An ‘industrial-innovation system’ approach to smart specialisation: the case of the agri-tech industry in the East of England

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Overview

1. Key messages
2. When ‘smart specialisation’ is not so smart
3. An ‘industrial-innovation system’ approach to smart specialisation
4. Case Study: Agri-tech industry in the East of England
5. Conclusions
Key messages
Key messages

• A critical challenge for smart specialisation is to properly characterise what makes a region distinctive at a useful level of detail and in a way that is recognised by local as well as external actors.

• However, identified priorities have been too generic and not appropriately connected to regional economic and innovation structures.

• Practice-oriented analysis frameworks and data sources at an adequate level of disaggregation to support this task are in short supply.

• An ‘industrial-innovation system’ approach is proposed to support key analytical tasks involved in smart specialisation.

• The utility of the approach is demonstrated through a selected case study in the agri-tech industry in the East of England.
When ‘smart specialisation’ is not so smart
The Smart Specialisation Mountain

‘GPS principle’

1. Where are we?
2. Where to go?
3. How to get there?

Operational Minefield
- too broad priorities
- no local asset assessment
(threats to effective EDP, etc.)

Analytical Slope

low capacity in regional govt.

power boundaries between ministries

short term-ism in political cycles

competition

DEAD END

DEAD END
Key strategic questions / analytical challenges to effective smart specialisation

<table>
<thead>
<tr>
<th>What we want in theory</th>
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<tbody>
<tr>
<td>clearly articulate <strong>what makes regions distinctive at a useful level of detail</strong> and in a way that is recognised by the local and external stakeholders</td>
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<tr>
<td>use <strong>region distinctiveness as the basis</strong> from which a <strong>limited number of promising opportunity areas</strong> are identified</td>
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<tr>
<td>strategise to ensure that <strong>distinctive &amp; competitive capabilities</strong> are leveraged in order to pursue <strong>promising &amp; feasible opportunities</strong></td>
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Collaboration with BEIS

A pilot project has been conducted as a collaboration between the UK Department for Business, Energy & Industrial Strategy (BEIS) and the Policy Links unit of the Centre for Science, Technology & Innovation Policy (CSTI).

The aims was to explore new approaches to enhance the effectiveness of smart specialisation in UK regions.

Case study in the agri-tech industry in the East of England.
Smart specialisation in the UK?

Making ‘smart specialisation’ stick: an industrial-innovation system approach

THE CASE OF AGRI-TECH EAST

A report for the UK Department of Business, Innovation & Skills (BIS), Policy Links, Centre for Science, Technology & Innovation Policy (CSTI), University of Cambridge.

APRIL 2016

Note: This report was commissioned and completed before the United Kingdom European Union membership referendum of 23 June 2016. While the results of the referendum have important implications for the report, the ideas here presented remain highly relevant to UK regional development policy efforts.
An ‘industrial-innovation system’ approach to smart specialisation
An ‘industrial-innovation system’ approach to smart specialisation

- Grounded on the recognition of the structure and dynamics of modern industries and technologies.

- Integrates value chain structure and an explicit distinction between knowledge generation, knowledge diffusion and knowledge absorption capabilities.

- Simple yet highly structured approach with the potential to guide not only more systematic statistical analyses but also a more effective ‘entrepreneurial discovery process’.
The value of the value chain structure

The issue

- Modern industries increasingly cut across sectors and technologies.
- Statistics available to policy makers have not kept up with pace of change (BIS, 2015).
- A number of ‘unmeasurable sectors’ (e.g. ‘app economy’) simply not monitored (NAE, 2015).
- Aggregated data does not allow identifying niche areas of regional strength.

need to understand industrial activity beyond sector & technology boundaries
The value of the value chain structure

The value chain framework provides a useful structure for smart specialisation analyses:

- holistic perspective and focus on processes of value addition and dynamic linkages between diverse economic actors
- sectoral & technological interdependencies

Processes of value addition
Diversity of industrial activities cutting across sectors and boundaries
Diversity of actors and interrelated capabilities

need to understand industrial activity beyond sector & technology boundaries
The value of the value chain structure

