Cranfield University

11th International Conference on Through-life Engineering Services (TESConf 2022)

8-9 November 2022

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Through-life Engineering Services

TESConf2022 Conference Details

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Please note that the conference will include an online streaming link for select authors. Photography and video recording will also be taking place at this event for online audience after the event. If you do not wish to be included in these recordings, please let us know by contacting the organiser at tesconfadmin@cranfield.ac.uk

Wifi

Free wifi will be made available on the day.

Welcome

Dear Colleagues,

It is a great pleasure for us to welcome you to the 11th International Conference on Through-life Engineering Services (TES) hosted by the Manufacturing theme at Cranfield University. This seasoned conference has served as a meeting point for the academic and industrial communities to discuss TES to address current and future industrial challenges. This meeting welcomes contributions about the state-of-the-art technologies and the implementation of advances in the sustainable and engineering management of high-value assets across their life cycle from design through to manufacturing, in-use and disposal.

This edition of the conference includes four Keynote speeches, three workshops, a panel discussion and five academic sessions, which cover the latest advances in TES. The sessions have been designed to enhance understanding in how to connect different phases of the asset life cycle. These will cover challenges such as design for service, evaluating the impact of degradation, and understanding the sustainability implications of TES. The Keynote speeches from academics and industrialists will offer insights from different sectors covering topics related to business models, engineering, skills and societal implications. The interactive workshops will cover topics ranging from optimisation, degradation management and condition-based maintenance. Our panel discussion will include esteemed members from industry and academia sharing their insights into today's developments and future opportunities in TES.

We hope you enjoy and have a successful conference.

Professor John Erkoyuncu
General Chair, TESConf2022

Dr Gustavo Castelluccio
Programme Chair, TESConf2022

Programme Overview

Tuesday 8th November 2022			
		Atrium	Meeting Room 1
08:30	09:00	Registration	
09:00	09:10	**Chair Welcome – Setting the Scene** Professor John Erkoyuncu General Chair TESConf2022 (Cranfield University, UK)	
09:10	09:15	**Welcome to Cranfield** Professor Dame Helen Atkinson Pro-Vice Chancellor (Cranfield University, UK)	
09:15	09:20	**Manufacturing & Materials @ Cranfield University** Professor Mark Jolly Director of Manufacturing (Cranfield University, UK)	
09:20	09:30	**Conference Overview** Dr Gustavo Castelluccio Programme Chair TESConf2022 (Cranfield University, UK)	
09:30	10:10	**Keynote 1:** Steve Gregson (Rolls Royce Plc, UK)	
10:10	10:50	**Keynote 2:** Professor Jan Aurich (Technische Universität Kaiserslautern, Germany)	
10:50	11:10	Break	
11:10	12:45	**Workshop 1:** **DOTES Workshop**	
12:45	13:55	Lunch	
13:55	14:35	**Keynote 3:** Professor Sarah Sharples, (University of Nottingham, UK)	
14:35	15:15	**Keynote 4:** Professor Ashutosh Tiwari (University of Sheffield, UK)	
15:15	15:35	Break	
15:35	17:15	**Workshop 2:** **Inspection and maintenance for railway infrastructure**	
17:15	17:30	Summary & Close of Day 1	
18:45	22:00	Drinks Reception followed by Dinner	

Wednesday 9th November 2022			
		Atrium	Meeting Room 1
09:00	09:05	**Opening: Dr Pavan Addepalli** Lecturer in Degradation Assessment, Organising Chair TESConf2022 (Cranfield University, UK)	
09:05	10:35	**Workshop 3:** **TES Panel Discussion**	
10:35	10:55	**Break**	
10:55	12:35	**Academic Session 1:** **Digitalisation**	**Academic Session 2:** **Maintenance**
12:35	13:30	**Lunch**	
13:30	14:50	**Workshop 4:** **NUST Tutorial**	**Academic Session 3:** **Materials**
14:50	15:10	**Break**	
15:10	16:30	**Academic Session 4:** **Manufacturing**	**Academic Session 5:** **Maintenance**
16:30	16:45	**Closing Ceremony & Awards Presentation**	

