

Reading Innovative Construction Research Centre

Key Facts	
Time Period	Phase 1 (2002-2007), Phase 2 (2006-2011) 9 Years total duration
Total Value of EPSRC Grant	£6.23m total over two phases
Other Funding <i>(Direct leverage of additional research funding specific to IMRC)</i>	£6.7m total , of which <ul style="list-style-type: none"> • £3.0m - Research Council (non-IMRC) • £3.7m - Private sector and Industry Groups
Projects funded to Date	35
Current Staff (IMRC-funded)	30 in total (12 academics, 16 PDRs, 2 support staff)
PhD Students	40 current + 31 completed from 2003 onwards <i>(funded by IMRC grant / supervised by IMRC staff)</i>
IMRC journal publications	90
Patents granted	0
Key Sectors of Focus	Construction
Current Research Themes / Specialisms	<ul style="list-style-type: none"> • Through-life management and innovation • Competitiveness, Productivity & Performance • Innovative Procurement
Examples of impact	<ul style="list-style-type: none"> • Leverage of additional research income • Inputs into a number of best practice standards on tendering and consortia – which will ultimately improve competitiveness within the construction sector • Inputs into government policy (OFT) on bid rigging - which will ultimately improve competitiveness within the construction sector • Inputs into the UKTI Export Strategy – which could potentially support an increase in UK Construction sector exports • Potentially reducing the costs of tendering within the construction sector. DTZ estimate that a 1% reduction in the cost of tendering would translate into a £6 million - £36 million cost saving per annum across the construction sector.
Examples of value added by IMRC model	<ul style="list-style-type: none"> • High level of industry engagement – leading to industry relevance of research • High level of engagement with policymakers • Coherent research strategy – supporting the development of critical mass and improvements in efficiency • Longevity of model – supporting long term investment in human capital • Strong governance structure – ensuring projects are high quality and of industry relevance • Grand Challenge projects supporting cross-institution working

Introduction and Overview of IMRC

The construction sector is a significant sector of the UK economy, generating annual output in 2009 in excess of £110 billion, and exports of £5 billion per annum. Current trends in the sector include increasing globalisation of value chains, and a shift from traditional approaches towards product-service systems. Similarly, a number of changes have impacted construction professional services (CPS) exports. Globalisation has opened up some markets and changed others. It has altered the way in which business is undertaken with the rapid growth of information and communication technologies. It has made parts of the world more connected and interdependent. This has led to change in the methods of procurement and the methods of working in the construction industry over the last decade with increasing numbers of joint ventures with overseas companies, partly as a result of the need to internationalise, but also because the nature of procurement is changing and the need to share risk.

The vision of the Reading ICRC is to be a world-class research centre supporting a globally competitive UK construction sector that competes on the basis of knowledge, advanced technology and through-life value creation. Reading ICRC takes a broad view of 'construction' including on-site production together with a dispersed network of other value-adding activities that evolve throughout the whole life of buildings and built infrastructure, together with architecture, and engineering. The translation of 'high value manufacturing' into the construction sector is at the heart of the guiding vision and research strategy of the ICRC.

The ICRC was established in 2002 with an initial grant of £2.5 million. The creation of the ICRC built on several existing projects at the University of Reading under the Innovative Manufacturing Initiative (IMI). The award was extended in 2006 for a further period of five years, with a grant of £3.73 million. In addition to its core activity, the ICRC is also a partner in the Health and Care Infrastructure Research and Innovation Centre (HaCRIC), which is a multi-institution IMRC involving Reading, Imperial College, Loughborough, and Salford).¹

The ICRC is based within the School of Construction Management and Engineering (SCME), which contains research expertise across a wide range of disciplines. This is one of the leading and largest faculties in the world dealing with the built environment, with 80 full-time members of academic staff. The school's construction management courses have expanded significantly in recent years, and attract a high proportion of international students. The school has links with other departments within the university such as: Law, Economics, Real Estate and Planning, Management, Psychology, Cybernetics, and Meteorology. In addition to the ICRC there are two other research divisions within the SCME – focusing on Sustainable Environments, and Innovative Technologies.

The ICRC is currently involved in 10 research projects (35 total to date), including involvement in the Through-Life Knowledge and Information Management Grand Challenge (jointly with 10 other UK universities).

IMRC Research Strategy

When the ICRC was established in 2002, the research was organised around six research themes as shown in the following table. These themes built on existing workstreams within the school – going back to the 1980s. As shown, over half of the research funding in Phase 1 was allocated to two themes – Integration of Design, Construction and Facilities Management; and Competitiveness,

¹ The activities and impact associated within HACRIC has not been considered within this review.

Productivity and Performance. The table also shows that the focus of the research is on management – with the exception of the ‘Innovation in through-life service provision theme which focused on design. There were a total of 15 projects in Phase 1.

	Total Number of Projects	Total EPSRC Funding (£)	Indicative % Design	Categorisation of research		
				% Techno- logies	% Manage- ment	
1 - Integration of design, construction and facilities management	4	£590,630	25%	0%		75%
2 - Competitiveness, productivity and performance	5	£374,159	0%	0%		100%
3 - Knowledge management and organisational learning	2	£317,356	0%	0%		100%
4 - Innovative procurement	2	£303,643	0%	0%		100%
5 - Human resource management and the culture of the industry	1	£118,577	0%	0%		100%
6 - Innovation in through-life service provision	1	£76,774	100%	0%		0%
Total Phase 1	15	£1,781,139	13%	0%		87%

An EPSRC panel review in 2003 identified the Innovative Procurement, and Competitiveness, Productivity and Performance themes as ‘Internationally Leading’ at the time. By the time of the 3rd year review in 2006, it was recognised that 6 themes was too many to achieve critical mass in any area, and the research strategy needed to be reconsidered to make it more coherent. The research strategy was reduced to three themes (theme 5 was absorbed into theme 2; themes 1, 3 and 6 were combined) as shown in the following table. The three themes were designed to be mutually-supportive, with extensive cross-connections.

The current themes can be summarised as follows:

- **Competitiveness, Productivity & Performance** – this focuses on techniques for performance improvement (process mapping, value management, risk management, and life-cycle costing); competitiveness and profitability within the marketplace. The approach of the centre is characterised by interdisciplinary research conducted in close collaboration with industry.
- **Through-life management and innovation** - this relates to the challenges faced by suppliers and service providers in responding to current trends in through-life procurement models (e.g. PFI/PPP), with a particular focus on the through-life interaction between technology and human activity systems.
- **Innovative Procurement** - this theme focuses on the extent to which procurement can be used to promote innovation; including consideration of the legal, economic and organisational aspects of procurement systems.

