Health and Safety Executive Board			HSE/12/07
Meeting Date:	25 January 2012	**FOI Status:**	Open
Type of Paper:	Above the line	**Exemptions:**	
TRIM Reference:	2011/654113		

Science Report 2012

Purpose of the paper

1. The Board has asked for an annual Science Report to cover the use, efficiency and effectiveness of HSE's investment in research and technical support commissioned from the Health and Safety Laboratory (HSL) and external contractors. This is the fourth of these Science Reports.

2. The Board is asked to note and comment on the report and oral briefing from the Director of Science (DS).

Background

3. HSE's mainstream budget for commissioned research and technical support in 2011/12 is ~ £33m[1]. In addition, about 1000 staff use their knowledge and skills to contribute scientific, engineering, technological and analytical expertise to the management of risk and development of evidence based policy.

4. This work is essential underpinning for HSE's role as an evidence-based regulator. It develops HSE's extensive knowledge base and intellectual property, which gets national and international recognition for its quality and potential market value.

5. The annual Science Report for 2012 is at Annex 1.0 and describes:

- background information about HSE's scientific requirements;
- how HSE uses science and research in its work, with examples of recent applied research and investment in HSE's futures work;
- how HSE is working to demonstrate the value of its commissioned work;
- progress towards the rolling science plan 2012/15;
- the long-term Strategic Research Programme at HSL;
- an update on the new science commissioning and management arrangements and the specialists' review;
- some emerging risks and future challenges.

[1] This excludes funding for science to support the Office for Nuclear Regulation and which has separate arrangements and the pesticides research programme that is funded by DEFRA.

Argument

6. The Science Plan for 2011-14 was prepared during 2010 and is based on the Strategy. The Plan is based on needs stated in business cases approved by directors. The Science Plan incorporates a strategic statement for science which is also included in this Science Report (Annex 1.7).

7. The budget for research and technical support for 2011/12 is reduced compared to last year by ~11% and will continue to reduce year on year for the period of the Spending Review 2010 (SR10). Funding for the Science Plan was allocated from the mainstream research budget to meet reactive support requirements in full, before resources were allocated to research projects.

8. The Chief Scientific Adviser and head of the Chief Scientific Adviser's Group (CSAG) was responsible for HSE's science until 31st March 2011. From 1st April 2011 responsibility passed to Dave Bench, the new Director of Science (DS). The DS heads two Directorates – the Chemical Regulations Directorate and the Corporate Science, Engineering and Analysis Directorate (CSEAD; formerly CSAG).

9. The Science Report 2012 explains arrangements for scientific work and includes examples of research completed and published in 2011. It provides some detail on the use and value of research and technical support. It provides an update on progress with the three year rolling science plan, including details on the newly established long term strategic programme of research at HSL. A progress report on the changes to make HSE's science governance arrangements more efficient is also given.

10. The report describes how the quality of scientific work at HSL is being demonstrated in terms of peer-review and briefly outlines the progress of the specialists' review.

Action

11. To note and comment on the Science Report 2012 and to support the DS in his approach to science planning, improvements in commissioning and disseminating science and to support the progress made with evaluating science.

Paper clearance

12. This paper was cleared by SMT by correspondence on 22nd December 2011.

Annex 1.0

Health and Safety Executive

Science Report 2012

1. Executive Summary

1.1 HSE's mainstream budget for commissioned research and technical support in 2011/12 is ~ £33m[2]. This budget is ~11% lower than last year and will reduce each year for the period of the Spending Review 2010. HSE devotes much of this funding to support investigations, enforcement and other front-line work. In addition, HSE has commissioned about 180 new research and technical support projects. This year there has been some reduction and slow down in extramural spend, partly due to closer scrutiny of proposals by senior managers.

1.2 The criticality of HSL's scientific contributions to successful investigations and prosecutions has been examined. The opinion (from inspectors and legal advisers) is that when scientific support is requested from HSL, its contribution to investigations/ prosecutions is frequently crucial, or provides important reinforcement. The value and impact of our science in the achievement of key business objectives has also been examined using an on-line questionnaire. Two thirds of respondents considered work to be 'good' or 'excellent' value for money. The value of HSE's science continues to be recognised by others and a number of staff have been presented with awards.

1.3 In April 2011 three longer term Strategic Research Programmes were established at HSL which will enable HSE to understand future risks. HSE continues to support HSL's Investment Research Programme which has significantly increased the investment in developing scientists to enable them to apply their skills in line with HSE's needs and the external market.

1.4 The impetus to communicate the scientific findings from HSE funded work has continued and at HSL there has been an increase in the amount of work disseminated and published through the peer reviewed literature.

1.5 This year has seen a reduction in the number of proposals put forward for inclusion in the three year rolling science plan; this may reflect the reduction in the science budget and changing demands on specialists. The implementation of the new arrangements for the procurement of science via directorates is underway. A single commissioning team has been created with some reductions in staffing resource.

2 Background

2.1 HSE commissions research and technical support to:

- support HSE's front line operational work, using forensic work and technical support for inspections, investigations and enforcement;
- acquire evidence to develop new ideas and knowledge about occupational safety and health;

[2] There are separate management and funding arrangements for science in the Office for Nuclear Regulation (ONR) and the Chemical Regulation Directorate (CRD). ONR and nuclear licensees work together to manage a programme of support and research which is funded by licensees. CRD manages a pesticides research programme that is funded by Defra.

- apply new ideas and knowledge to regulations, policies, guidance, standards, inspections, enforcement methods and other interventions; and
- evaluate and disseminate the new knowledge and results of this work.

Support for operational and regulatory work

2.2 HSE's core requirement is for scientific, technological, engineering and medical support for its operational and regulatory work. As in previous years, this requirement accounts for about 2/3 of our expenditure on commissioned science. It includes support for investigations and major incidents conducted by both HSE and Local Authorities.[3]

2.3 HSL is HSE's principal provider of forensic scientific support and has expertise and capacity in a wide range of disciplines. In 2011/2012, HSE commissioned ~ £7.5m support for investigations and major incidents from HSL. HSE also commissioned ~ £0.5m support from other providers where HSL has limited or no expertise.

2.4 HSE commissions ~ £14m planned support (mainly from HSL) which covers a range of activities, principally running operational and policy projects and developing HSL's capability. This is to make knowledge and information available to HSE to discharge functions such as developing early thinking on policy formulation.

Research

2.5 HSE commissioned ~£11m of applied research in 2011/2012[4]. HSE does not normally commission pure, academic or blue-skies research. There is 'futures' capability at HSL to identify emerging trends and technologies to inform HSE's future priorities and strategy.

2.6 Wherever possible, HSE aims to commission research in partnership with relevant industries and stakeholders, and collaborates with national, international and EU programmes.

Futures work

2.7 Futures work continues to have an influence on HSE strategy and science planning. Horizon scanning and futures work can help to identify future priorities in good time so that HSE is well positioned to react appropriately to future issues and to target resources in areas where changes in technology might radically change the issues. For more information on Futures work in HSE see Annex 1.3.

3 Overview and use of science in 2011/12

Mainstream research

3.1 As in 2010/2011, commissioned work was managed in four main science programmes:

[3] Annex 1.1 includes a glossary of definitions of reactive support, planned support and research.
[4] Annex 1.2 includes criteria for commissioning science

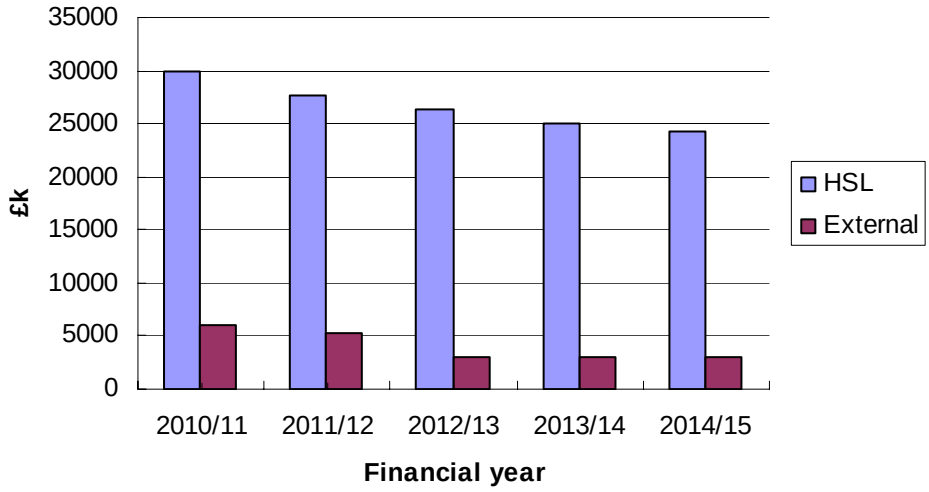
- Conventional Health and Safety – mainly research that supports the development and delivery of policy initiatives and operational interventions.
- Corporate – covering projects with a longer term or analytical perspective, important work not managed elsewhere, and currently includes resource to develop and maintain capability at HSL.
- Justice - covering technical support for HSE's inspection, investigation and enforcement work, and for Local Authorities; and
- Major Hazards – support for HSE's work in the major hazards sectors: offshore and onshore, mines, explosives and biological agents,

3.2 In July 2010 the then Chief Scientist (CS) issued a call for proposals from HSE Directorates and science customers to be considered within the 3 year rolling Science Plan. The 2011/12 Science Plan took account of the Strategy and involved policy makers, specialists from HSE and HSL. The content of the plan was agreed by directors and senior managers and approval to commission a number of extramural projects was given at Ministerial level.