Key

- Planery Sessions
- Regular Sessions
- Workshops
- Breaks

Keynote Speaker Biographies

Keynote Speaker 1

Steve Gregson

Engineering Fellow – Service System Solutions

Rolls-Royce Plc, UK

Steve is the Rolls-Royce Engineering Fellow supporting Services across the Civil Aerospace, Defence Aerospace & Power Systems businesses. He is the Industrial Co-chair of the UK Through Life Engineering Services Council. He is a Fellow of both the IMechE and Institute of Asset Management. Steve is an effective collaborator and "big picture" systems thinker with many years of global transformation experience.

Steve will talk about the delivery of value driven, digitally enabled Through Life Engineering Services capabilities and share important insights from the real-world implementation of these strategies. He will also talk about the UK TES Council and its work to create the environment in which TES flourishes and becomes the dominant business model for high value, complex equipment.

Keynote 2 Speaker

Professor Jan C. Aurich

Professor at the Institute for Manufacturing Technology and Production Systems

TU Kaiserslautern, Germany

Prof. Dr.-Ing. Jan C. Aurich studied mechanical engineering at Leibniz University Hannover and Colorado State University, Ft. Collins, USA, achieving his PhD in 1995. He has a background in product design and manufacturing due to several years in industry at Daimler AG in different management potions. After his career in industry, he took over the Institute for Manufacturing Technology and Production Systems (FBK) at TU Kaiserslautern in 2002. His research activities in environmental sustainability focus on the development of methods for planning, evaluating, and improving the ecological sustainability of factories, machines, and processes. Particular interests include technical product-service systems, circular economy, remanufacturing, business model innovation, and life cycle assessment.

Jan C. Aurich is member of the International Academy for Production Engineering (CIRP), the German Academic Association for Production Technology (WGP) and the German Academy of Science and Engineering (acatech). He is active as a reviewer for several research foundations (e.g. German Research Foundation DFG and United States National Science Foundation NSF) and as a member of editorial boards of several renowned scientific journals. Furthermore, Jan C. Aurich also has a strategic role building new communities that tackle challenges and opportunities in the scientific community of manufacturing in the role of member of the advisory board of the application centre Industry 4.0 Potsdam as well as academic director of the research facility “Laboratory for Ultra-Precision and Micro-Engineering” in Kaiserslautern.

FBK is active in the fields of sustainability in manufacturing, digital technologies for manufacturing systems, additive manufacturing, micro and ultra-precision machining, and machining technology. Besides research activities, the institute collaborates with partners from industry to transfer scientific knowledge into practice. The cooperation in interdisciplinary teams leads to an active exchange of experiences and connects researchers and practitioners.

In his keynote, Prof. Aurich will talk about design guidelines towards absolute sustainability for technical product-service systems (PSS). PSS comprise of physical products, non-physical products (services), and a network of companies together with supporting infrastructure to deliver customer benefits. They show the potential to deliver customer benefits with lower environmental impacts compared to the sale of products alone.

The recent shift towards an absolute perspective of sustainability changes the understanding of sustainable life cycle engineering and design. This new understanding challenges designers to create PSS that not only offer incremental environmental advantages but actively contribute to sustainable development.

Supporting designers to create absolute sustainable PSS, the keynote offers design guidelines, which address procedures along the entire lifecycle of PSS. The guidelines formulate basic requirements which include requirements for sustainability and the products environmental impacts as well as requirements for market orientation and customer satisfaction. Also, the guidelines enable lifelong improvements to through services and the use of data. Considering the end-of-life of PSS, the guidelines enhance circularity and contemplate rebound effects.

