Institution: Robert Gordon University
Unit of Assessment: 11, Computer Science and Informatics

a. Overview

Computer Science and Informatics research at Robert Gordon University operates independently from schools in a Research Institute under the theme title "Digital Technologies". There are 19 staff, from the Computer Science and Engineering schools, organised into four research groupings:

Computational Intelligence (CI) (Arana, Gaber, Macleod, McCall, Petrovski)
The CI group investigates machine learning and optimisation including naturally inspired computing, clustering and classification, neural networks, constraint satisfaction and local search techniques. The group develops novel algorithms and applies them in a range of areas including medicine, data mining, video coding and high performance computing.

Smart Information Systems (SIS) (Craw, Goker, Lothian, Massie, Wiratunga)
The SIS group researches intelligent information systems for information retrieval and case-based reasoning. Its research in data/text mining and knowledge extraction transforms databases, textual documents, and multimedia collections into smart knowledge-rich systems for information search and browsing, online recommendation, and decision support using information retrieval and reuse.

Socio-Technical Systems (STS) (Allison, Bass, Doolan, Elyan, Glassey, Holt)
The STS group investigates the interactions between information technologies, design methods and people. STS researches both organisation-level software design, development and adoption methods as well as user-focussed design technologies such as user simulation through cognitive modelling, face recognition and modelling, location/situation-aware systems, visualisation and mobile technologies.

Wireless and Video Communications (WVC) (Kannangara, Tu, Zhao)
The WVC group researches video streaming and content delivery optimisation to support future and emerging video applications. By developing cutting-edge technologies and exploring new theoretical findings, WVC has interest in wireless multi-hop video networking (sensor networks, mesh networks), cognitive video networking, QoS and QoE, performance analysis and optimised video coding.

b. Research Strategy

Vision

Our vision is to carry out applied computer science research, underpinned by theoretical innovation and rigorous science, mathematics and statistics. Our strategic aims in this period have been to significantly strengthen the quality and international reputation of our research while maintaining unit size, and to build a strong relationship with industry to align our research with current and future needs. We have sought to grow the research activity of existing staff and to recruit staff in new areas that bring a synergy.

Following RAE 2008, RGU set up three Research Institutes (RI) to strategically support the most successful research areas, including this unit. RIs have Directors and Theme Leaders appointed to strengthen and deepen research. This unit is placed in the Innovation Design and Sustainability RI (IDEAS) along with engineering, built environment and art & design. This structure, and links with two more RIs in Business and Healthcare, supports and encourages interdisciplinary research.

Achievement

The number of Category A staff submitted, 19, is the same as in RAE 2008 but with significant increases in research activity and heightened industrial focus. In particular:

- Average annual income from research has increased by 66% for the period and this trend is accelerating. Income sources have also diversified over the period towards industry and EU.
- Significant industrial engagement has been achieved during the period, evidenced by increased knowledge transfer and direct industrial funding.
- Research student completions have increased – 20 in 5 years vs 18 in the previous 6.5 year period. Research student population is 32 vs 27 in the last period, and growth is accelerating.

- Staff have leading roles in research pools and industry consortia: SICSA, NRP, NSRI, ScotlandIS.
- The unit has output over 300 peer-reviewed publications in the period.

Research groups have grown and re-configured, with an activity focus reflecting the strategic aims:

Computational Intelligence (CI)
Since 2008, CI has strengthened and broadened its position. Existing research themes in evolutionary algorithms with probabilistic models (**McCall)** and multi-objective particle-swarms **(Petrovski)** have been augmented with new interests that enhance our industrial relevance: machine learning for data mining **(Gaber)**, parallel computing (**McCall**, **Petrovski**), sensor networks (**Gaber**, **Petrovski**) and A-life (**MacLeod**, **McCall**). **Arana** has migrated from **SIS** and researches constraint programming focussed on industrially-relevant optimisation problems such as planning, scheduling and data structure learning. During the period, our research has found industrial application in telecommunications, oil & gas engineering, transport, brain-computer interfaces, sensor networks and defence. CI has a current population of two research fellows, two research assistants, a KTP associate and nine research students. CI had seven research student completions during the period.

