

The UK Packaging Industry – A Strategic Opportunity:

A Landscape Review and Technology
Roadmap Report

June 2018

Innovate UK
Knowledge Transfer Network



Contact

Brian McCarthy KNOWLEDGE TRANSFER MANAGER – ADVANCED MATERIALS
07964 563373 | brian.mccarthy@ktn-uk.org

CONTENTS

Executive Summary	5
Introduction	7
The Results of an initial KTN UK Packaging Technology Roadmap Workshop 2016/17 and Sector background	11
• Where are we now?	
• Needs and Opportunities	
• Capabilities	
• Trends and Drivers	
• Threats and Barriers	
The UK Packaging Industry – the Landscape	19
• The size of the Sector	
• Packaging and Environmental Concerns and Opportunities	
• Key Issues affecting the UK Sector	
Recent Innovations and Technology Developments	31
Future Opportunities	36
Conclusions and Recommendations	39
Acknowledgements	43



EXECUTIVE SUMMARY

This report focusses on the UK Packaging sector. It is a sector that by definition supports other key manufacturing and service industries – but is itself a provider and spur for innovation in addition to contributing to UK Gross Domestic Product (GDP). It is a sector that – though sometimes overshadowed – warrants further investigation and examination.

The last major review of the UK Packaging Industry was in 2003 and, though unpublished, important and relevant conclusions were presented. These conclusions were valid and informative and provide a framework on which to build. The Knowledge Transfer Network (KTN) has since arranged a number of key networking and briefing events for the UK Packaging and related communities. In consultation with the community, it was felt that a fresh landscape review and limited road-mapping exercise would be timely and would build upon previous work and highlight areas for future engagement.

Packaging is part of the multi-faceted system for delivering products from point of production to point of consumption. Its main purpose is to protect the product and ensure it is delivered safely and in perfect condition to the end user (manufacturer of product or consumer). Its role in a circular economy is to maintain the value in a product for as long as necessary and to help eliminate product waste. It is a sector ripe for future innovation. The following key points can be highlighted:

- The UK Packaging Manufacturing Industry has annual sales of £11 billion and employs some 85,000 people – representing 3% of the UK’s manufacturing workforce. It is a major contributor to the UK GDP and a vital link in the broader Packaging Supply Chain (Packaging Federation). Its productivity is more than double that of all industries’ average performance and it is a world leader in product innovation and manufacturing technology.
- A typical packaging product life-cycle would begin with design and innovation, progress through raw material selection and production, manufacturing, transport and distribution, intermediate use (stacking, storage and/or display) and finally to customer or consumer.
- This is an excellent time to provide a strategic review of UK Packaging – to address the entire VALUE CHAIN – to provide an oversight of the current UK landscape, to recognise the incredible complexity of the industry, to highlight touch points (points of contact or interaction, especially between a business and its customers or consumers), to apply a technology roadmap process and to identify Future Opportunities for innovation in terms of consumer needs and desires and the promise offered by emerging technologies suitable for adoption.

- The industry in the UK is widely diverse – from large multi-nationals through to micro-company start-ups – with complex and inter-acting supply chains. Packaging is a global business and the UK fits readily into a range of niche areas and activities. Like other UK sectors, it will face key issues associated with market changes linked to Brexit such as increased raw material costs purchased from overseas.
- With innovation – we can make all packaging fit-for-purpose, multi-functional and sustainable. Extant issues and problems (such as single use plastic for packaging) can become major opportunities for new business growth. Previous reviews can serve as a past structure to be built upon, updated and expanded.
- The sector will be significantly affected by technologies developed in other fields.

Current developments in a range of emerging technologies will impact on the UK Packaging Industry:

- » Printed electronics
- » 2D materials and nanomaterials
- » Smart technologies
- » Additive manufacturing/3D printing
- » Novel biomaterials and biopolymers
- » Internet of Things
- » Robotics and autonomous systems
- » Energy Harvesting and Storage
- » Embedded sensors
- » Functional materials
- » Industry 4.0
- » Biorenewables

The following conclusions / recommendations can be drawn from the various consultations with the Packaging community:

- Public and private investment is needed for innovation and R&D – to help turn emerging and developing issues into market opportunities.
- New investment is needed to address the ageing workforce and skills gap – appropriate structures must be put in place to address the clearly apparent skills and training deficit and sector-wide requirement. The sector has a particular requirement for apprenticeships (nationalcareerservice.direct.gov.uk).
- There are pockets of academic expertise spread across a number of UK Universities distributed in dedicated silos of knowledge – the community suggest this issue may be addressed for the long term by the possible creation of a UK Centre of Excellence for UK Packaging.
- The sector is currently (June 2018) dealing with the major impact of global attention to plastic use (in particular the issue of single use plastic in packaging) – which will have long-term implications and provide a major incentive to innovate.

INTRODUCTION

The Knowledge Transfer Network (KTN) helps businesses get the best out of creativity, ideas and the latest discoveries, to strengthen the UK economy and improve people's lives.

KTN links new ideas and opportunities with expertise, markets and finance through our network of businesses, universities, funders and investors. From agri-food to autonomous systems and from energy to design, KTN combines in-depth knowledge in all sectors with the ability to cross boundaries.

This report focusses on the UK Packaging sector. It is a sector that by definition supports other key manufacturing and service industries – but is itself a provider and spur for innovation in addition to contributing to UK Gross Domestic Product (GDP). It is a sector that – though sometimes overshadowed – warrants further investigation and examination.

Packaging is part of a complex system for delivering products from point of production to point of consumption. Its main purpose is to protect the product and ensure it is delivered safely and in perfect condition to the end user. Its role in a circular economy is to maintain the value in a product for as long as necessary and to help eliminate product waste (see Figure 1).

Packaging can be defined as an enclosure of products in various types of packaging format such as wrapped pouch, box, bag, can, tray, and others.

Packaging is very useful in information-sharing - to impart health and safety information or to support brand loyalty and promotion.

On average ten times more resources – materials, energy and water – are invested in products compared with the resources used to produce their packaging. Therefore the direct costs associated with using packaging are relatively small compared to the value it adds to the supply chain in ensuring that these embedded resources do not go to waste (www.incpen.org).

The KTN has previously arranged a number of key networking and briefing events for the UK Packaging and related communities:

Smart Packaging Workshop – York, 27th November 2014

Smart Packaging for Pharmaceuticals – Westminster, 13th April 2016

The UK Packaging Roadmap and Landscape – NEC Packaging Innovations, 27th March 2017

Plastics use in the Food Industry – Birmingham, 1st May 2018

In consultation with the community, it was felt that a fresh landscape review and limited road-mapping exercise would be timely and would build upon previous work and highlight areas for future engagement.