	Total Number of Projects	Total EPSRC Funding (£)	Indicative % Design	Categorisation of research % Technologies	% Management
Through-life management and innovation	10	£3,618,174	60%	0%	40%
Competitiveness, Productivity & Performance	6	£1,235,233	0%	0%	100%
Innovative Procurement	2	£300,382	50%	0%	50%
Total Phase 2	18	£5,153,789	39%	0%	61%

Comparing the two Phases, it is clear that overall research budget increased substantially – particularly within the first two themes. There was also a noticeable shift towards design research (13% of value in Phase 1 compared to 39% in Phase 2).

The centre's research focus spans 'upstream and 'downstream' research – i.e. combining the long-term development of theory and the knowledge-base, with the application of research to industry. The centre has been identified as an exemplar in terms of the 'co-production' of research with industry, due to its close relationships with industry partners which span across many projects. There has been an increasing focus within the industry and within the ICRC on technology use and on global projects – these areas are being targeted for current and future research within the centre.

ICRC Management

The ICRC is managed according to the following structure:

- The **Executive Steering Committee** provides input on policy and strategic direction. This is comprised by representatives from industry and the international research community, and meets on a bi-annual basis. The steering committee members frequently provide input into project proposals before they are approved; ensuring relevance and alignment of the research strategy to industry needs.
- The **Internal Management Board** takes responsibility for operational issues, and is comprised of six of the senior staff within the centre. The board meets on a quarterly basis and is responsible for the prioritisation of research within the centre.
- The **Centre Director** is Professor Stuart Green - who also leads on Reading's input into the KIM Grand Challenge project
- The ICRC also receives input on research themes and output quality from an **International Scientific Advisory Panel**. This ensures that the work of the centre remains internationally leading and does not become insular. The panel has no executive function, but acts as an impartial advisor.

The process for development and approval of research projects is as follows:

- Research project ideas are often initiated in conjunction with industry partners, often through industry fora and policy networks
- Proposals are then worked up by the relevant member of staff
- Proposals are critiqued through a 'peer review' process with at least three members of the management board
- Industry support is verified with formal letters of support. Firms in the construction sector generally have quite limited R&D budgets, and therefore often provide a significant input of resources in kind – e.g. data, access to senior staff
- Projects are then approved based on three criteria:

- Research quality
- Strategic fit with identified themes
- Contribution to current or future industry needs

In addition to funded projects, there are also three strategic research fellowships, where the focus is on 'seed corn' projects which could potential result in new research projects or even research themes:

- Dr Chris Harty - *Innovation and the Sociology of Technology*
- Dr Libby Schweber - *Mainstreaming Sustainability*
- Dr Dylan Tutt – *Methodological capacity building*

Economic Impact Analysis

Funding and Leverage

According to the data provided by Reading ICRC for this exercise:

- A total of £6.7 million (cash and in-kind contributions) has been provided by partners for research at the ICRC. Thus, for every £1 provided by the ICRC, £1.08 has been provided from other sources.
- The majority of these contributions (£3.7m or 55%) are from the private sector or industry groups.
- The remaining contributions are additional EPSRC grants – related to HaCRIC (£1.1 million), the Design Innovation Research Centre (£1.0 million), the KIM Grand Challenge (£520,000), and the 'Big Ideas' project (£237,000)

In addition to this, it is worth noting the considerable sums of money leveraged into the department from overseas students. The total amount of fees from overseas students (BSc, MSc, and PhD) within the ICRC amounts to at least £6.8 million.²

Human Capital

The ICRC has created and delivered human capital to the labour market in a number of ways, as follows:

- The centre currently employs 30 staff (12 academics, 16 PDRs, 2 support staff)
- The ICRC has trained a total of 71 PhD students (40 current plus 31 completed from 2003 onwards)
- ICRC staff have contributed towards enriching the student experience at all levels, including creating links to the doctoral training centre within the department.
- The continuity of the ICRC model has allowed significant investment and development of staff within the centre. The ICRC has facilitated the recruitment of eight permanent academic staff, plus there are five instances of Research Assistants progressing to lectureships within the centre.
- Human capital is transferred to industry through collaboration with companies, and the application of knowledge to commercial situations.
- There is also a direct transfer of human capital through recruitment - the following table shows that 24% of former staff and students are now in industry, with the majority of the remainder in academia.

² This comprises £5.7 million of income from overseas BSc and MSc students since 2004/05, plus £1.1 million of income from overseas PhD students since 2002.

Approximate proportion of former staff/researchers in:	
Academia	72%
Industry	24%
Government	4%

Impact Case Studies

Three case studies have been selected by DTZ in conjunction with IMRC and EPSRC to illustrate the economic impact of research funded through the ICRC, as shown in the table below. These case studies have been selected on the basis of the agreed shortlisting criteria, as follows:

1. **Demonstrates a range of types of economic impact as defined by BIS** – the case studies selected demonstrate Improvements to Existing Businesses and Improvements to Public Policy/Public Services – which are typical of the types of impacts resulting from ICRC projects.
2. **Demonstrate the added value of the IMRC model** – the case studies highlight a number of added value features of the IMRC model such as high levels of collaboration with industry, other UK institutions, and government; and critical mass.
3. **Coverage of the different research themes within the IMRC** – the case studies cover all three of the current research themes.
4. **Sector coverage** – this IMRC is only focusing on Construction

Overall, the selection of case studies is typical of the types of work which the ICRC is engaged with, whilst focusing on the examples which demonstrate significant impact and added value. The Procurement case study reflects a continuous sequence of research projects, largely focused around one key individual – Professor Will Hughes.

Case study	BIS Impact Headings	Added Value aspects	IMRC research theme	Sector
Through Life Knowledge and information management grand challenge project: Dynamics of knowledge capture	Improve existing businesses (competitiveness)	Grand challenge project – critical mass Inter-university collaboration High level of industry engagement	Through-life Management and Innovation	Construction
Procurement & input on building standards	Public service aspect (government efficiency savings)	Collaboration with government (OGC and NAO)	Innovative Procurement	
Competitiveness and export performance	Informing public policy (UKTI export strategy)	Collaboration with major construction and professional service companies to improve export performance	Competitiveness, Productivity and Performance	

Discuss here how the selection fits with the broader suite of projects / impacts covered by the IMRC – e.g. how do they fit with research themes; are these projects typical or atypical of the IMRC; were they part of a strategic whole or serendipitous.

