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Newsletter: Issue 8: Summer 2019

Introduction

We are now at the end of the first three years of Connected Everything. Over the past three years, the Connected Everything network has grown to over 270 registered members, representing over 95 different institutions and organisations, covering an extensive range of discipline areas. We have hosted three conferences, funded 11 feasibility studies, eight early career placements and two summer schools, along with specific workshops supporting our road mapping activities. This edition of our newsletter lists some of the publications linked with these funded activities. As well as details of these activities, the Connected Everything website provides access to our own publications, including case studies, project reports, thematic area reports and the research challenges report. This report was used by the ISCF Manufacturing Made Smarter Challenge team as a foundation to the research priorities detailed in the Fast Start funding call below.

As you will know, we have been awarded funding for a further three years and we are busy making plans for the coming year's activities. These will include funding calls for feasibility studies and short term industry placements, preparations for the 2020 conference, and a call to host the 2020 summer school. All of these activities will be informed by or co-created with industry. We are also looking to form a new virtual ECR working group, which will identify dedicated training and support activities which will help PhD students, post-docs and ECRs who are working in the discipline areas of relevance to the network to develop their technical and professional skills.

Through Connected Everything II, we will deliver a network of networks which will accelerate multidisciplinary collaboration, foster new collaborations between industry and academia and tackle emerging challenges which will underpin the UK academic community’s research in support of people, technologies, products and systems for digital manufacturing. We will focus on three goals of building partnerships, developing leadership and accelerating impact. Our thematic focus will continue to be directly influenced by industrial need, through working directly with catapults, linking with the KTN and delivering events that offer opportunities to develop new partnerships. We will work directly with other networks and provide a communication channel for any relevant project so please keep sending us articles regarding your work for inclusion in the newsletter.

We are very excited about what Connected Everything has managed to achieve in the past three years and what we can all achieve in the coming three years.

Moira Petrie, Connected Everything Network Manager

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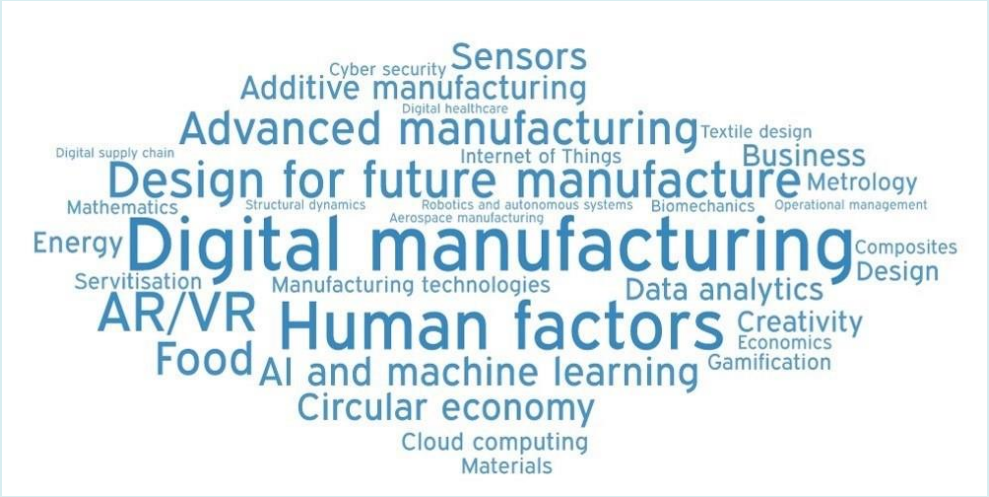

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Connected Everything Conference - "Designing a Connected Future", University of Nottingham, 25-26 June 2019

This year's Connected Everything conference brought together people from industry and academia to share ideas and network. Following an opening address from Professor Chris Tuck, (APVC Research & Knowledge Exchange, Faculty of Engineering, University of Nottingham), the conference kicked off with its first keynote talk, given by Dr Carol Brigley of Mondelez International, USA. "The Digital Oreo Cookie" detailed Mondelez' journey to move to a Smart Factory. The programme on Day 1 was full of thought provoking presentations. Session 1, entitled "The Value of Design", brought to the fore the new Connected Everything theme of creativity, with Professor Rebecca Cain (Loughborough), Dr Kate Goldsworthy (University of the Arts, London) and Professor Steve Benford (University of Nottingham) providing fascinating insights into the design process. The rest of Day 1 included updates from five of the network's feasibility studies (Session 2) and showcased industry perspectives from three companies: Intelligent Plant Ltd, CNC Robotics Ltd and Jaguar Land Rover (Session 3). To conclude the day, delegates enjoyed an exciting Conference Dinner in the grand rooms of Nottingham's Council House with entertainment from Ezekiel Bone who gave his take on the history of Nottingham and its part in the first Industrial Revolution.