The last major review of the UK Packaging Industry was in 2003 and though unpublished the following important and relevant conclusions were presented:

- The boundaries of the industries are difficult to define
- Estimated turnover of £15-17 billion (UK)
- Employs some 250,000 people
- Global sales approaching £300 billion
- Paper/board and plastics increasing market share – metals declining
- Density of company distribution highlights the South East and North West of the UK
- Representative sectors (with approximate percentage distribution) include –
 - » Converters (57%)
 - » Merchant stockists (34%)
 - » Packer Fillers (25%)
 - » Contract Packers (13%)

- Large proportion of SME's
- Sector Research and mapping – professional and trade bodies, academic providers, courses and programmes and level.
- Survey required to determine Industry requirements and views.
- Training, Food and non –food training needs– now/future. Graduate apprenticeship specifications – working group industry/ academia about to start KT, industry engagement mechanisms/providers
- Specialist (neutral non-commercial) environments e.g. food grade/pharma. Industry showcase for new tech. Space required and services. A National Centre of Excellence – proposed location requires space and analytical support– national agrifood innovation campus, Sand Hutton. Industry support from food and drink, professional societies, trade associations.
- Networking / communication - Interactions with funders, innovation support, venture capital etc.

These conclusions were valid and informative and provide a framework on which to build.

Figure 1: Circular Economy

Reasons to Innovate... for a Circular Economy

- To survive and thrive
- To increase revenue
- To adapt to customer expectations
- To attract new markets
- To drive employee engagement
- To future proof business against raw material risks/costs
- Brand differentiation
- To develop new services which match customer needs

Opportunities to Innovate... for a Circular Economy

- Developing a new technology or applying technology to a new problem.
- Developing a new model for the way in which a business generates its revenue.
- Novel materials
- New processes
- New appliance/instrument/machine
- Long-life products
- Incentivised return
- Hire/rental/leasing
- Product service systems
- Reuse



THE RESULTS OF AN INITIAL KTN UK PACKAGING TECHNOLOGY ROADMAP WORKSHOP 2016/17 AND SECTOR BACKGROUND

Representatives from the UK Packaging academic and industrial communities were invited to attend a one-day workshop at the KTN London office in 2016. Organisations attending and contributing are listed in the Acknowledgements section of this report. The information generated and captured during the workshop was collated and is available via the KTN.

The audience were asked to brainstorm and contribute against the following headings:

- Where are we now?
- Needs and Opportunities
- UK Capabilities
- Trends and Drivers
- Threats and Barriers

The audience was sufficiently broad to cover both the food and drink and non-food sectors.

The following highlights emerged:

Where are we now?

Packaging industry – complex, interactive, importance of retailers as drivers

Lack of industry voice – perception by government and consumer

Reactive

Packaging as solution not problem – importance of consumer education

Good track record of innovation

Capacity and capability

Need to skills training at all levels and UK Packaging Centre of Excellence

Needs and Opportunities

Address image – career opportunities – graduate apprenticeships

More investment in innovation, R&D, skills and demonstrators

Stronger links to science base – UK Packaging Centre – to fill broad range of activities/needs

Support for the UK waste management industry

Capabilities

There are key areas of capacity from UK SME's but access to finance is a problem

Packaging industry has capability and technical excellence on manufacturing side

Need to find a way to marry short-term demands of fast moving consumer goods with academic aspiration

Trends and Drivers

Packaging industry has capability and technical excellence on manufacturing side

Need to find a way to marry short-term demands of fast moving consumer goods with academic aspirations

Circular economy – extended producer responsibility

Need to extend shelf life

Light-weighting – environmental impact, cost savings

Value protection

Brexit and value management

Threats and Barriers

Consumer perception that packaging is environmentally bad or delivers a poor consumer experience

Brexit

Lack of trained staff

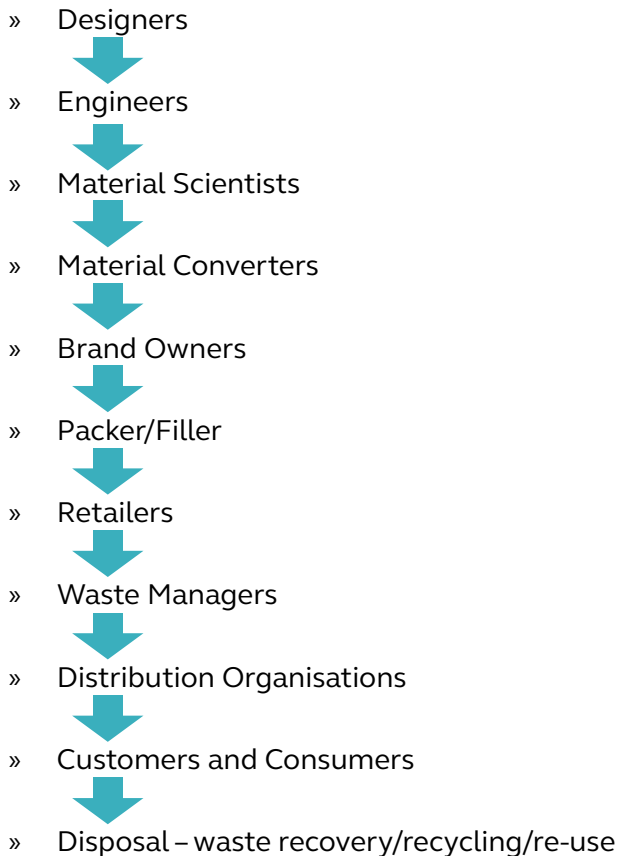
Legislation that limits innovation

The documentation was circulated to other members of the packaging community for review and a summary was presented at the NEC 'Packaging Innovations' conference/Exhibition in March 2017.

A typical packaging product life-cycle would begin with design and innovation, progress through raw material production and selection, manufacturing, transport and distribution, intermediate use (stacking, storage and/or display) and finally to customer or consumer. A typical packaging value chain is shown in Figure 2.

Figure 2: UK Packaging Value Chain

UK Packaging Industry consists of:



The UK Packaging Industry is a key enabler for both consumers and product manufacturers in providing product or component protection and preservation. The industry is currently focussed on ensuring the packaging is fit-for-purpose and effective – but also sustainable and recyclable.

This is an excellent time to provide a strategic review of UK Packaging – to address the entire VALUE CHAIN – to provide an oversight of the current UK landscape, to recognise the incredible complexity of the industry, to highlight touch points (points of contact or interaction, especially between a business and its customers or consumers), to apply a technology roadmap process and to identify Future Opportunities for innovation in terms of consumer needs and desires and the promise offered by emerging technologies suitable for adoption.

The industry in the UK is widely diverse – from large multi-nationals through to micro-company start-ups – with complex and inter-acting supply chains. Packaging is a global business and the UK fits readily into a range of niche areas and activities. Like other UK sectors, it will face key issues associated with market changes linked to Brexit such as increased raw material costs purchased from overseas. The UK Packaging Industry is well placed and receives excellent support from the Packaging Federation (www.packagingfedn.co.uk/) and the Packaging Society (www.iom3.org/packaging-society) both London-based.