Added Value of the IMRC Model and Impact Optimisation

The ICRC model demonstrates a number of features which add value compared to other research funding models such as responsive mode research:

- **Industry engagement and ‘Co-production’ of research** – Reading ICRC has a high level of engagement with industry, which is a requirement of the IMRC funding model. Engagement includes collaborating with the professional institutions and governmental bodies that play an important role in setting standards and disseminating best practice across the sector. These deep and long-running relationships have led to a ‘co-production’ model of research. Reading ICRC is frequently cited as an example of best practice in co-production of research, and connectivity and interaction with industry.
- **Quality and Industry Relevance** of research is ensured by the input from the Steering Committee and International Advisory. The model adopted has guided Reading ICRC towards research which is internationally leading and relevant.
- Publication in internationally recognised journals provides **validation of the quality of output**, as well as ensuring the research reaches a global audience.
- The ICRC has developed a **coherent research strategy** with clearly defined research themes, which has created **greater critical mass and efficiency** compared to previous funding models. The centre is more coherent than previously, with more interaction, communication and cooperation between individual researchers and through collaborative working with other institutions. The model also creates greater efficiency due to the removal of duplication in industry interaction.
- The ICRC model has allowed greater **long-term investment in human capital** due to the certainty and longevity of funding. Appointments within the ICRC have been made on the basis of the overall research strategy, rather than fit with individual projects (e.g. Dr Chris Harty recruited to develop new research activity related to Innovation and the Sociology of Technology; Dr Libby Schweber who has developed research capabilities in Mainstreaming Sustainability; and Dr Dylan Tutt has been recruited to develop the Centre’s capacity regarding research methodologies). The ICRC has also facilitated the recruitment of six other permanent academic staff, which has led to better dissemination of the results into the teaching and short course programmes.
- The ICRC has a **strong governance structure**, which ensures that research projects are of a high quality, rigorously peer reviewed, and of industry relevance.
- The ICRC has been involved in a number of **multi-institution projects** (e.g. HaCIRIC, KIM Grand Challenge) which have fostered greater levels of **communication and cooperation between institutions and with industry**. This model has led to some interesting new linkages between industry partners which are unlikely to have occurred otherwise – for example, the cross-industry comparisons made within the KIM Grand Challenge project have forged linkages between firms in completely different sectors.

Nelson Ogunshakin OBE, Chief Executive of the Association for Consultancy and Engineering(ACE) and a collaborator on the Competitiveness Case Study below, commented that *‘the value of the research was in the way it combined theoretical knowledge with practical application; providing independent insights cutting across the entire construction sector. This was support by the collective approach of the ICRC.’* Nelson Ogunshakin OBE is also a member of the ICRC’s steering committee, and commented that *‘with the support of the ICRC, the construction industry now has a clear Roadmap for industry focused research. The beauty of the ICRC programme has been the way it has combined theoretical knowledge with providing industry-focused insights.’*

Case Study 1: Through-Life Knowledge Information Management – Grand Challenge

Key Facts	
Time Period	2005 – 2009
ICRC Funding	£105,940
Other Funding	EPSRC - £519,808
Collaborator(s)	Project undertaken in collaboration with 10 other universities and 40 industrial collaborators. Key partners at Reading ICRC included ABB, Balfour Beatty, Bovis Lend Lease, Halcrow, Max Fordham, Skanska, and Rolls Royce.
ICRC Research Theme	Through-life management and innovation
Research Output	Best practice guidance Recommendations on decision support models and practical implementation of state of the art practices and technologies 54 journals plus more than 150 additional publications (across whole KIM project)
Pathway to Economic Impact	Via collaborators – the research will be taken forward through application of knowledge and learning within industry
Actual Economic Impact	
Potential Economic Impacts	<ul style="list-style-type: none"> • Contributing to an increase in the efficiency of firms • Contributing to creating competitive advantage which leads to an increase in turnover • Developing capacity and networks between institutions and industry
Sector Focus	Construction

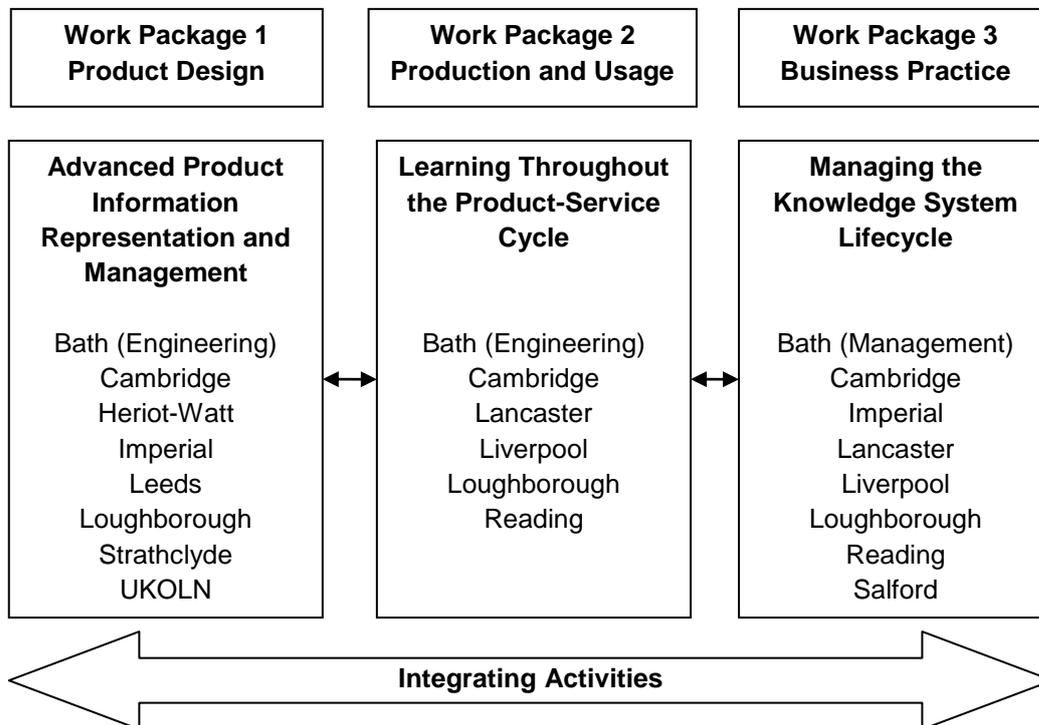
Context

The design, manufacture and operation of complex engineering products and construction projects uses and generates a vast amount of data and information. When the product has a long life span (e.g. 30 + years) there is a need to collect and maintain this information to facilitate high quality customer service and future product development. However, information is often stored across a number of media (e.g. note books, emails, databases, design programmes etc) and the rapidly changing nature of the information technology used to create and store the information brings further challenges for making knowledge and information available to operators, maintainers and designers over a long period of time. These issues are particularly relevant in the construction sector, where PFI/PP projects are often of a very long duration; and construction firms often have a strong divisional structure which limits internal information sharing.

The Grand Challenge Project

The KIM Project (Immortal Information and Through-Life Knowledge Management: Strategies and Tools for the Emerging Product-Service Business Paradigm) brought together eight IMRC's and five other departments from 11 different UK Universities. The project also involved significant industrial collaboration across a number of industries. The £5.5m research programme was and jointly funded by the Engineering and Physical Sciences Research Council (EPSRC) and the Economic and Social Research Council (ESRC). The overall lead for the Grand Challenge project was the IdMRC at Bath University, with Reading ICRC leading on Work Package 3 (described below).

