Institution: Liverpool John Moores University
Unit of Assessment: UoA 12
a. Context

This submission is from a unit consisting of LOOM (Liverpool Logistics, Offshore and Marine Research Institute) and MEMARC (Mechanical Engineering and Materials Research Centre) within the School of Engineering, Technology and Maritime Operations. Impact-generating activities have been conducted in the two groups' main research areas. The Unit's local industrial advisory committee consists of eight members involving representatives from bodies including Lloyds Register. The Unit also has an international industrial advisory committee of ten members including ones from China, Greece and USA. The members of these two committees were mainly selected from those having collaborations with the LOOM and MEMARC members through both completed and on-going research projects. Some key relevant organizations were involved in the nomination of committee members. Members from both committees are informed about the Unit's research outputs and are also involved in providing impact-generating suggestions on a biannual basis.

The industrial beneficiaries of LOOM's research include ship/offshore operators, risk assessment consulting companies, classification societies, regulatory bodies, public services, port terminals and other maritime logistics organisations. LOOM has worked closely with its industrial partners to develop its research impact. For example, since 2009 LOOM has been in partnership with Portia for developing consulting businesses in the port industry mainly in the Gulf region (e.g. Saudi Arabia). Examples of the main types of impact specifically relevant to LOOM's research are in areas of risk-based decision making in offshore design through collaboration with the HSE; maritime risk and reliability assessment with Shanghai Pilot Station; risk-based design and operational rule development with Maritime & Coastguard Agency; and optimisation of port terminal operations in collaboration with the Oostende Port.

The industrial beneficiaries of MEMARC's research, covering the three main streams in mechanics, materials and process control, include material producers, machinery manufacturers, energy companies, engineering consulting companies, sports equipment manufacturers and NHS services. MEMARC has worked closely with industrial partners to develop its research impact with both national and international beneficiaries. Examples of the main types of impact specifically relevant to MEMARC's research are in areas of materials characterisation in collaboration with Unilever; integrated materials modelling and product development with sports footwear manufacturers such as ANTA; ultrasonic non-destructive examination of strongly anisotropic steel weldments in collaboration with Serco Assurance Ltd; and control of engine systems through joint research projects with BMW E30 Munich.

The Unit's members have been encouraged by the School to participate in regional, national and international advisory/rule making/consultation committees. For example, Wang has been a member of the International Maritime Organization's Formal Safety Assessment Experts Group since 2009.

b. Approach to impact

Impact-generating activities have been facilitated with full support at both the School and University levels. Close involvement with the Unit's local and international industrial advisory committees has led to a clear emphasis on the approach to impact by the members of the Unit. While the members included in this submission have actively expanded their existing impact generation, much effort has been made in developing new industrial impact in both traditional research areas and some emerging research areas (e.g. sports materials). For example, LOOM has enhanced the interaction for producing industrial impact with organisations such as the HSE and Shell Global Solutions. An example of developing new relationships with industrial users is the partnership with Risktec Solutions Ltd. The partnership with Risktec Solutions Ltd in the areas of risk assessment started through a KTP project in 2008 (I. Jenkinson, £123k, 2008-2010). After winning the best North West KTP in 2011, the project has eventually led to a successful training business launched with a significant turnover (i.e. £1.2m of new businesses from 2011 to 2012) to Risktec Solutions Ltd mainly from overseas clients. To further develop this partnership, an industrial lectureship post 50% funded by Risktec Solutions Ltd and 50% by the University has been established since January 2013. The appointed industrial lecturer, Matellini is submitted as an ECR in this submission, has spent and will continue to spend

50% of his time in Risktec Solutions Ltd to exploit further impact-generating opportunities. Over the assessment period, the Unit has undertaken another 5 KTP projects with Reed Ltd, Vista Panels Ltd, Delta Fluid Products Ltd, Northstone Ltd and Cubis (two of which won the Best EPSRC funded Partnership Award 2009 and the Business Leader of Tomorrow Award 2009 respectively).

The Unit has taken every possible opportunity to increase its industrial impact. For example, X. Ren has completed an industrial secondment of 12 months (3 days per week) at Serco Technical Services through financial support from RAEng over the assessment period. MEMARC has successfully expanded its research into some emerging areas, such as health care and sensors with application to SMEs through industrial case projects. For example, the enterprise project with ANTA has developed a new sports footwear design with improved safety performance.

The members submitted in this unit have been given training from the School together with the University on how to achieve industrial impact through regular seminars (e.g. the Transport Knowledge Transfer Network scheme). Such professional training and education programmes have been reviewed on an annual basis taking suggestions from the industrial advisory committees. For example, acting on a suggestion by an industrial member from Peel Ports, we now ensure that our 3-D port simulation project takes into account the Liverpool 2 project's design plans. The Unit also has an agile approach to responding quickly to industrial needs. The two EPSRC case projects were developed with the help of the North West healthcare network and the electronics-enabled product KTN. The development of the automotive lab within the Unit has benefited from direct industrial input from Jaguar to provide research direction.