Day 2 stimulated our thoughts about the future of Digital Manufacturing (Session 4), with presentations relating to four current EPSRC digital manufacturing projects, and included a workshop in which delegates had an opportunity to help shape the network of the next three years (Session 5). Discussions focused on identifying the two most pressing questions regarding digital manufacturing. Outputs from the session will be made available shortly. The second keynote talk was given by Professor Jan Godsell, University of Warwick, who presented “Thriving in a connected age: 4 strategies to

digitise the supply chain". Awards for Best Posters were made by Dr Nik Watson (see below). After closing remarks from Professor Sarah Sharples, delegates joined post-conference tours of the University of Nottingham's new Advanced Manufacturing Building and its Mixed-Reality Laboratory.

Where they can, speakers have shared their presentation slides. Other key conference materials are also available to view on our website:

Conference booklet, Conference Programme, Conference Posters

Best Poster Awards

1. Low Cost, User Friendly Embedded Machine Vision System Implementation for High-Speed Industrial Manufacture. Frank Worcester, Philip Breedon, Kira Iaquinta,

   Mick Anderson, Steve Brooks, James Sprinks (Department of Engineering, Nottingham Trent University)

2. Industry 4.0 and Augmenting the Millennial Worker: AR for Offshore Wind

   Eleanor Smith, Paul Blackwell, Dorothy Evans, Hugh Welsh (Design, Manufacture and Engineering Management,University of Strathclyde)

The delegates' choice of best poster went to...

3. Analysing Sociotechnical System Interactions for Supporting Technology Integration in Manufacturing Environments (ASSIST-ME)

   Elizabeth M. Argyle, PhD (University of Nottingham), John White, CEng and Chris Nex, CEng (RollsRoyce Plc)

Digital Manufacturing Career Workshop

To support enthusiastic PhD students and Early Career Researchers with an interest in pursuing a career in Digital Manufacturing, Connected Everything held a Digital Manufacturing Career Workshop on 26 June. This was a post-conference event. The workshop's interactive sessions included: What is Digital Manufacturing and what skills will be required? (Dr Nik Watson, Assistant Professor of Chemical Engineering), information on the KTP scheme (Andrea McCluskey) and advice and insights from the University of Nottingham's Career and Employability Service (Clare Jones and Christian Jameson-Warren). The personal anecdotes offered by Philippa Glover, CNC Robotics Ltd, and

by Josh Plumbly, Neil Varnas and Steve Aitken from Intelligent Plant Ltd in the 'Career Journeys' session brought to life the challenges and opportunities that choosing a pathway into Digital Manufacturing in an industry setting may bring. Our intention is to continue developing career support for researchers during Connected Everything II.

Priorities for digital manufacturing - views from UK industry

As part of the network's commitment to engage with industry, Dr Claire Woolley (Connected Everything's Knowledge Exchange Research Officer) interviewed six leading industrialists working in digital roles in a range of sectors to find out their perspectives on the key opportunities and challenges for digital manufacturing. The main findings of this exercise were presented in a poster at Conference 2019. While the specific opportunities highlighted by industry leaders were diverse and contingent on their roles, the Made Smarter Review's findings and recommendations were generally endorsed. In terms of challenges to address, only two themes emerged consistently across this small set of interviews. The two key priorities for UK industry and academia in digital manufacturing identified were:

1. Social Challenges: Industry leaders all point to the need to consider the effects of automation on people. We must consider the challenges of new jobs, the need for skills and up-skilling, cultures supporting change for new organisational structures, adoption of technology and new business models.

2. The Challenge of Interoperability: Another priority identified by industry leaders is the need to develop a common language and framework to allow interoperability and the integration of systems. Standardisation and enterprise architectures were pointed to as key.

CEII will include the themes of 'Future Industrial Worker' and 'Regulation', ensuring that these areas are given thoughtful consideration.