Smart Information Systems (SIS)
Synergy has grown from established groups in information retrieval and case-based reasoning via a common interest in retrieval and reasoning using 'big data' information sources including social media (**Goker**, **Wiratunga**) and large online collections (**Craw**). Case-based decision support (**Massie**, **Wiratunga**) has been extended to text mining (**Lothian**, **Wiratunga**), knowledge extraction (**Craw**, **Wiratunga**), and knowledge-rich content for information reuse (**Craw**, **Massie**, **Wiratunga**). Information retrieval is increasingly context-aware (**Goker**, **Glassey**), visual (**Goker**, **Lothian**) and user-centred (**Goker**), including mobile delivery. SIS research on smart technologies is applied in modern domains: news trends from social media for journalists, news feeds for children, recommendation for on-line music, interactive information for tourists, medical diagnosis from electronic patient records, lessons learned for planning in offshore oil & gas. SIS has three research fellows, a KTP Associate and eight research students with seven completions since 2008.

Socio-Technical Systems (STS)
STS has grown from the previous Cognitive Engineering group. **Allison** and **Bass** research Agile methodologies and collaborate on the deployment of applications as cloud-hosted software services. **Allison** continues work on software improvement processes in commerce and industry, while **Bass** has initiated and leads research on ICT in Developing Countries. **Allison** and **Holt** collaborate with **Glassey** (early career researcher) in location- and situation-aware systems. **Holt** has maintained and grown research in HCI and developed work in optimising interface design with human cognitive modelling. **Holt** and **Elyan** use cognitive modelling to enhance user interaction. **Elyan** also researches 3D facial modelling. **Doolan** continues to research issues relating to mobile technology. STS has four KTP Associates and twelve research students with five completions since 2008.

Wireless and Video Communications (WVC)
WVC is a recently-formed research group. **Tu** has recently joined the unit and her research strongly complements the work of **Kannangara** and **Zhao**. Since 2008, WVC has combined fundamental research in algorithms design and theoretical analysis for video content delivery in both wired and wireless networks (**Tu**), with industry-oriented research on complexity management of video coding for low-power mobile devices (**Kannangara**, **Zhao**), quality measurement (**Kannangara**, **Zhao**), optimised video coding for high definition television broadcasting (**Kannangara**), mobile digital management systems for outdoor workers (**Tu**). **Kannangara** and **Zhao** contributed to International video coding standard development (ISO/IEC MPEG) through technical proposals on fully-configurable video coding. WVC currently has two research students and has one student completion in the period.

Future Strategy
Our future strategy will build on our experience of industrially-relevant research to gain critical mass in application areas that synergise our research strengths. We will leverage our involvement in the Scottish Sensor Systems Centre and in two Innovation Centre bids (Oil & Gas and Data Lab)

to achieve significant traction in big data analytics applied in the oil and gas industry. The recent additions of **Goker**, **Gaber** and **Tu** complement existing strengths and align well with this strategy. The university has identified Data Analytics as a key priority and committed to investment in new staff and facilities in addition to the existing complement.

c. People, including:

I. Staffing strategy and staff development

Our staffing strategy in the period has been to maintain unit size while building the quality of output and activity of staff, guided by our strategic aims. The Theme Leader (**McCall**) and other professors (**Allison**, **Craw**, **Goker**, **Holt**) play an important role in motivating and mentoring staff through direct interaction, collaboration and development and leadership of development activities. In the IDEAS RI, staff belong to one of four activity levels: Senior (S), Established (E), Developing (D) and Probationary (P), the last applying only to early career staff. The levels relate to extent and nature of research activity and are used explicitly to encourage staff development and directly link to resource planning. Nominally, the activity levels correspond to workload allocations for research of S: 60%, E: 40%, D: 20% and P: 30% of staff time. These nominal levels may be fine-tuned to recognise the needs of individual staff and externally funded projects. An annual review process allows staff to discuss their activity with more senior mentors and they may move from one level of membership to another. Our broad development aim has been to move from a mode of developing researchers to a mode of established researchers. Additional opportunities arise from natural turnover to recruit staff whose research extends or complements the research strengths of the unit in line with our strategy. To ensure this, a senior researcher is routinely included in recruitment and interview panels for the School of Computing Science and Digital Media. Since 2008, there has been a net turnover of ten staff in the unit.

Table 1 shows the numbers of staff at different levels of membership from the start of the RI in 2009 to now. These figures represent a significant shift in committed resource to research from other activities, which is backed by increasing success in generating external income from research. It shows how the unit is managing and sustaining the increase in research activity.

