Measuring the link between research and economic impact

Report of an MRC consultation and workshop
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Executive Summary

The MRC wishes to understand better the link between research and economic and societal impact, and to use this understanding to improve strategies for the support of research and, in particular, funding for health research.

In 2010, in advance of the Government Spending Review (SR), stakeholders such as the learned societies, universities, funding and research councils, and industry all compiled the available evidence to argue that public investment in research should be maintained. The crucial argument was that this investment provides an excellent return in terms of economic and societal benefit to the UK. Following the Government’s decision to establish a ring-fenced budget with level funding for research, there is an expectation that research councils will continue to develop the evidence for this argument, and apply learning to optimise their support for research.

In September 2011 the MRC ran a public consultation on economic impact and obtained feedback from experts in the field, medical researchers, members of the public, as well as representatives from Universities, learned societies, and funding agencies.

The ideas and comments received via the consultation were developed in a workshop, with focussed presentations from UK experts, and discussion sessions attended by medical researchers, and representatives from Universities, funding agencies and government.

Two broad approaches to estimating the return on investment from research were explored. The first was a whole economy (“Macro” or econometric) view, that correlated changes in inputs to research and development and growth. The second was a “micro” economics view which studies the links between specific research and resulting impacts. Studies might also combine these approaches to gain insight from each view of impact in a particular situation.

It was recommended that the MRC encourage new research in this field. There is little or no research in the UK aimed at applying these approaches to understand better what leads to impact, and to determine how impact can be maximised. The aim should be to progress beyond the exemplar study “Medical Research: What’s it worth?” published in 2008, and to complete at least pilot studies within this spending review period.

In responding to the consultation Roberto Solari (GlaxoSmithKline) summarised the importance of conveying the link between research and economic impact “I believe we can make a much better job of explaining the link [...] the MRC has transformed medical research yet few people have any idea of the massive contribution made by the MRC – [...] the invention of monoclonal antibodies [...] was] a massive inflection point in biomedical research. [...] in life sciences the MRC has single handed made the biggest contribution to the multi-billion dollar biotechnology industry. From protein structure, protein sequencing, DNA structure, DNA sequencing, monoclonal antibodies to antibody engineering the MRC has laid the foundations of modern biotechnology.”

One challenge is to not only be able to convey the rare and really transformative impacts, but also the background, steady, significant and aggregate progress made as the result of thousands of past and present MRC funded research projects.
Background

The MRC wishes to understand better the link between research and economic and societal impact, and to use this understanding to improve strategies for the support of research and, in particular, funding for health research.

The MRC sees a pressing need to deliver new insight into the economic and societal impact of medical research within this spending review period (2011/12 to 2014/15), and a need to develop longer term programmes of work in this area. Although interest in the link between research and economic and societal impact has grown significantly in recent years (certainly since 2006 with the publication of the Warry Report\textsuperscript{iii}), it appears that (outside of the US\textsuperscript{iv}) very little new “science of science policy research” has been supported. The work that has been funded in this area has tended to focus on inputs and activities, rather than outcomes and impacts\textsuperscript{v}. The exemplar work in this field is still the “Medical Research: What’s it worth?” report\textsuperscript{1}, commissioned by the MRC/Wellcome Trust and Academy of Medical Sciences and published in 2008. This work provided credible estimates of economic return and high quality recommendations for the field.

It is not clear what further progress might be delivered within the next few years which will be applicable specifically to health research in the UK and relevant to MRC. There is a need for all areas of public spending to examine what contribution can be made to economic growth, and for this thinking to assist Treasury plans to stimulate the economic recovery.\textsuperscript{vi} Examples of initiatives that are underway include the Council for Industry and Higher Education (CIHE)\textsuperscript{vii} and the Growth Review sponsored by the Department for Business Innovations and Skills (BIS)\textsuperscript{viii}.

In preparation for working out a rigorous and quantitative approach to understanding the MRC contribution to economic growth, the MRC discussed ongoing initiatives and requirements across research councils within the RCUK Impact Group, and in parallel sought the advice of MRC Council and Strategy Board, and the Office for Strategic Coordination of Health Research (OSCHR). The MRC has stated a delivery plan commitment to support new work to understand better the link between research and economic impact\textsuperscript{x}.