BOX 1: PACKAGING FEDERATION AND PACKAGING SOCIETY

Packaging Federation

www.packagingfedn.co.uk

The Packaging Federation is the “over-arching” trade association for the UK Packaging Manufacturing Industry. It is a unique representative body for companies and organisations in the UK packaging manufacturing sector and associated activities.

It actively promotes the economic importance of the industry, the products that it produces, the considerable benefits that derive from the use of packaging and the industry’s responsible concern for both the community and the environment.

Packaging Society

www.iom3.org/packaging-society

- To be recognised as the leading body for individual professionals involved in the packaging world.
- To promote the science, design, engineering, technology and sustainable development of packaging and its practical applications.
- To provide leadership, qualification, professional recognition and development to our members.
- To deliver knowledge, information and networking services to our membership and the wider packaging community.

The industry may be divided roughly into ‘food and drink’ and ‘other or non-food’ although the divide is not complete and overlaps certainly exist. Packaging can and does play a central role in preventing food and drink waste – a key problem seeking a range of innovative solutions.

In terms of food packaging, this is the largest segment in the packaging industry. As food falls under the consumable goods category, due to the direct or indirect intake of the products by the consumers, it is very important to protect, preserve, and avoid contamination from biological elements. Food packaging standard has also been designed in order to ease smooth distribution and transportation, storage, and delivery.

For example, in the UK, food and drink manufacturers, packaging companies and retailers are collaborating together on the Wrap Framework for Greater Consistency in Household Recycling, sharing a vision to make recycling at home significantly easier for the wider public (www.wrap.org.uk/content/consistency).

This framework is a strong development towards a more sustainable future, helping to increase resource efficiency and waste prevention, while contributing to an overall reduction in carbon - use these initiatives and the work of the Food and Drink Federation (www.fdf.org.uk/) and INCPEN (www.incpen.org) to help make supply chains more resource-efficient and better protect the environment. Importantly, by 2025 packaging will be designed to be recyclable, where practical and environmentally beneficial, and is labelled clearly to indicate whether it can be recycled or not.

The overall UK total packaging recycling rate is due to rise to 75.4% from the current level of approximately 65%. The targets (often referred to as the business targets) are to be applied to the packaging handled by all registered packaging producers in a given year and they are therefore at higher levels to compensate for companies outside the Packaging Waste Recovery Note (PRN) system who fall below obligation threshold (£2m T/O and 50 tonnes of packaging handled). The business targets for overall packaging recycling will increase from 75.4% in 2016 to 82% by 2020. These figures were delivered in the March 2017 UK Budget (www.complydirect.com/news/spring-budget-2017-further-challenging-packaging-target-set-through-to-2020/).

Table 1: Packaging Material Recycling Rates – 2017 to 2020

Packaging Material Type	2017	2018	2019	2020
Paper	69.50%	71.00%	73.00%	75.00%
Aluminium	55.00%	58.00%	61.00%	64.00%
Steel	76.00%	79.00%	82.00%	85.00%
Wood	22.00%	38.00%	43.00%	48.00%
General Recovery (EfW)	79.00%	80.00%	81.00%	82.00%
Total Recycling	72.70%	73.60%	74.50%	75.40%

www.complydirect.com/news/autumn-budget-2017-environmental-update/

PRNs are certificates of recycling evidence purchased to show that a company has met their obligations to fund the recycling and recovery of packaging waste as required by the UK Packaging Waste Regulations.

The PRN System:

- Packaging created and sold to the customer
- Packaging waste collected, recovered/recycled by an accredited reprocessor
- PRN is generated
- PRN's sold on an open market
- Packaging data and PRN's submitted to the appropriate environment agency to demonstrate compliance with the Packaging Waste Regulations

Packaging at end of life (so called packaging waste) represents a valuable and available resource for recycling and recovery – including,

as appropriate, energy from waste. It is less than 20% of household waste and the small amount of unrecovered material is less than 3% of annual landfilled waste.

The Packaging Industry needs to respond to the requirements of a diverse range of manufacturing sectors – from pharmaceuticals to automotive parts, from beer and spirits to hazardous waste. Each will set material performance demands, environment issues and regulatory requirements – but the span is large. The Food and Drink Federation (FDF) and INCPEN – the Industry Council for research on Packaging & the Environment – together are estimated to cover a significant proportion of businesses involved in the supply system for packaged goods, accounting for 46% of UK manufacturing employment with a turnover of around £280 billion. This represents a major business ecosystem for innovation and new product development.

The Environment Agency has now released the final verified figures for UK recycling in Q1 and also confirmed the UK's total obligation now that most of the country's registered packaging producers will have completed their data submissions (see Table 2).

Table 2: UK Obligation Table for 2018's first release and close of 2017

Material	UK Total Obligation (21/05/18)	UK Total Obligation (close of 2017)
Paper	2,863,535	2,888,152
Glass	1,590,425	1,622,462
Glass Other	528,265	539,594
Glass Re-melt	1,065,585	1,087,050
Aluminium	90,987	90,539
Steel	338,322	366,512
Plastic	1,033,316	1,024,664
Wood	405,351	249,114
EFW	590,845	608,149
General Recycling	834,166	1,087,031

www.eunomia.co.uk/reports-tools/plastic-packaging-shedding-light-on-the-uk-data/

In essence, we can divide packaging into 'good' packaging and 'bad' packaging – and we know what it is when we see and experience it. Good packaging is expertly designed and attractive, fit-to-purpose, unobtrusive and easy to recycle. Bad packaging is frustrating (cannot remove the lid from the jar, the carton leaks, the plastic beads cover the floor), bulky/inconvenient and visible. Good packaging may be highly visible and attractive prior to purchase – and invisible as we remove the attractive desired product – and simply place the package in the recycling bin. Bad packaging raises issues and problems – from bad design, wrong material selection, wrong shape/overweight – with resultant negative impacts on our lives and the environment.

With innovation – we can make all packaging fit-for-purpose, multi-functional and sustainable. Extant issues and problems can become major opportunities for new business growth.

The Packaging Industry obtains its raw materials from mineral extraction, forestry and the oil and gas sectors. Material production is provided by the aluminium/steel/metal sectors, paper and board, glass and the rubber and plastic communities. Primary material conversion results in cartons, bottles, cans and bags and films and may be followed by secondary conversion.

Leading retailers in the UK – including the major supermarkets – are major drivers of packaging innovations.

The UK Packaging Industry is heavily dependent on expert design (colour, product and labelling), research and development (including new product development), engineering and manufacturing innovations and the skills and training agenda.

Brexit raises a number of issues - immigration, tariffs, market access and currency fluctuations – and the risk that some manufacturers might just exit the UK and head for the continent. Key issues include regulations, tariffs, input and raw material costs and flexibility of labour (e.g. agriculture and seasonal work) – and the possibility of cross-border checks at entry ports.