Keynote 3 Speaker

Professor Sarah Sharples

Professor of Human Factors

Chief Scientific Adviser, Department for Transport

University of Nottingham, UK

Sarah leads research into how we can incorporate the requirements and capabilities of people She led the DigiTOP project that explored how sensing technologies can be used to understand human-technology collaboration in manufacturing, and leads the multidisciplinary Connected Everything network, that brings together researchers to innovate and propose new approaches to accelerate development and adoption of digital manufacturing.

Sarah is also the Chief Scientific Adviser for the Department for Transport, where she brings independent challenge and advice to the department and across government to help ensure that science, engineering, technology and innovation research and development informs the development of policy and transport systems.

Keynote 4 Speaker

Professor Ashutosh Tiwari

RAEng/Airbus Chair in Digital Manufacturing

Faculty Director of Research and Innovation – Engineering

University of Sheffield, UK

Professor Ashutosh Tiwari (PhD CEng FIMechE FIET) holds the prestigious RAEng/Airbus Research Chair in Digital Manufacturing at the University of Sheffield. He is also the Faculty Director of Research and Innovation for Engineering at the University of Sheffield. Internationally renowned for research in digital manufacturing, he is Sheffield Lead of £7mn Made Smarter Research Centre for Connected Factories, Deputy Director of £20mn EPSRC Future Electrical Machines Manufacturing Hub, and serves on the EPSRC Strategic Advisory Team (SAT) for Manufacturing.

With over 22 years of experience, he has a track record of leading cross-TRL projects worth over £15mn apportioned income through funding from EPSRC, RAEng, Innovate UK, ATI, AMSCI, KTP and industry, produced 343 publications (155 journal and 133 conference papers, h-index 38, citation count over 9,000), graduated 36 PhDs, and was awarded an EPSRC HVM Catapult Fellowship. He is an Associate Editor of 'AI for Engineering Design, Analysis and Manufacturing Journal' (Cambridge University Press), serves on the Editorial Board of 'Journal of Engineering Manufacture' (IMechE), and has served as Survey/Review Article Editor of Applied Soft Computing Journal (Elsevier).

This talk will focus on the development and application of novel digitalisation techniques for skill-intensive tasks in smart industrial systems. The simultaneous tracking of human actions and the effect of those actions on the workpiece(s) during a manual task and the digitalisation of this real-time knowledge will be demonstrated in this talk using a gaming interface technology. The main steps in this research are the spatio-temporal segmentation of the captured continuous digital data into human and workpiece states and the subsequent human-workpiece state interaction modelling. These steps enable deeper investigation of manual tasks, paving the way for in-process monitoring and intelligent automation support for skill-intensive manual manufacturing and maintenance tasks.

Workshops

Workshop 1: DoTES Programme Overview

Chair: Dr Andy Norton, Rolls-Royce Plc, UK
Time: Tuesday 8 November, 11:10 – 12.45

Session Summary:
As the aerospace sector strives to be more sustainable and cost effective, high-quality cutting-edge Research and Development is required in a variety of Through-Life Engineering disciplines. UK Government funded programmes such as DoTES (Digitally Optimised Through-life Engineering Services) are helping Rolls-Royce and BAE Systems become more effective and efficient in managing products. This session provides an overview of the DoTES programme and its consortium, with talks by Cranfield University and University of Cambridge on recent developments in cost modelling, degradation modelling, and logistics management.

Workshop 2: Inspection and maintenance for railway infrastructure

Chair: Professor Andrew Starr, Cranfield University, UK
Time: Tuesday 8 November, 15:35 – 17:15

Session Summary:
This session will showcase our work in

- railway robots and non-destructive testing (NDT)
- track design and monitoring.

Cranfield has undertaken a programme of work with partners in the EU Shift2Rail programme, including Network Rail, SNCF, Trafikverket, Strukton, and Chalmers University.