Feasibility Studies

Read about the exciting outcomes of these studies in End of Project reports and Case Studies on our website

Go to
www.connectedeverything.ac.uk/feasibilitystudies

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Publications from Connected Everything funded projects

Feasibility of capturing crafts-based knowledge in an AI System for future autonomous precision surface manufacturing

More steps towards process automation for optical fabrication. Walker D, Yu G, Beaucamp A, Bibby M, Li H, Petrovic S, Reynolds, C. 2017. Proceedings of the fourth European seminar on precision optics manufacturing, Volume 10326, https://doi.org/10.1117/12.2275231

A digital garment simulation tool for fashion design linking consumer preference and objective fabric properties

Structure/Function Analysis of Nonwoven Cotton Topsheet Fabrics: Multi-Fiber Blending Effects on Fluid Handling and Fabric Handle Mechanics. Easson M, Edwards JV, Mao N, Carr C, Marshall D, Qu J, Graves E, Reynolds M, Villalpando A, Condon B. 2018. *Materials.* **11** (11)

https://www.mdpi.com/1996-1944/11/11/2077

Continuous in-situ microstructure and composition analysis within 3D-printed structures using in-chamber sensors

"Warp: A Hardware Platform for Efficient Multi-Modal Sensing with Adaptive Approximation", Stanley-Marbell P and Rinard M, to appear, *IEEE Micro Journal*, 2019.

Circular 4.0: Using digital intelligence in automotive parts remanufacture to enable a circular economy

Simulation to Enable a Data-Driven Circular Economy, Charnley F, Tiwari D, Hutabarat W, Moreno M, Okorie O and Tiwari A.

Sustainability 2019, **11**(12), 3379; https://doi.org/10.3390/su11123379

Towards additive manufacturing process control using semi-supervised machine learning

Automatic Fault Detection for Laser Powder-Bed Fusion using Semi-Supervised Machine Learning. Okaro IA, Jayasinghe S, Sutcliffe C, Black K, Paoletti P and Green PL. 2019, *Additive Manufacturing, **27**, (pages 42-53)*
https://doi.org/10.1016/j.addma.2019.01.006

Computing Craft: Manufacturing cob structures using robotically controlled 3D printing

Thermal performance exploration of 3D printed cob, Gomaa M, Carfrae J, Goodhew S, Jabi W and Veliz Reyes A.

Architectural Science Review, 2019. https://doi.org/10.1080/00038628.2019.1606776

News from the Digital Manufacturing community

Funding competition: Manufacturing Made Smarter round 1 (fast start)
The Industrial Strategy Challenge Fund Manufacturing Made Smarter fast start competition has been announced by BEIS.

Up to £30 million is available for projects to transform the productivity and agility of UK manufacturing. Projects must have the potential for rapid impact.

- Competition opens: Wednesday 24 July 2019
- Competition closes: Wednesday 28 August 2019 12:00pm

Projects must be business led and collaborative, with all consortia involving at least one SME.

KTN is running a briefing event on 30 July in London to explain more about the Challenge and the opportunities it affords.

Funding competition: EPSRC Future Manufacturing Systems call

The aims of this Future Manufacturing Systems call are to:

- Discover potentially disruptive, manufacturing-relevant opportunities from emerging research areas
- Explore future manufacturing systems that might result from such disruptive opportunities
- Initiate new, long-term collaborations between researchers from EPS disciplines and beyond.

The EPSRC Manufacturing the Future Theme will provide up to £12 million (Research Council contribution, not fEC), spread over two streams of funding, to support a portfolio of Future Manufacturing Systems research projects.

The call opened on 18 July 2019 and closes on 24 September 2019

LCR 4.0 - set to generate £31m GVA and 955 jobs over next three years

LCR 4.0 is a UK manufacturing first that aims to put the Liverpool City Region at the heart of an evolution which is set to transform production in the modern world economy. Part funded by the European Regional Development Fund (ERDF), LCR 4.0 creates a collaborative community that connects SMEs to expertise and support from key knowledge assets in the region.

A dedicated LCR 4.0 team has helped SMEs explore the potential of Industry 4.0 technologies by providing support ranging from research and development, knowledge transfer and the acceleration of ideas from concept through to commercialisation.

As the project draws to a close, successes include creating 80 new jobs and adding £2.6m GVA to date. These figures were revealed at its Technology Showcase event which took place at Sci-Tech Daresbury on 6 June 2019. Read more about LCR4.0's expected future impact here.