THE UK PACKAGING INDUSTRY – THE LANDSCAPE

The size of the Sector

The UK Packaging Manufacturing Industry has annual sales of £11 billion and employs some 85,000 people – representing 3% of the UK’s manufacturing workforce. It is a major contributor to the UK GDP and a vital link in the broader Packaging Supply Chain (Packaging Federation).

Its productivity is more than double that of all industries’ average performance and it is a world leader in product innovation and manufacturing technology. Much of the industry is owned by non-UK based companies. Increasingly, their decisions to invest in their UK-based businesses are adversely influenced by perceptions of unilateral actions by the UK in pursuit of a low carbon economy (including carbon floor pricing) and the lack of a coherent strategy on the availability and pricing of energy. There is a real danger that this will seriously impact continued investment and employment in the industry’s UK manufacturing facilities. For many years, packaging manufacturing companies have been major recruiters of apprentices. Much of the industry’s skill base relies on this route to fulfil its employment needs. However, there are increasing concerns about the “fitness for purpose” of the educational system in delivering suitably educated and life/skill-trained young people. In particular, the lack of effective vocational education in the UK is placing us at a significant disadvantage to many of our international competitors. The Diploma in Packaging Technology is internationally recognised as the

premier qualification in the packaging industry and is accredited by PIABC - www.piabc.org.uk/. PIABC is approved as an awarding organisation by the Office of Qualifications and Examinations Regulation (Ofqual). The Diploma is a Level 5 (foundation degree-level) qualification that prepares students to take responsibility for packaging operations at any level through the supply chain and can also lead to higher level study.

Despite consistently increasing demands for goods and services, developments in packaging in recent years have enabled a decoupling of packaging growth from GDP growth. In the last ten years, the amount of packaging per person used in the UK has remained virtually unchanged whilst in the same period GDP and household expenditure have grown by some 20%.

Packaging at end of life (so called packaging waste) represents a valuable and available resource for recycling and recovery – including, as appropriate, energy from waste. It is less than 20% of household waste and the small amount of unrecovered material is less than 3% of annual landfilled waste.

Packaging is not sold to consumers – products are! Packaging is only used where products are sold and acts as a delivery system, in conjunction with modern distribution systems, for these products. Indeed, many products simply could not exist without modern packaging. Demand

for packaging is directly linked to consumer demand for products. Packaging only exists because consumers and modern lifestyles require goods and services. In an era where consumers expect to buy the widest range of goods and services 24/7, this can only be achieved through packaging which contains, protects and preserves the product. On average, the overall impact of packaging is less than 10% of that of the products that it contains.

Table 3: Examples of Packaging Companies and Website links

ALPLA	www.alpla.com/en/
Allied Glass	www.allied-glass.com
Amcor	www.amcor.com
Ardagh Group	www.ardaghgroup.com
Ball Europe	www.ball.com/eu
CeDo	www.cedo.com
Crown Holdings Inc.	www.crowncork.com
Dart Products Europe	dartproductseurope.com
DS Smith	www.dssmith.com
Essel Propack	www.esselpropack.com
Essentra	www.essentraplc.com
Global Closure Systems	www.gcs.com
Huhtamaki	www.huhtamaki.com
inspirepac	www.inspirepac.co.uk
Linpac Packaging	www.linpacpackaging.com
Logson Group	www.logsongroup.co.uk
Mayr-Melnhof	www.mm-packaging.com
Multi Packaging Solutions	www.multipkg.com
Nampak Plastics	www.eu.nampak.com
O-I	www.o-i.com
P I Global	www.piglobal.com
Rigid Containers	www.rigid.co.uk
Robinson plc	www.robinsonpackaging.co.uk
RPC	www.rpc-group.com
SAICA	www.saica.com
Sealed Air	www.sealedair.com
Smurfit Kappa	www.smurfitkappa.co.uk
Tetra Pak	www.tetrapak.com

There are a number of drivers of increasing importance. Recent pricing pressures and weight concerns (the on-going drive for light-weighting) has resulted in sizing polarisation within the sector. Flexible packaging benefits from addressing some of the major concerns of consumers and has seen strong growth and performance in recent times. Lightweight and sustainable packaging is seeing strong and continued development. Consumers are increasingly demanding and producers are supplying premiumisation and personalisation of packaging in food and non-food packaging. The UK is in a period of uncertainty due to Brexit and other globalisation factors are likely to result in intensifying cost pressures.

The Grocery retailers' price wars in 2016 put significant pressure on UK packaging producers. Polarisation in pack size is driven by numerous factors, with multipacks benefiting in recent times. Stand-up pouches are proving especially dynamic thanks to offering consumer convenience and low cost. Demographics continues to play a key part in this development.

Light-weighting, material reduction and compressibility remain in focus and the focus in this area will continue in the short and medium term. All UK packaging participants are focusing on the selection and use of more environmentally-friendly packaging materials.

The sector is currently subject to the Packaging (Essential Requirements) Regulations 2015 - although UK waste strategy (impacted by government budget cuts and Brexit) could impact on future waste legislation. UK recycling targets are rising but government is shifting focus from targets to incentives. A key difficulty is there is little cohesion in local recycling collection strategy and a multitude of initiatives seek to boost UK recycling rates

Attractive flexible packaging is used to minimise cost and environmental impact and mass customisation and short-runs is seeing growing interest.

UK Manufacturing has been in a structural decline for the last 25 years: Manufacturing accounted for 15.8% of the economy in 1990, and has now fallen by a third to 9.6%. Preventing the sector from further decline is a key priority for the UK Government. This has impacted on the UK packaging sector.



Packaging and Environmental Concerns and Opportunities

UK packaging producers could be affected by a growing number of European countries implementing differentiated fees based on eco-design and recyclability criteria, according to resource efficiency specialist, Ecosurety - www.ecosurety.com/

Norway and Germany have proposed legislation that would see producers paying more if they place complex packaging onto their local market. France already charges producers more for harder-to-recycle packaging and Italy is looking to trial fee changes next year.

It could mean UK producers will have to pay more for recycling if they do not improve the recyclability of their packaging aimed at EU markets.

Only half a million of the 1.5 million tonnes of recyclable plastic waste created every year is being reused as intended. The problems lie with a lack of knowledge about which packaging can be recycled along with local authorities lacking the facilities to deal with it.

The Co-op aims to have 80% of all its packaging recyclable by 2020 and is calling on other retailers to follow its lead on developing new packaging and working with local authorities to improve recycling levels.

There is a major revolution underway relating to the consumption of single use plastic and the utilisation of plastic as a packaging materials – that echoes back to the images of plastic waste disposed into the world’s oceans on the BBC programme Blue Planet 2 broadcast in December 2017.

Eunomia (an independent consultancy dedicated to helping clients to achieve better environmental and commercial outcomes - www.eunomia.co.uk) state ‘The UK’s system of managing plastic packaging waste has reached a crisis point: plastic packaging is ubiquitous, it is not always designed to be easily recycled, and where it is collected and sorted for recycling, the majority is exported. The proportion of what is exported that is actually recycled is not known. Even so, the UK has consistently reported it has achieved its plastic packaging recycling targets over a period of twenty years.