Provisional programme:

- Overview of session (Professor Andrew Starr, Dr Isidro Durazo Cardenas)
- Railway robots
- Navigation and location (Masoumeh Rahimi)
- Robot task actuation and simulation (Miftahur Rahman)
- Track testing: Ultrasonics automation (Dr Feiyang He)
- Vehicle automation, sensing and test (Prof Andrew Starr, Ade Ishola, Li Jian)
- Track design & modelling: Switches and crossings (S&C) advances (Dr Lawrence Tinsley)
- Q&A

Workshop 3: TES Panel Discussion – Emerging Challenges and Opportunities for digitalisation in Through-Life Engineering Services

Chair: Professor John Erkoyuncu, Cranfield University, UK

Time: Wednesday 9 November, 09:05 – 10:35

Session Summary:

Digitalisation is a hot topic across high value asset driven industries. There seem to be so many technologies, and approaches out there. But, where do you start if you are an SME, or a large company alike? Can it offer you benefits, or is it just a waste of money? Do you focus on skills development, or do you outsource it? This panel discussion will focus on a discussion about what could the role of digitalisation be for through-life engineering services (TES). As part of the discussions, we will be discussing questions such as: How can digitalisation contribute to value creation? Can it improve supply chain integration? Could there be better life cycle designs? Will we have a better chance at balancing supply and demand? Can we improve on our chances on delivering on sustainability targets? How can we enable effective adoption of digital technologies and processes?

We have structured the session to include 5 minute introductions from each of our panel members to set the scene for the topic. Thereafter we will initially ask our set questions as outlined above. Subsequently, we will open it up for the audience to ask the key questions that they would like answered.

Workshop 4: NUST Tutorial - Leveraging the Power of AI & Data Science for Decision Making in Manufacturing

Chair: Professor Usman Qamar, National University of Sciences and Technology (NUST), Pakistan

Time: Wednesday 9 November, 13:30 – 14:50

Session Summary:

To fully leverage the value contained in data, one needs to bring Artificial Intelligence (AI) into play. The impact of AI on the global GDP is expected to be USD 16 trillion. No longer are AI and Data Science confined to pure tech; they now have an impact on the whole of society. We are in the process of evolving from data-driven to AI-driven workflows. The difference between "Data-driven" and "AI-driven" isn't just semantics. Each term reflects different assets. Data holds the insights that can enable better decisions, however, to make sense of data we require machine learning and deep learning algorithms. From core concepts to case studies, this workshop will provide an insight into why Data science and AI technologies are considered to be the most disruptive technologies of this century and how they can be used in various domains of manufacturing from predictive maintenance to forecasting the remaining useful life of the equipment as well as demand forecasting to improve supply chain efficiency. And finally, we shall look at some of the challenges and pitfalls of AI adoption in manufacturing.

Detailed Programme

The conference will be held at the Atrium in CMRI Gallery, Building 38.

Day 1 - Tuesday, 8 November 2022

08:30 - 09:00 Registration

09:00 - 09:10 Chair Welcome – Professor John Erkoyuncu, Cranfield University, UK

09:10 - 09:15 Welcome to Cranfield – Professor Dame Helen Atkinson, Pro Vice Chancellor, Cranfield University, UK

09:15 - 09:20 Manufacturing and Materials at Cranfield University – Professor Mark Jolly, Cranfield University, UK

09:20 - 09:30 Conference Overview – Dr Gustavo Castelluccio, Programme Chair TESConf2022, Cranfield University, UK

09:30 - 10:10 **Keynote 1:** ***Service System Secrets (Atrium)***
Steve Gregson, Rolls Royce Plc, UK

10:10 - 10:50 **Keynote 2:** ***Design Guidelines towards Absolute Sustainability for technical Product-Service Systems (Atrium)***
Professor Jan Aurich, Technische Universität Kaiserslautern, Germany
*(Jan Aurich, Max Werrel and Moritz Glatt***)**

10:50 - 11:10 **Break**

11:10 - 12:45 **Workshop 1: DoTES Programme Overview** ***(Atrium)***
Chair*:* Dr Andy Norton, Rolls-Royce Plc, UK