As a first step the MRC launched an open consultation on economic impact, to gather views on current thinking about the link between research and impact\textsuperscript{y}. The consultation was used to collect ideas and views from other organisations, the research community and the public. The first chapter of this report summarises the results of this consultation and includes selected comments from respondents.

The second step was to hold a workshop to which researchers from the medical field, economists, and representatives from universities, funding agencies, and government were invited. The aim of the workshop was to focus thoughts and prioritise ideas arising from the consultation. Chapters 2 and 3 respectively cover the expert presentations and the breakout discussions at that workshop.

The third step was for MRC Strategy Board to consider ways in which the MRC could encourage a portfolio of research studies and continue the discussion with other research councils and stakeholders such as medical research charities and NIHR.

The options for action at the workshop were kept open. They included funding additional research (c.f. UK Evaluation Forum in 2004/05), commissioning specific analysis (c.f. international comparator study), advice on new collaborations (particularly with those organisations not represented at the workshop, such as UKTI, CBI, NESTA, ONS), or work to close data gaps (for example by commissioning new data gathering, or accessing/integrating existing data in new ways).

At its meeting in December 2011, MRC Strategy Board supported a new initiative to fund work on the link between MRC research and economic impact. MRC will establish an expert group early in 2012, in discussion with other funders, with the objective of selecting and supervising new research in this field.
## 1 The MRC consultation on economic impact

The consultation primed respondents to comment on five areas, with detailed questions to stimulate thought in each. Some areas provoked significant comment, and selected thoughts submitted to the consultation are included in the next section.

<table>
<thead>
<tr>
<th>1</th>
<th>The link between research and economic growth</th>
<th>Can we better explain this link, by examining research and development investment, research intensity, innovation, technological change and its impact on productivity? What are the key gaps in knowledge that matter most for decisions about the health sector?</th>
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<tr>
<td>2</td>
<td>The contribution that research makes to quality of life</td>
<td>What is the best evidence we can draw upon concerning the contribution that research makes to increasing life expectancy and quality of life? Can we identify which sorts of research have been most important, and whether high research investment in a country matter for quality and length of life? Are “common sense” or populist approaches to increasing quality life supported by the economic benefits and costs of extending quality life? Where are the conflicts?</td>
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<td>3</td>
<td>The benefits from research to industry and health users</td>
<td>How does public and charitable research stimulate business investment in research, total and inward investment to the UK, and employment? Is there more to understand about what promotes engagement between academia and industry? Can we improve quantification of changes not easily monetised (such as changes in skills in the workforce and uptake of new ideas), and better explain successes in health research? Can we capture the contribution of research to innovations and improvements in the health system, how much of this results from R&amp;D internal and external to the NHS?</td>
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<td>4</td>
<td>Translational progress</td>
<td>Can we establish/strengthen estimates of payback from research in this area? Alongside exploration of the performance of translational programmes themselves, what are the “uncertainties” in the UK innovation system that should be explored? Is there more we should do to track the influence of areas seen as key to growth (such as experimental medicine and regenerative medicine)? Where might changes in industry R&amp;D policies, or changes in scientific opportunity affect performance of translational schemes and are these changes measurable? What external (i.e. not under RCs’ direct control) factors in the University sector (tech transfer policies; NHS interactions; international collaboration; concentration and clustering) are most important to assess?</td>
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<td>5</td>
<td>Other priority questions</td>
<td>What are the economic benefits/drawbacks of globalisation of R&amp;D and academic knowledge? Will decisions on research collaborations driven by academic motives and tactics give the best result for the UK overall, or should other factors be considered? What is the added value of EC funding? Can we detect skill shortages in the labour market in a timely way? Medical research funding, and MRC’s in particular, is concentrated in relatively few Universities. Would further concentration aid economic impact, or harm it? What data and approaches are needed to strengthen our evaluation programme?</td>
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1.1. The link between research and economic growth