Those UK businesses that have an obligation under the relevant Regulations generally pay into “compliance schemes” to discharge their legal obligations on recycling: the more packaging they produce, the more they pay, although the costs of compliance to businesses are low. Indeed, it seems that UK packaging businesses barely pay anything to support the cost of the household recycling system in the UK, whereas in many other European countries, producers meet this cost in full’ (www.eunomia.co.uk www.eunomia.co.uk – Plastic Packaging – Shedding light on the UK Data – March 2018).

The sector needs to stop thinking about this plastic as a waste and start to use it as a resource. What is needed is a co-ordinated response to the problem. This should start with retailers and major brands listening to recyclers and developing packaging that is better for recycling.

Under the Packaging and Packaging Waste Directive, the UK reported that in 2015, the country generated 11.5 million tonnes of packaging waste. The UK data on plastic packaging, reported for the same year, 2015, suggested that 2.26 million tonnes were generated. This figure is intended to reflect the quantity of plastic packaging waste generated across the whole of the UK – in waste generated by households, the public sector, commercial businesses, industry, and in the process of construction (www.eunomia.co.uk).

The Office for National Statistics showed that the recycling rate in England has dropped from 44.8% in 2014 to 43.9% in 2015.

The dip takes recycling rates down to 2012 levels and means that the UK as a whole could miss the EU recycling rate target of 50% of household waste by 2020.

Wales has an impressive recycling rate of 61% while Scotland is also higher than England on 44.2%.

Reasons for the decline have ranged from local authority budget cuts to confusion from householders over what they can put into recycling bins.

For the UK, approximately 7-8% of household waste is plastic packaging.

A number of factors have been highlighted:

- The British Plastics Federation data is that 1.1 million tonnes of plastic packaging was recycled. Similarly, The figures the UK reported for recycled plastics packaging to Eurostat were 39% in 2015, 38% in 2014 and 32% in 2013.
- Generic issues - Population growth, resource depletion, waste, environmental impact. Consumer protection, supply chain operation & integrity, fraud control. Sustainability of operations. Although there is a focus on Food & Drink Sector, the wider packaging industry generally has the same problems and issues.

- General comments – role of packaging in addressing generic issues. Contribution to GDP, employment, exports.
- Contribution – shelf life, waste reduction, distribution (especially important in food and drink). Need to ensure sustainability of packaging production and products.
- Sustainability and future competitiveness of the sector – Survey - Profession Requirements – training, entry to profession, awareness of career options.
- Personnel - multidisciplinary – life sciences (food, biomed, health, pharma etc), chemistry (materials, analytical) physical sciences, engineering, creative arts
- Initial work and rationale – food and drink packaging, contribution to economy, scope of required developments to ensure future competitiveness,
- Issues identified and actions undertaken - engagement of industry, professional bodies, new programme development (industrially relevant PG – running since October 2016), Potential future developments - teaching (apprenticeships) and research, Knowledge Transfer, etc.
- Non- food issues – interest from the sector for similar reasons, initial discussions about to commence with a view to having similar problems across the industry



Key Issues affecting the UK Sector

Population growth, both globally and within the UK, will continue to put pressure on all elements of the agri-food supply chain. An integrated approach to the packaging industry is required and across all sectors of the industry there are problems with sustainability to ensure a continued supply of wholesome food whilst minimising environmental impact of processing and packaging. The agri-food sector is a large contributor to the British economy and innovation, underpinned by research and knowledge transfer, will be essential to ensure sustainability, maintain future competitiveness and secure new markets. There is an emerging need for new and efficient ways to economise on business processes, ameliorate safety and quality issues through the supply chain and reduce losses and waste in the food industry and by domestic users. Within this scenario, packaging is essential to enable effective preservation and distribution of food and drink, facilitate end-use convenience to the consumer whilst minimising waste and ensuring sustainability. It is currently worth 2% of GDP in developed countries, with an estimated 285,000 workers in the UK involved directly or indirectly in the packaging industry.

The National Skills Academy for Food and Drink Manufacturing has repeatedly identified the need for greater training and provision of food packaging technologists to counteract the effect of skills loss due to an ageing workforce and lack of higher level skills. The European food and drink sector industries are the largest manufacturing sector in the EU, with a share in turnover of 14.9%. Food and drink businesses in the EU amount to 287,000 in number; they employ at least 4.25 million people, making the food and drink industry the leading employer in the EU manufacturing sector with an overall share of 15%. The sector is dominated by SMEs with their share estimated to be 63.4% in food and drink industrial employment and 49.3% in turnover of the food and drink industry.

The food and drink sector contribute to the economy and employment regardless of any economic downturn as a large part of a family budget estimated to be 13% is spent on food and drink products. Coinciding with growing demand for food and drink, linked into population expansion, is an increasing requirement for safe, easy to prepare products with an additional expectation of higher nutritional value products.

Specific requirements identified by the packaging industry include the provision of higher level skills and qualifications in packaging technology of which there is limited provision by UK higher education establishments. An integrated programme addressing specific topics in packaging technology and new developments, in particular key areas of national significance such as the application of nanotechnology and biosensors to the food and drink sector, has recently been established at University of Chester. This newly developed post-graduate programme has been developed with the packaging industry in the UK and includes not only manufacturers of packaging materials but all of the major brand retailers as well. Training is essential to address this market failure and increase knowledge and understanding of key areas with applied sector specific benefits. This will then enable the industry to equip staff with the scientific understanding necessary to encourage innovation and provide beneficiaries with greater market penetration and an enhanced range of product development.

This will generate increased competitiveness and economic growth, creation and preservation of employment. Indirect benefits derived from upskilling of the workforce include:

- Improved awareness and responsiveness to societal challenges
- Greater understanding of legislation and regulatory processes
- Enhanced interaction with the UK knowledge base.

The objective as requested by the packaging industries will be to develop and deliver training programmes that will introduce participants to key concepts which will enable employees to understand the contributions from areas such as biocomposites, nanotechnology and smart packaging that will encourage staff to make use of the knowledge and skills when they enter the workplace. Higher education qualifications underline the expanding requirements of food science and packaging technology professionals entering the job market and the requirements that employers expect from graduates. The

current degree programmes offered across the EU cannot meet all of the demands of the food industry as food science and technology professionals cover a wide range of skills which often require specialist knowledge and training, however research indicates that newly qualified graduates are eager to expand their knowledge and skills into these more specialised areas. The area of specific post graduate opportunities in packaging technology is lacking in the UK H.E market.

A further objective of higher level training programmes will be to provide participants with the knowledge and skills that will enable them as managers and leaders to make more informed, higher level decisions that will enhance competitiveness, innovation and new market opportunities, whilst responding to global challenges and consumer needs. Collectively these will help support and stimulate a desire for new knowledge and further upskilling for the benefit of the UK food and drink sector industries.