3.3 During 2011 the science programmes have commissioned about 180 new projects of varying size.

Finance and cost recovery

3.4 In line with budget allocations following the spending review, in 2011/2012 HSE planned to spend £27.7m with HSL and £5.3m with other contractors. This represents ~8 % and 13% reduction in spend on research and technical support with HSL and external providers, respectively, compared to 2010/11 baseline figures. The science budget will continue to decrease over the SR10 period and we will continue to prioritise research and technical support to underpin delivery of our operational and regulatory responsibilities. The chart below illustrates the allocations of the mainstream budget for HSL and external providers over the SR10 period, assuming the base case in HSE's Financial Strategy.



3.5 The allocations of the mainstream science budget to the four science programmes were:

- Conventional Health and Safety - £5.57 m
- Corporate - £10.06 m

- Justice - £ 11.94m
- Major Hazards - £5.46 m

This year there has been some reduction and slow down in extramural spend in the Conventional and Corporate programmes. There are various reasons for this including closer scrutiny by senior managers of proposals linked with tighter controls being exerted through HSE's Corporate Efficiency Board.

3.6 There are a number of on-going science projects that are jointly funded with industry or have some collaborative funding. For example, in the Corporate programme there are 4 out of 24 extramural commissions and the value of these is ~ £27m, with HSE's contribution being £780k, approximately 3% of total sponsor contribution. For the Conventional Health and Safety science programme, 5 out of 13 extramural commissions have collaborative funding. The value of these is ~£1m, with HSE's contribution being ~ £500K, or 58% of total sponsor contribution.

3.7 Approximately £1.95m of the allocation to Major Hazards science programme in 2011/12 is cost recoverable. This follows our policy to recover costs incurred in the operation of permissioning regimes, either as costs attributable to an individual company or as 'common good' work. This equates to approximately £1.3m of "common good" activity, together with £560k of COMAH assessments and £100k of offshore assessments which are directly recoverable from an individual site or dutyholder.

Examples of research work completed in 2011

3.8 The work includes a diverse range of topics and requirements, including:

- Development of a web-based Leadership and Worker Engagement toolkit for small and medium enterprises in construction
- Good control practice for workers' exposure to gases in landfill
- A programme of work to help ensure a legacy of improved health and safety management, performance and practice (London Olympics 2012)
- An update of the literature on age and employment
- Improving the diagnostic criteria for work-related upper limb disorders for use in prevention and patient care
- Research to explore how medium sized organisations understand occupational health issues and manage health risk
- Routes to competence in the construction sector
- Evaluation of the impact of the Agriculture Revisited Programme
- 10 year review of the Iron Mains Replacement Programme

Annex 1.4 describes some of this recently completed work.

Demonstrating the use and value of work commissioned or completed in 2011

Reactive support

3.9 HSE commissions science from HSL and external contractors to provide immediate and high quality support for its operational activities - investigations, inspections and enforcement activity. Annually, HSE investigates about 4000 incidents which meet HSE's published Incident Selection Criteria and institutes around 500 - 550 prosecution cases. A degree of scientific support from

HSL (and external contractors) is required in around 12 – 15% of these investigations (550 – 600 annually) and in at least 10% of prosecutions (at least 50 per year).

3.10 In 2010/11 the budget for reactive support was approximately £8.0m, the greater part (£7.5m) from HSL. Around 80% (£6m) of the budget with HSL supported incident investigations undertaken by FOD and HID, the remainder funds technical matters identified during inspections.

3.11 This year we examined the criticality of HSL's scientific contributions to successful investigations and prosecutions systematically, using available data sources.

3.12 The prevailing opinion (from inspectors and legal advisers) is that when scientific support is requested from HSL, its contribution to an investigation or prosecution is frequently crucial, or provides important reinforcement. There was no evidence that delays in work or report delivery had affected the progress of the cases discussed. In some court cases the reports are left in 'draft' form so that they can be readily amended with additional material, if required.

3.13 Situations where HSL input has been considered to be vital include:

- the use of visual presentation services (including digital enhancement, aerial photography, laser mapping, computer modelling) to aid reconstruction of incidents and simplify prosecution cases, particularly where judges, magistrates, coroners and juries need a clear understanding of events leading to catastrophic failures of structures or processes.
- Identifying the causes of failures or explosions within complex or devastated industrial sites – using mechanical engineering and explosions safety expertise. Remotely operated cameras attached to unmanned aerial vehicles also play an important part in recording events at devastated sites that preclude other means of access.
- Investigations management (evidence collection and storage) and forensic problem solving.
- Occupational hygiene and supporting analysis.

Case studies highlighting HSL involvement in investigations

3.14 During our work on assessing the utilisation and value of reactive support we have interviewed investigating inspectors and specialists who have provided feedback on the contribution that HSL has made to specific investigations. The four cases mentioned here are examples of how HSL's analytical sciences contribute to successful prosecutions:

1) A fatal injury occurred in an engineering workshop during some practice welding taking place on the top of a drum that had been modified so that it could be used to collect liquid wastes and residues from the workshop. The drum exploded propelling the upper part and metal pieces resting on top of the drum upwards, impacting the welding mask and body of the person and passing through the roof of the building. HSL assisted the prosecution by analysing residues from the explosion, together with pure substances and products in the workshop. They demonstrated that the source of the xylene and toluene implicated in the explosion were components of a particular thinner used in the workshop. HSL also confirmed that the temperature of the weld spatter was sufficient to cause the ignition of drum

contents. Their analyses were crucial to bringing and winning the case as their report once sent to the defence resulted in a guilty plea.

2) An incident occurred during the operation of a fridge recycling machine at a recycling facility. The worker climbed up into a confined space to free a jammed fridge door, and passed out. HSL measured the oxygen levels at the site and showed that the oxygen concentration was only 13.5%. If the measurements had not been taken, HSE would still have prosecuted, but having measurements of the oxygen levels strengthened the case and disputed the defence that the operator had a respiratory complaint.

3) HSE had learned that a factory producing lead crystal was not carrying out blood lead measurements on its staff. The investigating inspector visited the factory with an HSE medical inspector and a field scientist .Blood samples were taken and analysed by HSL- they showed high levels of lead. HSL then made a site visit to measure air and surface contamination, which showed very high exposures. The measured lead levels proved that there were not just material, but serious, breaches of the Control of Lead at Work Regulations on which the company could be prosecuted. If HSE had known only that bloods were not being taken, and had not known the level of contamination, HSE would have brought lesser charges.

4) An incident occurred at a manufacturer of security products whilst a worker was applying a flocked surface to the inside of an under floor safe. He had first applied an adhesive and was then using a flocking machine that dispersed the flock within the inside of the safe. The adhesive was flammable, and the flock electrostatic, which created a spark leading to an explosion that resulted in the worker suffering serious burns to his left hand and wrist. The safety data sheet for the adhesive was poor but HSL confirmed that the adhesive was flammable. HSL also confirmed that the nylon flock was an explosable dust. They also showed that the solvent used to thin the adhesive and clean the brushes was highly flammable. This evidence was crucial to the prosecution, and influenced the defence to plead guilty.

Research and planned support projects

3.15 In the previous Science Report we acknowledged that procedures for demonstrating the value and impact of our science in the achievement of key business objectives needed improvement. We have now developed a short on-line questionnaire which provides feedback from customers about project outputs, potential users of results and information about the project's timeliness, costs and quality. At present we are trying to obtain data from a sample of all projects completed over the last 2 years and the plan is for all customers to receive the questionnaire shortly after project completion, whilst it is fresh in minds.

3.16 We will build on information provided in the feedback questionnaires to create a picture of the overall 'impact' of the science associated with individual topics – to follow up whether results were used as anticipated and to obtain a view of their contribution to operational delivery or policy development.

3.17 Initial analysis from the first 36 completed questionnaires show there are some emerging trends to be explored further as the numbers of responses increase. There is an indication that customers commissioning research or planned support may be less satisfied with the outputs than those commissioning reactive support (or

conversely that HSL are more able to meet the requirements of those commissioning reactive work).

3.18 Approximately two thirds of respondents considered the work to be ‘good’ or ‘excellent’ value for money. This seems to reflect the responses to other questions - whilst the majority considered the scientific quality and delivery to be ‘good’ or ‘excellent’, only half of respondents considered the objectives to be fully met and fewer felt that the business need or knowledge gap had been fully addressed. Improvements in the scoping of work at the initial commissioning stage should lead to an increase in the numbers of respondents who consider the work to have fully delivered.

3.19 About three quarters of respondents considered that the timescale of the work enabled them to use the results as planned, and a similar number state that the project did not exceed its original cost. In the small numbers of replies that were associated with increased project costs, or project delays, the reasons cited included extensions to scope, particularly in situations where the research led to new ideas requiring further development, or where unforeseen issues required resolution before further progress could be made. Delays associated with the customer or contractors were reported in approximately equal measure. These observations about timeliness and cost are broadly consistent with those seen and reported in previous years.

Lessons learned:

3.20 Data from the questionnaire are stored in spreadsheet format. As the dataset increases it will be possible to analyse by programme, contractor or topic, to follow up individual observations or to examine project outputs in context.

3.21 The individual reports provide useful lessons to learn from projects that have not gone according to plan. For example, feedback following the early termination of a longitudinal study into vibration-induced injury explained that the contractors had been unable to recruit a sufficient number of volunteers, despite strenuous efforts and the good working relationships with contacts and employers. This experience has been fed back to Science Business Partners and will be taken note of in the design and approval and design of any new longitudinal studies (e.g. in the occupational health area).

3.22 Using the contract management system, this year we have provided data for the Senior Management Team on commissioning and performance. Data on projects commissioned during 2011 show that ~23% of projects have been amended to reflect changes in time, cost or both; this is the same as last year. ~7% of projects have been amended at least 4 times. Variations from plan are made to reflect changes in HSE’s requirements, delays due to the suppliers or unavoidable circumstances (e.g. bad weather affecting outdoor experimental work and technical issues).

