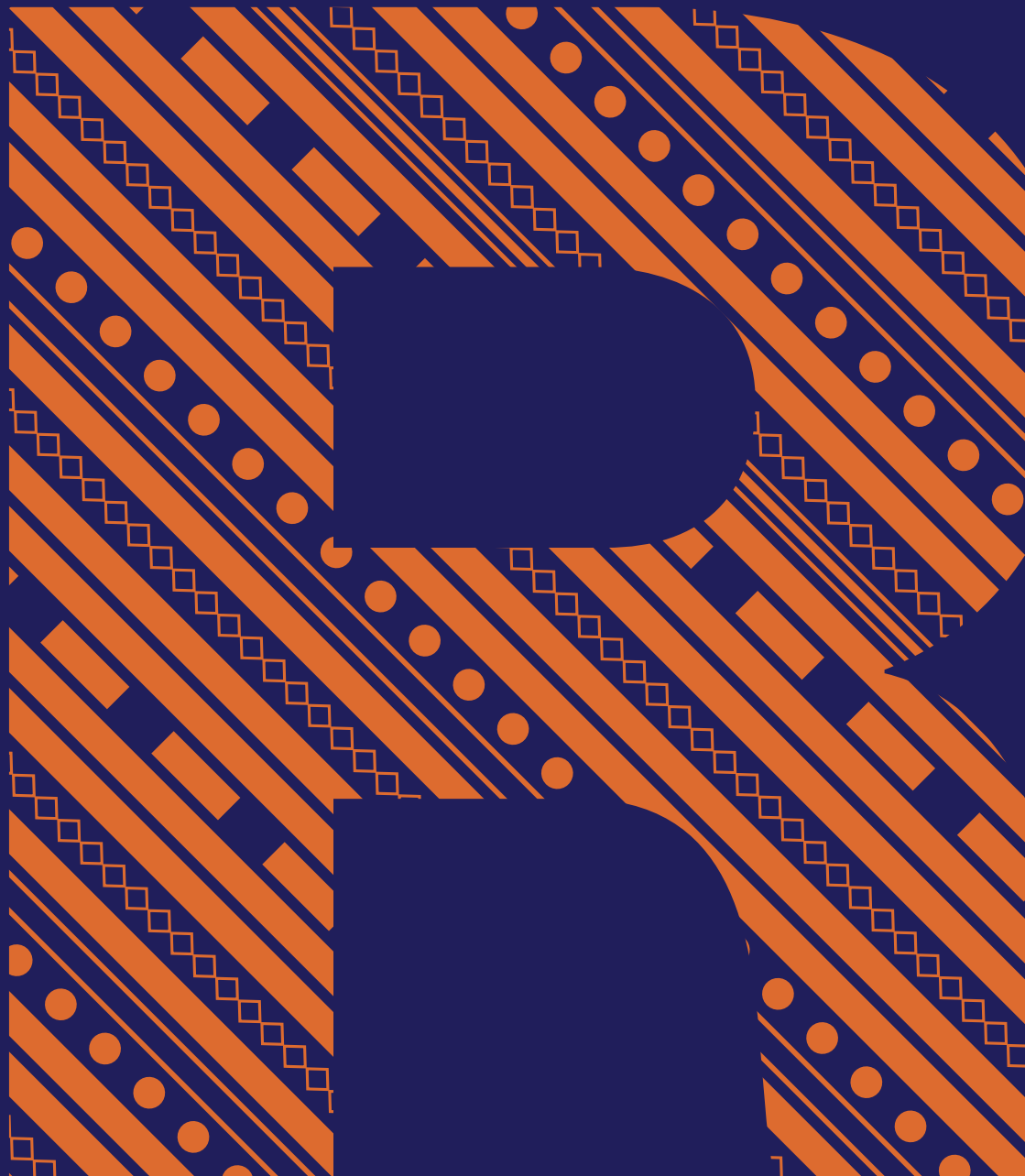




DIGITALLY ENHANCED ADVANCED SERVICES EPSRC NETWORKPLUS

Manufacturing Theme Research Agenda



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1

EXECUTIVE SUMMARY

This report presents the research priorities for the EPSRC-funded Digitally Enhanced Advanced Services (DEAS) NetworkPlus in the manufacturing sector. Recent developments in digital technologies make it easy for manufacturers to monitor the use of their products in the field and then offer services based on the capability of their product. These outcome-based services are known as Digitally Enhanced Advanced Services and these have the potential to deliver sustained value for the UK economy.

The DEAS NetworkPlus Team developed a theoretical framework which was then used to guide discussions between researchers and industry practitioners to identify the key questions facing the wider adoption of Digitally Enhanced Advanced Services in the UK. These questions fall into the following seven research topics which will now form the basis for providing research funding through the DEAS NetworkPlus:

- » How can innovative digital technologies enhance the communication, education and engagement of customers about DEAS?
- » How can innovative digital technologies enhance the communication, education and engagement within an organisation about DEAS?
- » How can innovative digital technologies enhance value creation, delivery and capture across networks supporting DEAS?
- » How can innovative digital technologies enhance data management and analysis to allow improved decision making about DEAS?
- » How can innovative digital technologies enhance business model design, adoption and evaluation for DEAS?
- » How can innovative digital technologies enhance productivity and growth of the UK economy through DEAS?
- » How can innovative digital technologies enhance organisation and cultural change for effective adoption of DEAS?



CONTEXT

2.1 AN INTRODUCTION TO DIGITALLY ENHANCED ADVANCED SERVICES

Digitally Enhanced Advanced Services (DEAS) are a cluster of high-value business models that focus on the delivery of 'outcomes' rather than products to customers. These usually include (i) revenue payments structured around product usage; (ii) performance incentives (e.g. penalties for product failure when in service); and (iii) long-term contractual agreements (e.g. spanning five, ten or 15 years) and cost-down commitments. Well-known examples of DEAS in the manufacturing sector include Xerox's Print Management offering¹, which bundles printing-equipment and maintenance-services whereby customers are charged for the use of the product-service-bundle (i.e. per print); or MAN's Pay-per-Kilometre offering², which bundles truck, maintenance and driver-management services where customers are charged for the extent of the use of the bundle (i.e. distance driven). Digital technologies such as Artificial Intelligence (AI), deep learning and data analytics play key roles in the development and delivery of DEAS, where they essentially provide remote monitoring of product and asset location, condition and use.