"Smart" Remanufacturing Network - Connecting People from the Digital and Remanufacturing Sectors

The "Smart" Re-Manufacturing Network has been launched on LinkedIn as a platform to share information, ideas, questions and opportunities specific to the remanufacturing industry. Hosted by the University of Birmingham's AUTOREMAN (Autonomous Remanufacturing) team, anyone with an interest in this field is welcome to join and contribute.

There is a lot of work being done on developing and implementing emerging digital technologies in the manufacturing arena, but research in remanufacturing is scarce. The variability in core quantity, quality and demand at the end of a product's life, is such that remanufacturing needs to not only implement the lessons learned from manufacturing, but also develop its own solutions specific to this industry to ensure profitability and sustainability.

The AUTOREMAN project is an EPSRC funded program focused on automating product disassembly. Subjects include research into applicable sciences e.g. the

removal of components whilst avoiding jamming and wedging. Researching the connectivity of systems at different levels of the remanufacturing process to support task allocation, automated decision making, compliance and learning strategies, are key objectives. Additionally, process planning based on CAD data extraction and geometric reasoning is also explored, layering and connecting different digital solutions, before demonstrating the concepts on real end-of-life products and disseminating the results to the wider community.

Already available on the network are links to videos showing the disassembly of water pumps and turbochargers, using a collaborative human-robot cell. For a taste of the content on the network, check out the teams YouTube Channel:

https://www.youtube.com/channel/UC19YoctUtyGAdazYFrYE1MQ

Material on automation, robotics, disassembly, smart technologies and sustainable manufacturing are shared and encouraged in an active, international, friendly environment, whilst, information on workshops, conferences or material that may interest others can also be posted. Join us at https://www.linkedin.com/groups/13609484/ or search “Smart” Re-manufacturing Network.

The International Workshop on Autonomous Remanufacturing (IWAR) - *Sustainable Remanufacturing in the Transition Towards Circular Economy and Industry 4.0*

The IWAR will take place in the **School of Industrial Engineering, Albacete, Spain, on October 1-2, 2019**. It provides an interdisciplinary forum for researchers, engineers, and industrial leaders to present their latest research results, ideas, developments, and applications in all areas of sustainable or Industry 4.0 remanufacturing. The workshop will bring together leading scientists, researchers and scholars from around the world and will enable the interactive exchange of state-of-the-art knowledge. The call for papers invites submissions in all areas relating to the theme of autonomous remanufacturing, including but not limited to:

- The circular economy
- Sustainable production technologies business models
- Green supply chains and reverse logistics
- Inspection and testing

- IoT and Industry 4.0
- Disassembly mechanisms
- Robotic disassembly and inspection
- Collaborative robots
- Remanufacturing of automotive or high-value products
- End-of-life strategies
- Lifetime extension, repowering and revamping power plants
- Advanced maintenance strategies

Previous IWAR events took place at the University of Birmingham (UK, 2017) and Wuhan University of Technology (China, 2018). The workshop is sponsored by the EPSRC project AUTOREMAN and several industrial companies. This year's event is organised by the University of Castilla-La Mancha (Spain), co-organised by the University of Birmingham (UK) and the Wuhan University of Technology (China).

Details of the workshop can be found here: https://eventos.uclm.es/32090/detail/iwar-2019-iii-international-workshop-on-autonomous-remanufacturing.html or contact Dr Javier Ramirez (organiser) directly on FranciscoJ.Ramirez@uclm.es for more information.

CNC Robotics Case Study

CNC Robotics Ltd provided The Temporary Storage Company with a bespoke industrial robotic arm fitted with an auto-tool-changing electro-spindle leading to greatly enhanced productivity. This led to The Temporary Kitchen Company being able to provide its products to even more customers. A Case Study on the CNC Robotics LTd LinkedIn page describes this successful venture. Details were provided by Philippa Glover who presented Manufacturing Challenges and the evolving role of the robotic integrator at the Connected Everything Conference in June 2019.

Transforming Construction Network Plus Conference 2019

The Transforming Construction Network Plus (N+) is delighted to announce its 2019 Annual Conference, which will be held on **Thursday 19 September at the Royal Society in London.** This one-day conference seeks to stimulate new perspectives, new ideas and new projects which will contribute to the transformation of the UK construction sector.

