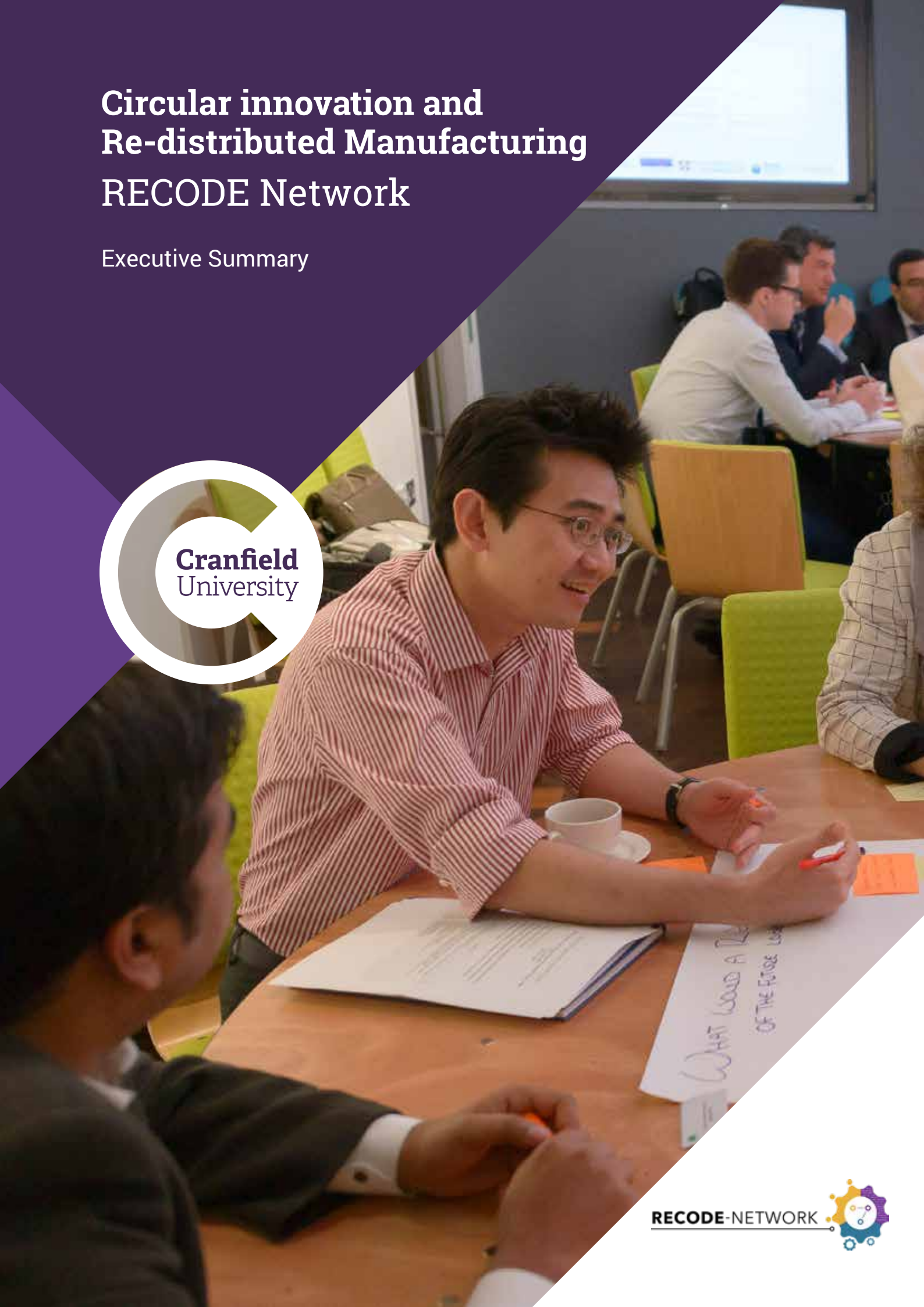
Circular innovation and Re-distributed Manufacturing