The transformation of manufacturing firms to develop, deliver, and ultimately compete through DEAS is a challenge to both practitioners and researchers. From a practical perspective, executives of manufacturing firms face a raft of questions and unknowns, for example; What intelligence can or should be captured about our customers operations? How can AI and data analytics provide insights into products and process of my customers? Which markets and customers are most suited? What should be the value proposition, revenue model and contract? What people and processes are needed to deliver such value proposition? From the research perspective, on the other hand, to understand DEAS and recognise its potential, a transdisciplinary research approach is required that crosses many disciplinary boundaries (for instance computer science, engineering, and management) to create a holistic approach. When pursuing this approach, there are two critical challenges facing the engaged scholars: (1) critical awareness; an understanding that each discipline has its own philosophy, methods, and processes, and (2) a strong grounding in disciplinary traditions, including familiarity with their language, theoretical and methodological approaches.



2.2 WHY DIGITALLY ENHANCED ADVANCED SERVICES ARE IMPORTANT TO THE UK ECONOMY

The Chief Economist of the Bank of England, Andy Haldane, recently gave a speech to the London School of Economics in which he referenced the 'productivity puzzle'³. Since 2008, UK productivity growth has underperformed consistently, relative to forecasts, and indeed productivity has hardly improved at all in the last ten years. Part of the root of this problem is historical; initiatives to improve productivity have tended to focus on improving the efficiency of 'inputs' (i.e. reducing time and costs), rather than increasing 'outputs' (i.e. increasing value created), and today there is a danger of repeating this mistake with digital technologies.

The value creation potential of digitalisation is immense, with a total estimated global economic impact of £800 billion to £2 trillion per year by 2025. There is, therefore, much excitement around the potential of digital technologies to enhance the efficiency of the organisations that adopt them and to transform all sectors of the economy. Additionally, since 1948 the demand for services has grown exponentially while the proportion of GDP from production and manufacturing has contracted. Within the UK, for example, approximately 80% of GDP now comes from services-based activities.

Furthermore, the nature of services is changing; we are in a world where fewer people are buying conventional products and services, and instead more and more are seeking to buy the 'outcomes' that these enable. Quite simply, rather than 'buying an engine' customers want to buy 'thrust', rather than 'buying a car' they want 'mobility', rather than 'buying insurance' they want 'reassurance'. In this way, the world of 'selling things' is giving way to one of "provision of outcomes". Indeed, a survey published recently by ServiceMax from GE Digital found that 77% of respondents (600 IT decision makers and field service management leaders) believed that Generation Z (those born from 1994 onwards) will be the last to experience a product-dominated economy.

For manufacturing firms, services therefore offer a huge potential to increase productivity, growth and commercial resilience. An exploratory project across 77 SMEs in the West Midlands region in the UK demonstrated that early adoption of advanced services stimulated growth in Gross Value Added (GVA) by £7,500/employee, an improvement in productivity of 16%, a two to three-fold improvement in the exploitation of digital technologies and a 10% increase in the value of exports⁴.

The development of the underpinning digital technologies for the purposes of delivering DEAS is thus the key research challenge adopted by this NetworkPlus.

¹ Baines, T and Lightfoot, H. 2013, Made to Serve: How Manufacturers Can Compete Through Servitization and Product – Service Systems, Wiley, London, UK, available at <https://www.wiley.com>

² Bustinza, O; Bigdeli, A; Baines, T and Elliot, C. 2015, Servitization and Competitive Advantage: The Importance of Organizational Structure and Value Chain Position, Research-Technology Management, Volume 58, 2015 - Issue 5

³ Haldane, A. 2017, Productivity Puzzles, [online] 20 March 2017, London School of Economics, available at: <http://www.bis.org/review/r170322b.pdf>

⁴ The Advanced Services Group, Project 080/016/P2 Exploiting Servitization in West Midlands SMEs, ERDF-funded business support project (2012-2015). <https://www.advancedservicesgroup.co.uk/programmes>

2.3 THE EPSRC DEAS NETWORKPLUS

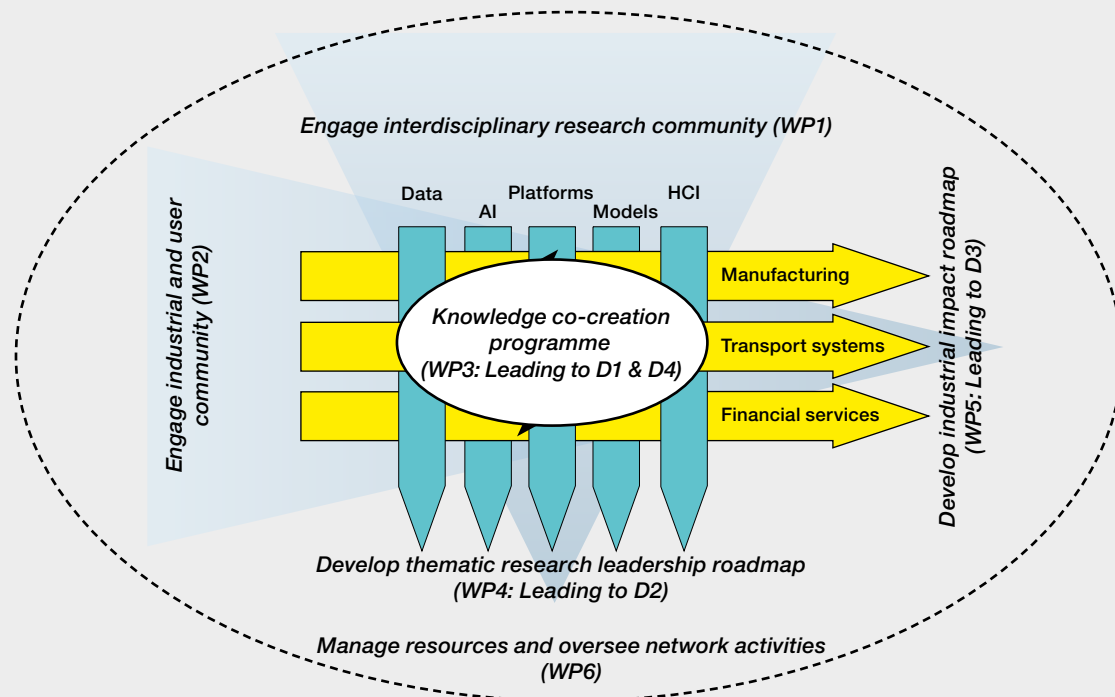
Our vision is that the UK should be the internationally leading research hub for the innovation of Digitally Enhanced Advanced Services and that this capability will significantly amplify the productivity, growth and resilience of industry in the UK. The aim of this NetworkPlus is to:

'Create a cohesive community of researchers and practitioners, working collectively across disciplines (e.g. computer science, engineering and business) and industry sectors, to accelerate the innovation of DEAS and improve UK productivity'.