The central feature of the economy is the transformation of inputs (labour, capital, raw materials) into useful products. Sustainable economic growth (annual increase in per capita GDP) results from improvements in productivity. Productivity can be thought of as a function which describes how much output can be generated from particular inputs, and how multiple factors can influence this (e.g. education, co-operation/competition, investment in infrastructure, healthcare and taxes). However a consistently cited factor, estimated in some studies to account for the majority of productivity improvements in economies such as the UK, is technological change. Despite the difficulty in observing “technological change”, studies show that this largely arises as a result of investing in research, and then developing that research into application. The process of translating the knowledge gained from research into new technologies or processes is complex; translational outcomes of research are highly uncertain, plus these outcomes are not always effectively or efficiently taken up into practice. In addition the whole process of innovation is modified by a range of other sorts of “knowledge spend” (e.g. on branding, design, and software development) and many other inputs that are difficult to quantify (for example intangibles such as training and changes in regulation).

There is a wealth of specific case study evidence to support the link between MRC funded research and health gain, and therefore economic impact, but it is harder to go beyond these individual examples to the effect on economic growth in the UK overall. Professor Lawlor (University of Bristol) commented: “we can retrospectively say that (MRC funded) research unequivocally showed the link between cigarette smoking and lung cancer, cardiovascular disease and other important causes of premature mortality and morbidity. And that further research demonstrated effective means of reducing cigarette smoking that have, at a population level, had major impact. The population reductions in cigarette smoking have been linked to population declines in lung cancer and CVD morbidity and mortality. In theory this should reduce NHS costs (for the treatment of these conditions), reduce premature mortality and hence increase active working populations who (in periods of economic growth) could contribute to work and further growth.”

Despite agreement on the link between research and growth, in practice this is difficult to demonstrate. Studies have used correlations between inputs and outputs at the whole economy level (often referred to as “macro econometrics”) to model the effect of particular variables (such as investment in research and development). Alternatively case studies have been used to study the link between particular inputs and outcomes.

Dr Grant (RAND Europe) “The challenge is how [to show the link between research and growth]... the downside of the econometric type analysis is that it is hard to demonstrate causation; the downside of more focused qualitative case studies is their generalisability. For that reason we need to focus on both approaches - breadth and depth if you like - by continuing to develop the evidence base but also develop new and appropriate methodologies (eg use of web crawlers to identify linkages in the system). It seems to me that in developing research priorities new and innovative methodologies is key.”

Matthew Bell (Frontier Economics) “the explanation needs to go back to an economic framework that clearly sets out the drivers of growth, develops clear hypotheses about how medical research links into each of those drivers and then tests the hypotheses. Current experience suggests it may be possible to test some of those hypotheses quantitatively (ie econometrically) but for some the data will not be available. In those cases other approaches are needed - including specific case studies - in order to demonstrate the possible impacts.”
Professor Georghiou (The University of Manchester) “The macroeconomic direct and indirect cost / benefits to the NHS of addressing unmet health challenges remain compelling. However, the more complex bottom-up links with economic growth from the outcomes of past and current research priorities may not be sufficiently informed to be well explained [via the spending review process]. More justification may be needed to protect budget allocation, and to guide strategic investment, particularly when the return on investment in GDP is increasingly dominated by trans-national industry consolidations in the biomedical impact sectors, with domestic industries contributing to the value adding and supply chains.”

Professor Georghiou and Professor David Clarke (The University of Manchester) set out several issues with estimating the link between research and growth, including the fact that relying on a linear model of translation would underestimated innovation, that there are major and indirect “spillover” effects across sectors, and that the long lag time between research and impact means that care has to be taken over interpreting links to impact and applying this learning to research underway now. Engagement between academia and industry is constantly evolving with funders seeking to change behaviours and industry moving into new fields (such as stratified medicine).

Luke Georghiou of Manchester University commented “…the link with economic growth relates to research investment of earlier decade(s). Observing and analysing past research may not inform and may even misinform or underplay the link with potential economic growth and health benefit of the substantial changes in impact processes and different priorities (eg current MRC Delivery Plan).”

The ABPI in their response recommended “A question may be added: What is [growth] dependent on?” Considering “What if” scenarios may be illustrative. This section should reflect on how to improve the innovation environment and ask what incentives are needed, given the long term for payback.”

### 1.1.1. Spillover benefits

Given the importance of spillover effects, it is important to outline further what these are and how they arise.