Building on project feedback to assess impact:

3.23 We are piloting an approach with selected topic areas to examine how science has contributed to policy development or operational activity, building on information collected in the feedback questionnaires. The approach will work through an end-to-end assessment, from scoping the topic and identifying projects,

through process evaluation and moving from identification of how outputs have been used and disseminated towards a consideration of the outcomes and a view of the consequences of not doing the research. The first two topics under consideration are societal risk and slips and trips and we plan to report on these next year.

Olympic research projects

3.24 In previous reports we have outlined a number of research projects within the Olympic Delivery Authority's (ODA) 'Learning Legacy' programme. On 17th October this year, the ODA launched the Learning Legacy website at the Institution of Civil Engineers. The website contains project details and all full research reports will be published over the coming months. The first report 'Leadership and worker involvement on the Olympic Park' has recently been published (see case study 3, Annex 1.4). This body of research will serve both to share with relevant sectors the health and safety experience from London 2012, and to inform planning by future host cities.

3.25 The ODA was the winner of the Safety and Health Practitioner (SHP) IOSH awards for 2011 in the 'Best in Construction' category and a finalist in the 'Innovation of the Year' category. The innovation citation in SHP noted that the ODA had set out to define standards across the whole programme. Its work on 'Visual Standards' used research prepared by the Steel Construction Institute and Loughborough University (commissioned by HSE) on the 'Trojan Horse health and safety messaging' project to provide high quality photographic illustrations of acceptable and non-acceptable standards across the London 2012 programme. The judges liked the fact that this simple concept provided a great example to others and could be easily adapted by other projects.

HSL Strategic Research Programmes

3.26 From April 2011 new arrangements were put in place to develop longer term Strategic Research Programmes (SRP). The aim of the SRP is to provide longer term work that is ambitious, multi-disciplinary and collaborative across HSE/HSL and beyond. The SRPs are intended to ensure that HSL staff develop their capabilities and knowledge, that HSE is gets better value from its investment in HSL and is better prepared for future changes in the workplace that may give rise to new risks.

3.27 The HSE Strategic Research Committee (SRC) approved funding in February 2011 for three SRPs (£2.3m/annum over 3 years):

- Health,
- Developing mathematical modelling to address current and emerging health and safety issues and,
- Capturing the occupational exposome: exposure and response profiling.

Each project has a Governance Board with representatives from HSE, HSL and an external independent expert, to scrutinise resources, ensure project progress to achieve delivery and monitor responsiveness to HSE business needs.

3.28 The main aims of the '*Health'* SRP are to develop quantitative methodologies and an accompanying evidence base to allow effective intervention strategies to be planned, implemented and evaluated for long latency diseases of high concern, such

as chronic obstructive pulmonary disease (COPD), asthma and silicosis; and to help coordinate health surveillance across UK workplaces, increasing participation by promoting adoption of effective schemes including establishing a free-to-use web-enabled suite of health surveillance tools.

3.29 The '*Exposome'* SRP will gather information about new hazards from new substances and new risks from 'old' hazards used in new ways. The goal is to improve HSE's intelligence of, and response to, emerging workplace health issues in an environment of constrained resources. Initially work will involve extrapolations from some current investigations e.g. recycling, isocyanates and silica.

3.30 The '*Developing mathematical modelling to address current and emerging health and safety issues* ' SRP aims to develop and widen the scope of the mathematical solutions HSL can provide to support current and emerging health and safety issues, in particular dense gas dispersion modelling and the integration of quantified risk assessment into geographical information systems (GIS).

3.31 These projects are relevant to specialists, policymakers and inspectors across HSE; it is intended outputs be highly visible and widely disseminated, be it sharing nuggets of insight or in-depth findings. We will report to the Board on the progress of the SRPs next year.

Communicating results

3.32 Research publications are scrutinised by contractors, customers, SCS and Press Office before addition to HSE's website. This year we have continued to identify a small proportion of research reports that fail to meet appropriate standards - some are poorly written in terms of scientific clarity, others fail to articulate the original purpose for commissioning the work or describe the expected benefits of undertaking the work.

3.33 Recent steps to improve science planning and management which ensure that future use and benefit is properly considered during the initial commissioning process should lead to a fall in the numbers of unacceptable reports. Furthermore work at HSL to address improvements in report writing (e.g. one day writing course, January 2012) should raise their quality. We will continue to monitor this aspect of publication and provide feedback to the Board.

3.34 Publication in peer-reviewed journals is an indicator of the quality of scientific work, and is recognition of the status of HSE and HSL in the science of health and safety at work. These publications are also an important means of disseminating findings to and engaging with key stakeholders. Peer-reviewed publications are particularly important where work provides part of the evidence base to inform significant policy or guidance development; is likely to be used to challenge information used by duty holders; or may be subject to challenge where it is used to inform responses to high-profile issues raised by interest groups. At HSL there has been an increase in the amount of work disseminated and published through the peer reviewed literature - there was a 40% increase in the number of papers published between 2009 and 2010 and HSL are on course to see a further increase in 2011 over 2010.

3.35 To ensure HSE-commissioned research is disseminated through peer review where appropriate, HSE introduced the 'Added Value' initiative in September 2008 to

fund the publication of work where there is clear value to HSE, but where a publication was not part of the original work commissioned: for instance lessons learned from incidents. In 2011, 15 'Added Value' papers were published; these are prefixed with # in Annex 1.5. During 2011, the Director of Science (DS) has continued to strengthen measures to ensure that, at the commissioning stage, the default report for scientific work should be output in a format suitable for publication as a peer reviewed paper.

3.36 Annex 1.5 lists HSL's 2011 scientific publications from January to October 2011. These describe work undertaken for both HSE and external customers.

3.37 This year we have examined the quality of HSL's work as described in previous Board Science Reports (over the three year period 2008-2010) by assessing the 'impact factor'[5] of the journals in which articles (excluding conference proceedings/abstracts) were published.

3.38 The average IF of journal that HSL published in during 2008 was 2.4, in 2009 it was 2.73 and in 2010 the average IF was 2.54. It appears that the average IF value is stable and there has certainly been no decline in the quality of journal in which work has been published over the last few years. It should be noted that the relatively low average impact factors shown here reflect the specialised work of HSL and the associated narrower audience for the findings.

3.39 Of particular note this year, was the publication of an edition of the international peer-reviewed journal 'Occupational Medicine' (IF 1.431), entirely dedicated to HSL's centenary. The August 2011 issue celebrated 100 years of HSL's mission to enable a better working Britain. The issue included papers relating to mortality and cancer among British agricultural pesticide users, health surveillance for noise and hand-arm vibration, the impact of worker education on respiratory sensitization in bakeries and medium-density fibreboard and occupational asthma. The editorial charts HSL's evolution from an experimental coal dust explosions facility in Cumbria to the research organisation it is today. As HSL has been the most frequent single contributor to this journal over the last five years a special virtual issue was also produced for subscribers.

3.40 Also of note this year was the publication of an HSL Centenary Edition of the international peer-reviewed journal, Process Safety and Environmental Protection (IF 1.453). This edition is disseminating important findings on process safety (including Buncefield research) to key stakeholders in industry and academia and raising the profile of HSL as a key national and international player in this research area.

3.41 Publications prepared by external researchers following research commissioned by HSE with them are listed in Annex 1.6. The provision of peer-reviewed papers is not enforceable contractually, these are therefore difficult to trace. The reduction in the number of these publications compared to last year may be a reflection of recent reductions in the budget for extramural research.

[5] Impact factor (IF) is a measure of the frequency with which an article has been cited in a particular year or period and relates to the importance of a journal within its field – the higher the IF the more important the journal. For example, the IF of the 'British Medical Journal' is currently 13.471 compared to an IF of 3.494 for the journal 'Occupational and Environmental Medicine'.

3.42 During 2011 the value of our science has been recognised by others and a number of HSE/HSL staff have been presented with awards, these included:

- the RoSPA Distinguished Service Award presented to HSE's Professor Colin Mackay. The award is given to those who have made an exceptional contribution to society through their work in health and safety.

- an IOSH award 2010 - HSE and its partners, the Scottish Centre for Healthy Working Lives, Scottish Chamber of Safety and RoSPA won the Partnership Initiative of the year award (October 2010). The award was for the Health Risks at Work - Do You Know Yours? initiative - a DVD and reference booklet which explains health risks in straightforward terms for small businesses. HSE's Bob Rajan has been HSE's driving force for this initiative.

- an IChemE award to mark the centenary year of HSL and in recognition of its contribution to the cause of better process safety and environment protection.

HSL's Investment research Programme (IRP)

3.43 HSE continues to contribute to HSL's Investment Research Programme, IRP. The IRP enables HSL to undertake innovative research and develop links with other institutes in order to develop new capabilities, methodologies and experimental approaches. This allows HSL to continuously develop and strengthen its ability to deliver practical solutions to health and safety challenges for both HSE and external customers. In 2011/12, there has been a significant increase in investment in developing scientists to enable them to apply their skills to new applications. This is to proactively reshape HSL's scientific capabilities in line with HSE's evolving needs, as well as growth areas for external work which will offset the planned reduction in scientific work placed by HSE over future years.

3.44 IRP funding is allocated to: strategic programmes (about 40%); product development (about 15%); and individual projects (about 45%) including research, scientific publications and scientific activities to underpin development of training courses delivered by HSL. HSE's funding contribution in 2011/12 will be approximately £1m (57% of the £1.75m total).