The issue

- Excessive focus on R&D not aligned with business opportunities (Foray et. al., 2012).
- Relatively weak focus on absorptive capacity and take up of capacity and take up of existing knowledge and technologies (EC, 2015).
- Lack of emphasis on mechanisms to diffuse knowledge.
The value of the value chain structure

**Regional innovation system** typically understood to be “a set of interacting private and public interests, formal institutions, and other organizations that function according to organizational and institutional arrangements and relationships conducive to the generation, use, and dissemination of knowledge” (Doloreux and Parto, 2005).

need to understand innovation beyond knowledge creation and R&D
A systemic view of the regional innovation system

At the most basic level, three types of interrelated innovation system capabilities can be distinguished:

• capabilities to create new knowledge

• capabilities to diffuse knowledge

• capabilities to absorb knowledge

Knowledge generation by universities, public and private research centres, private firms

Knowledge diffusion by intermediary institutions, advanced business services, extension services, cluster organisations

Knowledge absorption by industry

technological upgrading/diversification and increased regional value capture

need to understand innovation beyond knowledge creation and R&D
An ‘industrial-innovation system’ approach to smart specialisation

Regional economy characterisation

- Initial statistical comparative analysis and benchmark
- Broad areas of capabilities
- Relevant capabilities
- Generic opportunities
- Promising opportunities
- Distinctive & competitive capabilities aligned with promising & feasible opportunities

Regional level

Industrial-innovation system level

- Capability mapping
  - Value chain characterisation
  - Innovation system characterisation

- Opportunity identification
  - Market analysis & technology foresight
  - Upgrading options generation

- Implementation design
  - Gap assessment & opportunity prioritisation
  - Smart specialisation roadmapping

Where are we?
Where can we be?
How can we get there?

Analytical tasks supported by ‘entrepreneurial discovery process’

Smart specialisation evidence to support policy mix selection
Case study: agri-tech industry in the East of England
An ‘industrial-innovation system’ approach to smart specialisation

Regional economy characterisation

Initial statistical comparative analysis and benchmark

Regional level

Industrial-innovation system level

Where are we?
Value chain characterisation
Innovation system characterisation

Where can we be?
Market analysis & technology foresight
Upgrading options generation

How can we get there?
Gap assessment & opportunity prioritisation
Smart specialisation roadmapping

Distinctive & competitive capabilities aligned with promising & feasible opportunities

Analytical tasks supported by ‘entrepreneurial discovery process’
Value chain capability mapping

Agri-food chain of the East of England, 2013

Key economic variables analysed across the value chain
Value chain capability mapping

- Illustration on the whole range and types of stakeholders involved
- Supporting thinking about interrelated capabilities in a structured & dynamic way
- Highlighting linkages between stakeholders with seemingly different industrial interests and technical competencies
Regional innovation system capability mapping

- Systematic review of innovation system capabilities
- Explicit distinction between knowledge generation, diffusion and absorption capabilities; recognition that innovation is more than just R&D
- Careful characterisation of actors, mechanisms and institutions (and their linkages) in the regional innovation system
### Knowledge generation

#### Comparison of East of England and other UK regions

<table>
<thead>
<tr>
<th>Indicator</th>
<th>England</th>
<th>Greater Cambridge &amp; Greater Peterborough</th>
<th>Hertfordshire</th>
<th>New Anglia</th>
<th>South East</th>
<th>South East Midlands</th>
<th>East of England</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Value</td>
<td>% Ranking</td>
<td>Value</td>
<td>% Ranking</td>
<td>Value</td>
<td>% Ranking</td>
<td>Value</td>
</tr>
<tr>
<td>Business Enterprise R&amp;D expenditure (£ millions), 2013</td>
<td>16,838</td>
<td>1,332</td>
<td>7.9</td>
<td>1</td>
<td>1,322</td>
<td>7.9</td>
<td>2</td>
</tr>
<tr>
<td>Percentage of science, research, engineering, technology and associated professions in the total employment, July 2013 - June 2014</td>
<td>7.2</td>
<td>11</td>
<td>-</td>
<td>3</td>
<td>8.6</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>Students graduating with first degrees with honours in HEIs by LEP area, 2013/14</td>
<td>308,127</td>
<td>6,228</td>
<td>2.0</td>
<td>19</td>
<td>4,087</td>
<td>1.3</td>
<td>22</td>
</tr>
<tr>
<td>STEM Research-based doctorate degrees awarded by LEP area, 2013/1</td>
<td>3</td>
<td>53</td>
<td>0.5</td>
<td>26</td>
<td>179</td>
<td>1.6</td>
<td>21</td>
</tr>
<tr>
<td>Count of active patents, 2012/13</td>
<td>3</td>
<td>10</td>
<td>0.1</td>
<td>27</td>
<td>36</td>
<td>0.2</td>
<td>25</td>
</tr>
</tbody>
</table>