The purpose of the project was to establish good practice for the design and use of information and knowledge-support systems. The project was divided into three main work packages as follows:



The focus of the three work packages can be summarised as follows:

- **Work Package 1** - Develop tools and techniques for the representation of the engineered product, the process by which it has been designed and the rationale behind design decisions, and for the organisation of the resulting information sets.
- **Work Package 2** - Study how the understanding of products-systems and their impact on users develops throughout product life, and develop strategies and techniques to improve understanding and the knowledge and information associated with this understanding. This work package focuses on the organisational learning processes supporting Work Package 1 .
- **Work Package 3** (led by Reading ICRC) - Investigate the dynamics of knowledge collection and use throughout the life cycle of complex product-service systems, and to make recommendations for improved effectiveness. The focus of this strand is on the areas of organisation and governance of the companies in the product-service supply chain, supporting human resource management (HRM) policies and decision-support throughout the product life cycle. This aim delivers the environment in which the results of Work Packages 1 and 2 can be made operational and effective.

Reading's Role in the Grand Challenge

The research team worked closely with industry partners particularly in the construction sector and wider engineering sector. The case study has focused on the interactions with Balfour Beatty and ABB.

The collaboration with Balfour Beatty took place over a 4 year period, and was broken down into a series of stages. The focus of the research was on the ongoing 'servitisation' within Balfour Beatty – the shift from traditional construction products to product-service systems, for example in the case of

PFI/PPP projects. One of the issues in making this transition within Balfour Beatty was the decentralisation of the firm into a number of relatively discrete divisions (of which Reading ICRC worked with the Civil Engineering, Capital Projects and Infrastructure divisions). This decentralization presented a problem to Balfour Beatty insofar as the shift towards product-service systems required a far greater level of collaboration and learning between divisions than was previously occurring. One of the key questions for the collaboration with Reading ICRC was how firms like BB can learn lessons from different divisions and roll this out throughout the firm

The outputs from the research were varied – including workshops, short reports, presentations, and feedback sessions to senior staff at BB – providing ‘provocations’ (rather than recommendations) on how they could reorganise themselves. Reading ICRC added value to BB by providing insights to senior executives on an impartial basis, drawing on best practice and empirical evidence. This included comparisons and benchmarking of practices against other sectors (e.g. comparisons with ABB described below). This input was of significant value in developing the firm, and would have been difficult to get internally within the firm or elsewhere.

The research contributed to improving the performance of Balfour Beatty via inputs to senior executives and into strategic planning. This contributed to a number of changes internally, such as the creation of new ‘networks of practice’ within the firm, which allowed greater and more effective sharing of knowledge, and a less compartmentalised business.

“The underlying principle of the KIM Project – providing the right information in the right context at the right time – is at the heart of our business proposition. In addition to the enormously useful insights gained into the information management problems that we face every day, engagement in the KIM Project and its knowledge transfer activities has proved very useful in developing our Group Knowledge Management Strategy. The outputs of the research have been useful in bringing together silos of knowledge and information – both within Balfour Beatty itself, and between the firm and academia.”

Simon Flint, Business Development Manager, Balfour Beatty

One of the other major collaborators within this project was ABB – a major engineering product manufacturer with a global turnover of \$25 billion per annum, and around 2,300 staff based in the UK. ABB’s Business Change group collaborated widely with 7 universities through the Grand Challenge project – the biggest work package involving Reading, Loughborough, Bath, and Liverpool.

ABB is involved in the manufacture and servicing of power and automation technologies. Given the long lifespan of these products (for example electrical power transformers have a lifespan of up to 60 years), there has been an ongoing shift towards ‘servitisation’ occurring within ABB. Consequently, ABB has created a Service Group to offer product and service packages to clients.

The collaboration with the Grand Challenge partners involved working up a number of case studies on aspects of knowledge and information management over a period of two years – drawing comparison between the engineering sector (ABB), construction (Balfour Beatty) and Aerospace (Rolls Royce). The collaboration of ABB with Reading ICRC focused on social and management aspects of knowledge management, whilst other partners focused on aspects such as technology. Reading ICRC interacted with around 50-60 ABB staff in the UK through consultations and workshops. The focus of the interaction was on the role of service engineers as part of the knowledge and information management process – as they often act as the interface with customers and generate large quantities of information.

Nigel Chapman (formerly the Organisation & Systems Development Manager at ABB, and now retained by ABB as a consultant), commented that the value of the collaboration with the ICRC was due to the “neutral and impartial reflections and provocations from the researchers” on how to

improve knowledge and information management. The collaboration helped ABB to understand the product to service shift, the dynamics of knowledge capture, and how lessons from company divisions could be rolled out more widely.

At the same time as the interaction with the Grand Challenge partners, ABB created a global team to investigate how to organise its service offering, which was in part informed through the collaboration with the Grand Challenge partners. ABB subsequently appointed a UK Country Service Manager (Mike Crawford) to lead the development of its service offering, a division which now has around 500 employees. Nigel Chapman commented that the provocations from the Grand Challenge partners were a 'useful ingredient' in informing the development and implementation of ABB's Service Strategy, and there 'was value in having an independent perspective from the universities' (although acknowledging that without the collaboration, ABB might still have reshaped itself in this way).

An indication of the perceived value of the collaboration was that ABB's senior executives were prepared to invest significant amounts of time in the process – for example ABB's Senior Vice President was actively involved in the co-production process. ABB estimate that the collaboration involved around 200 days worth of input.

Assessment of Economic Impact

The following economic impacts have been identified:

- Contributing to an increase in the efficiency of firms
- Contributing to creating competitive advantage which leads to an increase in turnover
- Developing capacity and networks between institutions and industry

Both ABB and Balfour Beatty identified that the collaboration could potentially **improve efficiency within the firm**, through the adoption of best practice information management processes and systems. Neither firm was able to quantify the contribution of the collaboration with Reading ICRC – due to the fact that the firms were already in the process of shifting towards greater servitisation, but both firms recognised the value of the input from Reading ICRC and other Grand Challenge partners, as described above. This view was reiterated by other KIM Grand Challenge partners interviewed as part of the review of Bath IdMRC.

Consultation with other Grand Challenge partners (interviewed as part of the review of Bath IdMRC) identified that the KIM Grand Challenge could potentially improve the way that engineering design information is collected, stored and managed. It is estimated that engineers spend 20% of their time looking for information. Therefore if the collaboration could inform KIM can design new processes and systems that reduces the amount of time spent looking for information, then this could have a significant cost saving.