	Senior	Established	Developing	Probationary
2009	4	4	8	3
2013	4	7	7	1

Table 1: Change in Activity Levels since RI Established

Research staff are supported in developing funding applications and managing research projects. The university runs an annual three-stage workshop where staff are assisted in developing a proposal from initial idea to robust scrutiny by a panel of experienced reviewers. The unit also ran two series of research funding workshops in 2009-10, one aimed at Research Council / EU funding and one aimed at industrial funding. Proposals emerging from these workshops have been successful in attracting funding. The unit has a vibrant seminar series, organised by **Doolan**, with regular talks from internationally-leading academics. Additionally the research groups organise their own internal seminar series with a mix of internal and external speakers. Cross-disciplinary workshops are also run within and across RIs.

RGU is actively committed to the Concordat to Support the Career Development of Researchers. In engaging in this important initiative the University has initiated and promoted a number of activities for training research staff across all different levels from research students through to professorial-level staff. Research staff development has, since 2006, been one of the University's strategic staff development priorities. The RI encourages research-active academic staff by providing support for PhD studentships, travel, staff time, and equipment purchases. In the unit, since 2008, **McCall** has been promoted to Professor and **Petrovski** and **Wiratunga** have been promoted to Reader. **Bass** has gained Established activity levels and **Elyan** has enhanced research allocation in recognition of research income. **Glassey** benefits from enhanced research time allocation as an early career researcher.

Research Fellows and Assistants are generally employed on a fixed term contract if their funding is grant related. However some may also be on a permanent contract if the funding duration and

project is for a lengthy period of time or they have 4 years service. All staff, regardless of employment status, have full employment rights after the relevant qualifying service. Increased funding means that 5 RFs and 2 RAs are now supported. Regnier-Coudert, Horsburgh and Garba were PhD students at RGU, Rattadilok, Corney, Fernandez and Goli were externally recruited.

The unit has a strong international make-up with 8 out of 19 staff (42%) originating from outside the EU. Academic posts are routinely sourced globally through community mailing lists, research networks and personal contacts. Key appointments in the period were: **Song** from Open University, since moved to Tianjin, China under the 1000-talent scheme; **Goker** from City University; **Gonzalez-Velez** from Edinburgh since moved to head the Cloud Competency Centre at NCI, Dublin; **Gaber** from Portsmouth; and **Tu** from Nottingham Trent.

RGU is an Equal Opportunities employer and this is embedded in all our HR policies and processes. A range of family-friendly policies includes generous maternity pay and leave above the statutory provision. RGU has a flexible working policy allowing staff with sufficient service to apply for flexible working regardless of their personal circumstance. The Athena SWAN Charter recognises a commitment to advancing women's careers in science, technology, engineering, mathematics and medicine in higher education and research. RGU gained Charter Membership in 2012 and intends to submit for a Bronze University Award in April 2014. **Wiratunga** is a member of the university's Athena Swan working group. In this unit, 2 of 5 professors and 2 of 4 readers are women. Women comprise 6 out of 19 submitted academic staff (32%).

c. II. Research students

The unit has a healthy annual recruitment of research students, typically around 9 or 10 over October and January intakes since 2008. This population has grown during the period and intake has accelerated towards the end as evidenced by increasing completions and the current increased research student population resulting from funding success. The RI supports six fully funded PhD scholarships per year of which usually two to three are awarded to the unit on a competitive basis. Acceptance criteria for scholarships are high – first class undergraduate degree or distinction Masters. Competition for these places is very strong and applications are received from around the world. Often, scholarship students already have publications. Some fees-only scholarships are also offered. This supplements studentships funded externally via a range of industrial sponsorship, grants and external scholarships, for example SICSA and NRP research pools and the Nigerian PTDF scheme. All applications are reviewed jointly by a research student coordinator **(Petrovski**) and potential supervisors. Shortlisted applicants are ranked by interview. The research coordinator ensures objective quality standards are applied to all recruitment, reducing risk. Final decisions are guided by considerations of fit to strategy and staffing. Our current student population comprises 32 students of whom 24 are international and 8 home/EU. Our increasing cohort of KTP Associates routinely register for MRes, taken over 2 years.

