pilot scale solvent extraction facilities
- Flexible plug and play downstream capabilities for:
  - Solid / liquid separation
  - Fractionation and extraction
  - Clarification, purification and concentration

Demonstrator Facility
- 10,000 litre fermentation facilities
- Upstream processing capabilities for solids, slurries, aggregates and liquids
- Pilot scale distillation
- Demonstration of process and product
- Inline analytical technologies
- Downstream processing capabilities for:
  - Solid / liquid separation
  - Fractionation and extraction
  - Clarification and concentration

Total scale factor at one location with CPI is $10^7$
Case Study – Project Tees

- Technology transfer;
- Technology development and scale-up;
- Standards and training;
- Analytical development;
- Project Management (Technical and engineering);
- Engineering Scoping and Design;
- Safety Assessments;
- Full Operation and Maintenance contract services for integrated facility;
<table>
<thead>
<tr>
<th>WP</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Technical Transfer from Norway</td>
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<tr>
<td>2</td>
<td>Seed process development</td>
</tr>
<tr>
<td>3</td>
<td>Hazard Analysis Critical Control Parameters</td>
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<td>4</td>
<td>Engineering Design and support</td>
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<td>5</td>
<td>Plant operation and Commissioning</td>
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<tr>
<td>6</td>
<td>Overall Technical Transfer</td>
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<tr>
<td>7</td>
<td>Analytical Laboratory and equipment</td>
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<td>8</td>
<td>Microbiological QC</td>
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<tr>
<td>9</td>
<td>Project Management</td>
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<tr>
<td>10</td>
<td>Engineering support to commissioning</td>
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Innovation Team

• 3-way collaboration between
  – Client
  – CPI
  – Engineering Contractor (Otto Simon Limited)

• Multiple disciplines;

• Complex Multi stream project (tech transfer, tech dev, analytical, HACCP, scale-up/down, engineering, operations)

• Multi £million
<table>
<thead>
<tr>
<th>Project Stage</th>
<th>Client Team</th>
<th>CPI Team</th>
<th>Capabilities</th>
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<tr>
<td>Feasibility</td>
<td>1 exec, 1 scientist</td>
<td>2 eng 1 op 3 scientists</td>
<td>Ferm Sci, Chem Eng, Ops</td>
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<tr>
<td>Initial Tech Transfer</td>
<td>1 scientist</td>
<td>4 scientists</td>
<td>Ferm Sci, Microbio,</td>
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<tr>
<td>Process Development</td>
<td>2 scientists (recruited)</td>
<td>8 scientists (24 x 7)</td>
<td>Microbio, Ferm Sci, scale-up/down, Chem Eng</td>
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<tr>
<td>Analytical/ QA</td>
<td>2 scientists (recruited)</td>
<td>1 PM 2 scientists</td>
<td>HACCP, PAT</td>
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<tr>
<td>Process design/build</td>
<td>1 exec 1 eng</td>
<td>5 eng 2 ops 1 scientist</td>
<td>Chem, Elec, Control Eng, Ferm Sci, Ops</td>
</tr>
<tr>
<td>Tech Transfer/Start-up</td>
<td>5 scientists</td>
<td>6 scientists</td>
<td>MicroBio, Ferm Sci, PAT</td>
</tr>
<tr>
<td>Operation</td>
<td>3 scientists (oversight)</td>
<td>15 ops, 1 eng, 5 scientists (24 x 7)</td>
<td>Chem Eng, Ops, Ferm Sci, PAT, QA</td>
</tr>
<tr>
<td>Total Resources</td>
<td>1 exec, 2 eng, 5 scientists + admin</td>
<td>2 PM, 11 scientists, 15 ops, 6 engs</td>
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Project Tees – Technology Transfer

• Technology transfer from Client to CPI;
• Reconfiguration and modification of CPI lab hardware (Rand 1.1m):
  – Mass flow to gravimetric flow regimes;
  – Controller reconfiguration
• Two scientist team working with client;
• Reproducible and repeatable results
Project Tees – Engineering design and construction
Science of Scale-Up and Commercialisation

- Refined media
- Energy crops
- Residues (F&A)
- Wastes (S&L)
- Wastes (Gas)
- Analytical & Analysis (PAT, inline/offline, lab/plant, multivariant/component analysis)
- Process Engineering & Modelling
- Process Economics (& Modelling)
- Lab to Multi-purpose Piloting (Scale-down, DoE, QA, Robustness, Statistical relevance)
- IP Landscape & FTO Assessment (Due-diligence)
- Bespoke Piloting
- Environmental (By-product/waste; LCA assessment)

- Systems Biology Host Design
- Downstream Processing
- Product Specification/Formulation

- Pharmaceutical
- Fine Chemicals
- Probiotics
- Bulk Chemicals
- Fuels
Our Vision
The UK as a global leader in biorefining technology development and bio-based product manufacture within a sustainable high-value bioeconomy.

Our Mission
A stable, integrated, cost-effective pilot and process development service

Increase UK knowledge and capabilities in biorefining and industrial biotechnology (IB).

Nurture the development of SMEs to support the growth of UK bio-based value chains
SmartPilots – Interreg Europe

Improving policies in support of shared pilot facilities to increase their impact on the Key Enabling Technology Industrial Biotech and the European Bioeconomy

Partners

- Bio Base Europe Pilot Plant (Belgium) PROJECT LEAD
- Department of Economy, Science and Innovation – Flemish Government (Belgium)
- Centre for Process Innovation (United Kingdom)
- VTT Technical Research Centre of Finland Ltd (Finland)
- Bioprocess Pilot Facility (Netherlands)
- Province of Zuid Holland (Netherlands)
- Innovhub SSI (Italy)

Case Studies

- Fraunhofer Institute for Chemical-Biotechnological Processes (Germany)
- ARD - Agro-Industrie Recherches et Développements (France)