RECODE Network

Executive Summary



Cranfield University

RECODE-NETWORK

RdM & CIRCULAR INNOVATION

CHAIR: DR. MARIALE MORENO

LOCALISATION, CIRCULAR MANUFACTURING & BIG DATA

THE CRITERIA

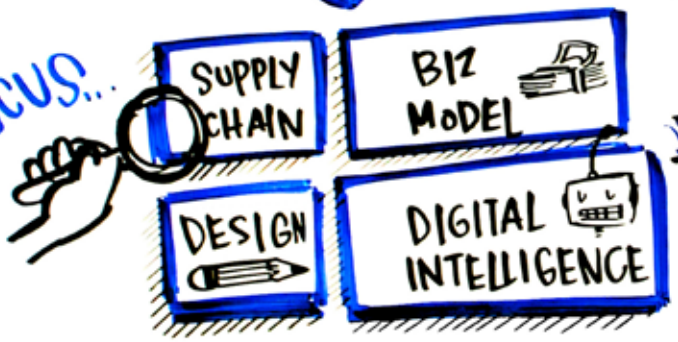
- LOCALISATION
- USER INTERACTION
- USE of DATA

& HOW THEY INTERACT

LOCALISED!

OUR IDEAL... THAT'S HOW WE SET UP the SHOE LAB

FOCUS...



PLASTIC INDUSTRY? ← RETURN PACKAGING → TRACING

ENGAGE CUSTOMERS

HOW to USE BIGDATA?

ENVIRONMENTAL IMPACT of REMANUFACTURE?

TABLE 1...

RESTAURANT SPECIFIC MAGNUM...

...PIZZA vs AMAZON DELIVERY

TABLE 2...

HIGH VALUE END COSMETICS

PERSONALISED & REUSABLE

or REVERSE LOGISTICS?

STARBUCKS PRODUCTS vs PACKAGING...

RECODE Network

Circular innovation and Re-distributed Manufacturing

Fiona Charnley
Cranfield University

Mariale Moreno
Cranfield University

Richard Court
Teesside University

Callum Campbell
Teesside University

Matt Wright
Cranfield University

Executive Summary

Background, aim and objectives

The RECODE Network envisages a connected, localised and inclusive model of production and consumption that is driven by the exponential growth and embedded value of big data. The use of data to narrow the gap between manufacturers and end users to enable user-driven design of customised goods and services at a local scale through ad-hoc supply chains and on-demand production also enables significant opportunity for circular innovation and localised, regenerative models of production. Estimates indicate that the total material value of consumer goods is US$3.2 trillion, with approximately 80% of materials ending up in landfills, incinerators or wastewater removing the potential to feed these valuable materials back into the system. Data driven insight has the potential to inform and incentivise circular models of production; uncovering new revenue streams for manufacturers and suppliers and developing new circular business models based on local and connected value streams. This 6-month feasibility study aimed to investigate the opportunities, challenges and requirements for big data and re-distributed manufacturing (RdM) in the development of localised and circular models of consumer goods production and consumption. This aim was fulfilled through undertaking the following objectives:

- Review and analyse existing local and regional business models to identify and compare examples of circular and re-distributed activity and the associated opportunities, challenges and requirements,

- Identify and select three local use cases, from within the consumer goods sector, that demonstrate, or have the potential to enable, circular and re-distributed activity,

- Map, model and analyse the flow of materials, data, revenue and stakeholder interaction for each case to demonstrate the potential opportunities, challenges and requirements for re-distributed manufacture and circular innovation.

Contribution to Re-distributed Manufacturing

Contribution to Re-distributed Manufacturing
Selected case studies were chosen according to existing local, regional and global business models within the consumer goods sector. The selected case studies were those that demonstrated use of digital intelligence, de-centralised, re-distributed and circular production and consumption, and had to be business to consumer in which the final user is an individual or household. In total 33 case studies were chosen and analysed against six RdM characteristics: Localisation, Customisation, Distributed Ownership, Distributed Knowledge and Distributed Structure, and five Circular innovation characteristics: Value Optimisation, Resource Efficiency and Sufficiency, Continued Ownership and Economic Viability, which emerged from a cross-cutting literature review. A further analysis of the case studies and their use of digital intelligence was conducted, to better understand their digital intelligence capabilities. From the analysis, three types of RdM with circular innovation characteristics were identified (Figure 1).