12:45 - 13:55 **Lunch**

13:55 - 14:35 **Keynote 3:** ***Designing digital manufacturing technologies for people – a whole systems perspective (Atrium)***
Professor Sarah Sharples, University of Nottingham, UK

14:35 - 15:15 **Keynote 4:** ***Digitalisation of Skill-Intensive Manufacturing and Maintenance Processes (Atrium)***
Professor Ashutosh Tiwari, University of Sheffield, UK

15:15 - 15:35 **Break**

15:35 - 17:15 **Workshop 2:** ***Railway inspection, repair and design (Atrium)***
Chair: Professor Andrew Starr, Cranfield University, UK

15:35 – 15:45 Overview of session, Prof Andrew Starr

15:45 – 16:00 Railway robots: Navigation and location, Masoumeh Rahimi

16:00 – 16:15 Robot task actuation and simulation, Miftahur Rahman

16:15 – 16:30 Track testing: Ultrasonics automation, Dr Feiyang He

16:30 – 16:45 Vehicle automation, sensing and test, Prof Andrew Starr, Ade Ishola, Li Jian

16:45 – 17:00 Track design and modelling: Switches and crossings (S&C) advances, Dr Lawrence Tinsley

17:00 – 17:15 Q&A

17:15 - 17:30 Summary and Close of Day 1

18:45 - 22:00 Drinks Reception followed by Dinner

Day 2 - Wednesday, 9 November 2022

09:00 - 09:05 Opening – Dr Pavan Addepalli, Organising Chair TESConf2022, Cranfield University, UK

09:05 - 10:35 **Workshop 3: TES Panel Discussion**
Chair: Professor John Erkoyuncu, Cranfield University, UK

10:35 - 10:55 **Break**

10:55 - 12:35 **Academic Session 1 (Atrium) - Digitalisation**

10:55 – 11:15 Experimental spaces for the introduction of disruptive technologies in production
Björn Papenberg, Sebastian Hogreve and Kirsten Tracht

11:15 – 11:35 Developing an ontological framework for effective data quality assessment and knowledge modelling
Christina Latsou, Marta Garcia I Minguell, Suresh Landon-Valdez, Roger Orteu I Irurre, Martinmark Palmisano, Ayse Nur Sonmez, John Ahmet Erkoyuncu, Pavan Addepalli, Jim Sibson and Olly Silvey

11:35 – 11:55 A Framework for Constructing a Common Knowledge Base for Human-Machine System to Perform Maintenance Tasks
Haoxuan Deng, Samir Khan and John Ahmet Erkoyuncu

11:55 – 12:15 Medical 4.0: A Review of Malaysian Medical Facilities Waste Management Systems
Nurul Mohamed, Samir Khan and Sandeep Jagtap

12:15 – 12:35 **[Online]** ICT infrastructure supporting seamless integration of certification procedures in microfactories
Pietro Perlo, Andre Rocha, Duarte Alemao, Nelson Freitas, Fabio Oliveira

10:55 - 12:35 **Academic Session 2 (Meeting Room 1) – Maintenance**

10:55 – 11:15 **[Online]** Exploring product-service system innovation opportunities through the perspective of systemic rebound-effect
Salman Alfarisi, Yusuke Tsutsui, Hanfei Wang, Yoshiki Shimomura and Yuya Mitake

11:15 – 11:35 **[Online]** A modification of P-diagram for the design of robust product service system
Hanfei Wang, Yuya Mitake, Yusuke Tsutsui, Salman Alfarisi and Yoshiki Shimomura

11:35 – 11:55 Moment-Based Analysis for Brain Tumor Health Monitoring
Barmak Honarvar Shakibaei Asli and Yuhan Wang

11:55 – 12:15 Track geometry deterioration modelling for asset management: A visual analytics approach
Abdulaziz Alotaibi, Isidro Durazo Cardenas, Bernadin Namoano and Andrew Starr