All research students undertake the *Postgraduate Certificate (PgCert) Research Methods* course. This operates as two modules, each worth 30 Scottish Credit and Qualifications Framework (SCQF level 11) credits, and delivered intensively in one week blocks regardless of study mode. Students from all subject disciplines are taught together. A key feature of this course is academic exercises working in interdisciplinary teams. The course considers development of research questions, selection of suitable methodology and presentation of research. The second module develops skills in research writing in preparation for the transfer to PhD.

Student induction is delivered via a *Graduate School Induction Programme*, which was implemented in 2011. A number of seminars and training sessions are also arranged for doctoral students on specific issues including workshops on:

- developing research proposals for funding applications
- preparation for the viva;
- teaching and demonstrating for ad hoc tutors.

Since 2004, a Supervisor Training Programme for all research degree supervisors, regardless of experience, has been operated by the University. Supervisors must attend every three years to refresh skills, reconsider supervision procedures and exchange best practice. The programme is seen as a useful vehicle for inexperienced supervisors to be mentored by experienced supervisors.

In the unit, students are encouraged to regularly present their work at research group seminars and to attend the computing science seminar programme. A separate seminar series is organised by the research students for them to gain experience in presenting research to their peer group. All students also participate in the SICSA graduate student programme. SICSA organise summer schools and an annual PhD conference as well as general themed workshops, which our graduate students attend, present at and have participated in organising.

Research student progress is monitored by annual reports. A self-assessment is completed by each student identifying progress and key training needs. A separate assessment is completed by supervisors and students and supervisors then discuss the separate assessments, coming to an agreed position. Finally, each student is interviewed separately by the research degrees coordinator. Students are encouraged to complete personal development plans.

Our students are highly successful in attaining relevant positions on qualifying. Recent post-doctoral destinations include: post-doctoral research fellowships at Loughborough, Rutgers, MIT, IIT Madras and Tianjin; risk analyst at Det Norsk Veritas; research analyst at British Telecom; and lectureships at LAUTECH, Nigeria and Northwest A&F University, China.

d. Income, infrastructure and facilities

Infrastructure and Facilities

During the period the unit operated in a purpose-built Computing Technologies Centre (CTC). This provided open-plan workstations for the full community of research students, with offices for research staff, including professors and research fellows. Additional office space accommodated visiting researchers and was also used as break-out space to support academic staff working on proposals or publications. CTC also offered 2 dedicated seminar rooms and a coffee / foyer area used for informal meeting, post-seminar discussion, poster presentations, workshops and other events. In July 2013, we moved to the new £120M Riverside East Building at the RGU Garthdee Campus. The new state-of-the-art facility offers an excellent environment to support the work of the unit going forward, enhanced by co-location in a Research Hub with other research disciplines.

The unit is supported by a dedicated technical team who manage computing research facilities as well as providing technical support for the School of Computing and Digital Media. The team liaise with the university IT Services to provide seamless connectivity around RGU and with external networks. The team consists of a systems manager and 5 FTE technicians. During the period all facilities were managed in a dedicated server room with specialist facilities in dedicated lab space. High specification workstations are provided to staff on a 3-year cycle. We operate a mixed economy of Macs, PCs and Linux machines. A standard desktop build is enhanced by specialist installations for particular purposes. Specialist facilities supported by the team include the £50K Xookik shared-memory cluster providing a parallel programming resource for partners in the EU FP-7 ParaPhrase project (**McCall**) and the £10.5K server supporting the SocialSensor project (**Goker**). Recently these server suites were re-located to the new North East Scotland Shared Data Centre (NESS DC), operated jointly with University Aberdeen.

The strategic aims of the unit have been supported by the RI through investments in research infrastructure and facilities needed to underpin the specialisms of the research groups. This is also attractive to some industrial collaborators, in particular SMEs, who would not otherwise have access to such facilities. A £10K IBM Blade server cluster was installed to support computationally intensive work. Examples of use include by CI for data structure learning on a 50K-datapoint Gulf of Mexico drilling market dataset (**McCall**) and by SIS for music genre classification on a million-song corpus (**Craw**). A Human Design Lab provides a controllable environment for user modelling experiments. Specialised hardware includes a £20K Eye Tracker, a continuous investment in photography and video equipment amounting to £25K so far, £4k high definition displays and a £10K Microsoft Surface. Examples of use include: by STS for cognitive aspects of information retrieval focused on how users identify genre through visual features (**Holt**); and by WVC for testing of perceptual video quality optimisation algorithms (**Kannangara**), computationally intensive video data processing and complex mathematical modelling (**Kannangara**, **Zhao**). A £10k investment has also been made in a Sensor Lab to build capacity in sensor networks. Equipment includes a MEMSIC IRIS Professional wireless sensor networks kit and four ePuck robots.