### Knowledge diffusion

- Higher Education Business and Community Interaction income (3 year average in real terms values / £1000), 2010/11-2012/13: £3,000,000 - £5,000,000
- Contract research income in HEIs (3 year average in real terms values / £1000), 2010/11-2012/13: 967,439
- Collaborative research income in HEIs (3 year average in real terms values / £1000), 2010/11-2012/13: 668,294
- Continuing Professional Development income in HEIs (3 year average in real terms values / £1000), 2010/11-2012/13: 309,124
- Consultancy income in HEIs (3 year average in real terms values / £1000), 2010/11-2012/13: 314,666
- Regeneration and development programmes income in HEIs (3 year average in real terms values / £1000), 2010/11-2012/13: 129,615
- Facilities and equipment related services income in HEIs (3 year average in real terms values / £1000), 2010/11-2012/13: 117,273
- Intellectual property income in HEIs (3 year average in real terms values / £1000), 2010/11-2012/13: 63,452

### Knowledge absorption

- Percentage of firms engaged in product or service innovation, 2010-2012: 45
- Percentage of firms engaged in process innovation, 2010-2012: 10
- Percentage of firms engaged in strategic and marketing innovation, 2010-2012: 16
- Percentage of firms undertaking R&D by local economic area, 2010-2012: 15
An ‘industrial-innovation system’ approach to smart specialisation

Regional level

Regional economy characterisation

Initial statistical comparative analysis and benchmark

Broad areas of capabilities

Generic opportunities

Industrial-innovation system level

Where are we?

Capability mapping

Value chain characterisation

Innovation system characterisation

Where can we be?

Opportunity identification

Market analysis & technology foresight

Upgrading options generation

How can we get there?

Implementation design

Gap assessment & opportunity prioritisation

Smart specialisation roadmapping

Distinctive & competitive capabilities aligned with promising & feasible opportunities

Analytical tasks supported by ‘entrepreneurial discovery process’

Smart specialisation evidence to support policy mix selection
What are the main market opportunities for the region?
Please tell us your Top 3

Opportunities identified in both arable and horticultural crops and across various stages of the value chain
Identifying opportunities: technologies opportunities

Plant Breeding, Genetics and Genomics
- Photosynthetic Efficiency and Nutrient Utilization in Agricultural Plants
- Controlling Weedy and Invasive Plants
- Plant breeding
- Air & soil biological sensors
- Plant-Associated Insects and Nematodes
- Plant-Associated Microorganisms and Plant-Microbe Interactions

Precision agriculture
- Agricultural robots
  - Telematics, positioning technologies
    - Auto-steer
    - Light bar guidance systems
    - Differential GPS
    - Wide area augmentation system
    - Real time kinematic
    - Electronic & mechanical sensors
- Field characterisation (soil, vegetation, insect damage, etc.)
  - Grid sampling
  - Directed sampling
  - Management zones
- Remote sensing
  - Drones, airplanes
  - Satellites
- Computer-controlled nozzles
  - Fertilizers
  - Pesticides
  - Water
- Yield monitoring systems

Food supply chain mgmt. systems
- Data analytics and decision support solutions

Transport & Distribution
- Wholesale & Retailing
- Consumption

Plant sciences

Opportunities expected from a combination of disciplines, in particular plant sciences and engineering
An ‘industrial-innovation system’ approach to smart specialisation

**Regional level**

**Industrial-innovation system level**

**Where are we?**
- Capability mapping
  - Value chain characterisation
  - Innovation system characterisation

**Where can we be?**
- Opportunity identification
  - Market analysis & technology foresight
  - Upgrading options generation