3.45 Newly commissioned research in 2011/12 includes: strategic programmes to expand capability on Geographical Information Systems, promote the culture of scientific knowledge exchange within HSL and develop inter-disciplinary heath and safety consultancy; and research projects into materials for 4th generation nuclear reactors, medical implant device safety, and the determination of inorganic elements in lung tissue.

3.46 Recent IRP work has allowed HSL to:

- develop apparatus to generate and measure aerosolised microorganisms thus enhancing research capability in infection spread and control;
- incorporate inter-individual variability in metabolising industrial chemicals into the HSL 'POPGEN' mathematical tool, which generates virtual human populations for physiologically-based pharmacokinetic modelling;
- develop expertise in modelling fluid-structure interactions for applications such as the response of structures to fire and blast;

- undertake and publish a systematic review of preventative behavioural interventions for dermal and respiratory hazards;
- construct new diagnostic criteria for extrinsic allergic alveolitis that can be used in any future investigations of outbreaks among metalworking-fluid workers;
- develop a screening tool to identify workers with undiagnosed chronic obstructive pulmonary disease; and
- prepare and publish a position paper on the implications of climate change for workers' health.

4 Progress on the Science Plan for 2012 and beyond

4.1 As agreed by the Board, the 3-year rolling plan will continue to be structured to follow the themes and goals of the Strategy.

4.2 This year 'HSE's Summary Science Plan 2011 and beyond' was published on HSE's website. The plan, which includes a brief Strategic Statement on Science (Annex 1.7), sets out how HSE will apply science and engineering resources to the delivery and realisation of its strategy goals over the next three years.

4.3 In June 2011 the DS issued a call for proposals to be considered within the 3 year rolling plan from 1st April 2012. From this date science commissioning arrangements are changing (see para. 5.6) and directorates will have responsibility for their own research and technical support, rather than the current system of funding science through programmes (e.g. Conventional Health and Safety, Corporate, Justice and Major Hazards). The DS asked that proposals articulate the benefits of the work and links to directorate delivery plans.

4.4 In line with the new commissioning arrangements (paras. 5.6-5.8) individual proposals are being approved by relevant directors in Corporate Science, Engineering and Analysis Directorate (CSEAD), Cross-cutting Interventions Directorate (CCID), Field Operations Directorate (FOD), Hazardous Installations Directorate (HID), Operational Strategy Division (OPSTD). Directors are therefore personally accountable for ensuring the work supports their delivery plans. The DS will provide scientific assurance for the overall science plan.

4.5 The science plan is being developed in collaboration with colleagues responsible for production of the Strategy Implementation Plans (SIPs) to ensure that all sector science requirements that have been identified during development of the SIPs are incorporated into the science plan.

4.6 CSU and the DS have reviewed ~ 100 proposals and subject to further consultation on scope and methodology with customers, the majority will be commissioned. Many proposals in key areas have been identified, these include:

- Sector-based requirements as identified in the SIPs e.g. waste and recycling, construction, offshore oil and gas, explosives etc.
- Corporate statistics and economic analysis to meet Board and statutory requirements;
- Long latency diseases, including occupational cancer and silicosis.

4.7 Compared with last year's call, there has been a reduction in the numbers of proposals submitted. This may be due to lack of specialist resource in certain areas

of the business and associated ability to identify areas where research is required. The DS has asked that Science Business Partners and CSU work to formulate proposals around themes for more long range issues e.g. non-HID engineering. These may be commissioned as part of the CSEAD science portfolio during 2012/13.

4.8 As in previous years, we have been working with HSL to give them early sight of proposals and therefore an indication of our potential requirements. This will help to match capacity and capability and to identify those areas of the laboratory where there is high demand and areas where staff may be under-utilised and work is declining, before finalising the commissioning process.

5 Specialist review and governance issues

5.1 SMT commissioned a Specialist Review in 2011 to ensure HSE has access to the specialist skills it needs now and in future. This review has confirmed the vital contribution that specialists make to HSE's business. Whilst the major requirement for specialist expertise is to develop HSE's evidence base and to deliver front line interventions, the review has also recognised the business critical contribution made by specialists to inform HSE policy and strategy development.

5.2 The review is currently developing options and proposals to improve how HSE manages and deploys its specialist workforce. This also involves developing the supporting infrastructure needed to sustain the specialist workforce, such as specialist competency and career review arrangements. Options and recommendations that build on existing processes and good practice already in use across HSE will be submitted to the Review Steering Group in early December 2011. Agreed proposals will then be presented to the SMT for approval in January 2012.

Emerging risks and future challenges

5.3 As highlighted in last year's report there are still a number of challenges which unless they are addressed will become significant business risks for research and technical support, these include:

- continuing difficulties prioritising HSE's work and external contracts at HSL in areas of high demand and specialised resources e.g. major hazards;
- reductions in HSL's science budget of up to ~20% over the spending review (SR10) period and its ability to offset this with increases in external contracts;
- scarcity of certain in-house expertise including the ability to identify important trends for HSE to acknowledge and research;
- whether staff as 'customers' will have the capacity to commission research along side pressing operational including cost recovery and other work;

Governance

Science review of HSL

5.4 The DS will continue with the plan to review the quality of HSL's scientific activities over a four-year period. The third of these science reviews was due to be conducted in October 2011, but due to difficulties recruiting external assessors it will

now take place in May 2012. This review will cover human factors and risk science and will also cover knowledge transfer by HSL including: development of guidance and practical tools, training courses; developing risk education for undergraduates in safety critical professions, and engagement with health and safety professionals through peer-reviewed journals and conferences. The review findings will be reported to the Board in the next annual Science Report.

Procurement of HSE science

5.5 Last year's Science Report, indicated that the review of science arrangements as requested by the Board in February 2010 was underway. The review reported in March 2011 and recommended that from April 2012 science budgets would be allocated to directorates and delegated to and managed by main budget holders. This means that from April and as part of HSE's Change programme, cross-directorate science commissioning will cease.

5.6 The new arrangements include making senior management accountability and responsibilities clearer and making arrangements for sustainable staffing of science procurement functions. The arrangements will ensure closer links between strategy implementation and directorate delivery plans and the research and technical support which will underpin these.

5.7 Implementation is being led by Corporate Science Unit (CSU) and progress to date includes:

- all staff responsible for commissioning science were brought together in April 2011 into a single team of currently 19.8 people within CSU. This is helping to provide a more consistent approach to commissioning in HSE and HSL;
- SMT are now receiving quarterly high-level progress reports on completion of commissioned research projects;
- CSU working with HSL to address capacity/capability issues early in the commissioning process;
- there has been a reduction of 5.2 FTE posts (equivalent to ~£240k payroll) since January 2011 in the commissioning staffing resource, some of these reductions resulting from HSE's voluntary exit scheme (February 2011).

Glossary

Scientific and technical support

Scientific and technical support for operational activities accounts for ~ 2/3 of HSE's spend This work generally involves the utilisation of existing information and/or provision of such information in a usable form. Most support work is characterised as meeting relatively short term, immediate operational demands. It is categorised as reactive or planned support.

Reactive support
Support is classified as 'reactive' if it used to:

- investigate a specific incident, or accident, and any subsequent enforcement activity;
- investigate local issues and matters of evident concern identified at inspections of particular factories/premises; or
- answer specific questions about HSE's policies e.g. Parliamentary Questions, Freedom of Information requests etc.

Planned support
This includes a range of activities to deliver HSE's requirements, principally operational and policy projects and developing capability. Most is supplied by HSL. Planned support includes:

- work to assimilate information and knowledge (through research, statistical analysis, attendance at professional events etc.) and make it available to HSE to develop early thinking on policy formulation, work planning, focusing customer contacts etc.;
- technical, social and economic advice for any topic area that falls under HSE's remit e.g. during negotiations and delivery of legislation;
- test method development;
- representational role at technical meetings;
- production of draft Approved Codes of Practice, sector guidance, guidance on the interpretation or application of legislation; and
- advice to the general public on scientific issues relating to health and safety

Research
HSE commissions little basic, blue skies research. Our requirement is for applied research, which, in contrast to support work, is generally original investigation in order to acquire new knowledge, but directed to a practical aim or objective.

HSE commissions applied research:

- to provide independent advice for regulatory purposes;
- where industries lack the relevant scientific and technological expertise;
- where industries require new ideas to stimulate and encourage improvement; or
- where availability of results could be restricted if research can be conducted by only one company.

Annex 1.2

Criteria for commissioning science.

These are the criteria for using science to deliver the Strategy.