This Digital Economy NetworkPlus will deliver a vibrant community that will position the UK as the internationally leading research hub for Digitally Enhanced Advanced Services. Rather than focus on the product that is delivered, DEAS focuses on the capability that the product provides. This is a

major change in how firms earn money and is being enabled by transformative digital technologies that allow for example, payment per use or availability or outcome. The impact of these changes is in company productivity. The traditional focus of productivity (outputs/inputs) is on internal efficiency but digital technologies applied to advanced services also transform the value of the output.

The DEAS NetworkPlus will be formed through an integrated programme of activities as summarised in Figure 1. There will be five technical work packages (WP1-5), which will run concurrently. WP1&2 will focus on processes for identifying and attracting researchers and practitioners, WP3 is then a programme of co-creation activities, with WP4&5 creating roadmaps for research and impact. This programme will be overseen throughout by a management work package (WP6).



THE DEAS NETWORKPLUS WILL DELIVER FOR THE UK:

(D1) a new, interdisciplinary community progressing the topic of DEAS,

(D2) a road-map articulating a thematic research agenda and priorities for international leadership in this topic,

(D3) an equivalent road-map illustrating the opportunity space for maximising impact on different sectors based on their level of maturity e.g. manufacturing, transport and financial services, and

(D4) a portfolio of innovative research projects that will accelerate the impact of DEAS in collaborating companies.

Success will be measured through: (i) the scale and diversity of the community we develop, (ii) the level of activity and participation across this community on publications, events, workshops, and research agenda (iii) the relevance and direct impact on industry.



3

PROCESS

3.1 AIM

This report establishes the research agenda for Digitally Enhanced Advanced Services NetworkPlus in the manufacturing sector.

To ensure that those characteristics are built into the research agenda, the team adopted this process:

Step 1 – The ground work: to make sure that the research agenda is broad and balanced the DEAS NetworkPlus Team developed a relevant theoretical framework. The foundation of this approach is the Empathise phase of the design thinking methodology. The framework is designed to enable us to (1) capture inclusive viewpoints on the challenges, (2) classify the empirical discussions in a structured way, and (3) synthesise an agenda for future projects.

3.2 METHODOLOGY

The DEAS NetworkPlus Team (see Appendix 1) have established the required characteristics of the developed research agenda as being:

- » **Broad** to cover a wide range of related areas including organisational change, digital technology, techniques, and processes;
- » **Inclusive** to look at the challenges from a range of disciplines;
- » **Balanced** in order to be guided by theory to ensure a sensible consideration of topics;
- » **Exploratory** to be aligned with the overall objectives of DEAS project, and
- » **Relevant** to lead to impact on business and make contribution to knowledge.

Step 2 – Workshop: in November 2018, we held a DEAS NetworkPlus Manufacturing Workshop at Aston University at which researchers from each of the identified disciplines (i.e. computer science, engineering, and management) could listen to, question and discuss with practitioners from industry who have experience of developing and delivering Digitally Enhanced Advanced Services. See Appendix 2 for a list of the practitioners and Appendix 3 for the list of researchers.

After these introductions to the companies and the service they offer, the researchers were split into three multi-disciplinary groups and were given the opportunity to discuss advanced services with each pair of industrialists: the mid-size companies (Baxi UK and Ishida Europe); the small companies (Nicklin Transit Packaging and UV Light Technology Limited) and those with long experience of advanced services (Rolls Royce plc and Microlise Group Ltd).

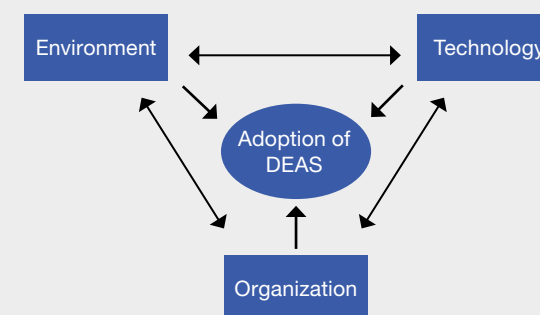
The overall question for the workshop was, “How can transformative digital technologies accelerate the innovation and success of advanced services?”. At the workshop, each industrialist was invited to describe their company and its development toward advanced services using the Technology–Organization–Environment Framework⁵ (Figure 2) as defined by these questions:

The researchers were then split again into three groups, this time based on their research discipline: engineering, digital technologies and management and again had an opportunity for questions and discussion with each pair of industrialists.

All the discussions were captured in a list of comments and questions which firstly set out a broad portfolio of research and then, from the research discipline focussed discussions, developed a deeper understanding of where the research issues lie. These discussions were also captured by a visual scribe in a series of mind-maps, synthesising the essential elements of the event into a combination of words and images.

Step 3 – The comments and questions from Step 2 were validated and refined by the researchers using a Delphi methodology.

- » What is your company and what advanced service offering do you (aspire) to have (or enable)?
- » What organisational challenges do you have/anticipate in achieving this?
- » What technological challenges do you have/anticipate in achieving this?
- » What business environment challenges do you have/anticipate in achieving this?



⁵ Baker, J. 2011 in Y.K. Dwivedi et al. (eds.), Information Systems Theory: Explaining and Predicting Our Digital Society, Vol. 1, Integrated Series in Information Systems, Springer Science+Business Media

4

RESEARCH TOPICS

As a result of following the methodology described in Section 3, the researchers have identified seven research topics which are described in detail in the following pages. The seven topics are:

- 4.1 How can innovative digital technologies enhance the communication, education and engagement of customers about DEAS?
- 4.2 How can innovative digital technologies enhance the communication, education and engagement within an organisation about DEAS?
- 4.3 How can innovative digital technologies enhance value creation, delivery and capture across networks supporting DEAS?
- 4.4 How can innovative digital technologies enhance data management and analysis to allow improved decision making about DEAS?
- 4.5 How can innovative digital technologies enhance business model design, adoption and evaluation for DEAS?
- 4.6 How can innovative digital technologies enhance productivity and growth of the UK economy through DEAS?
- 4.7 How can innovative digital technologies enhance organisation and cultural change for effective adoption of DEAS?