**How can we get there?**
- Implementation design
  - Gap assessment & opportunity prioritisation
  - Smart specialisation roadmapping

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**Regional economy characterisation**

- Initial statistical comparative analysis and benchmark
- Broad areas of capabilities
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- Generic opportunities
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**Analytical tasks supported by ‘entrepreneurial discovery process’**
Example: Gap assessment & opportunity prioritisation

**Large**
- Nutrition specific improvements
  - Low: 0
  - High: 9
- GM improved crop varieties
  - Low: 0
  - High: 5
- Robotics esp. harvesting
  - Low: 4
  - High: 9
- Smart irrigation / Water optimisation / Water management
  - Low: 11
  - High: 8

**Small**
- LED’s
  - Glasshouse controlled environment
    - Low: 2
    - High: 2
- Food waste reduction solutions
  - Low: 3
  - High: 2
- Remote sensing
  - Low: 6
  - High: 3
- Process automation
  - Low: 8
  - High: 3

Five smart specialisation opportunities selected for further analysis

**Level of current capability**
**Description of challenge / opportunity (including indication of size)**

- EOE (inc Lincs) produces around ~40% of UK’s (daily) fresh produce
- Consumer demand for healthy product
- High market value commanding higher prices
- Import substitution (↑ food security for UK)
- Innovative fresh produce growers – tightly linked to retailers (inc M&S, Ocado)
- Industry led, hungry for innovation

**Why should the region pursue this?**

- End-to-end capability to create and capture value/economic benefit
- Non-glasshouse (field)
- Very strong links with academia and growers and breeders
- Highly innovative, research-active growers, hungry for new innov. & appetite for new things
- Academics, institution capable of utilizing new genetic resources in veg germplasm
- Strong/growing links between R&D organisations and retailers

**What are the main agronomic / technical challenges?**

- Matching varietal delivery with required inputs (water, chemical, management)
- Soils – link between soil/inputs and nutritional quality/impact of product
- Management of pests and diseases
- Management of extremes of weather/climate change
- Consumer perception/acceptance

**Local capabilities to address challenge / opportunity**

<table>
<thead>
<tr>
<th>Current relevant capabilities / strengths</th>
<th>New capabilities / strengths that will need to be developed</th>
<th>Key issues to be addressed</th>
<th>Key competitors, their initiatives &amp; strengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetics / genomics / plant sciences / quadrum</td>
<td>Hardware and product development for data value extraction</td>
<td>Produce novel genetic lines</td>
<td>UC Davis</td>
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<tr>
<td></td>
<td></td>
<td>link between husbandry / management regime and nutritional quality of product</td>
<td>Wageningen</td>
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<td></td>
<td></td>
<td></td>
<td>Warwick</td>
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<tr>
<td>In the research &amp; innovation base</td>
<td>NO GAPS!</td>
<td></td>
<td></td>
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<tr>
<td>In local organisations / networks</td>
<td>Farmer groups</td>
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<td></td>
<td>Anglia Farmers</td>
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<td></td>
<td>Innovation Farm</td>
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<tr>
<td>In the industrial value chain</td>
<td>Unilever</td>
<td></td>
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<td></td>
<td>Bayer / Syngenta</td>
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<td>Elsoms</td>
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<td></td>
<td>Managing supply and demand</td>
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<td></td>
<td>Interpretation of big data information leading to better decision making and input management</td>
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<td></td>
<td>Better supply chain management</td>
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<tr>
<td></td>
<td>No match for translational resource</td>
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<td></td>
<td>Need better understanding of targets for bio-fortification</td>
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<td></td>
<td></td>
<td></td>
<td>Netherlands</td>
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<td></td>
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<td></td>
<td>Spain</td>
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<tr>
<td>Other</td>
<td>Exclusion gap of subsidy funding to farmers (who would otherwise be excluded)</td>
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<td>Loss of critical crop protection products in the EU could lead to low</td>
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<td></td>
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<td>biodiversity</td>
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</table>
Feedback from stakeholders

“Claiming you are world class in everything will not be believed and therefore in an emerging sector like agritech it is vital that we collectively agree where our real strengths lie.