HSE will:

- Use science to meet its role as a modern regulator to understand the most effective and efficient ways of securing improved health and safety outcomes.
- Use science with a strong focus on health and human and organisational behaviour, having regard for equality issues, and ensuring that money and resources are targeted at the delivery of the strategic priorities.
- Improve the linkages between science, policy and delivery and promote a better collaboration between scientists, policy makers and deliverers.
- Contribute to the development of Government science policy and apply it to all its work.
- Use its in-house resource, supported by external expertise where appropriate, to deliver its regulatory functions and contribute to the evidence base for the development of policy. This will be achieved through:
  - front line work (e.g. incident investigation; inspection; safety case and report assessment; standards & guidance)
  - cross-cutting activity (e.g. horizon scanning; generic guidance)
- Continue to apply research:
  - where independent advice is required by HSE on the extent and nature of the hazards and risks involved
  - where there is a need for informed HSE participation in national and international standards making
  - where information is needed in the light of incident experience or to support specific enforcement activities or policy initiatives
  - where projects are too risky for firms to go ahead with themselves, though there are clear health and safety benefits; for example, when timescales are long and/or the technical risks are high
  - when the particular part of industry lacks the relevant scientific and technological expertise
  - when entry costs are high for manufacturers of safety-related equipment and the industry is small and fragmented
  - where industry is complacent or not innovative and requires the stimulus and competition of new ideas to encourage improvement
  - when the potential beneficiaries are too diffuse for any one company to undertake the research on its own or the availability of results will be restricted
- Provide support for HSE's regulatory activities through the commissioning of scientific support, with HSL as primary supplier to:
  - understand the causes of incidents and ill-health
  - propose remedial measures
  - contribute to the evidence base to develop and deliver its priorities and programmes
  - make the knowledge gained widely available
  - have regard to, and use, relevant science activities in Britain and internationally. Where appropriate, HSE will seek opportunities to collaborate with others
  - make publicly available information on our science programmes, subject to over-riding considerations for national security and/or HSE's intellectual property policy

Annex 1.3

The work of the Futures Group

Established in 2005, the Futures Team, based in the Health and Safety Laboratory (HSL), has been identifying emerging issues of interest with the potential to impact on HSE and the health and safety system, producing a range of reports and other outputs. Since 2009 their work has been strengthened by input from the Futures Group. This Group, representing specialisms across HSE, meets two to three times a year to review topics and produce a pan HSE response. At recent meetings, the group has considered, for example, the hydrogen economy, waste and recycling, and prioritisation of horizon scanning topics. The prioritisation exercise revealed interesting results, with six energy related topics appearing in the top ten, reflecting the increasing importance of this area. Recycling remained high priority, while working practices/precarious working had risen up the list. Nanotechnology dropped from second to twenty-second reflecting perhaps that this topic had been absorbed into 'mainstream' work.

During 2010, HSE's Chief Scientific Adviser led a drive to encourage longer-term strategic research proposals, using the Futures Team's findings to stimulate forward thinking. The outcome in early 2011 was a series of Strategic Research Projects based at HSL to whose design the Futures Team contributed and in which they are participating. For example, 'Exposome', is a project investigating the potential for exposures to hazardous chemicals in a range of situations, including novel manufacturing environments. Rapid Manufacturing, identified as an up and coming issue in a 2007 report by the Futures Team, has been selected as the first subject to be studied in the Exposome project.

The HSL Team's involvement in the Strategic Research Programme has led to the identification of other projects in which futures can add a strategic dimension. For example, in a project looking at the future role of worker involvement, the Futures Team ran a scenario workshop for stakeholders using HSE's Scenarios for the Future of Health and Safety in 2017 to enable them to consider the role of worker involvement in a range of different futures. The various factors affecting worker involvement in each of four alternative futures ranging from high tech booming economy to risk averse make do and mend were considered.

As progress is made in embedding Futures into HSE's work, HSE's reputation in futures continues to result in invitations to contribute to external events. Examples of these include the Health and Safety Expo at the NEC and at the IOSH National Safety Seminar in September 2011. The theme of this latter conference was 'Cutting costs, not corners'. HSE is also represented on the Heads of Horizon Scanning group, organised by the Horizon Scanning Centre in BIS.

Following a decision in BIS that the work of the Horizon Scanning Centre in stimulating horizon scanning in departments had achieved its aim, and that BIS should focus on a number of high level projects, departmental futurists are taking it upon themselves to keep in touch. The HSL Team attended a meeting with futurists from several departments earlier this year and was invited to present at a multi-departmental event hosted by the Defence Science and Technology Laboratory in December 2011.

The project 'Foresight of New and Emerging Risks to Occupational Safety and Health Associated with New Technologies in Green Jobs by 2020', which is being

carried out by the HSL Futures Team with external partners for the European Agency for Safety and Health at Work (EU-OSHA) is into its third and final phase. This involves scenario workshops in four European Member States. Reports on the successfully completed first two phases are available on EU-OSHA's website. This two-year project is due to finish in Spring 2012. The results are likely to be of great interest to HSE, given the range of sectors involved. In particular, the strong representation of novel energy sectors links well to HSE's recent Emerging Energy Technologies programme, keeping HSE and the HSL Team at the forefront of new information and insights in these areas.

Examples of work completed in 2011.

Case Study 1 – Development of a web-based Leadership and Worker Engagement (LWE) toolkit for small and medium enterprises in construction

This report summarises the final phase of a project ongoing since 2007, aiming to improve health and safety practices in construction through leadership and worker engagement (LWE). A web-based, interactive toolkit was developed with SMEs in mind. In-depth feedback (workshops, focus groups, interviews) was obtained from 17 companies (13 SMEs) at key milestones. In parallel, the validity and reliability of a Health and Safety (cultural) Diagnostic Tool (HSDT) contained within the toolkit was examined.

The toolkit was found to be useful for SMEs; it met their needs, they wanted to continue its use, had secured some quick wins and thought that other SMEs would benefit from using it. The added value dimension of the toolkit was considered to be its prescriptive ('how to') nature with simple tools and techniques. The HSDT was considered to be sufficiently reliable and valid, and helpful for making sure that changes adopted suit the company's level of (cultural) readiness.

Important considerations for ongoing implementation of the toolkit once launched on HSE's website include: how to effectively market it to SMEs, setting up a support mechanism for users, keeping the toolkit 'live', and evaluating its effectiveness in practice e.g. through case studies of SMEs using it.

View the full report: RR880 - Development of a web-based Leadership and Worker Engagement (LWE) toolkit for small and medium enterprises in construction

Case Study 2 – Good control practice for workers' exposure to gases in landfill

Gases generated by decomposition of landfill contain, principally, methane and carbon dioxide, but may also contain hazardous concentrations of trace components. This project gathered information on the potential exposure of workers to trace components during specific types of tasks, to provide evidence to develop new guidance on good practice for the control of exposure.

In cooperation with the waste industry, the study was conducted at six land fill sites identified as having the potential to generate high concentrations of three representative trace components, vinyl chloride, hydrogen sulphide and benzene. Comparisons of personal exposures were made with the levels found in the collected raw gas. The personal task based exposures (given the environmental conditions prevailing at the time monitoring was conducted) were insignificant for all three components and would not normally pose a health concern.

View the full report: RR870 - Good control practice for workers' exposure to gases in landfill.

Case study 3 – Leadership and worker involvement on the Olympic Park

The aim of this research was to understand the degree to which various approaches impacted positively or negatively on worker involvement in health and safety (H&S) matters at the Olympic Park, and identify what could potentially be transferable both to other construction projects and to industry more widely. More specifically, the project sought to explore in more detail the range of initiatives and approaches used assessing their impact on worker involvement, attitudes and behaviours and other desired outcomes. The issues were explored through a literature review, analysis of existing data, four in-depth case studies of projects within the Olympic Park, interviews with senior leaders from the Olympic Delivery Authority (ODA) and CLM (a delivery partner appointed by ODA to manage the construction programme), and an indicative survey of worker views.

The ODA had a significant impact on H&S. One of the clearest elements in creating a strong safety culture was the role played by the ODA in articulating a clear vision, priorities and a strategy for H&S. The ODA produced a clear statement of its expectations which incorporated a set of standards concerning H&S, including requirements for effective (two-way) communication, behavioural safety, and reward and recognition. Project leaders (from both the ODA and CLM) engaged with the supply chain and developed a collaborative, mutually responsible, challenging and learning culture where contractors assumed accountability not only for their own area but across the site. There was also a willingness amongst the project leaders to stop work if standards were not met.

Effective communication both up and down the chain of command was achieved through the use of a variety of methods (induction, daily pre-task briefings, meetings, posters, safety alerts, anonymous near-miss reporting) and constant reinforcement. Multiple opportunities existed for two-way dialogue and this was supported by behavioural safety initiatives such as a course for supervisors designed to improve their communication skills and ability to engage the workforce. Providing feedback to workers on issues they had raised, and the actions taken as a result, was felt to be key to maintaining their engagement.

The commitment of senior managers to health and safety on site was emphasised by delivery of briefings, their attendance at H&S meetings, and their regular presence on site. Specific initiatives were aimed to encourage workers to observe and provide feedback on other work areas (with the permission of those working in the area). Good safety practice was recognised through incentives and awards.

The context for the research is a strong public commitment to safety from the ODA resulting in a remarkably good safety record that was recognised in the form of a five star award for safety from the British Safety Council.

View the full report: RR896 - Leadership and worker involvement in the Olympic Park

Case study 4 – An update of the literature on age and employment

Demographic trends indicate that the make up of the labour force in the UK (and other developed countries) is changing. Older workers are becoming more prevalent in the workforce, there are fewer new workers joining the labour force and older workers are continuing to retire early. These changes to the labour force could lead to labour and skills shortages in the future and have implications for the economy in terms of the age dependency ratio.

The research in this area suggests that employers can have stereotyped views of the abilities and attitudes of older workers, which can both positively or negatively, influence the retention and recruitment of older individuals. A previous report by Benjamin and Wilson (2005) considered some of the common stereotypes about older workers (over the age of 50) and provided evidence and arguments aimed at dispelling inaccurate perceptions about older adults. The Department for Work and Pensions (DWP) and HSE commissioned a report to review and update the Benjamin and Wilson report.

The findings of this updated review on the effects of ageing and employability are that there is little evidence that chronological age is a strong determinant of health, cognitive or physical abilities, sickness absence, work-related injuries or productivity. Where there is evidence of age-related declines, the consensus of opinion is that overall these declines do not generally have an adverse affect on performance or productivity. There is general agreement in the literature that work is generally good for physical and mental health and well-being of people of all ages including people with common health problems. The findings of this review suggest that older workers do not need to be treated any differently to younger workers as long as employers are aware that there may be a reduction in some physical and mental capabilities with age and that these can be identified on an individual basis and suitable accommodations put in place.