New training programmes will address the lack of post graduate training opportunities in the packaging sector and should include:

- Development and use of bionanotechnologies for food safety, quality and integrity incorporated into packaging materials
- Functional ingredients for food packaging materials
- Packaging and barrier systems including further developments in modified atmospheres and related technologies

Quantity : 100

Quantity : 100



RECENT INNOVATION AND TECHNOLOGY DEVELOPMENTS

Packages have to perform numerous tasks simultaneously: meet the needs of marketing and sales, comply with safety and hygiene regulations, and satisfy such consumer requirements as sustainability and easier handling while keeping the cost of production, transport, and storage low. Thanks to the very latest machines with highly automated sensor- and microprocessor-controlled drive technology, coupled with innovative materials that can be produced and disposed of sustainably, the packaging industry has succeeded in converting a 6,000-year-old idea into modern, high-tech products.

The following examples are intended to highlight the range of innovations currently in progress or development rather than attempting a complete comprehensive review.

As a key player in the Factory of the Future movement, Gebo Cemex confirms its commitment to help producers embrace Industry 4.0 opportunities by demonstrating a portfolio completely based on its Agility 4.0™ program. Agility 4.0 encompasses smart machines, system and data intelligence, digital connectivity and powerful simulation tools, all within a philosophy of sustainable production. It brings Smart Factories to life in order to create a world of greater choice and unique consumer experience driven by packaging mass customization and product diversity - www.gebocermex.com/

Smart packaging includes active and intelligent packaging. Active packaging is packaging that provides one additional function, in addition to its primary purpose of containment and protection—for example, moisture absorption or oxygen control through desiccants.

Intelligent packaging is packaging that senses a change in the environment and communicates or signals this information to an interested party—a two-step process. Functions of intelligent packaging include counterfeit protection, supply chain management control, food safety, and marketing applications. Examples include ripeness indicators, time or temperature indicators, or NFC labels.

Global Smart Packaging market is accounted for \$28.96 billion in 2015 and is expected to reach \$45.03 billion by 2022 growing at a CAGR of 6.5% from 2015 to 2022. The high R&D costs and lack of sustainable E-Packaging products are the major challenges faced by the players. Advancement in printed technology is the opportunity that resides the market growth. Limited user awareness, high rate and accessibility are the restraining factors for smart packaging. The key drivers include change in consumer lifestyle, food consumption and demand for smart packaging - www.newsmaker.com.au/news/190495/global-smart-packaging-market-2016-trends-research-analysis-review-forecast-2021#.WFeU01WLRhE



Berry Mango

Mixed Berry

Mango

Mixed Melon

Berry Mango

Mixed Berry

Berry & Kiwi

Technologies include:

- Active Packaging
 - » Gas Scavengers
 - * Ethylene (Ethene) Scavengers
 - * Oxygen Scavengers
 - » Corrosion Control
 - » Moisture Control
 - » Antimicrobial
- Modified Atmosphere Packaging (MAP)
- Intelligent Packaging (IP)
 - » Tracking Devices
 - » Indicators

The global smart packaging industry in terms of revenue was USD 10.8 Billion in 2015 and is expected to reach USD 26.7 Billion by 2024, recording a CAGR of 10.6% from 2016 to 2024.

NFC (near field communication) is projected to be the fastest growing segment within intelligent packaging registering a CAGR of over 12% from 2016 to 2024. Usage of NFC in the telecom industries is rising exponentially. Smartphones equipped with NFC which can be paired with NFC tags or stickers, programmed by NFC apps to automate tasks and hence, is likely to fuel the growth of smart packaging market over the forecast period.

Personal care sector is expected to register a CAGR of over 10% from 2016 to 2024 accounting for about 9% of the total market in 2015. Growing demand for personal care products particularly organic products on account of rising awareness about various health benefits over their synthetic counterparts is likely to fuel the industry over the forecast period.

Alternatively, the global market for smart packaging is currently estimated at \$5.3 billion and growing at CAGR of 8% for a projected value of \$7.8 billion by 2021, according to market analysts Smithers Pira.

Intelligent packaging technologies incorporated or embedded in a pack (like codes and tags) provide a means to access information, check authenticity, monitor product conditions, receive and store data as well as deliver messages to customers, shippers and brand owners.

Another subset of smart packaging is IoT packaging which is forecast to grow at 18% per year to \$2.2 billion by 2021 - www.packworld.com/trends-and-issues/smartactive-packaging/pac-future-customization-connection-community

Time-temperature indicator label is a part of intelligent packaging that displays accumulated time-temperature history of the product. Interest towards this technology has been growing and it is considered as smart packaging. Time-temperature indicator label is used to monitor the shelf life of packaged perishable products. Depending on the response tool, the time-temperature indicator label indicates partial history or full history of the temperature. Time-temperature indicator is witnessing gradual adoption in the food products market - satprnews.com/2016/12/02/time-temperature-indicator-labels-market-global-industry-analysis-and-opportunity-assessment-2016-2026/

Printing technologies have been well known for its streamlined steps involved in the production process, better usage of materials, cost effective fabrication and simplified patterning techniques resulting into low cost manufacturing. Over the years, printing technologies has developed various electronic materials compatible with diverse substrates, has led to further expansion of printed electronics into development of printed sensors. Printed sensor are gaining popularity as they provide benefits over conventional silicone sensor such as light weight, thinner size, flexibility, organic materials and low cost, among the others. Glass and plastic are most commonly

used substrates and conductive silver ink as well as carbon nanotechnology are among the most widely used inks for development of printed sensors. Moreover, printed biosensors have existed in the market for several years, whereas other printed sensors such as printed temperature, printed image sensors, printed photodetectors, and the others have recently evolved from the R&D into vast applications. These printed sensors are emerging into application areas such as consumer electronics, healthcare, industrial, smart card, and smart packaging, among others.

Danone and Nestlé Waters, the world's two largest bottled water companies, have joined forces with Origin Materials, a startup based in Sacramento, California, to form the NaturALL Bottle Alliance. Together, the three partners aim to develop and launch at commercial scale a PET[1] plastic bottle made from bio-based material, i.e. 100% sustainable and renewable resources. The project uses biomass feedstocks, such as previously used cardboard and sawdust, so it does not divert resources or land from food production for human or animal consumption. The technology represents a scientific breakthrough for the sector, and the Alliance aims to make it available to the entire food and beverage industry - bmsocialmedia.fr/danone-and-nestle-waters-launch-the-naturall-bottle-alliance-with-biotech-startup-to-develop-the-worlds-first-100-bio-based-bottles/

The Global Nano-Enabled Packaging market is estimated at \$8.2 billion in 2015 and is expected to reach \$19.82 billion by 2022 growing at a CAGR of 13.3% from 2015 to 2022. The nano-enabled packaging market is driven by increasing shelf life of the food, convenience and increase in demand for packaged food. Limited awareness among the users in nano-enabled packaging is currently hampering market penetration and growth. Active packaging technology in nano-enabled packaging holds the largest share in this technology segment and the smart packaging segment is expected to grow at a faster CAGR during the forecast period

www.satprnews.com/2017/02/22/nano-enabled-packaging-market-is-expected-to-reach-19-82-billion-by-2022/>

The Centre for Process Innovation (CPI) has developed a device -- which uses near-field communication (NFC) for power -- as part of the HaRFest project, launched to develop a low-cost energy-harvesting device that can be integrated into sensors, displays, and storage devices.