In addition, both firms also reported that the collaboration could potentially **improve their competitiveness** compared to other firms. Balfour Beatty described that their competitive edge is driven by two interlinked factors:

- Embeddedness in a market niche – firms can achieve a competitive advantage through their organisation and positioning
- Localised learning – this can be achieved through a continuous process of reflection to ensure that a firm is providing services relevant to a particular geography or market niche

The collaboration with Reading ICRC and other Grand Challenge partners has contributed to improving knowledge and information management, which will support both of the above drivers of competitiveness. However, it has not been possible to quantify the scale of this improvement, or the

extent to which this can be attributed to the Reading ICRC or other Grand Challenge partners – as there were other factors and internal initiatives involved at the time.

In addition to research and business outcomes, the KIM Project also had wider impacts in that as a Grand Challenge it enabled participants to work with academics and universities that they did not previously have a relationship with. In addition, the project facilitated a sharing of contacts from partner organisations between the academic partners. Over 60 people were involved in the KIM project, which built up a network of relationships between academia and business. Overall, the KIM project helped to develop capacity within a number of universities, and develop networks between universities and industry.

Position without IMRC Funding

Consultees identified that the collaboration with the IMRCs through the Grand Challenge project created value through the following means:

- It took senior executives outside their normal space to think and speak freely, and to collaborate and exchange information with academics
- This gave senior executives a deeper understanding of issues, and influenced decision-making within their organisations; challenging the traditional approach to managing projects.
- There was a degree of value in having researchers involved from a number of different institutions and backgrounds to ensure that the collaboration was rigorous and provided a range of perspectives.
- There was also value in bringing together collaborators from a number of different sectors – to learn from each other. ABB and Balfour Beatty have continued to collaborate since the Grand Challenge project, for example by holding a number of events involving graduates from across the two companies, which were extremely well received.

The KIM project comprised a significant coordinated investment across 11 universities. It is possible that without the IMRC and Grand Challenge models, some of this research could have been funded through alternative routes. However this is likely to have resulted in a series of partial, disconnected initiatives, which would have failed to achieve the level of multi-disciplinarity, or the level of cooperation and sharing of information between institutions and between firms.

Consultees

The following individuals were consulted and reviewed a draft of the case study:

- Professor Stuart Green, University of Reading
- Simon Flint, Balfour Beatty
- Nigel Chapman, ABB

Case Study 2: Construction Procurement research

Key Facts	
Time Period	2001 onwards
ICRC Funding	Initial investment of £99,374 (2001-2003)
Other Funding	Matched initial investment of circa £136,000
Collaborator(s)	Reading Construction Forum, Construction Round Table, Amey plc, Carillion plc, Gleeds, Lloyds TSB Bank plc, Citex Group, Colt International Ltd, Kier Group plc, Gardiner and Theobald, Irvine Whitlock Ltd, Amec Capital Projects Ltd, Bevan Ashford Solicitors, Waterman Partnership, Drake & Scull, University of Melbourne, Morthumbria University, Asite, Synchro, OFT, OGC
ICRC Research Theme	Innovative Procurement
Research Output	Journal articles, conference papers, advice to existing businesses, expert input into standards and government policy
Pathway to Economic Impact	Via collaborators – Asite and Synchro Via policymakers – in particular via OFT, and also through standards Via dissemination – consultancy and presentations across a number of countries
Actual Economic Impact	<ul style="list-style-type: none"> • Improved performance of collaborator firms Asite and Synchro • Leverage of additional consultancy income • Inputs into a number of best practice standards on tendering and consortia – which will ultimately improve competitiveness within the construction sector • Inputs into government policy (OFT) on bid rigging - which will ultimately improve competitiveness within the construction sector
Potential Economic Impacts	<ul style="list-style-type: none"> • Improving existing businesses – Reducing the costs of tendering within the construction sector. DTZ estimate that a 1% reduction in the cost of tendering would translate into a £6 million - £36 million cost saving per annum across the construction sector.
Sector Focus	Construction

Context

In 2001, Reading University initiated research into the Cost of Procurement in the Construction sector; which has resulted in an ongoing stream of work on procurement over the lifetime of the ICRC. Prior to this work, there was a lack of quantitative evidence on the costs of procurement in the construction sector. This work sits within a broader theoretical body of research on business economics and transaction costs, and lessons learned from the empirical data and analysis generated through this work can be transferred to other sectors. The research within the ICRC was led by Professor Will Hughes, who is now regarded as one of the global experts on procurement in the construction sector and innovative procurement methods.

The ICRC Project

Initial Research

The *Cost of Procurement in Construction* was one of the legacy projects which contributed to the establishment of the ICRC – forming one of the six Phase 1 research themes (and remaining as a distinct theme in Phase 2). The project was initiated in 2001 with EPSRC funding of around £100,000. The work was undertaken in collaboration with industry – 14 industrial partners were recruited through the Reading Construction Forum, providing around £135,900 of additional funding to the initial project.

In addition, Northumbria University collaborated on the project, with an additional EPSRC grant of around £6,000 and University of Melbourne cooperated, with a view to setting up a parallel study in Australia. The project aimed to:

- Develop a mechanism for measuring the true costs of tendering, to explore the structure and magnitude of the costs of tendering and develop a deep understanding of the costs of tendering.
- Use this new data and understanding to quantify the relationship between forms of procurement, types of project and the costs of tendering.
- Demonstrate how performance improvement (in terms of approaches to tendering) can be measured in practice.
- Contribute to an understanding of the most advantageous approaches to forming construction project teams.
- Establish whether there was a business case for change in the sector

As the project progressed, the research team met the directors of **Asite** – a company providing support and web-based technologies to construction firms in relation to collaborative working and tendering. Asite assisted with the research by embedding an electronic questionnaire for firms within their website – the data from which was then analysed by University of Reading. Another company, **Marketing Works**, became involved in the research and they were running their own on-line questionnaire about costs of tendering. Working together with the team from University of Reading, this on-line data collection exercise was developed to generate data useful to both parties.

The main findings from the research were:

- Companies did not track the costs of tendering.
- Procurement costs varied widely within the construction sector particularly with different roles - Contractors spend very little of their turnover on tendering (0.5-3%), but tend to then subcontract up to 90% of the value of projects. Consultants appeared to spend up to 20% of turnover on tendering, while manufacturers spend roughly 10% of their turnover on tendering. There was huge variability within each category.
- The research highlighted instances where companies manipulated the market and tendering processes through power relationships.

The findings of the research allowed collaborative companies such as Asite to better understand the tendering process, and therefore provide insight to their clients throughout the supply chain. The research also had wider benefits to the construction sector as a whole, by **helping firms to understand and reduce the costs associated with the bidding process.**

Follow-on Research

This initial piece of research has grown into an ongoing suite of research projects relating to procurement in the construction sector, and innovative procurement methods – led by Professor Will Hughes at the ICRC. The following are examples of subsequent projects, which built on the initial research.