View the full report: RR832 - An update of the literature on age and employment

Case study 5 – Investigating diagnostic criteria for work-related upper limb disorders for use in prevention and patient care

Musculoskeletal disorders of the upper limb (ULDs) may be caused or aggravated by work, and may limit the capacity to work. However, their optimal classification remains controversial, with substantial disagreement among experts which makes the research literature for policy makers and practitioners difficult to interpret and impedes the surveillance of occupationally-related MSDs. The researchers proposed five requirements of a satisfactory classification scheme: 1) definitions that are clear, well documented, unambiguous and feasible to apply; 2) relevant and credible coverage; 3) repeatable findings; 4) agreement with a good reference standard (where there is one); and 5) practical utility in informing follow-on actions, such as risk control and better patient care. The evidence on classification by these criteria has been explored through literature searches and consultation with research experts from Europe and North America.

The report concludes that several schemes fulfil criteria 1-3, though the fourth is limited by questionable reference standards. Regarding utility, simple case definitions serve as well as complex ones for many preventive applications, including surveillance; differences are also sufficiently small to encourage data pooling. Less is known about optimal case definitions to guide patient care, and recommendations to improve research reporting are offered.

Optimal case definitions may vary with purpose. However, there is scope for moving towards a simpler, more rational, and better harmonised approach to classifying ULDs in many circumstances.

View the full report: RR869 - Improving the diagnostic criteria for work-related upper limb disorders for use in prevention and patient cure

Case study 6 – Research to explore how medium sized organisations understand occupational health issues and manage health risks

Research was commissioned to understand how duty holders in medium sized organisations of 50 to 150 employees in the construction, manufacturing and engineering sectors understand and manage health risks. The research was also designed to gain insights into the best ways for HSE to engage with them on this issue with a view to developing tailored support.

Findings showed that duty holders do not conventionally use the term 'occupational health' and indicated that while they are doing much to manage long term health risks, they do not separate health risk management from safety management. Management of long term health risks was seen as an integrated part of health and safety management. Therefore, any communications on this subject should avoid the term 'occupational health' and seek to address health risk management in the context of duty holders' overall health and safety duties.

The research identified three areas in which duty holders might require support and advice in their management of health risks in the future. These are (1) employee engagement (how to communicate health risks to employees and ensure they act in accordance with proper procedures); (2) resources (how to allocate resources to risk management appropriately and influence senior managers on this issue); and (3) legislation (how to keep abreast of legislative and regulatory changes and act appropriately on these).

HSE was seen as an appropriate provider of support and guidance on all of these issues and a range of delivery methods, including online, face-to-face and postal communications was identified.

View the full report: RR841- Research to explore how medium sized organisations understand occupational health issues and manage health risks

Case Study 7 - Routes to competence in the construction sector

The health and safety record of the UK construction sector is a prime focus of the HSE combining as it does high fatality and injury rates with relatively high rates of work-related ill-health. Persuasive proof of the link between competence and health and safety is difficult to demonstrate but, nevertheless, 'competence' has been central to improving the sector's health and safety performance since the late 1980s.

The key questions of this research were whether current routes to competence - qualifications (both work-based and college-based), short courses, safety passport courses, competent person development, as well as on-the-job mentoring and general experience - are adequate for the sector, and whether our understanding of what makes a construction worker 'competent', in the deepest health and safety sense, remains sufficiently robust for current-day needs.

Competence is evidenced directly by competence-based qualifications or indirectly by a plethora of card and passport schemes.

The research highlighted other safety-critical industries that require 'job competence', enhanced health and safety awareness, and, critically, 'human factors'. It concluded that the industry's current understanding of 'competence' may warrant extension to develop an 'industry-specific' definition and broadening to encompass both situational awareness and the sustaining of appropriate behaviours, throughout an operative's working life. This last is particularly critical as evidence points to at least the possibility that human factors, particularly for those aged over 50, may be a significant cause of accidents and that a focus on human factors and on this age group may well save a significant number of lives in the sector.

View the full report: RR877 - A commentary on routes to competence in the construction sector.

Case study 8 – Evaluation of the impact of the Agriculture Revisited initiative

Ipsos MORI were commissioned to carry out a major social survey to evaluate the extent of behavioural or attitude change towards health and safety within the farming sector since the start of the Agriculture Revisited initiative. The key conclusions of the research were that:

The Agriculture Revisited initiative has been very successful in attracting farmers' attention and to a more limited degree involvement.

The extension of the Make the Promise (MTP) campaign to a wider audience does not seem to have diluted this success.

Many farmers claimed to have made changes and the largest number claimed to think more of their family. This was a core proposition of the MTP campaign.

The campaign does seem to have had an impact on those farmers targeted in terms of increasing their consciousness of risk and increasing their motivation to take action to reduce risks. However, given the timescale of the research undertaken, it was not possible to robustly evaluate the scale of actions taken (or yet to be taken).

HSE's future agriculture strategy will build on the results of this research.

For further details on Ipsos MORI findings see HSE Board paper 'Agriculture Revisited – an Update'.

Case study 9: 10 year review of the Iron Mains Replacement Programme

The Iron Mains Replacement Programme (IMRP) was introduced in 2002 to address societal concern regarding the potential for failure of cast iron gas mains and the consequent risk of injuries, fatalities and damage to buildings. The objective of the IMRP, or '30/30' programme, was to decommission all cast iron mains within 30 metres of property in 30 years. The IMRP accelerated the replacement of cast iron mains to a level that was estimated to be as fast as practicable at that time, given the potential risks faced by society and the resources required. The IMRP excluded steel mains and services from the replacement programme as potential risks from steel, at that time, were considered to be at a lower level than risks from cast iron mains.

HSE together with the Office of Gas and Electricity Markets (Ofgem) commissioned an independent review to assess the progress of the IMRP to date, and evaluate potential options for the remaining 20 years of the original programme. The analysis has shown that to date the IMRP has been extremely expensive, given the number of lives potentially saved from it, but this was already known to be the likely outcome when the programme was originally designed. The evidence suggests that there are a number of options available to restructure the programme that have the potential to deliver significant cost savings in the future. It is critical that any structural changes that may occur to the IMRP in the future be accompanied with a significant improvement in the way in which data is captured and interrogated to inform the implementation of the programme. This will play an important role in optimising the delivery of the IMRP on a year on year basis going forward and would also support any future appraisal/review of the programme.

View the full report: RR888 HSE/Ofgem 10 year review of the Iron Mains Replacement Programme

Papers and Editorials in Peer-Reviewed Journals, Papers in Conference Proceedings, Book Chapters, and Other Publications

January to October 2011[6]

A Papers and Editorials in Peer-Reviewed Scientific Journals

A.1 Papers and Editorials in Peer-Reviewed Scientific Journals - Published

1. ADISESH, A., GRUSZKA, L., ROBINSON, E., EVANS G. Smoking status and immunoglobulin E seropositivity in workplace allergens. *Occupational Medicine,* Jan 2011, 61(1), 62-64

2. #ADISESH, A., LEE, C., PORTER, K. Harness suspension and first aid management: development of an evidence based guideline. *Emergency Medicine Journal*, Apr 2011, 28(4). 265-268

3. ADISESH, A., ROBINSON, E., CURRAN, A.D. Climate change: enabling a better working Britain for the next 100 years. *Occupational Medicine,* Aug 2011, 61(5), 292-294

4. ADLER, S., LOIZOU, G. et al Alternative (non-animal) methods for cosmetics testing: current status and future prospects – 2010. *Archives of Toxicology*, May 2011, 85(5), 367-485.

5. #BRADSHAW, L., HARRIS-ROBERTS, J., BOWEN, J., RAHMAN, S., FISHWICK, D. Self-reported work-related symptoms in hairdressers. *Occupational Medicine,* Aug 2011, 61(5), 328-334

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8. CAMARGO CA JR, INGHAM T, WICKENS K, THADHANI R, SILVERS KM, EPTON MJ, TOWN GI, PATTEMORE PK, ESPINOLA JA, CRANE J; NEW ZEALAND ASTHMA AND ALLERGY COHORT STUDY GROUP (INCL FISHWICK D). Cord-blood 25-hydroxyvitamin D levels and risk of respiratory infection, wheezing, and asthma. *Pediatrics,* Jan 2011; 127(1), 180-7

9. COCKER, J. Biological Monitoring for Isocyanates. *Annals of Occupational Hygiene,* Mar 2011, 55(2), 127-131

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11. CURRAN, A.D. Enabling a better working Britain: celebrating the centenary of the Health and Safety Laboratory. *Occupational Medicine,* Aug. 2011, 61(5), 290-291

12. CURRAN, A.D. Photography at HSL: capturing one hundred years of history. *Occupational Medicine,* Aug. 2011, 61(5), 299-302

13. EVANS, G.S., CURRAN, A.D. Review of recent research published by HSL in Occupational Medicine. *Occupational Medicine,* Aug 2011, 61(5), 295-298

[6] Publications prefixed with # are 'added value' papers see paragraph 3.35 of this report. See HSL's website for latest publications

14. FISHWICK, D., HARRIS-ROBERTS, J., ROBINSON, E., EVANS, G., BARRACLOUGH, R., SEN, D., CURRAN, A.D. Impact of worker education on respiratory symptoms and sensitization in bakeries. *Occupational Medicine*, Aug 2011, 61(5), 321-327

15. FROST, G., BROWN, T., HARDING A-H. Mortality and cancer incidence among British agricultural pesticide users. *Occupational Medicine,* Aug 2011, 61(5), 303-310

16. FROST, G., DARNTON, A., HARDING, A-H. The effect of smoking on the risk of lung cancer mortality for asbestos workers in Great Britain (1971-2005). *Annals of Occupational Hygiene*, Apr 2011, 55(3), 239-247