The device works by drawing energy from a user's mobile telephone, and uses NFC to establish radio communication with another device or sensor by touching or being in close proximity to it. It is comprised of a printed antenna alongside printed passive and active components, including an array of tuning capacitors. The device can be tuned to resonant frequency in order to maximize harvested power output. The device allows for the integration of printed electronics into packaging designs, the thin substrates of which typically can not accommodate thick or inflexible batteries to provide power for sensors for smart-packaging solutions, researchers said.

PragmatIC Printing Ltd., which develops flexible integrated circuits, led the project with CPI -- which fosters technology innovation aimed at the manufacturing sector -- and the EPSRC Centre for Innovative Manufacturing in Large-Area Electronics. The latter was represented in the project by academic partners the University of Cambridge and the Welsh Centre for Printing and Coating at Swansea University - www.uk-cpi.com/news/harfest-project-successfully-develops-printed-energy-harvesting-device-next-generation-smart-packaging/

FUTURE OPPORTUNITIES

The UK Packaging Industry has a record of innovation and new product development that can be taken to a higher level with additional resources and investment. There are a number of key emerging opportunities where the UK can demonstrate competence and capacity and take a leading role in developing new markets for niche smart packaging. It can address those niche areas that deliver high value-added.

For example, a biopolymer is a variant of polymer that can be either bio-based or bio-degradable. The three major factors that define the evolution of bio-plastic industry are market demand, government mandates and technical maturity. As with conventional plastics, bio-plastics have a very broad application spectrum. Bio-plastics tend to have a generally very high consumer acceptance. It derives its use in various commercial applications which includes packaging, textiles, consumer goods, agriculture & horticulture, automotive and many more. Owing to the great packaging solutions with entirely novel functionalities, like biodegradability/ compostability, new materials such as PLA, PHA, cellulose or starch-based materials are used in consistently in packaging. Bioplastics are now delivering entire packaging sector solutions right from a niche product in organic trade to premium packaging for branded goods. The UK has a world-class biosciences network to provide the necessary ideas and skills.

Food waste is an environmental, social, and financial concern to the world but at the same

time providing an opportunity for the packaging industry to develop smart packaging solutions. Around 25% of all food produced around the world ends up in landfills annually, implying that nearly 1.3 billion tonnes of food get wasted, Food and Agriculture Organization estimated. It is assessed that around 58% of all food waste are generated in Europe, where the UK tops the chart and waste around 7.2 million tonnes (£12.5 billion worth) annually. In developed markets, food is mostly wasted at the consumption stage, while in low-income countries it is the opposite.

The smart packaging plays a vital role in reducing food waste by maximising the shelf life of products and informing consumers with accurate information through smartphones. It is one of the best ways to prevent food from damage and spoiling throughout the supply chain. The 'best before' issue can be resolved if smart packaging could 'test' whether the food is still safe to eat. For that purpose, food producers need to add an electronic sensor circuit in packaging to monitor the acidity level of the food which could be read with a scanner or smartphone to assess the freshness of food contents.

However, the main challenge to using smart packaging on a wider scale is the high cost involved. The growth in the smart packaging market will be supported by a range of applications such as time-temperature indicators to identify ideal conditions for storage, freshness indicators, temperature sensors, RFID tags, thermochromic displays etc.

Smart Packaging Market was valued at US\$12.646 billion in 2016 and will reach US\$19.787 billion by 2021, at a CAGR of 9.37% over the forecast period.

Smart packaging comprises of the use of active packaging, intelligent packaging, and modified atmosphere packaging solutions. Factors such as rising demand for ready-to-eat and ready-to-cook meals and snacks, growing awareness regarding good health and fitness, and increasing demand from consumers to know more about the product they are consuming are driving the demand for smart packaging by various end-use industries. Moreover, these packaging solutions provide an improvement in visual appearance, reduce quality deterioration and tracking. Stringent regulations associated with smart packaging are further boosting the market growth.

Current developments in a range of emerging technologies will impact on the UK Packaging Industry:

- Printed electronics
- 2D materials and nanomaterials
- Smart technologies
- Additive manufacturing/3D printing
- Novel biomaterials and biopolymers
- Internet of Things
- Robotics and autonomous systems
- Energy Harvesting and Storage
- Embedded sensors
- Functional materials
- Industry 4.0
- Biorenewables

For example, the UK Packaging Industry has a role to play in addressing the generation of packaging waste (including clinical waste) by the NHS. Recent times have seen regular instances of delays at A&E Departments due to lack of hospital beds frustrating admission of patients. Innovations in packaging may allow recovering patients to be discharged earlier – freeing beds currently blocked by patients who could be allowed home but face specific needs – e.g. simpler packs could provide patient nutrition during convalescence at home. Innovations could provide the delivery of treatment at home enabling independent living, earlier discharge to the safe home environment and improved patient care and quality of life.

The demand for clinical trial packaging has witnessed an uptick in the recent past. The functionality and usability of clinical trial packaging differs from commercial packaging to a great extent. Increase in the number of clinical trials is creating is influencing the clinical trial packaging market. In-depth study and research has been undertaken to analyze possible ways for designing to minimize risk of product damage during shipment. Compared to commercial packaging, clinical trial packaging are least market facing so the aesthetics on packaging will be completely omitted.

Traditionally, pharmaceutical companies have been reluctant in investing in clinical trial packaging, as only a small percentage of drugs have reached the commercialization stage. Since clinical trial packaging is used for medicines which are yet not commercialized, and it is to be taken under necessary guidelines, therefore, there is an additional responsibility to concern manufacturer of the package in such a manner which can be used as tool to drive patient adherence and make them aware frequently to take the dosage correctly and the repercussion of not following the protocol correctly.

Smart plant based food packaging is one of the areas where food packaging companies can emphasize on refining their practices. Reutilizing in-house and using eco-friendly and/or recyclable packaging is another step, but making plant based material and packaging means using more biodegradable products. Heinz, Coca-Cola and SINTEF are the major companies participating in the movement towards the use of smart plant based food packaging. Coca-Cola uses Brazilian sugarcane but is also looking into other plant based materials. Currently all of the company's bottles are made of fully recyclable plastic using bio-based products whereas SINTEF is now ready to present the first demonstration of packaging made from polyactic acid. The company has partnered with other collaborators like Logoplaste and Greek company Agro to develop plant based food packaging. Other food packaging companies need to find if they can alter their packaging necessities and fit plant based packaging material in their budget for which the USDA has proposed a loan guarantee program which will give these manufacturers easy access to loan and also cheaper interest rates in order to build a new plant.