Organisations will invest in research because of the direct return this can bring in terms of greater productivity in that organisation (private rate of return). However the benefits from research and development can also “spill-over” across organisations, sectors and nations, impacting positively on economic growth. This is particularly so for knowledge generated from research, which is usually a public good, open to all. It is less so for discoveries that are protected by patents etc.

There is a lot of evidence demonstrating that this “social rate of return” from research investment is substantially higher than the private rate of return. Knowledge can be reused extensively and, (subject to the “absorptive capacity” of potential adopters) applied in new situations. A single research output could have wide influence and therefore create significant economic “spill overs”.

Organisations will of course tend to invest based solely on the private rate of return from research that they can directly appropriate and protect, and so Governments introduce incentives for organisations to increase their investment in research beyond what they might otherwise be inclined to invest in, in order that the social return can also be increased. These incentives may include; tax credits, providing direct funding for research (e.g. via Research Councils or initiatives such as the UK Innovation Investment Fund), investing in infrastructure (such as bioincubators and technology innovation
centres, education and training (e.g. via Universities), and adjustments to regulation and competition policy (such as introduction of the “Patent Box”).

In its response to the consultation CRUK commented “There is very little research into the potential spill-over from investment in non-commercial biomedical research. Other industries have this evidence base (e.g. R&D in mobile phones, space technology and Formula 1). The medical research community needs to be able to demonstrate these potential benefits in order to ensure that we can continue to make the case that investment in research is beneficial to the economy.”

We specifically asked in the consultation “should we examine the transmission of spill-over benefits from the private sector to R&D in the public and charitable sector, and vice versa from the public and charitable to the private sector?”

Luke Georghiou “There is a growing spillover of private sector R&D into public/charitable research investment, where influences on transmission can probably be well explained by industry. What may be more informative would be examination of the resulting transmission into health economic impact, distinguishing global industry and the indirect spillover effects on the return on co-investment and the link to GDP.”

Vincent Farrelly “Yes, it will help give an appreciation of the economic impacts that such interactions between private & public funding have on innovation. However not all relevant data may be available due to commercial sensitivity/confidentiality”

Steven Wooding (RAND) “we can only estimate these effects very inaccurately as most of the background work looking at the spillover effects of research investment is based on work done in a different social/economic context - ie the US, in the 1970s/80s, on agricultural research.”

It would seem important to be able to better estimate the spill-over effects from medical research, whether at the whole economy level, or via individual case studies. Particularly in the UK context.

1.1.2. Is it useful to compare different sectors and disciplines?

It is clear that there are different research intensities in different sectors and disciplines, and it may be interesting to learn from comparing translation and economic impact achieved in these different sectors.

Jill Pell (University of Glasgow) commented “The [differences are] quantifiable but I would question if it is meaningful to quantify them. The aims are often different - some research aims to increase productivity, some to improve equity, some to improve health - direct comparisons may not always be meaningful”

Douglas Robertson (Praxis Unico) explained that it might be valid to ask “Are there quantifiable differences between R and D in the life sciences sector and its impact on GDP by comparison to other sectors.”

Helen Mott (University of Cambridge) pointed out that “Obviously engineering is a more applied science and so the effects on GDP will be felt more immediately. We manufacture everything in other countries, so even if the ideas come from the UK the GDP growth will end up elsewhere.”
Richard Jennings (Cambridge Enterprise) stated that "[There are] different levels of profit margin in different sectors [and this] dictates how much can be invested in research and [the] risk return ratio".

Matthew Bell (Frontier Economics) "it is straightforward to correlate R&D with GDP growth across sectors. However, I do not think that really gets to the answer you need. What you would like to understand is two things: (1) is there a causal link between R&D and growth (2) whether the current level of R&D in each sector (and clearly particularly in medical research) is optimal - is more spending in research likely to lead to greater growth (proportionately or more than proportionately to the investment). In general, the economic literature finds that the impact of R&D on growth is a function of where and when that R&D takes place (eg in small versus large firms, depending on what has taken place already etc) and so you might see variation in the data across sectors that reflect the different characteristics of those sectors. It is then a separate question about whether that variation is "optimal" or action could be taken to enhance the links."