17. HARRIS-ROBERTS, J., BOWEN, J., SUMNER, J., STOCKS-GREAVES, M., BRADSHAW, D., FISHWICK, D., BARBER, C.M. Work-related symptoms in nail salon technicians. *Occupational Medicine*, Aug 2011, 61(5), 335-341

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20. KEELEY, D. M. (2010) Management of the UK HSE failure rate and event data. *Journal of Loss Prevention in the Process Industry,* May 2011, 24(3), 237-241

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A.2 Papers and Editorials in Peer-Reviewed Scientific Journals - in Press

1. ATKINSON, G. Blast damage to storage tanks and steel clad buildings. *Process Safety and Environmental Protection.* Available online 18th July 2011

2. ATKINSON, G., CUSCO, L. Buncefield: a violent, episodic vapour cloud explosion. *Process Safety and Environmental Protection.* Available online 18th July 2011

3. COLDRICK, S., GANT, S.E., ATKINSON, G.T., DAKIN, R. Factors affecting vapour production in large scale evaporating liquid cascades. *Process Safety and Environmental Protection.* Available online 23rd July 2011

4. CRUSE, H., BUSTON, J., VECHOT, TICKLE, G., ROWLANDS, R. Modelling spills of water-reactive chemicals. *Process Safety and Environmental Protection.* In press Oct 2011

5. GANT, S.E., ATKINSON, G.T. Dispersion of the vapour cloud in the Buncefield incident. *Process Safety and Environmental Protection* Available online 12th July 2011

6. GANT, S.E., KELSEY, A. Accounting for the effect of concentration fluctuations on toxic load for gaseous releases of carbon dioxide. *Journal of Loss Prevention in the Process Industries,* available online 28 Jun 2011

7. GANT, S., PURSELL, M.R., LEA, C.J., FLETCHER, J., RATTIGAN, W., THYER, A.M., CONNOLLY, S. Flammability of hydrocarbon and carbon dioxide mixtures. *Process Safety and Environmental Protection* Available online 21 July 2011

8. GRAHAM, S.R., HODGSON, R., VECHOT, L., ESSA, M.I., Calorimetric studies on the thermal stability of methyl ethyl ketone peroxide (MEKP) formulations. *Process Safety and Environmental Protection* Available online 21 July 2011

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10. LISBONA, D., SNEE, T. A review of hazards associated with primary lithium and lithium-ion batteries. Pr*ocess Safety and Environmental Protection.* Available online 12 July 2011

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12. ROYLE, M., WILLOUGHBY, D. The Safety of the Future Hydrogen Economy. *Process Safety and Environmental Protection.* In press Oct 2011

13. SAMS, C., JONES, K. Biological monitoring for exposure to deltamethrin: a human oral dosing study and background levels in the UK general population. *Toxicology Letters*, Available online 25 April 2011

14. WILDAY, J., PALTRINIERI, N., FARRET, R., HEBRARD, J. BREEDVELD, L. Addressing emerging risks using carbon capture and storage as an example. *Process Safety and Environmental Protection.* In press Oct 2011

15. WILDAY, A.J., WARDMAN, M., JOHNSON, M., HAINES, M. Hazards from carbon dioxide capture, transport and storage. *Process Safety and Environmental Protection.* In press Oct 2011

A.3) Papers and Editorials in Peer-Reviewed Scientific Journals - Submitted

1. BAILEY, C., BESWICK, A., MORTEN, L A novel method for the detection of bacteria from beauty salon body wax materials. *Occupational Medicine*

2. BARBER, C, BURTON, C., CROOK, B., SCAIFE, H, EVANS, G. A systematic review of case definitions for occupational lung disease outbreaks in workers exposed to metalworking fluids. *American Journal of Industrial Medicine*

3. BESWICK, A., FARRANT, J., MAKISON, C., GAWN, J., FROST, G., CROOK, B., PRIDE, J. Comparison of multiple systems for laboratory whole room fumigation. *American Biological Safety Assoc*. (ABSA) *Journal.*

4. BUTLER, O., CAIRNS, W., COOK, J., DAVIDSON, C. Atomic spectrometry update. Environmental analysis. *RSC JAAS*

5. BURTON, C., CROOK, B., SCAIFE, H,M EVANS, G., BARBER, C. Systematic review of ill-health outbreaks associated with exposure to water-based metal working fluids. *Occupational and Environmental Medicine*

6. HARDING, A-H, DARNTON, A., OSMAN, J. Cardiovascular disease mortality among British asbestos workers (1971-2005). Occupational and Environmental Medicine

7. HARRIS-ROBERTS, J., TATE, P., ROBINSON, E., GRIFFIN, P., MASON, H., BARBER, C., CURRAN, A.D., FISHWICK, D. Latex exposure and respiratory symptoms in a textile-braiding factory: use of bespoke allergen assessments. Occupational & Environmental Medicine

8. HEMINGWAY, M.A., WALSH, P.T., HARDWICK, K.R., WILCOX, G. Evaluation of portable single gas monitors for the detection of low levels of hydrogen sulfide and sulfur dioxide in petroleum industry environments. Journal of Occupational and Environmental Medicine

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10. JONES, K., COCKER, J., PINEY, M.Improving isocyanate exposure in motor vehicle paint spraying evidence from biological monitoring. *Annals of Occupational Hygiene*

11. KEEN, C., COLDWELL, M., MCNALLY, K., BALDWIN, P., MCALINDEN, J., COCKER, J. A follow up study of occupational exposure to 4,4'-methylene-bis (2-chloroaniline) (MbOCA) & isocyanates in polyurethane manufacture in the UK. *Toxicology Letters*

12. LISBONA, D., JOHNSON, M., MILLNER, A., MCGILLIVRAY, A., MADDISON, T., WARDMAN, M. Analysis of a loss of containment incident dataset for major hazards intelligence using storybuilder. *Journal of Loss Prevention in the Process Industries*

13. LOIZOU, G., HOGG, A. MEGen: a physiologically based pharmacokinetic model generator. *Computer methods and programs in Biomedicine*

14. MCNALLY, K., COTTON, R., COCKER, J., JONES, K., BARTLES, M. RICK, D., PRICE, P. LOIZOU, G. Reconstruction of exposure to m-xylene from human biomonitoring data using PBPK modelling, Bayesian Inference and Markov Chain Monte Carlo Simulation. Toxicological Sciences

15. MAKINSON, C., CLAYTON, M., CROOK, B., GAWN, J.M. A method for evaluating the effectiveness of surgical masks against influenza virus bioaerosols. The Journal of Virology.

16. MELLOR, N. The Management Standards approach to work-related stress: understanding the effectiveness of its implementation through key process components. Workplace Health Management

17. MORTON, J., COLDWELL, M., COTTON, R., KEEN, C., GRIFFIN, P. The use of biological monitoring as an exposure assessment tool for stainless steel welders. Annals of Occupational Hygiene

18. #OKUNRIBIDO, O., EDGAR, J. Patient safety during assistant propelled wheelchair transportations - the effect of the seat cushion on risk of falling. *Journal of Advanced Nursing*

19. PALOMINO, M., ELLWOOD, P. Web-based horizon scanning: concepts and practice. *Foresight*

20. STAFF, J., COTTON, R., MORTON, J., WARREN, N. Comparison of urinary thallium levels in non-occupationally exposed people and workers. *Biomarkers*

21. THORPE, A., WALSH P.T. Direct-reading inhalable dust monitoring - an assessment of current measurement methods. *Annals of Occupational Hygiene*

22. UNWIN, J., COLDWELL, M., KEEN, C., MCALINDEN, J. Investigation of potential exposure to carcinogens and respiratory sensitisers during thermal processing of plastics. Annals of Occupational Hygiene

B) Conference Papers

B.1) Conference Papers Published

1. #ATKINSON, G. Blast damage to storage tanks and steel clad buildings. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 76, 543-552.

2. BRADDOCK, R., CHAMBERS, C. Tank gauging systems used for bulk storage of gasoline. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 77, 553-559

3. CHAMBERS, C., PEARSON, J. A discussion of some common pitfalls in the application of layer of Protection Analysis (LOPA) to the overfill of fuel storage tanks at Buncefield type sites. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 75, 535-542

4. #COLDRICK, S., ATKINSON, G.T., GANT, S.E. Large scale evaporating liquid cascades - an experimental and computational study. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 78, 560-569

5. CRUSE, H., TICKLE, G.A., CARLISLE, J.E., MACBETH, R., BUSTON, J.R.H., ROWLANDS, R. STAWaRS: A new source term model for water reactive substances. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 44, 287-297.

6. GANT, S., PURSELL, M.R., LEA, C.J., THYER, A.M., CONNOLLY S. Flammability of hydrocarbon/CO2 mixtures: Part 2. Predictive models for gas jet ignition. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 67, 456-468.

7. HARE, J., JOHNSON, M. Pressure relief Venting Systems - examples of good and bad practice. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 17, 113-118.

8. HEATON, R. Lawnmowers - does the vibration emission test work? *46th UK Conference on Human Response to Vibration,* 20-22nd September 2011, Buxton, UK, 311-319

9. HEWITT, S. Vibration emission of electrically powered hammers. *46th UK Conference on Human Response to Vibration,* 20-22nd September 2011, Buxton, UK, 279-290

10. #HODGES, J. Blast furnace no. 5 incident, Corus, Port Talbot, 8th November 2001. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 83, 593-599.

11. HOLBROW, P. (2010) Dust explosion venting research. *Hazards XXII: Process Safety and Environmental Protection,* 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 81, 583-587

12. #HOOKER, P., ROYLE, M., GUMMER, J., WILLOUGHBY, D., UDENSI, J. Self ignition of hydrogen by various mechanisms. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 64, 432-439

13. LISBONA, D., WARDMAN, M. Development of methods for geographical representation of local societal risk*. Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 40, 261-266.