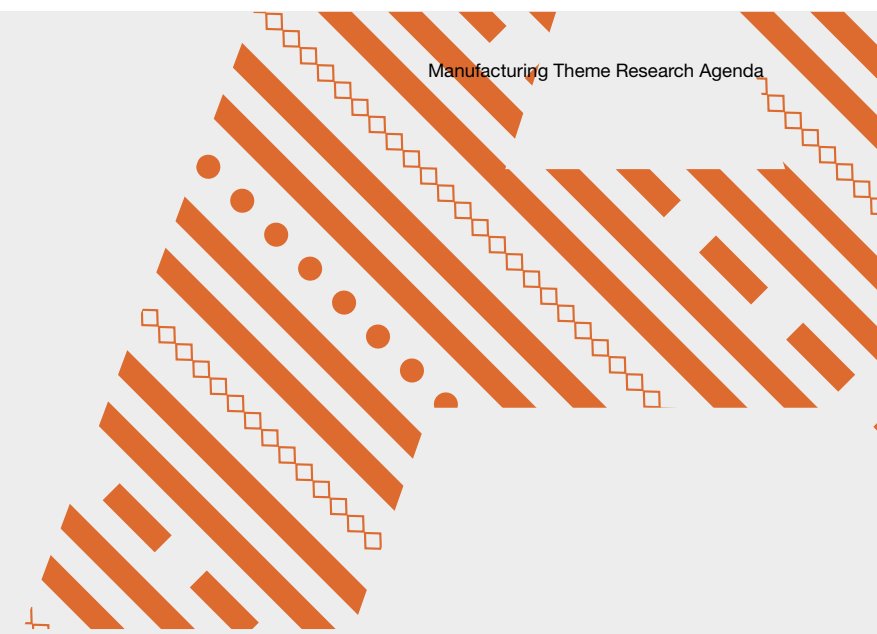


4.1

How can innovative digital technologies enhance the communication, education and engagement of customers about DEAS?

INTRODUCTION

There is a need to raise awareness of what Digitally Enhanced Advanced Services are and how such services add value in general. The opportunity to sell advanced services occurs when the service provider aligns its offer with the customer's concept of value. It is a huge change to switch the basis of the relationship from the customer buying a product to selling them the outcome provided by that product. Digital technologies have the potential to help a customer understand the value of the outcome provided by the product and consequently how a DEAS can help them (the customer) perform better.



KEY QUESTION

How to use digital technologies to raise awareness of the benefits of DEAS in all sectors of the economy?

CHALLENGES

How can a company define a DEAS offer if they don't have input from their customers and how can the customer express their needs if they don't understand the concept? If a company has not yet developed a DEAS offer, how can it justify the expense of developing one if it's customers will not understand the offer? How can innovative digital technologies provide tools to enable a business to demonstrate the value of a DEAS offer in terms that the customer will understand?

POSSIBLE RESEARCH PROJECTS

- » How to educate the customer so they can see the value in the DEAS offer?
- » How can innovative digital technologies get the customer to understand their new role in a DEAS partnership?
- » Considering new risks associated with the introduction of DEAS, what would assure customers? Across different markets?
- » Can gamification help a customer understand the value of DEAS?
- » How does the customer view the value of the data created during the operation of a DEAS?

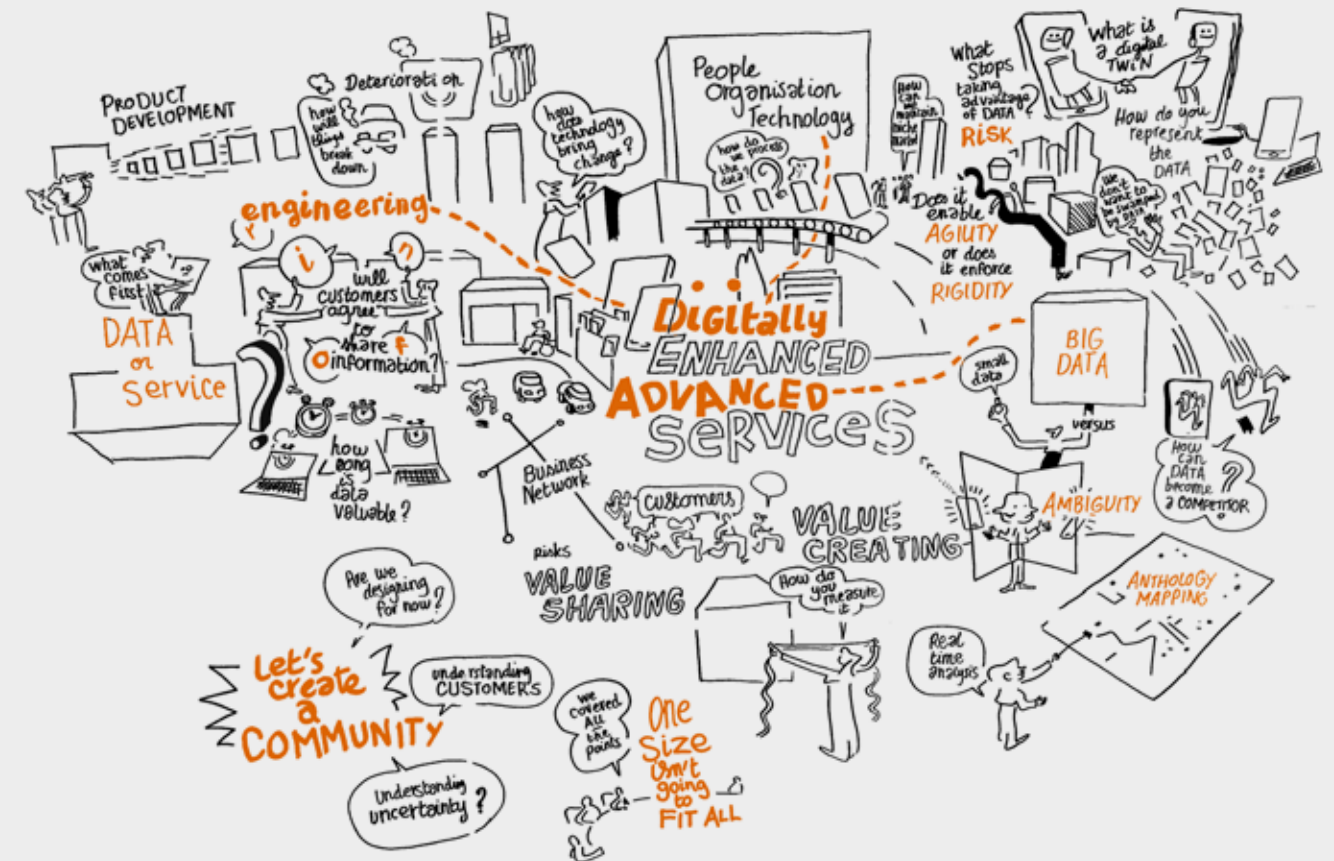


4.2

How can innovative digital technologies enhance the communication, education and engagement within an organisation about DEAS?