12:15 – 12:35 Metrological characteristics of an on-machine tool optical measuring system
Amrozia Shaheen, Giuliano Bissacco, Klaus Liltorp, Ivan Nedrehagen, Øystein Svinning, Nicolaj Elias Nielsen and Christian Wissing Kruse

12:35 - 13:30 Lunch

13:30 - 14:50 Workshop 4: NUST Tutorial (Atrium)
Chair: Professor Usman Qamar, NUST, Pakistan

13:30 - 14:50 Academic Session 3 (Meeting Room 1) – Materials

13:30 – 13:50 Surface analysis of conversion coating of ASTM A 516
Muhammad Ali Khan, Aqueel Shah, Adeel Yusuf and Salman Nisar

13:50 – 14:10 On the undulatory behaviour of metallic glass foils: A novel spring-type behaviour
Osama Shahin Elzoubi, Nikolaos Panagiotopoulos, Martin Stiehler, Konstantinos Salonitis and Konstantinos Georgarakis

14:10 – 14:30 Performance evaluation of Cu-Ni 90/10 alloyed structures exposed to various seawater compositions and their remaining service
Muntazir Abbas, Syed Ali Sarfraz, Shoaib Sarfraz and Farhan Ashraf

14:30 – 14:50 Estimation of Thermal Barrier Coating Fracture Toughness Using Integrated Computational Materials Engineering
Xibo Geng, Richard Wellman, Luis Isern Arrom, Christine Chalk and Gustavo M. Castelluccio

14:50 - 15:10 Break

15:10 – 16:30 Academic Session 4 (Atrium) - Manufacturing

15:10 – 15:30 Specific cutting energy analysis of turning Ti-6Al-4V under dry, wet and cryogenic conditions
Muhammad Ali Khan, Syed Husain Imran Jaffery, Aamer Ahmed Baqai and Mushtaq Khan

15:30 – 15:50 Human behaviour modelling for digital twin in human-robot collaboration – state of the art
Guoyi Xia, Zied Ghrairi, Aaron Heuermann and Klaus-Dieter Thoben

15:50 – 16:10 **[Online]** Product-Service System integration framework design for Train Braking Systems
Bongani Trevor Shihundla, Khumbulani Mpofu and Olukorede Tijani Adenuga

16:10 – 16:30 **[Online]** Development of Bio-Based Cutting Fluid from Roselle Oil with Titanium Dioxide Nano Additive for CNC Machine Turning Operation
Mohammed Sani Haruna, Kaisan Muhammad Usman and Muhammad Ibrahim Kawule

15:10 - 16:30 Academic Session 5 (Meeting Room 1) - Maintenance

15:10 – 15:30 **[Online]** Improving maintainability of the battery storage system in Electric Aircrafts
Ashrith Jain, Alberto Martinetti and Leo van Dongen

15:30 – 15:50 Demonstration of an autonomous ultrasonic testing concept for rail flaws inspection
Feiyang He, Isidro Durazo-Cardenas, Haochen Liu, Miftahur Rahman, Masoumeh Rahimi, Andrew Starr and Michael Poulter

15:50 – 16:10 Through-transmission pulsed thermography, a review of the state-of-the-art
Zain Ali, Sri Addepalli and Yifan Zhao

16:10 – 16:30 Preventive Maintenance of Materials
Farhan Ashraf, Arijit Lodh and Gustavo M. Castelluccio

16:30 - 16:45 Closing Ceremony and Awards Presentation (Atrium)

Committees and Chairs

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John Erkoyuncu, Cranfield University, UK

Programme Committee

Gustavo Castelluccio (Programme Chair), Cranfield University, UK
Pavan Addepalli (Local Organising Chair), Cranfield University, UK

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This conference is organised by the:

The Manufacturing theme (led by the Centre for Digital Engineering and Manufacturing and the Centre for Life-cycle Engineering and Management), Cranfield University, Cranfield, Bedfordshire, MK43 0AL, UK

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