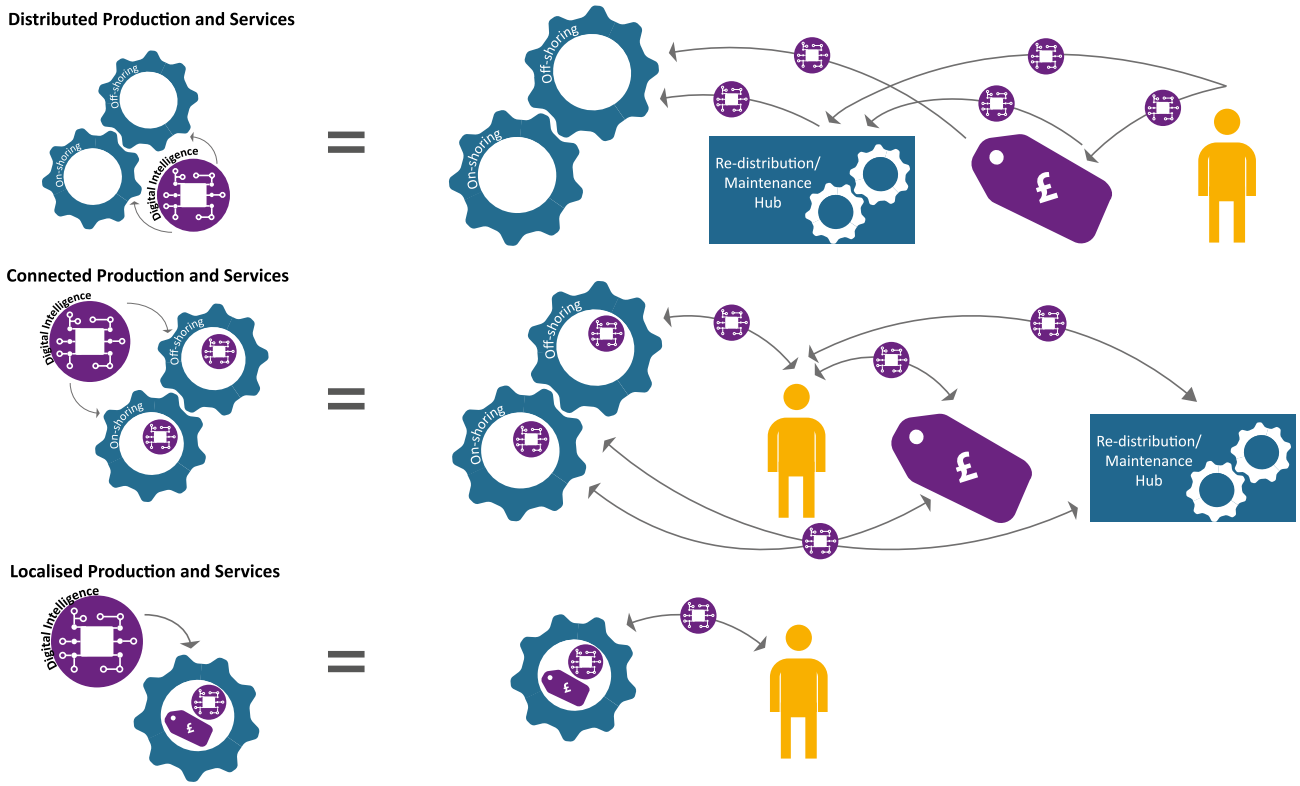


Figure 1 Types of RdM models with circular innovation characteristics

Distributed production and services

This model represents distributed manufacture that captures big data to monitor the processes of production and consumption. From the three models, this is the one that has the least potential of capturing and delivering value and is most closely linked to our current system, therefore the most cases were identified. Within this model, activity mainly happens offshore with some on-shore capabilities of manufacture and re-manufacture as well as local capabilities to manage logistical operations. Big data is used to enable mass customisation as it flows in one direction from the end user to the manufacturer. Closed loop material flows could be captured through monitoring end users, however that was not seen in many cases. Case studies that were analysed as having these characteristics and represent this model, include Splosh.