INTRODUCTION

DEAS is often a response to the need to diversify and an aspiration to move away from transaction-based income. There is a need for a shared business vision: it is challenging to change the mind set at every step of the product (and service) development process. This vision needs to engage the entire organisational: e.g. a £1 saving on procurement of a washer (product mentality) could lead to a failure costing £m to repair (service mentality). With DEAS the service provider gets paid for NOT touching the asset: any touch is a cost. Therefore, there is a need to focus everyone on the final outcome. Innovative digital technologies have the potential to inform and educate both in regard to the concept of DEAS and to the impact of real-time data on decisions. Can we provide simulations to inform decisions in every part of the organisation?



KEY QUESTION

How can innovative digital technologies embed a DEAS mentality across the organisation?

CHALLENGES

The lead person's role may be divided among many tasks and not focussed solely on DEAS. It can be difficult getting people to sell the service to customers but even more challenging to sell the idea of DEAS to your colleagues. Performance targets are based on the existing way of making money so there is a need to align incentives with the new way of making money. Vital also to get cross functional agreement. The DEAS lead will be fighting against traditional product development for access to R&D resources.

POSSIBLE RESEARCH PROJECTS

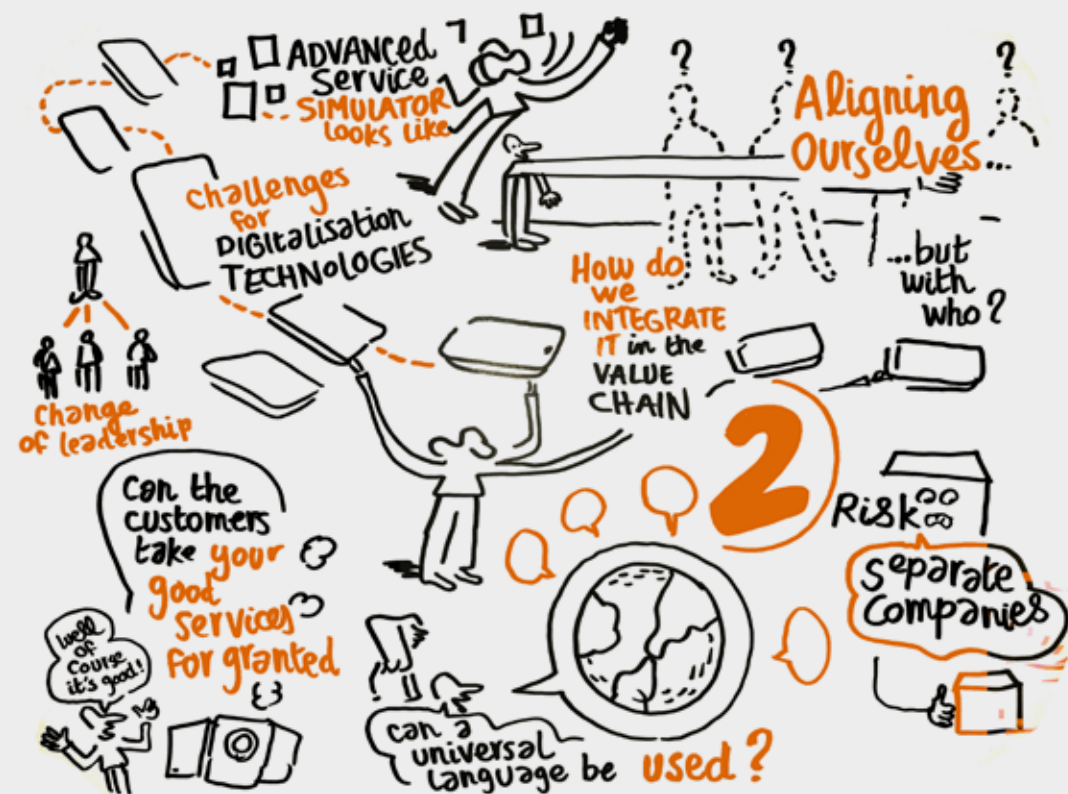
- » What are the internal challenges for digital enhancement?
- » How do we change people's beliefs and values? Change mindsets about products and services to build a DEAS vision
- » What are the risks associated with people, organisation and technology in the development and delivery of DEAS? Categories: trust & risk / customer behaviour / network
- » How do you demonstrate the value of DEAS internally / externally?
- » How do develop a shared vision for DEAS between the senior team, frontline staff and back office team?

4.3

How can innovative digital technologies enhance value creation, delivery and capture across networks supporting DEAS?

INTRODUCTION

All companies are connected with suppliers, customers and partners in a value network. The introduction of DEAS by one company in that network may challenge the other companies in that value network or even companies in a different market space while the new, digitally enabled products may challenge the customer's existing ability to maintain the equipment. Does a company embarking on a DEAS transformation understand its position in the value network and the power or opportunity it has compared to other market players? In the digitally connected world, there will be opportunities to collect and share data with all organisations in a value network that delivers or could deliver DEAS to the end customer. The selection of appropriate data will enable value to be shared based on real-time analysis of how the service is being used.



KEY QUESTION

Can innovative digital technologies help organisations share the value generated when DEAS is introduced to an existing value network?

CHALLENGES

The person running the system into which you supply has an incentive to take over your service: suppliers, OEMs etc each want to offer the whole solution and keep all the money. How to determine the most appropriate role in the value network for your organisation? What stops you and them sharing data? Lack of trust. Sharing data with the value network should be OK but only with confidentiality. How to get each participant to trust the data and agree with the value share that it gives them? Value can arise from many different aspects of a service but getting paid is essential to company survival. A whole network may depend on a tiny contribution from a small company.

POSSIBLE RESEARCH PROJECTS

- » How to use digital technologies to bring about change in a business network to deliver DEAS?
- » How do we manage databases related to DEAS across a value network?
- » How should we use technology (e.g. IoT) to improve the visibility of collaboration in a DEAS value network?
- » How can revenue / value be shared across a DEAS value network to ensure everyone is motivated and successful?
- » New technology can change who thinks they are prime: how do you manage shifts in power most efficiently?



4.4

How can innovative digital technologies enhance data management and analysis to allow improved decision making about DEAS?

INTRODUCTION

In a DEAS system, we will capture not just data to monitor the system and its components but also data for the customer and, possibly about the activities of their customers. Who owns this data? Who needs to access it and use it? The ability to turn data into decisions will be the source of value. This is an opportunity for big data and artificial intelligence. What controls need to be in place?

KEY QUESTION

How to extract meaning from the huge volumes of data that are generated by devices connected to deliver a DEAS?

CHALLENGES

As soon as we fit our products with sensors and arrange for them to send measurements back to our control centre, we face a deluge of data. For example, readings of location, ambient temperature, product status sent every hour from thousands of devices. How to recognise which data is important - not only for today but for the potential new DEAS of the future. How to present that data in a way so that informed decisions can be made?