The ABPI advised "There are differences in time scales between sectors, in part reflecting the timescales of Research & Development vs technology. The economic downturn should be acknowledged, and the fact that biomedical systems require more prolonged research and development than non-biomedical systems because of the need to gain prolonged data. Therefore an additional question may be posed: "How can these disadvantages be overcome?"

1.1.4. How does the UK compare to other countries?

As with differences between sectors and disciplines within the UK, it may be helpful to contrast differences between the UK and other countries. Particularly where there are differences in the strategies to try to maximise economic impact.

Ian Hall (Nottingham) expects that "the UK will get worse [at transforming medical research into growth], mainly because of the reduction in the presence of major pharma to help exploit developments"

Kate Bishop (Birmingham) "The loss of R&D operations to other geographic territories is a demonstrator that the UK [will get] worse at realising the benefit from commercial exploitation."

Averil Horton (Brunel University) comments "The UK is always said to be poor at converting R&D into £££, but many writers dispute this - there was a report from NESTA that looked at all R&D, not just 'technical' R&D, and came to a very different conclusion."

Michael Whittaker (Newcastle University) notes that "[according to UKTI we do] worse than the US, but better than most in biotechnology"

Matthew Bell (Frontier Economics) explains "I'm not aware of evidence specifically about medical research. If this question is about the aggregate performance of the UK, [then] what has been known for some time is that the UK has relatively low productivity growth compared to its peers (eg Germany, France, US) but does not perform so badly when it comes to R&D (although it depends a little on how R&D is measured - eg through patents, spending etc). To the extent that is true, it would suggest that the UK does suffer relative to its peers in converting R&D into growth."
1.1.5. Are there approaches to capture the global return on investment from public and charitable R&D?

Luke Georghiou “Given the scale of the potential domestic health cost benefit from global industry, and the spillover effect to GDP and the international contribution of domestic medical research, questions may be better formulated to separate the flow or relative contribution of knowledge transfer, innovation and technological change in domestic health benefit from industry with limited or no domestic manufacture, and the involvement of domestic industry in the development, supply and value adding chain. Further to EU initiatives (eg IMI), greater coordination of prioritisation of globally-relevant areas internationally would be helpful.”

Jon Sussex (OHE) “It is important to analyse the global benefits from UK funded research. But the methods for doing so are conceptually the same as to analyse the UK benefits from UK funded research. Data will always be the issue, not what to measure.”

1.2 Quantifying the contribution that health research makes to quality of life

Improvements in health for people of working age clearly have significant economic impact, as levels of worklessness are decreased, people contribute as tax-payers, and save for retirement. Beyond working age health improvements will decrease the burden on the healthcare system, but the societal impact of living longer is complex.

The ONS Social Trends report has published information on the health, wealth and habits of the UK population for over 40 years\textsuperscript{xvii}. In 2010 Social Trends reported a record low infant and neonatal mortality rate in the UK using data from 2008, falling by around 90 per cent since records began in 1930. Improvements in nutrition and the advancement of medical science and technology mean we are living longer, though individual behaviours such as diet, drinking and smoking clearly impact on morbidity and mortality. For example the proportion of adults in England classified as obese increased by 9 percentage points between 1994 and 2008 to reach 25 per cent. Figures indicate that over the last decade the proportion of adult regular smokers in Great Britain has fallen to 22 per cent for men and 21 per cent for women. Data from the US CDC on mortality also highlight record low death rates, and high life expectancy, with the pace of increase growing in recent decades.

However we wish to know what proportion of these improvements might be due to research, and over what time period. The ABPI has highlighted that the mortality from cancer (all malignancies) has decreased 12% for men and 8% for women over the last ten years (despite an increase in incidence), and mortality from coronary heart disease has decreased 36%, and make the point that these decreases are largely attributable to improved surgical and medical treatments between 1998 and 2007.

As in the methodology set out in the “Medical Research: What’s it worth?” report, once the interventions or advice responsible for improved health are identified, it is possible (although difficult) to track back to the research these interventions rely upon.