The N+ conference will feature renowned speakers from the UK and beyond – some advocating for new thoughts on the way we should build, some suggesting alternative routes and unique opportunities, and some showcasing incredibly promising new projects.

Our first confirmed speakers are:

- Sam Stacey, Challenge Director, Transforming Construction Challenge
- Prof David Gann CBE, Professor of Innovation, Imperial College London
- Dr Anne Kemp OBE, Chair, UK BIM Alliance, and Director, Atkins
- Judit Kimpian, Chair Sustainability Group at Architects' Council of Europe
- Dr Daniel M. Hall, Associate Professor, ETH Zurich
- Mike Eggers, VP, Product & Innovation, Project Frog
- David Adams, Technical Director, Melius Homes
- John Pelton MBE, Programme Strategy Director, Palace of Westminster

The event will bring together industry and academic delegates from the construction, manufacturing, energy, social sciences and digital sectors. The N+ will also present for the first time the projects funded to support and contribute to the Transforming Construction Challenge and address some of the biggest obstacles currently facing the construction industry.

Be the first follower – Register for the 2019 N+ Conference now. > https://creating-a-movement-for-change-conference.eventbrite.co.uk

Administered by UK Research and Innovation, and supported through the Industrial Strategy Challenge Fund, the N+ is uniting academic and industrial communities to create a new research and knowledge base, dedicated to address the systemic problems holding back the sector.

Internet of Food Things Network Plus - Conference 2019

Date and time: Tuesday 17 Sept 2019 - Thursday 19 Sept 2019

Location : Lincoln Institute for Agri-Food Technology, University of Lincoln

The conference includes a great collection of speakers representing many of the key players in the digitalised food production supply chain.

Further details and registration

EPSRC Digital Economy: DEAS NetworkPlus Workshop, Cranfield University, 24 September

Can you help us shape a broad and inclusive research agenda that will underpin the UK's future transportation competitiveness in digitally enabled and advanced services?

Digitally Enhanced Advanced Services (DEAS) are a cluster of high-value disruptive business models. They focus on delivering '*outcomes*' to customers rather simply selling a product – for example in manufacturing it's about customers 'buying a hole' rather than 'buying a drill', in transport 'buying mobility' rather than 'buying a car', and in financial service 'buying assurance' rather than buying insurance'. Pioneering examples of advanced services exist in industry; Rolls-Royce sell 'power-by-the-hour' to airlines rather than just jet engines, Alstom's Train Life Services sell 'passenger movement' rather than just trains. These exploit digital innovations and embrace society's increasing appetite for services, and help to deliver business growth, productivity and resilience.

Our vision is that the UK should be the internationally leading research and practice hub for the innovation of DEAS. To support this ambition the EPSRC has made an award of £1.4M over three years to create a network of businesses and researchers to enable a coordinated programme of research to be designed and piloted. Over £600k of this funding will be cascaded to researchers across the communities of business, computer science and human factors, to build interdisciplinary teams to work together on these pilots.

Foundational to the success of this programme is a thorough understanding of the challenges faced by the transportation industry as they set about innovating their business models, digital technologies, and organisational change to compete through DEAS. Therefore, to begin to understand these we are hosting an initial workshop where a range of businesses within the transportation and mobility sectors will openly share and debate their challenges and opportunities in this space. This will then inform our research agenda for our DEAS Network. Potential DEAS areas of interest to the transport and mobility sectors could be predictive maintenance, improved scheduling of

services based on usage, dynamic pricing models or multi-mode scheduling of services.

This is *your* invitation to get involved. We would very much welcome researchers to join us at this workshop and ask the questions of these businesses that lead us to begin to define the research agenda within transportation and mobility for DEAS. This agenda will then inform the pilot projects we commission and help to grow the membership of our networkplus. We encourage ECRs to attend.

We invite you to our workshop that will take place at Cranfield University on Tuesday 24th September 2019, from 9.30am – 3.30pm.
To reserve your place please complete the registration page at:

https://www.eventbrite.com/e/deas-networkplus-workshop-cranfield-university-24th-september-2019-tickets-65563745929

For more information contact Gill Holmes g.holmes@aston.ac.uk.

We look forward to welcoming you to Cranfield.

Join Connected Everything at connectedeverything.ac.uk

Connected Everything is led by **Professor Sarah Sharples, University of Nottingham,** and an **Executive Group,** with members from **17** organisations. The Executive Group provides guidance to the Network and links to other key strategic funded initiatives.