POSSIBLE RESEARCH PROJECTS

- » How do we represent our level of confidence in the data and its interpretation? What happens if it is non-deterministic?
- » How do you represent complex datasets from DEAS to the right people in the right way? How can it be adapted to the user?
- » Should manufacturers be triangulating data sources across the DEAS value network to measure what they really want?
- » In DEAS, do we need complex datasets to make decisions? (site v content v sources)
- » How can data from DEAS value networks be used to identify patterns of use? To identify new services?

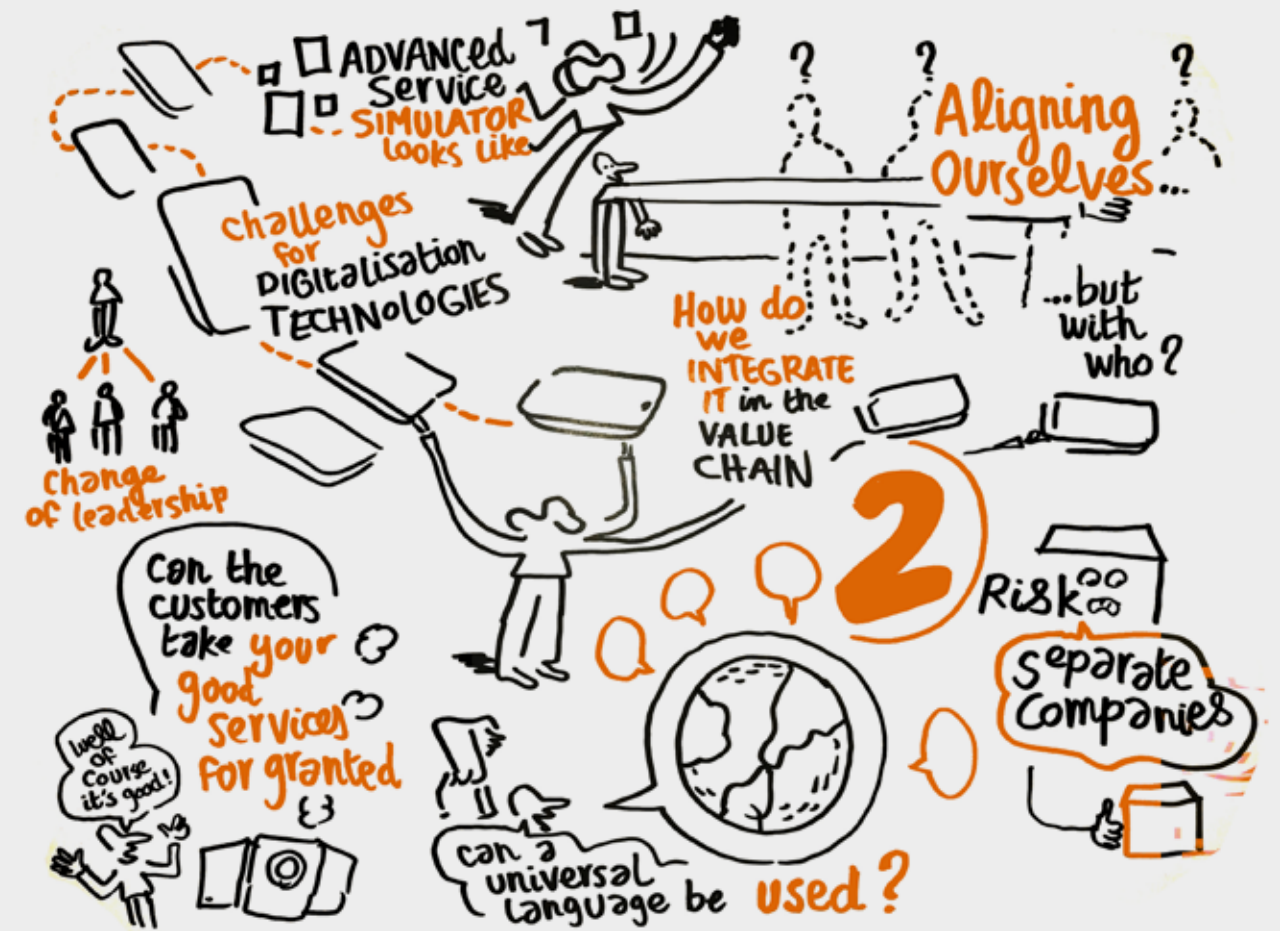


4.5

How can innovative digital technologies enhance business model design, adoption and evaluation for DEAS?

INTRODUCTION

The change from selling a product to selling the capability that the product provides presents some challenges, e.g. the boiler value chain is simple, but the heating value chain is complex. Everyone has a vested interest in the existing value chain. DEAS challenges status quo. To provide the DEAS, a company may need a new business model and new business partners. Once started, it will be a challenge to handle the growth and scale up of operations: to gather data - not just about the products but also related to the environment in which they operate.



KEY QUESTION

How do you combine digital technologies, engineering and business organisation to deliver value through DEAS?

CHALLENGES

The existing transaction business model (selling products) is strong so why change? Good R&D is developing new standard products every year. As you start to gather data, you learn new aspects of how your products deliver capability: how to adapt your DEAS as you learn? Once you have insight, you want foresight - how to predict what the market will want next?

POSSIBLE RESEARCH PROJECTS

- » How to change the business model and organisational structure to support DEAS?
- » How do we predict / address risk in DEAS? New risks of digitisation, cyber security etc?
- » When you already offer DEAS, how do you grow? Scale or new services or both?
- » Do DEAS enable agility or embed rigidity in the existing processes and business model?
- » Are we considering future technology requirements enough? Can we anticipate future requirements and future technological solutions?

4.6

How can innovative digital technologies enhance productivity and growth of the UK economy through DEAS?

INTRODUCTION

Andy Haldane (Chief Economist of the Bank of England) in his recent report on productivity puzzle (essentially stagnant growth since the financial crash) argues that despite the advent of the digital age and the adoption of digital technologies by some leading companies there is a very long tail of poorly productive firms across all sectors. In addition, there is a growing preference to purchase services on a subscription basis. Many companies are however using all their available resources just to stay in business. What can be done to make it easy for companies to transform their business model to adopt Digitally Enhanced Advanced Services?



KEY QUESTION

How can digital technologies, engineering and management combine to enable companies in the long tail of poorly productive firms to benefit from DEAS?

CHALLENGES

The challenge is to provide these firms with tools so that they can explore how the switch to DEAS can provide increased and sustained value to them and their shareholders. This needs to be done quickly and effectively as they will need to divert resources from their current core business in order to establish: what advanced services they can offer; how their products can be adapted to enable DEAS; how their organisation needs to change and how to sell this new concept to their customers.