Innovation leads to new health technologies and treatments, and drives change in the NHS. These new treatments may be more costly than the interventions they replace. Even if new treatments cost less per unit, they may be more effective or cause less discomfort, both of these qualities will stimulate higher use. Additional applications for existing technologies (such as magnetic resonance imaging) may also increase healthcare costs. Some interventions (such as vaccinations) have been shown to reduce
healthcare costs, but generally changing technology in medicine results in higher spending and accounts for between half and two thirds of healthcare costs in excess of inflation\textsuperscript{viii}. In the US healthcare costs (as measured by rising insurance premiums) have increased significantly above the growth in wages and the McKinsey Global Institute estimates that the cost of health care in developed countries will rise from 10 percent of GDP today to around 15 percent by 2030. Affordability of healthcare is a pressing concern globally. This highlights that it just as important to consider a focus on low cost routes to delivering healthcare in Europe and the US as it is in resource-poor settings such as Africa. The ABPI has highlighted that in the UK expenditure on medicines specifically has actually fallen as a percentage of the total NHS budget in the last 10 years\textsuperscript{13}, and more new treatments are now introduced under patient access schemes\textsuperscript{xix}.

Of course the benefits from improvements to healthcare, in terms of longer lives and better quality lives should exceed the cost of delivering these improvements. There is a large amount of evidence that this is the case (for example “Medical Research: What’s it worth?”), and in part the role of the National Institute for Health and Clinical Excellence\textsuperscript{xx} is to ensure that new treatments are affordable and cost effective. However the cost to the economy of issues not yet effectively addressed by health research such as the growing burden from conditions of old age, and chronic diseases such as obesity, is regularly highlighted.

1.2.1. Are we getting healthier?

Roberto Solari (GSK) summarised “Yes and no. We are living longer, we have largely been freed of common infectious diseases, but our lifestyle is creating new diseases which create a huge burden on society. I think the large increases in life expectancy we have seen over the past 100-200 years have largely been the result of biomedical research and improved public health measures.”

Bruce Hollingsworth (Lancaster) commented “… as we have a healthy ageing population, public health and health promotion are key to this in future, possibly more than biomedical research as we look at ways of allocating resources to this population to ensure their contribution to the productivity of society.”

Averil Horton (Brunel) advised “It might help to articulate what other sources of improvement there may be. We are undoubtedly healthier, we are also staying healthier for longer, and whilst this harder to measure, QALYs (Quality Adjusted Life Years) provide a useful metric.”

Martin Roland (Cambridge) explained “There’s a modest literature on this - e.g. from Simon Capewell in Liverpool\textsuperscript{xxi}. However, it’s on the proportion of the increase in health that is due to health services. Obviously its a step further to attribute this to research. We are certainly getting healthier - life expectancy is increasing by 3 months every year.”

Luke Georghiou (Manchester) “Biomedical research and engineering research investment has led to or been focused upon interventions to ameliorate illness and so increase life expectancy. Greater understanding of the cases of negative economic benefit and quality of life, and how this may increase with the complexity and cost of interventions, will inform and guide the development of stratified medicine, and help with the possible negative public perceptions. Foetal development conditions, genetics and lifestyle are recognised as among the key areas whose variations and interplay most affect morbidity/mortality outcomes. The high contribution of domestic of research to this
understanding can be quantified. Greater understanding is needed of the possible health and GDP benefits of the growth in domestic contribution to biomarker and related technologies and their integration into public health, preventative and intervention science.”

Alistair Kent (Genetic Alliance) “It is important to recognise that health improvements must be taken in context and seen from the patient’s perspective. When measuring health gain, we must ensure that we are gathering information that can truly communicate the success or failure of an intervention in a meaningful way for the end user, the patient. For example a patient with Pompe’s disease is on enzyme replacement therapy. This is an expensive treatment which allows her a 4% gain in lung function. Described in a quantitative way, and out of context, this 4% gain can easily be written off as insignificant. However when we see that this 4% is the difference between her having to constantly wear a respirator and her being able to breathe for herself for a few hours at a time, we can understand the real health gain. This small change in lung function allows a big change in her independence and options in life. When attributing improvements in health to biomedical research, we must be certain to utilise meaningful measures of health gain.”

Jon Sussex (OHE) “This is not a vital area for research. More relevant is whether the costs of particular streams of research are justified by the benefits, not how much credit do different disciplines claim for the results.”