Firstly, through discussion with Asite, Professor Hughes was able to meet with the chairman of the board Sir John Egan. Egan had previously chaired an industry task force which resulted in the production of the Egan Report in 1998 - an influential report on the UK construction industry. One of the follow-on pieces of work from the ICRC project was a research project on **Performance-Based Contracting** – which developed an idea highlighted by the Egan report about how the construction

sector should sell a 'service' based on the performance of buildings, rather than simply selling materials and labour. The work was undertaken as an ICRC project from 2003-2005, in collaboration with Sir John Egan. The project resulted in a number of journal publications, and the output from the project was recently published by RICS in February 2011. This work will inform the development of policies and practices on performance-based contracting, and ultimately improve the value of services provided by construction firms to certain clients.

Second, another strand of research which emerged was that of the **power relationships** within tender process, and the potential abuse of power within the marketplace. Building on the initial research, Reading ICRC carried out a research project for the **Office of Fair Trading (OFT)**, with Professor Hughes working as a consultant to Europe Economics. The OFT has uncovered a significant number of competition law violations within the construction sector – it fined 13 companies within the roofing sector for collusion or bid-rigging in 2004 alone, resulting in fines totalling £4.3 million. The OFT wished to discover whether their actions were having an impact on understanding in the construction sector – in particular whether firms understood whether they were engaged in illegal practices. The OFT commissioned Europe Economics and Professor Hughes to undertake a study on this issue. The impact of this research was to inform OFT's strategy towards bid rigging and collusion, which ultimately will have an impact in terms of the competitiveness of the construction sector. The value of Professor Hughes' input to the project can be summarised as follows:

'Will Hughes' knowledge of the construction sector strengthened our bid for this work. He provided valuable insights into construction industry business models and helped shape our conclusions.' Jonathan Green, Europe Economics

Third, Professor Hughes has completed several pieces of a work for the **Office of Government Commerce (OGC)** on issues such as approaches to e-tendering, and the formation of consortia within the construction sector. These projects leveraged additional research funding for the ICRC to the value of £15,300.

Fourth, in the process of carrying out this research, as well as securing market intelligence data from Asite and Marketing Works, the research team also collaborated with Emap Glenigan, who provide information to contractors on contract leads. In association with Emap Glenigan, Professor Hughes instigated a further research project on analysing the market for construction work in the UK, extending and developing our collective understanding of the dimensions of the market for the period 1993-2003. This led to refereed journal papers and conference presentations.

Fifth, two further major projects funded by EPSRC incorporated the learning from this project, and included Professor Hughes as part of the research team in both cases:

- Knowledge and Information Management (KIM) Through-Life Grand Challenge Project funded primarily by the Engineering and Physical Sciences Research Council (EPSRC - Grant No EP/C534220/1), the Economic and Social Research Council (ESRC - Grant No RES-331-27-0006).
- Health and Care Infrastructure Research and Innovation Centre (HaCIRIC) (EPSRC – Grant No EP/D039614/1)

Sixth, with his insights into procurement in construction, Professor Hughes was invited to participate in a colloquium on procuring complex performance, which included academics and practitioners from public procurement, defence procurement and health care procurement. The first two colloquia in this series led to the publication of an edited book including a chapter by Professor Hughes. The third colloquium was hosted at University of Reading, and further outputs are being planned.

Seventh, building on all of the above research, Professor Hughes has inputted into a number of standards, for example:

- **BSI PAS98** – a code of practice for the establishment and management of consortia formed for the purposes of establishing standards. The purpose of this standard is to provide a codification of good practice and procedures for the establishment and operation of consortia across a wide variety of market applications, taking into account the various business needs that consortia should deal with. Professor Hughes provided input from the perspectives of the construction sector.
- **ISO10845** – this standard sets out best practice conditions of tender for use in procurements relating to goods, services and construction works and disposals other than by auction. Professor Hughes was part of a British Standard Drafting Committee that was asked to comment on the developing ISO.
- **BS 8345** – Professor Hughes was a member of the drafting committee for a new standard on construction procurement, and provided input in terms of how to structure the approach to defining and choosing among the complex range of options. The impact of this standard will be to improve the quality and robustness of the whole procurement process, at all tiers of the supply chain in the construction sector.
- **FIDIC** (the International Federation of Consulting Engineers) – Professor Hughes provided input into standard forms of contract for World Bank projects, through a funded commission to carry out an investigation into the role of the engineer in international construction projects.

Professor Hughes has communicated the findings of the above research through a number of means such as industry seminars, and invited presentations in global locations including Netherlands, Sweden, Finland, Taiwan, Hong Kong, Croatia, Australia, China, Japan, USA. Professor Hughes has provided advice to the Japanese government on how to introduce more competition within the construction sector in order to meet WTO obligations. He has also been involved in establishing an EPSRC network of expertise on international construction contracting. Professor Hughes has published 46 pieces of work since the creation of the ICRC – including journal publications, book chapters, and keynote presentations.

These follow-on strands of research have all come on the back of the knowledge developed within the initial research described above. The longevity of the ICRC funding model has supported the development of this strand of research to a greater extent than could have been achieved with a responsive mode grant.

Assessment of Economic Impact

The economic impacts of the project have been identified as follows:

- Improving the performance of collaborator firms Asite and Synchro
- Informing public policy (e.g. OFT and OGC) and standards
- Leverage of additional research income (OGC, OFT/Europe Economics)
- Potentially reducing the costs of tendering in construction firms

Improving the Performance of Collaborator Firms

The dialogue between Asite and Reading University allowed Asite to better understand how procurement worked within different sub-sectors of the construction industry, and understand the culture and requirements of its customers. This helped to guide investment by Asite on new product development and service enhancement, and contributed to the transition within Asite from offering a rigid process-driven software, to a software which enabled a free-flow of information between parties in the construction supply chain. The collaboration with Reading University focused new investment

on areas of the greatest importance where the greatest impact could be made for clients – and therefore maximised the effectiveness of new investment by Asite to help grow the business. This contributed to safeguarding market share and employment within Asite – which has been operating in a very challenging market.

Tom Degenis, former Chief Executive of Asite commented that *‘the work done by Professor Hughes at the University of Reading is extremely detailed, and far more illuminating than any other source of information or insight. There is no-one who has helped me to understand the specific processes of the UK construction industry more than Professor Hughes.’*

When the CEO of Asite (Tom Degeneris) left Asite to become CEO of another company (Synchro), he continued to take forward the findings from the research. The relevance of the work to Synchro was sufficiently strong that Will Hughes was appointed as a non-executive director of the firm, to integrate lessons from the research into the business. Synchro produces software based on Building Information Modelling (BIM) to enable the synchronisation of design, scheduling, delivery processes and supply chain management. Again, as a result of the collaboration with the ICRC, Synchro has been able to develop a business strategy and tools which connect directly with the needs of firms in the construction sector.