POSSIBLE RESEARCH PROJECTS

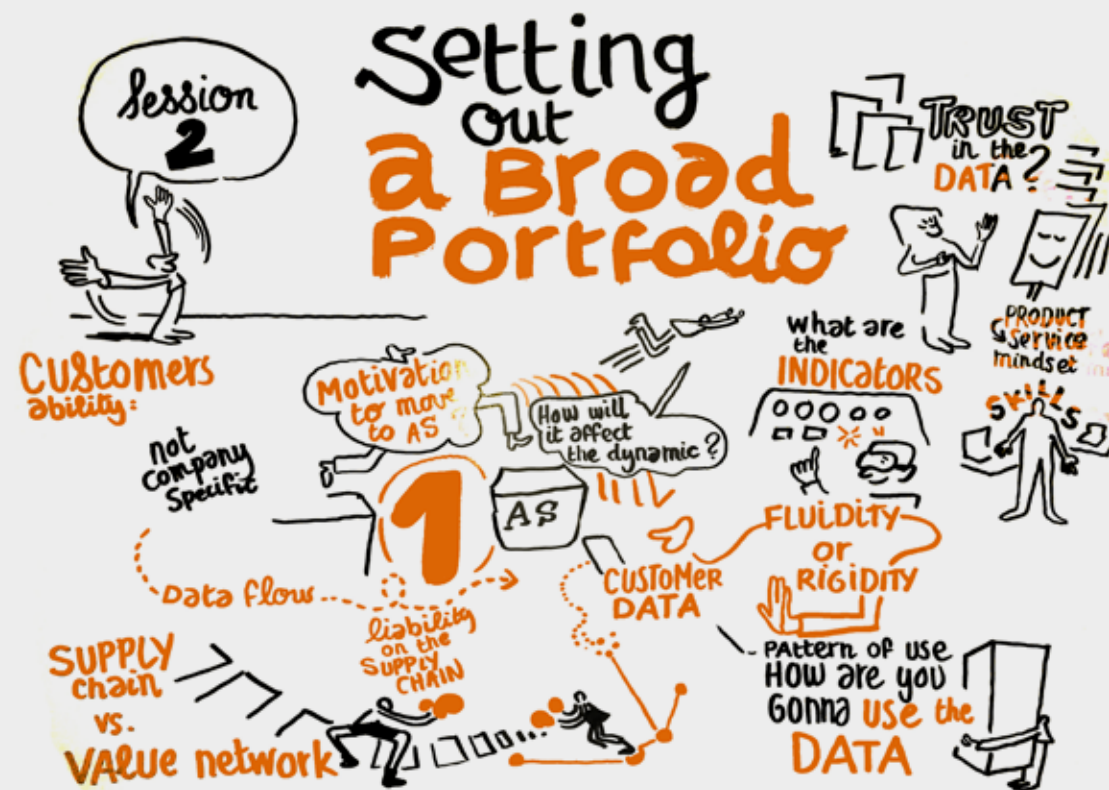
- » How to develop an on-line tool to allow a firm to build a business case for a switch to DEAS?
- » What can be done to help smaller companies take the DEAS step? Can larger organisations help?
- » How does an SME identify / assess the appropriate technology for DEAS?
- » How can SMEs be aware of / learn what is available to implement DEAS given less resources?
- » How to develop skilled people that can apply big data and AI techniques to developing DEAS?

4.7

How can innovative digital technologies enhance organisation and cultural change for effective adoption of DEAS?

INTRODUCTION

Organisations, particularly SMEs, are often reluctant to adopt new systems because they are unsure of their own readiness for the change. Companies who are considering DEAS systems not only need to know the requirements and habits of external members of their value networks to be confident, they also need to know they have the internal conditions and personnel in place to achieve operational effectiveness. Can innovative digital technologies enable organisations to assess their own requirements and develop confidence that they have the right conditions and people in place to optimise DEAS implementation?



KEY QUESTION

Can innovative digital technologies enable organisations to assess their own requirements and develop confidence that they are ready for DEAS implementation?

CHALLENGES

The challenge is to develop a reliable understanding of the most important factors affecting uptake and effective adoption of DEAS systems and to develop practical tools that organisations can apply to self-assess their current circumstances and identify what they need to put in place to optimise DEAS implementation.

POSSIBLE RESEARCH PROJECTS

- » What are the key organisational barriers to / enablers for DEAS implementation?
- » What are the internal direct user requirements for DEAS implementation?
- » How can these factors be measured to evaluate an organisation's current readiness for DEAS?
- » How can personnel skills be developed using innovative digital technologies to optimise DEAS integration?
- » How can organisational conditions (environment, culture, etc) be developed for DEAS integration?



5

CONCLUDING REMARKS AND NEXT STEPS

This report has presented an overview of Digitally Enhanced Advanced Services and their potential benefit to the UK economy. In addition, this report has described the process by which the essential research themes have been identified by researchers in the fields of digital technologies, engineering and management. Working together across these academic disciplines and alongside practitioners in industry, projects based on these research themes will identify tools and techniques to enable small, medium and large businesses across the UK to benefit from Digitally Enhanced Advanced Services.

The next steps are to invite bids for research projects based on these research topics:

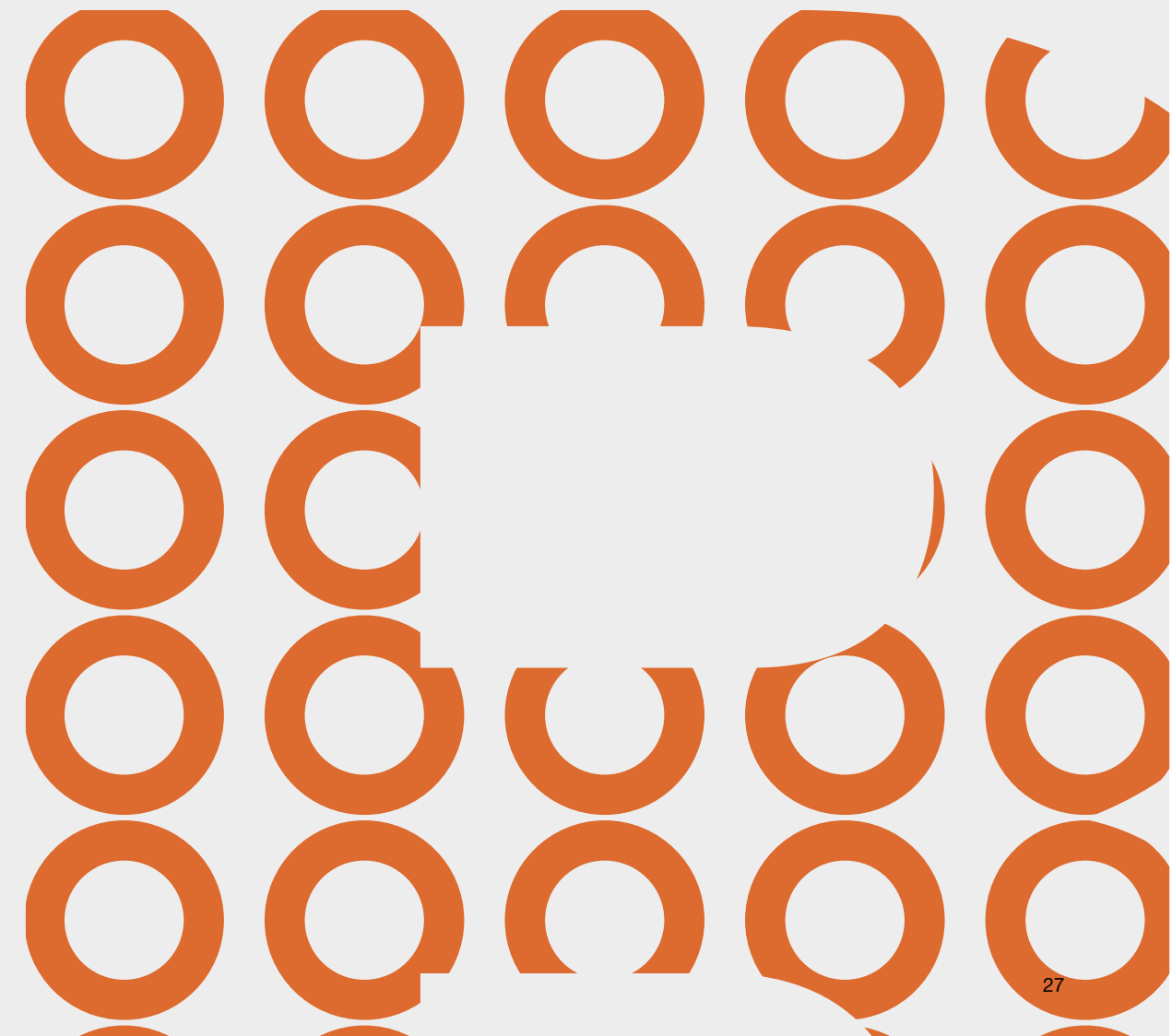
- » How can innovative digital technologies enhance the communication, education and engagement of customers about DEAS?
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- » How can innovative digital technologies enhance organisation and cultural change for effective adoption of DEAS?

6

FURTHER INFORMATION

For more information about the DEAS NetworkPlus visit www.deas.ac.uk or for resources and information about advanced services visit www.advancedservicesgroup.co.uk

To become a member of our Digitally Enhanced Advanced Services NetworkPlus community sign up to our mailing list www.jiscmail.ac.uk/DEAS



Appendix 1

THE DEAS TEAM

THIS RESEARCH AGENDA WAS DEVELOPED BY THE FOLLOWING:

Dr Ali Bigdeli

Senior Lecturer in Industrial Service Innovation, Aston Business School, Birmingham.

Professor Roger Maul

Professor of Management Systems and Academic Director of INDEX (Initiative in the Digital Economy at Exeter) at University of Exeter, London.

Professor Tim Baines

Professor of Operations Strategy and Executive Director of The Advanced Services Group, Aston Business School, Birmingham.

Professor Robert John

Professor of Operational Research and Computer Science, ASAP Research Group, University of Nottingham.

Dr Sarah Fletcher

Senior Research Fellow, Centre for Structures, Assembly and Intelligent Automation, Cranfield University.

Dr Zena Wood

Senior Research Fellow, INDEX (Initiative in the Digital Economy at Exeter) at University of Exeter, London.

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Project Officer DEAS NetworkPlus, INDEX (Initiative in the Digital Economy at Exeter) at University of Exeter, London.

Dr Phil Godsiff

Senior Research Fellow, INDEX (Initiative in the Digital Economy at Exeter) at University of Exeter, London.

Gill Holmes

Senior Research Manager, the Advanced Services Group, Aston Business School, Birmingham.

Appendix 2

THE PRACTITIONERS

Ishida Europe: Ross Townshend	Ishida Europe is a mid-size company supplying food packing, weighing and quality control equipment. It works in a highly competitive market and needs to diversify. A move to provide services based on a pay per pack model in which they guarantee the performance of the whole packaging line would deliver that change for them.
Baxi UK: David Willetts	Baxi UK is a mid-size company which manufactures domestic and industrial boilers. They are currently exploring the benefits of fitting sensors to their boilers to provide pro-active maintenance services as a step toward selling "Heat as a Service".
Nicklin Transit Packaging: Danny Harrison	Nicklin Transit Packaging is a small company that manufactures pallets and other packaging materials. They fit their pallets with sensors, so they can monitor what happens while in use and inform their customer about the location of the pallet and the way in which it is being handled. Feedback from this monitoring allows them to improve the design of the pallet and advise customers about correct use.
UV Light Technology Limited: Paul Jackson	UV Light Technology Limited is another small company and specialises in the manufacture of UV light devices that disinfect food packaging. They are exploring the opportunity to sell a service based on bugs killed per hour or increasing the best before date.
Rolls-Royce plc: Andy Harrison	Rolls Royce design and manufacture jet engines for a variety of markets. In aerospace, they have been selling "Power by the Hour" for over 20 years.
Microlise Group Ltd: Matt Hague	Microlise is a technology company that provides data capture, communications and, if needed, data analysis for their customers which include MAN.

Appendix 3

THE RESEARCHERS

Pavan Addepalli	Cranfield University
Kyle Alves	University of West of England
Javier Andreu	University of Essex
Tim Baines	Aston University
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Amar Behera	Queen's University Belfast
Ahmad Beltagui	Aston University
Ali Bigdeli	Aston University
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Tinkle Chugh	University of Exeter
Simon Coupland	DeMontfort University
Philip Davies	Henley Business School
Caroline Ennis	Westminster University
Helen Feilden	University of Strathclyde
Sarah Fletcher	Cranfield University
Phil Godsiff	University of Exeter
Dave Golightly	University of Newcastle
Scott Gordon	University of Adelaide
Victor Guang-Shi	University of Sheffield
David Harrison	Glasgow Caledonian University
Robert John	University of Nottingham
Kawaljeet Kapoor	Aston University
Soheeb Khan	Glasgow Caledonian University
Alexander Kharlamov	University of West of England
Boriana Koleva	University of Nottingham
Liam Maguire	Ulster University
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