

Cranfield
UNIVERSITY

Advances in Manufacturing Technology XXVII

Proceedings of the 11th International Conference on Manufacturing Research

Incorporating the 28th National Conference on
Manufacturing Research

Essam Shehab. Peter Ball. Benny Tjahjono
Editors



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Dr Essam Shehab, Dr Peter Ball and Dr Benny Tjahjono

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Cranfield
Bedfordshire
MK43 0AL
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ISBN 978-1-907413-23-0 ISSN 2053-3373 Cranfield University Press

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11th International Conference on Manufacturing Research

19th - 20th September 2013

Organised by
Cranfield University

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Foreword

The International Conference on Manufacturing Research is a major event for academics and industrialists engaged in manufacturing research. Held annually in the UK since the late 1970s, the conference is renowned as a friendly and inclusive environment that brings together a broad community of researchers who share a common goal; developing and managing the technologies and operations that are key to sustaining the success of manufacturing businesses.

For over two decades, ICMR has been the main manufacturing research conference organised in the UK, successfully bringing researchers, academics and industrialists together to share their knowledge and experiences. Initiated a National Conference by the Consortium of UK University Manufacturing Engineering Heads (COMEH), it became an International Conference in 2003.

COMEH is an independent body established in 1978. Its main aim is to promote manufacturing engineering education, training and research. To achieve this, the Consortium maintains a close liaison with government bodies concerned with the training and continuing development of professional engineers, while responding to the appropriate consultative and discussion documents and other initiatives. COMEH is represented on the Engineering Professor's council (EPC) and it organises and supports national manufacturing engineering education research conferences and symposia.

The host universities for National Conference on Manufacturing Research (NCMR) have been:

1985	Nottingham	1994	Loughborough
1986	Napier	1995	De Montfort
1987	Nottingham	1996	Bath
1988	Sheffield	1997	Glasgow Caledonian
1989	Huddersfield	1998	Derby
1990	-	1999	Bath
1991	Hatfield	2000	East London
1992	Central England	2001	Cardiff
1993	Bath	2002	Leeds Metropolitan

In 2002 the conference was accorded the title International (ICMR) to reflect the current trends in manufacturing engineering and to promote the exchange of research and engineering application experiences internationally. The ICMR, has since its introduction, incorporated the NCMR. The 11th ICMR incorporates the 28th NCMR. The host universities for ICMR have been:

2003	Strathclyde	2009	Warwick
2004	Sheffield Hallam	2010	Durham
2005	Cranfield	2011	Glasgow Caledonian
2006	Liverpool John Moores	2012	Aston
2007	De Montfort	2013	Cranfield
2008	Brunel		

Acknowledgements

On behalf of the ICMR2013 organising committee, first and foremost we would like to thank COMEH for inviting Cranfield University, once again, to host the ICMR2013. We would also like to take the opportunity to thank all of the contributing authors for their high quality of papers submitted, the reviewers for their time and constructive comments, the keynote speakers for sharing their experiences to the delegates and the local organising committee for their meticulous preparation of the conference.

Special thanks go to Kostas Salonitis and Isaac Sanya for their help in editing the papers. Last but certainly not least, we are most grateful with the administrative support provided by Ellie Collins and Teresa Bandede.

This year, ICMR2013 takes place on the 19-20 September 2013 at Cranfield University. The conference focuses on any aspects of product development, manufacturing technology, manufacturing systems, information systems and digital technologies. It provides an excellent avenue for researchers to present state-of-the-art multidisciplinary manufacturing research and exchange ideas. In addition to the 4 keynote speeches and 3 invited presentations, there are 107 papers in these proceedings. These papers are split into 24 technical sessions.

We look forward to welcoming you to an exciting and lively conference!

Essam Shehab, Peter Ball and Benny Tjahjono
Editors

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