Informing Public Policy and Standards

The research undertaken by Professor Hughes has led to the following impacts on public policy and standards, as described above:

- Informed OFT strategy on bid-rigging and collusion. Ultimately this will boost competitiveness in the construction sector (by reducing the extent of anti-competitive illegal practices).
- Input into PAS98 on guidance for the formation of standard-setting consortia. This standard will promote good practice and procedures for the establishment and operation of consortia across a wide variety of market applications, especially in the IT sector.
- Input into ISO 10845, BS 8345, and FIDIC guidance on best practice forms of contracts and tenders, resulting in an improvement in the quality and robustness of tender processes.
- Dissemination of research including invited presentations to governments including Taiwan, Hong Kong, Croatia, Australia, China, and Japan.

Leverage of Additional Research Income

The total value of additional research funding leveraged as a result of the initial ICRC project amounts to **£880,000**. This has come from a range of funding sources as follows:

- The Grand challenge project = **£130k** (one of the four themes related to this area of work)
- HaCRIC (one of the two themes undertaken by Reading related to this work) = **£550k**
- ICRC Performance-based contracting project = **£104k**
- ICRC UK Construction Projects 1993-2002: Whole Population Data = **£18k**
- EPSRC Network grant = **£50k**
- Europe Economic consultancy agreement = **£11k**
- OGC project on consortia = **£15k**

Reducing the costs of tendering and negotiation

The research has helped construction firms to better understand the tendering process and the costs associated with tendering. It has also contributed to developing the services provided by companies such as Asite and Synchro which assist companies in tendering and creating consortia. The research

carried out by the ICRC could ultimately lead to reductions in the costs of tendering within the construction sector.

The ICRC research demonstrated that construction contractors (who tend to be at the top of complex consortia and sub-contracting arrangements) spend 0.5% - 3% of their turnover on tendering. Given that the total turnover of the construction sector is estimated at around £120 billion per annum³, this means that total tendering costs across the industry could be in the range £600 million - £3.6 billion.

It has not been possible to quantify the impact of the research undertaken by the ICRC in terms of reducing this cost – however even if the research reduced this cost by just 1%, this would translate into a cost saving to the industry of **£6 million - £36 million per annum**.

Position without ICRC Funding

Prior to this research, there was a clear gap in empirical evidence on the costs of procurement in the construction sector, which had not been addressed by any other researchers or by industry. The reason for this is likely to be due to **spillover effects** – in that it would be difficult for any one business to internalise the benefit, and benefits would therefore be felt by the industry as a whole. There was limited rationale for any one party to undertake the research. In addition, there were coordination failures holding back businesses from undertaking this research – in that it required the ICRC to gather data from a number of construction firms. This process was only possible through a collaborative approach between companies and an impartial researcher (i.e. the ICRC).

The ICRC funding model supported the realisation of economic benefits for the following reasons:

- The ICRC model is based strongly on industry collaboration. The initial research was undertaken in collaboration with a number of construction firms. The strength of relationships built with partners ensured that data was shared by partners firms – boosting the depth of the research and value of the analysis.
- The longevity of the ICRC funding model was supportive in turning this from an individual research project into a strand of research – allowing time for various avenues of the research to be fully explored.

Consultees

The following people were consulted and reviewed a draft of the case study:

- Professor Will Hughes, Reading University
- Thomas Dengenis, Synchro Ltd (formerly of Asite)

³ 2009 figure – relates to construction plus construction professional services

Case Study 3: Competitiveness of the Construction sector

Key Facts	
Time Period	2003-2005 plus follow on project (2007-2009)
ICRC Funding	£175,000, plus follow on project of £143,000 relating to construction professional services
Other Funding	N/A
Collaborator(s)	Association of Consultancy and Engineering, UKTI, ONS, CIOB, RICS, RIBA
ICRC Research Theme	Competitiveness, productivity and performance
Research Output	1 journal paper and five conference papers Increased understanding of the UK construction sector. Emphasis on output was placed on disseminating widely to key decision makers at industry and professional institution events both in the UK and overseas
Pathway to Economic Impact	Via policymakers such as the UKTI and industry bodies
Actual Economic Impact	Informed public policy – specifically the UKTI Export Strategy for construction Leverage of additional research funding
Potential Economic Impacts	Increasing exports of UK construction firms – DTZ estimate that a 0.1% increase in construction sector exports would translate into additional revenue of £5 million p.a.
Sector Focus	Construction

Context

This project was intended to highlight the challenges of measuring construction exports, particularly construction professional services (CPS) which are an integral part of the sector. The outputs from the research undertaken by Reading ICRC have increased awareness amongst policymakers about the importance and value of construction exports, and improved data and decision-making.

The UK economy is heavily focused on services – accounting for around 75% of UK output. The UK relies on the positive balance of trade provided by professional services (to counteract the negative balance of trade in goods). Construction is a major sector of the UK economy with output of £110 billion recorded in 2009, and a major exporter – with an estimated £5 billion of construction projects and materials exported from the UK annually.⁴ These figures exclude CPS which have an output of £13.9 billion in the UK (Construction Statistics Annual, 2010), which are predominantly professional services, ranging from architectural and engineering design, manufacturing components, contracting on site, through to the insurance services provided on a construction project. In the past, contractors focused upon bidding for overseas projects in regions where control stayed in the UK. The knowledge economy has changed the nature of an export and the methods of exporting range from human capital to sending plant and equipment overseas. The export data groups CPS firms under the umbrella of “Architectural, Engineering, Surveying and other Technical Services”, which does not reflect the range of services they provide and the way they are delivered. Services account for about three-quarters of UK’s GDP (ONS, 2010, p. 9); they are also very important to the UK’s balance of trade; a surplus has been recorded every year since 1966 (ONS, 2009b, p. 22). Whilst services have steadily increased over a 40-year period, the negative balance of trade for goods has deepened. This situation is not unique to the UK. Many countries have a trade deficit. Current government policy is to stress the importance of an export led economic recovery.

⁴ Source: UKTI website

The success of a nation's economy is the ability to trade successfully and to expand into markets beyond its national boundaries. The past dominance of the primary and secondary sectors of the economy - agriculture and manufacturing - has led to a well-developed system of measuring the export of goods; unlike the system for measuring services exports. This shift towards services exports merits consideration; there is only limited understanding of the role of services in the wave of globalisation and how the strengths of the UK service sector help to respond to the challenge of global competition.

The UKTI is the key government agency in the UK responsible for trade promotion and attracting foreign direct investment, and have a Construction sector team. Professor Roger Flanagan (the PI for this project) sits on the UKTI Construction Sector Advisory Group for Exports, together with a number of CEOs of major construction companies and professional service. The group was concerned that the available information on construction exports was not reliable, under-representing the true level of construction exports; and therefore policymakers and companies were making decisions based on poor information. The UKTI convened a group of consultants with an aim of addressing this lack of robust information.