Connected production and services

This type represents a distributed and digitally connected model. This model can capture high optimisation and delivery of value. This is because, despite manufacture still taking place off-shore and on-shore, it demonstrates a closer proximity to the end user that allows a radical model of consumer goods production, purchase and use. With the use of big data, users can engage in a data-driven open innovation process in which high levels of customisation occur as demonstrated in the Graze case. It also demonstrates high optimisation of manufacturing processes and logistical operations through the use of digital intelligence. In addition, the two-way flow of data represented in this model allows material flows to be closed easily by the monitor, control and optimisation of resources.

Localised production and services

The third type identified represents a localised and digitally connected model of RdM where everything is done on-shore and the retail ecosystem is completely re-distributed contributing to capturing the highest value amongst the three models. This is because users are highly involved in an open be-spoke design and manufacture process, where consumer goods are produced and sold in the same physical or digital space. Personalisation is the key driver as well as shorter supply chains. This model enables high control and optimisation of resources as material flows happen in proximity to the factory and retail floor. The case study Unto-This-Last is an example of this type of RdM. This type of RdM was identified as being the least represented by the case studies as it is the most radical model requiring the biggest transformation to our current system.

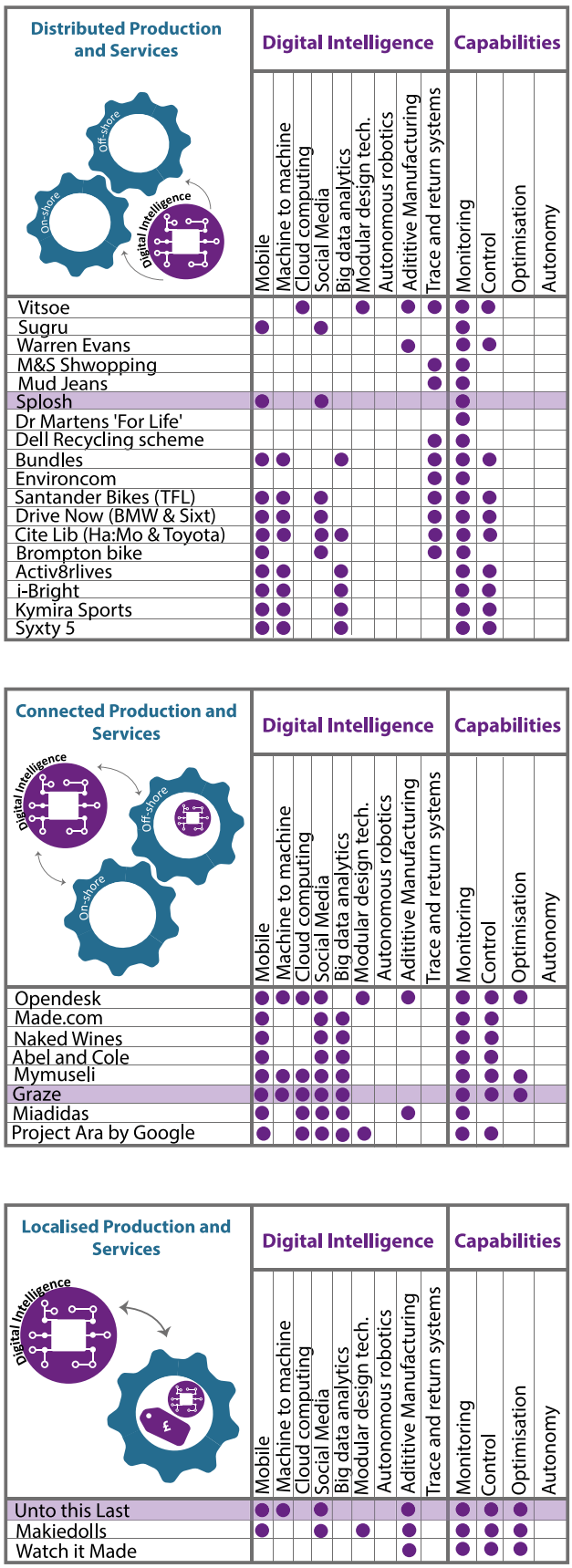


Figure 2 Digital intelligence and capabilities of each analysed case study

Splosh a localised detergent manufacture, Graze a localised snack manufacture and Unto-This-Last furniture retail and manufacture, were further analysed. The selection of these case studies was based on their use of digital intelligence capabilities to enable circularity within their business model, through a consultation with panel of three industry experts. The 'Four Lens Framework' was used to further analyse these case studies. The 'Four Lens Framework' was built from a further review of the literature looking at digital intelligence and re-distributed manufacturing to enable circularity in new business models. The framework proved useful to analyse the value that can be created by applying circular economy principles. As such, the analysis helped to identify further circular opportunities to then quantify material flows regarding with a Discrete Event Simulation (DES) method. The Splosh DES analysis focused on the re-used of detergent bottles, the Graze analysis focused on implementing a take-back scheme of their packaging and the Unto-This-Last analysis focused on the re-manufacture of tables.

Analysis demonstrated that the re-distribution of systems of production and consumption could benefit circular innovation. However, a dilemma still exists surrounding the cost-benefit of doing so. The Splosh case study, demonstrated that if such a business model was to scale up, greater environmental benefits could be achieved. However, the re-use of bottles could impact the plastic industry causing an economic downturn. With Graze, a take-back scheme of packaging brings substantial economic and sustainability benefits and opens a new area of operation in