Examples of use include simulation of oil slick clearing using bio-inspired robots (**MacLeod**) and monitoring and processing of operational data from electric power systems (**Petrovski**).

Future plans for infrastructure spending focus on our strategic target area of big data analytics. The university has committed £80k for investment in a big data facility, which will benefit from location in the new facilities at Riverside East. It is expected that this commitment can be leveraged with strategic industrial partners. Discussions with potential partners are well advanced.

Income

The financial returns on income in REF4 show that the research funding portfolio has increased and diversified over the period. Average annual spend over the period was £460K, compared with an average annual spend of £270K from 2001 – 2007. This represents an average increase of £190K (70%). Notably, this trend has been accelerating in the last two years of the period (£520K, £504K). A major area of growth has been income from EU projects and from industry and commerce while income from research councils and charities, taken as a whole, has been broadly maintained. This increase and diversification is closely linked to our vision of applied industrially-relevant research achieved through our strategy of engagement with industry. Key grants exemplify our approach.

The ERDF, SEEKIT-funded £600K dePICT project (**Holt**) supported SMEs in ICT product research and development. Led by RGU in collaboration with Aberdeen and Dundee, the project engaged with 30 SMEs in a broad range of industries with research input from many staff in the unit. dePICT played a central role in realising our income diversification strategy and many engagements led on to larger technology transfer projects funded by grant or directly by industry. Impact of dePICT is discussed further in REF3a.

The EPSRC- funded £609K (RGU: £328K) Autoadapt project (**Song**), developed techniques for the automatic adaptation of knowledge structures for assisted information seeking. The work was in collaboration with deRoeck (Open) and Kruschwitz (Essex). A separate £962K (RGU: £324K) EPSRC project by **Song** in collaboration with Rueger (Open) and Lalmas and van Rijsbergen (Glasgow), investigated approaches to context-sensitive information theory inspired by quantum theory.

The 2.6M€ (RGU: 381K€) EU FP7 ParaPhrase project (**McCall**) aims to produce a new structured design and implementation process for heterogeneous parallel architectures (http://paraphrase-ict.eu). The project is led by St. Andrews with academic partners in Turin, Pisa, Belfast, Dublin and Stuttgart. **McCall** leads a work package investigating metaheuristics to intelligently coordinate skeletonised code running in real time on multi-processor CPU/GPU platforms.

Goker brings the 10M€ EU FP7 SocialSensor project to RGU from City University. SocialSensor is developing a new framework for enabling real-time multimedia indexing and search in the Social Web (http://www.socialsensor.eu) **Goker**'s team receives 1M€ of the total and applies her expertise in context, personalisation and search to mining and aggregating user inputs and content over multiple social networking sites.

The unit has been highly successful in attracting KTP funding from the Technology Strategy Board during the period. **Wiratunga**, **Craw** and **Massie** applied CBR to develop the ExcelicareCBR diagnostic tool with AxSys, the main supplier of Electronic Patient Record technology to the NHS (£106K). **Craw** used CBR to improve planning for oil well engineering for XCD (£122K). **McCall** and **Petrovski** incorporated Bayesian network structure learning in a tool to predict drilling rig performance for the leading oil industry data supplier ODS-Petrodata (£205K). **Elyan** is developing advanced visual CAD interfaces and design tools for timber construction company James Jones (£125K). **Holt** is applying user task modelling to develop novel web learning interfaces with Polaris (£134K). **Petrovski** has developed a virtual instrumentation software system, V Sentinel, for detecting faults in subsea hydraulics with Viper Subsea (£130K). **Wiratunga** is developing a text-mining approach to automated question generation for the market research firm Pexel (£130K).

Direct industrial funding includes a £180K defence research project funded by Selex (**Petrovski**) and operations management research with British Telecom and haulier ARR Craib (**McCall**).

The Scottish Government has made available the SFC Horizon funding scheme for applied projects to support key Scottish industry sectors. RGU is a participant in two such programmes.