The ICRC Project

The starting point for this research was that the data collected by the ONS through the Construction Statistics Annual and 'Pink Book' was based on out of date information and mis-represented the true value of construction exports. One of the reasons for this was that the data collection methods employed by the ONS failed to reflect the true workings of the sector – for example the fact that large firms sub-contractor specialist work (often internationally) and often utilise resources across multi-national teams to deliver projects.

The aims of the ICRC project were:

- To understand the key factors driving export success of the UK engineering and design consultancies in a global market place.
- To consider how well data collected on the export of professional services reflects the reality of the sector in a modern economy.
- To consider the best way to measure export performance of UK construction services.
- To investigate the ways in which the export data for professional services are collected by the Office for National Statistics (ONS).
- To consider how the ONS data is used by policy makers and professionals in the construction sector.
- To understand the business organisational models used by professional service firms in the delivery of overseas projects.

The project involved semi-structured discussions with industry contacts, and round-table discussions with industry and government representatives. The research found that:

- The impact of globalisation and rapid changes in technology, ownership structures, procurement, and delivery methods are not fully reflected in the official statistics. National and international statistics are underpinned by definitions and classifications which fail to reflect the changing landscape of the PCS sector. A more appropriate methodology is needed to better reflect the project-specific and knowledge-intensive nature of CPS firms.

- The data are highly aggregated and do not take account of the project-based nature of the work or adequately distinguish between sub sectors.
- The research also highlighted the need of UK firms to increase the use of technology and focus on high value niche areas in order to compete globally.

The research resulted in a number of recommendations about how to improve the data on the CPS sector, together with a focus on the challenges of exporting professional services for UK companies. These recommendations have been disseminated and followed up through additional research as follows:

- **UK Industry** - Dissemination of research recommendations at a high profile event to 70 CEOs of leading construction companies, to UK industry bodies such as ACE, RICS, RIBA, CIOB, ICE, and to governmental committees such as UKTI Advisory Group Construction Exports. This project has had a high level of engagement from ACE (the Association for Consultancy and Engineering) which is an industry body representing around 650 construction professional services firms, with a combined turnover of £10 billion. ACE have been heavily involved in this research and disseminating the research outputs to all of its members. The impact of dissemination to industry has been to improve their understanding of the special characteristics and core competencies within the UK construction sector, improving competitive positioning, and increasing construction sector exports.

Nelson Ogunshakin OBE, Chief Executive of ACE, commented that *'the value of this research was in the way it combined theoretical knowledge with practical application; providing independent insights cutting across the entire construction sector. This was support by the collective approach of the ICRC.'*

- **UK Government** - Dissemination to parliamentary committees to increase awareness of the importance of the CPS in the context of an increasing focus on an export led recovery. The researchers also held workshops with 14 UKTI trade counsellors from the overseas UK Embassies – which are extremely influential in promoting UK firms in relation to major international contracts. This collaboration subsequently helped to inform the production of the UKTI Export Strategy.
- **International Dissemination/Collaboration** – provided background papers and/or presentation at conferences in Korea, Malaysia, Ireland, Cyprus, Hong Kong, China, South Africa, Namibia, Mauritius, UAE, Bahrain, and Libya; and to the OECD, WTO and the African Development Bank. The collaboration with the Libyan government resulted in a follow-on two year study on 'Rethinking the Libyan Construction industry'. A £150,000 study commissioned by the Libyan government was initiated to help restructure their construction industry to improve competitiveness, which would have indirectly benefited UK firms by providing insight into how UK construction firms could increase involvement in the Libyan market. This was aborted in the light of the upheaval in the country. However, other Middle Eastern countries have shown interest in similar work. A position paper was prepared for the OECD on the export of professional services and presented to a members meeting. The team reviewed a paper on the industry for the WTO in Geneva. A government official from the Ministry of Construction, now the Ministry of Housing, Urban-Rural Development, in China had a Chinese government sponsored 6 month sabbatical with the team to understand the research methodology being used.

Assessment of Economic Impact

The economic impacts of the project have been identified as follows:

- Informing public policy-making – UKTI Export Strategy for construction services. Indirectly help UKTI to raise profile of UK construction professional services sector and help UK firms to win more business.
- Improving existing businesses by increasing understanding of exports by the UK construction sector within industry and government
- Leveraging additional research income to the UK from overseas

Informing public policy-making

The researchers disseminated the findings of the research to 14 UKTI counsels, and inputted into the UKTI Export Strategy for construction. This will ultimately improve understanding of the UK Construction sector and its strengths and characteristics in export markets, allowing UKTI Counsels and other public sector bodies to better promote UK firms.

Improving existing businesses

Following on from the above point, the greater awareness and understanding of the UK construction sector by policymakers and industry could potentially lead to increased sales for the UK construction industry. The Association for Consultancy and engineering (ACE) have a membership of over 650 companies including all the top engineering professional service firms; employing over 100,000 qualified professionals across the built and natural environments with annual turnover in excess of £10 billion. ACE is engaged in heavily promoting UK expertise, together with British Expertise, previously the British Consultants Bureau. They have both been active and influential in steering the work, and are key agents in promoting UK firms' capabilities overseas and helping UK companies to win more business. A greater understanding of UK capabilities will make the job of the UKTI and ACE members easier and potentially more successful. Similarly, notwithstanding the current political situation, the follow on work in Libya has increased the understanding of the Libyan construction market by UK firms – which in the long term could lead more firms to target the Middle East market.

The total value of UK construction sector exports has been estimated at £5 billion per annum. If this research could help the industry bodies, and UK construction and professional service firms to attract more business to the UK and increase this by even 0.1%, then this would translate to an increase in sales by UK construction firms of **£5 million p.a.**

Position without ICRC Funding

Prior to this research, there was a clear deficiency in the knowledge and awareness of the UK construction sector both within the industry and by policymakers. Gaps in knowledge had not been addressed.

This is likely to be due to co-ordination failures holding back businesses from undertaking this research – in that it required an independent researcher such as the ICRC to gather data from a number of construction-related enterprises, using a collaborative approach with industry. No single firm could have undertaken this research on their own, due the unwillingness of other firms to contribute or collaborate.

The ICRC model supported the realisation of economic benefits for the following reasons:

- The ICRC model is based strongly on industry collaboration. The research was undertaken in collaboration with a number of construction firms and industry bodies. The strength of

relationships built with partners ensured that data was shared by partners firms – boosting the depth of the research and value of the analysis.

- There is complementarity between the researchers and research themes within the ICRC, which allowed different researchers within the centre to work with the same industry contacts – and ‘cross-sell’ possible avenues for research.

Consultees

The following people were consulted and reviewed a draft of the case study:

- Professor Roger Flanagan, University of Reading
- Nelson Ogunshakin OBE, Chief Executive Officer of the ACE (the Association for Consultancy and Engineering)