The workshop successfully brought together a wide cross section of partners to identify the USP of the AgriTech East region and this will strengthen our ability to attract companies and investment to the area, as well as helping us to develop bids for national and EU funding.”

Representative of family-owned firm
Conclusions
Conclusions

• Strategies that are really ‘smart’ and ‘specialised’:
  – characterise regional industrial and innovation capabilities at a level of detail that allows clearly recognising what makes the region distinctive
  – identify, upon the recognition of this distinctiveness, promising opportunity areas against the backdrop of international competition
  – strategise to ensure that distinctive & competitive capabilities are leveraged in order to pursue promising & feasible opportunities

• An ‘industrial-innovation system’ approach to better characterise regional value chain and innovation system capabilities offers the potential to make smart specialisation smarter.
Policy Links is the knowledge exchange unit of the Centre for Science, Technology & Innovation Policy (CSTI), University of Cambridge

Contact: Carlos Lopez-Gomez, cel44@cam.ac.uk
Sources of evidence

Analytical & documental evidence
- Regional data (e.g. regional innovation scoreboard)
- National data (e.g. ONS, BIS reports)
- International data (e.g. international foresight studies)

Qualitative insights
- Expert interviews (scoping and scanning approach)
- Site visits (first-hand observations)
- Smart Specialisation workshop (supporting ‘entrepreneurial discovery process – EPD’)
Challenges to effective smart specialisation

Operational challenges

- difficulties to bring together participants from very different environments in an ‘entrepreneurial discovery processes’ (EC, 2015).
- national and regional governments might feel threatened by a transparent and inclusive bottom-up process.
- ensuring alignment of the priority setting with the budgetary process
- building absorptive capacity inside regional governments
- working with functional regions rather than administrative borders (Foray, 2014; OECD, 2013).
- cutting across traditional power boundaries between ministries
- project ideas that may differ from previous ministerial plans
- risk aversion to engage in new paths
- traditional interest groups and power structures might hinder openness to diversification (EC, 2015).
Note of clarification

• Focus on crops (not livestock in this instance)

• ‘East of England’ boundaries often have different interpretations → potential source of discrepancies

• Pre and post-gate activities considered
The case study proved the value of the suggested approach, in particular in:

– guiding a **clear identification** of what makes the cluster **distinctive**
– helping visualise how different organisations and stakeholders **fit and complement** each other rather than viewing the activities in competition with each other
– recognising the **role of technology-led firms** that are critical to the industry but are often not accounted for in the sector statistics.
– highlighting the **critical role of intermediaries** in the translation of knowledge from the science and research base into industry.
Feedback from workshop participants

“The structured methodology of the event provided a valuable focus to discussions. As a result, the output from the day felt that it had really captured the essence of the regions strength in agri-tech.”

Lead Technologist - Agriculture and Food, Innovate UK

“The workshop provided a valuable insight into the challenges that farmers are facing in our area and the output will play a key role in helping the academic and industrial communities prioritise areas for research and investment. This will support the critical role played by Agri-Tech East in developing innovative solutions for farmers and creating new business opportunities, both of which will be critical in maximising the potential of this area.”

Representative of major transnational agricultural firm

“Claiming you are World class in everything will not be believed and therefore in an emerging sector like agritech it is vital that we collectively agree where our real strengths lie. The workshop successfully brought together a wide cross section of partners to identify the USP of the AgriTech East region and this will strengthen our ability to attract companies and investment to the area, as well as helping us to develop bids for national and EU funding.”

Consultant and representative of family-owned firm
Insights and perspectives from interviews

What makes the East of England different?

“Unique depth and breadth of the research and business sectors”
“Feeling of being just one person away from knowledge”
“Combination of strong research bases in engineering & plant sciences”
“Except for dairy, the whole agri-tech supply chain can be done entirely in the East of England”
Concept of ‘smart specialisation workshop’

Workshop with carefully selected local stakeholders

Collaboration with leading cluster organisation in the region.

Over 20 (carefully selected) representatives from industry, academia, govt.

3 main exercises
• What Makes Agri-tech in the EoE Different?
• Market Opportunities
• Addressing Challenges / Exploiting Opportunities