CONCLUSIONS AND RECOMMENDATIONS

This KTN report focusses on the UK Packaging sector. It is a sector that by definition supports other key manufacturing and service industries – but is itself a provider and spur for innovation in addition to contributing to UK Gross Domestic Product (GDP).

The UK Packaging Manufacturing Industry has annual sales of £11 billion and employs some 85,000 people – representing 3% of the UK’s manufacturing workforce.

It has been seen as one of the UK’s Mundane Sectors - almost invisible for policy purposes but significant in economic terms - but this assessment is being addressed and revised.

The UK Packaging Industry would be well placed to contribute to activities/innovations supported by the UKRI Industrial Strategy Challenge Fund (www.ukri.org/).

The UK Sector is well served by the Packaging Federation and the Packaging Society.

The UK graduate level workforce is ageing and there is a need for graduate and graduate-level Apprenticeship courses – a clear need for innovation, skills and training from boardroom to shop-floor.

The community have highlighted the need for a national Centre of Excellence – a central resource of sector-specific knowledge - this could be delivered for example as an EPSRC Innovation and Knowledge Centre (IKC).

A diverse range of emerging technologies will impact on the UK Packaging Sector and the sector must be informed of opportunities for innovation and exploitation:

- Printed electronics
- 2D materials and nanomaterials
- Smart technologies
- Additive manufacturing/3D printing
- Novel biomaterials and biopolymers
- Internet of Things
- Robotics and autonomous systems
- Energy Harvesting and Storage
- Embedded sensors
- Functional materials
- Industry 4.0
- Biorenewables

Academic expertise and facilities are dispersed across the UK – access could be facilitated by proposed Innovation Hubs or other mechanisms – but the issue of access needs to be addressed.

Crucially, Innovation can take place at any stage of the packaging product life-cycle – with a focus on fit-for-purpose, multi-functional and sustainable.

Extant issues and problems can become major opportunities for new business growth (e.g. single use plastic for packaging). Examples include modified atmosphere packaging and the Pharma focus on traceability.

The following conclusions / recommendations can be drawn from the various consultations with the Packaging community:

- Public and private investment is needed for innovation and R&D – to help turn emerging and developing issues into market opportunities.
- New investment is needed to address the ageing workforce and skills gap – appropriate structures must be put in place to address the clearly apparent skills and training deficit and sector-wide requirement. The sector has a particular requirement for apprenticeships (www.nationalcareersservice.direct.gov.uk).
- There are pockets of academic expertise spread across a number of UK Universities distributed in dedicated silos of knowledge – the community suggest this issue may be addressed for the long term by the possible creation of a UK Centre of Excellence for UK Packaging.
- The sector is currently (June 2018) dealing with the major impact of global attention to plastic use (in particular the issue of single use plastic in packaging) – which will have long-term implications and provide a major incentive to innovate.

BOX 2: THE POSSIBILITY OF LINKS TO IKC AND CATAPULTS

Innovation and Knowledge Centres (IKCs) are a key component of the UK's approach to the commercialisation of emerging technologies through creating early stage critical mass in an area of disruptive technology. They are able to achieve this through their international quality research capability and access to companion technologies needed to commercialise research.

Based in a university they are led by an expert entrepreneurial team. While continuing to advance the research agenda, they create impact by enhancing wealth generation of the businesses with which they work

www.epsrc.ac.uk/innovation/business/opportunities/impactschemes/ikcs/

- The Catapult centres are a network of world-leading centres designed to transform the UK's capability for innovation in specific areas and help drive future economic growth - catapult.org.uk/

They are a series of physical centres where the very best of the UK's businesses, scientists and engineers work side by side on late-stage research and development – transforming high potential ideas into new products and services to generate economic growth.

The Catapults network has been established by Innovate UK, and is one of the ways we support innovation by UK business. They will do this by providing access to expert technical capabilities, equipment, and other resources required to take innovative ideas from concept to reality.

Prof Graham Bonwick and Dr Cath Birch of the University of Chester have established the FuturePack Group on LinkedIn - www.linkedin.com/groups/13509098/profile and they state that packaging is essential for effective commercial operation, as well as contributing to specific areas such as food security, supply chain integrity and consumer protection. The group is designed to provide a forum that will help drive future developments in training, research and innovation.

Following discussion with industry partners through the FuturePack network, they state that there are various requirements that will need to be met to support the future growth and competitiveness of these businesses across the UK. These include:

- Development of a national focus to enable growth of a cluster drawn from across the supply chain with the emphasis on packaging technology and its application to sectors such as agri-food, pharma, personal care and other non-food areas.
- Provision of a facility to support research, innovation and training in packaging for food and non-food sectors to offset the shortage of skilled personnel and lack of awareness of career opportunities.
- Access to a technology demonstrator or showcase space suitable for the presentation of packaging equipment of materials, as well as training.
- The development of a UK Centre of Excellence for Packaging Technologies would further support UK businesses as the UK moves towards separation from the EU as currently there is no UK focused central facility to support the packaging industry.

It is considered that the establishment of a national Centre of Excellence can provide the required focus for a packaging cluster and support for this concept has been offered by a range of UK industries, especially from the food and drink sector.

The proposed Centre of Excellence would ideally support the development and application of new materials and technologies to enhance sustainability, security and integrity of the supply chain. Interaction with other clusters such as nanotechnology and nanomaterials and in particular the use of resources drawn from the exploitation of biorenewables. These are of interest due to the anticipated growth in exploitation in areas such as the food supply chain. There is also potential to establish new synergies, for example use of waste derived biomaterials aiding growth of the bioeconomy. The resources available would also help support innovation and development of active and intelligent packaging that will contribute to sustainability, food security (for example through shelf life extension and waste reduction) and public health protection, as well as better serving the needs of the ageing population or those with mobility problems. Independent testing of the performance of new packaging solutions is also required as well as the potential risks posed by new materials to health and the environment.

ACKNOWLEDGEMENTS

The KTN would like to acknowledge the invaluable contributions made by the following individuals and organisations.

1HQ

Astrazeneca

British Plastics Federation

CPI

Crown Packaging

David Wiggins

DRW Packaging Consultants

Enercon

Food and Drink Federation

GSK

INCPEN

Innovate UK

Invest NI

IOM3

Keith Barnes

Packaging Federation

Packaging Society

PEC Partnership - Richard Inns

Pragmatic Printing Limited

Sheffield-Hallam University

The Co-op

The Retail Institute

University of Cambridge

University of Chester

WRAP



Head Office

Knowledge Transfer Network Ltd
Suite 218 Business Design Centre
52 Upper Street
Islington
London N1 0QH

Telephone: 03333 403251
Email: enquiries@ktn-uk.org
ktn-uk.org
@KTNUK

Innovate UK
Knowledge Transfer Network