which 'short use' items are considered as assets. In addition, further opportunities exist by the application of digital intelligence, where implementing asset tracking could enhance circularity, which could work better in re-distributed models as these allow local operations. If these opportunities are capitalised, the materials will be less geographically dispersed, increasing their utilization and allowing management of distribution operations locally, through collecting and tracking data of materials being returned by type, location and customer, plus monitoring of its condition for re-use and recycling. Implementing a successful cost beneficial take back scheme would depend on the sufficient number of return items on a predictable timescale. Thus, consumer behaviour is imperative to achieve the number needed of return boxes in suitable conditions. Finally, Unto-This-Last, a re-distributed model of production and consumption could implement a re-manufacturing system of their products on a local scale. This could bring greater environmental impacts regarding resource and material used. However, a balance between the availability of products in use and the number of products supplied has to exist to be cost effective for the company. As such, to fully understand the economic and environmental benefits, further research would need to be conducted to calculate environmental impacts such as carbon equivalent emissions, as well as a financial appraisal of the cost-benefits of circular opportunities such as the ones presented in this report.

Impact and future research

This feasibility study was one of five feasibility studies conducted for the RECODE Network. The study identified RdM and circular innovation definitions, fundamental drivers, and case studies to better understand the feasibility of decentralising the consumer goods sector whilst at the same time enabling circular systems. The study revealed that the integration of digital intelligence could enable a distribution of knowledge, structure, ownership and different levels of customisation, offering more connected, meaningful and durable relationships with the end user. Digital intelligence can also allow circular business models through automated monitoring, control and optimisation of resources and material flows. The study identified examples of digital intelligence being used to incentivise de-centralised, re-distributed and circular models of production and consumption. However, there is not an 'ideal' example of the potential that could be achieved by integrating RdM and Circularity into the business model, and that further value creation needs to be analysed. In addition, the opportunities and challenges of RdM and circular innovation are not still fully explored and questions still persist. For example, could a franchise manufacturing model work? What would scalability look like? What are the implications for intellectual property? What will the consumer acceptance to these disruptive models be? What are the learning capabilities needed for the use of big data? How will localised versus globalised models be managed? And, will retail ecosystems be competing with each other?

Finally, it can be said that the potential for Re-distributed Manufacturing and digital intelligence to enable a regenerative economy is promising, but it is essential to understand where the value is captured and delivered to provide the significant opportunities that decentralisation of the consumer goods sector could bring.