The University's Business Development Office provides support in business case preparation, intellectual property ownership and its protection, and spin-out company development. The Marketing and Corporate Communications Team is responsible for all aspects of marketing at a corporate level with respect to communication and media strategies for the key areas of growth identified in the University's Strategic Plan. The School has a designated Head of Enterprise (G. Colquhoun) responsible for exploitation of knowledge transfer opportunities in order to realise possible industrial impact. The School has a scheme dedicated to giving a commensurate reduction in teaching/administration duties to each academic member for industrial impact-generating activities. The School also has provided funds to support academic members for industrial visits for possible impact generation and for attending national and international sector conferences. The School has covered the annual membership subscription for four professional groups (e.g. Mersey Maritime Group representing the maritime cluster of more than 1,700 businesses). Furthermore, the Unit has organised impact-generating workshops with invited industrial specialists specifically for a purpose. For example, LOOM, with the financial support of £4,720 from the RCUK Global Uncertainties Impact Support Fund, organised a research impact-generating workshop on maritime security (20 external attendees) in February 2013. J. Wang and Z. Yang, jointly with Liverpool University, organised a Liverpool-Shanghai Symposium on Maritime Logistics (120 industrial attendees) in Shanghai, 18th-19th August 2010 with financial support of £24k (£12k to Wang & Yang, EP/I004947/1, 2010) from the EPSRC. This event provided a good opportunity for LOOM's research outcomes to be used in industry.

The Unit has been operating monthly research seminars since 2010 with a number of industrial specialists having been invited depending on the theme. Industrial speakers make presentations at such monthly seminars on a regular basis (e.g. Laidlaw, Maersk Line Manager) to compliment the discussions of on-going research. The Unit, along with the School, has been leading the development of research/industrial practice informed teaching/learning activities such as the 'Design Week' (2 weeks per semester) during which leading industrial speakers have been invited to visit the School to give industrial lectures on current industrial needs and practice.

c. Strategy and plans

The Unit formalised its strategy for achieving impact in 2008 building upon active knowledge transfer to industry over the past two decades. The overall aim of the Unit's strategy is to encourage all members in the Unit to be involved actively in impact-generating activities. The objectives of the strategy that have been achieved over the assessment period are 1). engaging industrial partners in the Unit's research activities; 2). supporting financially impact-generating activities such as field trips for knowledge transfer; 3). having industrial secondments by the academic members and to host industrial specialists for building partnerships, and 4). prioritising areas for knowledge transfer. LOOM

focuses on maritime safety and security assessment, ship operations, sustainable maritime logistics and optimisation of port terminal operations. MEMARC's priority of impact-generating activities lies in areas of fault diagnosis of engineering systems, design mechanics and new materials application. The School Management Committee ensures that the aim and objectives of the strategy for impact generation are achieved. Each year one or more of the Unit's members have been and continue to be supported either by internal or external funds for industrial secondment of one to six months for impact-generating purposes. The Unit's possible impact-generating activities are co-ordinated by Jenkinson and X. Ren, with due regard to any overlap between the areas of the two groups (e.g. safety issues associated with use of different materials).

The Unit utilises a list of industrial organisations to prioritise collaboration that will leverage the greatest impact. This list is managed by the School's designated Head of Enterprise, but is compiled through a variety of sources, including the two industrial advisory committees. This list has been updated on an annual basis with each organisation having a designated contact. Although the majority of such organisations are local or within the UK, the international element is integrated into the research projects' impact-generating plans. For example, maritime safety related impact-generating activities have been and continue to be conducted internationally with industrial organisations because on-going collaboration and ship operational activities largely take place in the Far East. MEMARC has put much effort and continues to achieve industrial impact in areas of new materials applications using the already formulated links with some organisations in the Far East and also recognising the fact that manufacturing centres involving the use of those new materials are outside the UK. The Unit has responded to changes in the global manufacturing industry to maximise research impact. For example, the research of MEMARC on crack resistant hard faced materials will continue to help the development of green manufacturing in China over a range of industries in particular in mining and iron/steel sectors.

d. Relationship to case studies

The two Impact Case Studies selected in this submission exemplify the impact-generating activities of both LOOM and MEMARC. The University and the School have been fully behind the involved members in these cases through the reduction of teaching/administration duties, provision of staff support, co-ordination of the available expertise/resources within the institution and provision of the necessary financial support for attending the impact-generating activities. The two submitted Impact Case Studies are completely in line with the School's and Unit's strategy for impact. The Unit is expanding possible industrial impact in the areas of the two submitted Impact Case Studies, based on current achievements and also taking into account other potential market opportunities. The Unit's target is that in each of the prioritised areas described above, there will be a solidly formulated partnership with industry.

Impact Case Study 1 (ICS1) from LOOM has been associated with several organisations with which collaboration has been formulated over the past decade with financial support from many funding sources. Many of those grants (e.g. five consecutive standard EPSRC grants with Wang as PI since 1998) obtained since the late 1990s required collaboration with industrial partners, partially leading to such industrial impacts. The momentum of generating industrial impact has been increasing since the late 2000s as many of the research results in risk and security analysis started to mature for possible industrial application. Collaboration with more overseas organisations has also increased the international reach of industrial impact. The main outcomes of impact-generating activities in ICS1 include increased profit through helping develop new business, better informed changes of regulations by regulatory bodies, improved performance of ship operations, and reduction of potential risks in safety critical situations.

Impact case study 2 (ICS2) from MEMARC has been developed with a clear application focus or involvement of industrial partners either in the UK or internationally. The work in materials characterisation was developed recently through several research projects with support from the EPSRC, NHS and industry. The work in materials characterisation has acted as a pivoting point for the integration of materials, design, and modelling and led to several successful multidisciplinary product development projects. The work in developing hard-facing materials is based on long life basic materials and structural integrities research over the past ten years. New material developments have benefited from systematic computational modelling and structural integrity studies. The main impact outcomes of ICS2 include new material development and applications, new sports shoe designs and new welding wire development.