Craw is a PI for the SICSA Smart Tourism Programme funded by SFC Horizon and the dot.rural RCUK Digital Economy Hub (£700K). To date Smart Tourism has funded 10 Innovation Projects including Living History, a 3-way partnership between **Craw** and **Massie**, SME AmbieSense, and problem-holder Historic Scotland. Living History delivers interactive information at remote historic sites through NFC tags, solar powered local wifi, and synchronization with a central server. A demonstrator was developed for Tolquhon Castle and a user trial is set up for Spynie Palace.

A £700K SFC funded Horizon project entitled 'Creating High-value Cloud Services' with St Andrews University was awarded to **Allison** as the RGU PI. **Bass** is an academic investigator on the project. The goal of this project is to support companies in Scotland who are interested in taking advantage of the opportunities for market development offered by a move to cloud computing. The project has 7 software SME partners across Scotland. The aim is to work with companies who currently sell high-value software products (typically software products in a specialised area, such as project or customer relationship management) and explore the practical technical and non-technical issues of adapting these products for cloud delivery. The results of these studies with industry are being widely disseminated to the Scottish SME community, and have initiated a special issue of JITIM on cloud adoption which **Allison** and **Bass** are co-editing.

RGU is part of a SICSA consortium bidding for a Data Lab Innovation Centre (IC). If funded, the £30M Scottish Government project will support innovation hubs at Edinburgh, Glasgow and RGU. The hub at RGU will support research engagement with industry by universities based in North-East Scotland. This facility, in conjunction with the CENCIS IC on sensor networks and a planned Oil & Gas IC, will provide an excellent locus for our planned research in data analytics for the oil and gas industry.

e. Collaboration and contribution to the discipline or research base

A key component of the implementation of our strategy is the maintenance and growth of collaborative networks with academic and industrial partners. The unit has a wide range of academic and industrial collaborators around the world. Collaborative activity is strongly encouraged by the IDEAS RI with a generous budget for travel to conferences and workshops or for individual visits to external academic groups to develop research or write funding proposals. Since 2008 we have won funding and/ or co-authored publications with academic groups at universities including: Aberdeen, St. Andrews, IIT Bangalore, Basque Country, Boston, Bradford, Cambridge, Carlos III de Madrid, Carnegie Mellon, Complutense Madrid, Cork, Dundee, Eindhoven, Essex, Glasgow, Heriot-Watt, Missouri (St. Louis), IIT Madras, Manchester, Monash, Rennes, T. U. of Madrid, Twente, Warwick and many more.

The unit has been successful in obtaining external funding to support sustained academic collaboration. A £96K British Council-funded UKIERI research cooperation award supported extended exchange visits between RGU (**Wiratunga**, **Craw**, **Lothian**, **Massie**) and IIT Madras during 2007-2011. This resulted in several joint publications and collaboration between the groups continues. A £46k EU FP7 Marie Curie Staff Exchange scheme, Qontext, led by **Song**, supported exchanges between information retrieval research groups at RGU, Glasgow, Padua, Brussels, Queensland, Montreal and Tianjin universities in 2010-2012. **Song** later moved to Tianjin.

The unit belongs to two major government-funded research pools, SICSA and NRP. **Scottish Informatics and Computer Science Alliance (SICSA)** is the research pooling for Computing in Scotland of which RGU was one of ten founding members. SICSA aims to develop and extend Scotland's position as a world leader in Informatics and Computer Science research. RGU staff play leading roles in SICSA. **Craw** and **McCall** are on the SICSA Steering Committee. **McCall** is Theme Leader for the Complex Systems theme, the largest interest grouping in SICSA. **Wiratunga** is a member of the SICSA Early Research Career funding review committee and **Petrovski** is on the SICSA Education Committee. RGU staff have organised and hosted several SICSA-funded workshops and events. SICSA has part-funded three studentships at RGU supervised by **McCall**, **Petrovski**, and **Wiratunga**. **Northern Research Partnership (NRP)** is a partnership with the universities of Aberdeen and Dundee. The goal of NRP is to develop a critical mass of research excellence in engineering and related disciplines. **Holt** is Director of the Joint Research Institute for Computational Systems in NRP. **McCall** is Depute Director of the Complex Systems JRI and **Craw** is a member of the NRP Management Board. NRP supports a chair in information retrieval at RGU,

originally held by **Song**, now replaced by **Goker**. NRP has also supported 4 research studentships in this unit.