14. MENDES, R., CHAPLIN, Z., MACBETH, R., WILDAY, J., WARDMAN, M., GIOVANNINI, S., MITIDIERO, L, M HWANG, E., MURATORE, M.. Pipeline risk criteria methodology. *Rio Pipeline 2011*, Rio de Janeiro, Brazil, 20-22 September 2011

15. #MYATT, S.G., BALE, E.W. Hazards associated with the large-scale storage of fireworks- human failure and its consequences. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 56, 384-390

16. PITTS, P., MASON, H.J., POOLE, K.A., YOUNG, C.E. The relative performance of frequency weighting WH and candidates for alternative frequency weightings when used to predict the occurrence of hand-arm vibration induced injuries. *12th International Conference on Hand-Arm Vibration*, Ottawa, Canada, 13-17 July 2011

17. PURSELL, M. R., GANT,S.E., FLETCHER, J., RATTIGAN, W., THYER, A., CONNOLLY, S. Flammability of hydrocarbon/CO2 mixtures: Part 1. Ignition and explosion characteristics. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 65, 440-449.

18. SHANKS, E. Evaluation of test code for vibration emission from hand-held electrically powered drills. *46th UK Conference on Human Response to Vibration,* 20-22nd September 2011, Buxton, UK, 291-310

19. SHANKS, E., HEWITT, S., PITTS, P. Investigation of the relationship between vibration emission and in-use vibration for electrical tools. *12th International Conference on Hand-Arm Vibration (HAV 2011),* The Westin, Ottawa, Canada, 13-17 July 2011

20. VECHOT, L., BUSTON, J.E.H., KAY, J., ROUND, G.A., MASHARANI, S., TICKLE, G.A.,ROWLANDS, R. Experimental study of the liquid phase hydrolysis reaction of titanium tetrachloride. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 37, 238-245

21. VECHOT, L., KAY, J., WILDAY, J., CARSON, D., BIGOT, J-P Round Robin vent sizing exercise on a gassy system: 40% dicumyl peroxide in butyrate solvent. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 43, 278-286

22. #WILDAY, J., HOLROYD, J., HARE, J., SHORE, S., TRAVERS, I. COMAH Remodelling: the COMAH competent authority as a learning organisation for major hazards. *Hazards XXII: Process Safety and Environmental Protection*, 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 31, 198-204

23. WILDAY, J., PALTRINIERI, N., FARRET, R., HEBRARD, J. BREEDVELD, L. Carbon capture and storage: a case study of emerging risk issues in the iNTeg-Risk project. *Hazards XXII: Process Safety and Environmental Protection,* 11-14 April 2011, Britannia Adelphi Hotel, Liverpool, UK, Paper 50, 339-346

B.2) Conference Papers Submitted

1. GANT, S.E., ATKINSON, G.T. CFD for reconstruction of the Buncefield incident Dechema 50th Tutzing Symposium, 23-25 May 2011 (*Conference proceedings to be published towards end of year)*

2. JONES, A., BATES, S., LEAH, C., RILEY, D., BOHM, J. The human factors contribution to preventing entrapment incidents involving mobile elevated work platforms. *IEHF - Ergonomics & Human Factors 2012*, Blackpool, 16-19 April 2012

C) Book Chapters in Press

1. MELLORR, N, KARANIKA-MURRAY, M., and WAITE, E. (2011). Integrating multi level change perspectives for addressing psychosocial issues. In: *Managing psychosocial risks in the workplace: The role of process issues*. Eds C. Biron, M. Karanika-Murray and C. Cooper. Routledge. In press Sept 2011.

2. DANIELS, K., KARANIKA-MURRAY, M., MELLOR, N., and VAN VELDHOVEN, M. (2011). Moving Policy and Practice Forward: Beyond Prescriptions for Job Characteristics. In: *Managing*

psychosocial risks in the workplace: The role of process issues. Eds C. Biron, M. Karanika-Murray and C. Cooper. Routledge. In press Sept 2011.

D) Other publications

1. CURRAN, A.D. Wellbeing as a way of life. Health Service Journal, 2 Jun. 2011, 24-25

2. #OKUNRIBIDO, O.O., EDGAR, J. Preventing falls when pushing people in wheelchairs. Nursing and Residential Care, 18 Apr 2011, 13(5), 228-230.

Annex 1.6

Representative publications associated with extramural research contracts– 2011

HSE does not maintain a record of all publications associated with extramural research contracts. Some of the following references were identified by HSE's Information Management Unit (end October 2011) by searching Databases for references to research that acknowledged funding, co-funding or sponsorship from HSE. Included here are publications arising from The Health and Occupational Reporting (THOR) scheme.

1. Shift work and chronic disease: the epidemiological evidence; X-S. Wang, M. E. G. Armstrong, B. J. Cairns, T. J. Key and R. C. Travis. Occupational Medicine. 2011; 61, 78-89.

2. Review on the validity of self-report to assess work-related diseases; Annet F. Lenderink, Ilona Zoer, Henk F. van der Molen, Dick Spreeuwers, Monique H. W. Frings-Dresen & Frank J. H. van Dijk. International Archives of Occupational and Environmental Health. DOI 10.1007/s00420-011-0662-3 On-line first - June 2011

3. Experimental analysis of tools used for estimating risk associated with industrial machines. Yuvin Chinniah, François Gauthier, Serge Lambert, Florence Moulet. IRSST. 2011. REPORT R-684.

4. Improving estimates of incidence of specialist diagnosed, work-related respiratory and skin disease in Great Britain. Carder M, McNamee R , Turner S, Hussey L, Money A, Agius R Occupational Medicine. 2011; 61 (1): 33-39

5. Work-related sickness absence as reported by general practitioners in the UK. Hussey L, Turner S, Thorley K, McNamee R and Agius RM. Occupational Medicine. 2011, In press

6. Incidence of work-related occupational hearing loss in the UK. Money A Carder M, Turner S, Agius R OSSA Occupational Medicine. 2011; 61(4):226-233.

7. Occupation and work-related ill-health in UK construction workers. Stocks, SJ, Turner S, McNamee R, Carder M, Hussey L and Agius RM. Occupational Medicine. 2011 doi: 10.1093/occmed/kqr075

8. Has European Union legislation to reduce exposure to chromate in cement been effective in reducing the incidence of allergic contact dermatitis attributed to chromate in the UK? Stocks SJ, McNamee R, Turner S, Carder M and Agius RM. Occupational and Environmental Medicine. 2011. In press.

9. CIPD. Preventing stress: Promoting positive manager behaviour. Phase 4: How do organisations implement the findings in practice. (July 2011) http://www.cipd.co.uk/hr-resources/research/preventing-stress-promoting-positive-manager-behaviour-phase-4.aspx.

10. Safety Assessment Federation. Guidelines for the safe operation of escalators and moving walks (May 2011) http://www.bifm.org.uk/bifm/news/6520

Strategic Statement on Science.

The following paragraphs state how HSE uses it scientific and engineering resources in support of our mission to prevent death, injury and ill-health to those at work and those affected by work activities.

HSE is a strongly scientific and evidence-based organisation with about a quarter of our staff being qualified scientists or engineers. Approximately 15% of HSE's budget is devoted to commissioning scientific research and support. Although we use a wide range of institutions and contractors, our principal supplier is the Health and Safety Laboratory, which is an agency of HSE and a world-class facility. It provides vital technical and research level experience and problem solving skills.

Our scientific activities enable us to gather evidence, identify and develop practical solutions, and monitor and evaluate their success in supporting our Strategy and delivery plans. At all stages the ability to anticipate and evaluate the importance of future challenges is critical to maintaining HSE's position as a forward-thinking regulator.

What do we do?

HSE's Science:-

- supports delivery of the Strategy (*The Health and Safety of Great Britain: Be part of the solution*) and associated delivery targets
- supports front line regulatory functions (e.g. incident investigation)
- looks ahead to identify future challenges

The 3yr rolling Science Plan identifies and prioritises science in support of the key themes of the Strategy to:-

- acquire evidence for policy development
- support delivery of operational objectives
- develop practical solutions
- understand new and emerging issues and
- evaluate impact

Forensic support for incident investigation is essential to enable HSE to carry out its enforcement activity with a high degree of confidence and success. HSE invests in the skills of its laboratory staff to document evidence, keep up to date with analytical and technological innovations and research, and develop new techniques and models as appropriate.

HSE is alert to the implications for health and safety of new technologies and changes in the workplace. We seek to advise and inform so that GB is well placed to capitalise on innovation without detriment to our mission to prevent death, injury and ill health to those at work and those affected by work activities.

Our principles - Why do we do it?

- We have a strong tradition for scientific method, use of experts, advisers and committees in the development of HSE's policies and regulations. This is

drawn from our duty to commission and publish appropriate research and to provide training and information in connection with this, duties enshrined in the Health and Safety at Work (etc) Act 1974.

- We procure individual projects in accordance with best practice and continually strive to improve the management of commissioned science to improve efficiency and effectiveness by:
    - working in partnership with industry, research councils and professional bodies to share funding,
    - by working with academics, other experts, industry groups and international regulators to improve the quality of research proposals and research outputs,
    - applying best practice with regard to procurement.
- HSE will continue its policies to attract and retain high quality professional scientists and engineers and develop appropriate scientific career structures – in line with the guidance of the Government's Chief Scientific Adviser.
- We aim to improve the understanding, communication and utilisation of the results of our scientific research through:
    - closer working between scientists and policy makers
    - greater emphasis on peer review, research evaluation and publication in the scientific literature
    - better knowledge management to enable easier identification of existing research.