We collaborate with a wide range of companies in sectors where our expertise is needed to add value. This informs our research and increases our experience and awareness of real world concerns. Engagements range from short proof-of-concept studies of around £5K value through 3 – 6 month studies and internships to large funded projects such as KTP, direct industrial funding or EU projects. For example, a 12 month project funded by British Telecom, supervised by **McCall**, applied metaheuristics to the tuning of a field workforce simulator used for management decision support (see Impact Case Study 2). A 6 month, £68K project at haulage company ARR Craib, led by **McCall**, developed optimisation software to assist in the real-time control of truck operations.

The expertise of the unit lends itself to interdisciplinary research and we have informed our future strategy through interdisciplinary engagement with industry. **McCall** led a scoping study on innovative condition monitoring and control (ICAN) of subsea installations for the National Subsea Research Institute (NSRI - www.nsri.org.uk). The study involved 16 academics from RGU (**Craw**, **Holt**, **McCall**, **Petrovski** and **Wiratunga**), Newcastle and Aberdeen universities. As well as forging strong links with the oil and gas industry, the study identified major opportunities for our research to impact this important global industry. This fed into development for our future strategy and laid a strong foundation for the industrial partnerships we are now developing.

National or international advisory board memberships:
Allison: non-Executive Director, ScotlandIS, the national IT trade body. **Craw:** Frank Knox Scholarships Selection Panel for Harvard (2004-2009). **McCall**: Director of TECHFEST (not-for-profit public awareness of science co. Local organisers of British Science Festival, Aberdeen 2012)

Leadership in industry, commerce, Research Councils, societies or professional bodies:
Craw, **Holt**, **McCall**, **Petrovski**, **Wiratunga**: SICSA and NRP - see above**. Bass:** Secretary IFIP Working Group on Social Implications of Computing in Developing Countries. **Craw**, **McCall**: EPSRC Peer College. **Craw**: Steering Board, Scottish Sensors Systems Centre. **Gaber**: International Panel of Expert Advisers for the Australasian Data Mining Conferences. **Holt**: Director of Computational Systems JRI, NRP. **McCall**: IEEE Intelligent Systems Applications Technical Committee, IEEE Evolutionary Computation Technical Committee. **Tu:** Executive Committee, IET Multimedia Communication Networking, 2011 - 2012. **Wiratunga**: Executive member, BCS SGAI.

Conference Programme Chairs:
Craw: Chair, IJCAI Workshop on Grand Challenges for Reasoning from Experiences, 2009; **McCall:** EDA Track Chair, ACM GECCO 2013, Co-Chair: UKCI 2013; **Tu:** Chair, Int. Wkshp Wireless Multimedia Networking and Applications, 2009. **Wiratunga:** Co-Chair 19th ICCBR**.**

Invited Keynote Lectures:
Allison: KT, CMMI 2013; **Craw:** KT, 30th BCS SGAI Int. Conf. on AI; KT, 8th ICCBR 2009; **Goker:** KT, 15th Int Conf on Electronic Publishing, 2012; **Kannangara:** KT, IEEE SOCC 2008.

Election to Membership or Fellowship of Learned Societies:
Allison, Bass, Craw: Fellow of BCS; **Bass** Senior Member IEEE.

Journal Editorships:
Allison: Assoc. Ed., Jnl. of International Technology and Information Management; **Bass:** Sen. Ed., Electronic Jnl. of Information Systems in Developing Countries; **Goker:** member of Ed. Board Jnl. of the American Society for Information Science and Technology; **Wiratunga:** Ed., BCS SGAI Expert Update, 2008 – 2011.

Fellowships, Awards and Prizes:
Allison: Best paper award IEEE Conf. on Cog. Meth. in Situation Awareness and Decision Support, 2011; **Gaber:** Australian Postdoctoral Fellowship (2008-10), Monash University (only 120 per year awarded nationally); **Goker:** RSE Enterprise Fellow, MIT Entrepreneurship Development Programme, Team Winner 2009.

Other Gaber: grant application assessor for the Swiss National Science Foundation, **Goker:** EU-IST R&D Project Reviewer, grant application assessor for Norwegian Research Council R&D, **McCall**: grant application assessor for Netherlands Science Research Council (NWO) (2011)