1.2.2. To what extent is this increase in health the result of health research?

Professor Jill Pell outlines "Research would suggest that circa 50% of the improvements are due to lifestyle improvements and 50% due to clinical treatment. Clearly the latter are due to the discovery/development of new therapies/technologies and their adoption - i.e. largely due to research. However, the former can also be attributed in a major way to research since public health legislation, health education etc have all arisen as a result of epidemiological research informing us what constitutes a healthy/unhealthy lifestyle. We are currently benefiting from historical improvements in health in terms of increased life expectancy. However current trends may halt or reverse historical improvements - in particular childhood obesity, less favourable trends in smoking in younger age groups, less favourable trends in physical activity in the young, increasing type II diabetes etc”

Debbie Lawlor (University of Bristol) "In part this depends on your starting point, but there is no doubt that health has improved considerably even in the last 50 years (and certainly over the last century) including in both length and quality of life. These improvements have in part been due to general improvements in hygiene and nutrition - to which engineering, cultural, societal changes made a contribution and also (particularly for more recent improvements) to interventions that were influenced by biomedical research - e.g. population reductions in smoking, dietary salt intake, use of anti-hypertensives, statins and also to technological improvements and health and safety in the workplace that have reduced occupational injury and ill-health.”

Steven Wooding (RAND Europe) "What fraction is attributable to biomedical research etc will vary by sector and disease area. The question for UK policy is more nuanced - how much is due to UK research and which funders. Would it matter if the UK stopped funding biomedical research in certain areas and just depended on research done overseas?”
1.2.3. **Is satisfaction/wellbeing of the public improved by research?**

Jill Pell (Glasgow) [There is] “insufficient empirical evidence assessing this directly. However, quality of life in a country is driven more by equity than wealth per se. Hence higher in eg Scandinavia than eg USA. This suggests that wellbeing would be increased more by research into reductions in health inequalities rather than improvements in health. However, this all presupposes that research is translated into policy.”

Jonathan Grant (RAND) “This could be very novel; the key is what is the outcome measure (eg well being)”

Luke Georghiou (Manchester) “Greater understanding of the influences of the transition from faith in innovation to greater public understanding and decision taking will inform and guide the direction of the growing force for both negative and positive public satisfaction, influencing both charitable donation and well being.”

1.3. **The benefits from research to industry and health users**

In its response to the consultation, CRUK outlined “It is largely felt that industry is attracted to the UK because of its research expertise and quality of research, leading to new ideas and invention. While there are several areas that have been identified as needing improvement to further encourage industrial investment, for example greater streamlining of regulation and governance of clinical studies to reduce the time it takes for a trial to be set up in the UK more work needs to be done to understand how long it will take to improve certain areas, for example it is understood that there is need for faster more efficient translation of research, but there is little in the way of evidence to identify the best way to do this.

The sector would greatly benefit from a better understanding of the best structures and processes to enable advances in knowledge to be translated into patient benefit. Similarly there is very little evidence to elucidate how much of the potential delay in translation is due to governance issues (e.g. too long to set up clinical trials) and how much is due to barriers to translation (e.g. when a researcher has an idea that could be developed into an new diagnostic test, but there is no local expertise and no clear pathway for this idea to be developed). Without knowing where the burden of the delay is, it is difficult to target resources to make improvements. This sort of information could perhaps be provided by drawing a detailed comparison of the different models that work well across the world.”

1.3.1. **Should we collect firm-level data to better understand the links between research and industry/innovation?**

The Department for Business Innovation and Skills also conducts an innovation survey every two years, which investigates in greater detail the innovation activity of UK firms. Data from the 2009 survey (from over 14,000 firms) showed that in 2008 around 33% of total innovation expenditure was on acquisition of capital, 32% was on internal R&D, 11% was acquisition of external R&D and 6% was acquisition of external knowledge. The larger the firm the greater the proportion of innovation expenditure devoted to
acquiring external R&D and supporting internal R&D. 20% of turnover in these businesses was generated by novel, new or improved products. 15% of innovators included Universities or public sector research institutes as partners in their innovation. This information should be helpful in examining the link between research and growth, but greater granularity is needed in the breakdown between sectors and more detail about the link between businesses and research council funded researchers.

Ian Hall (Nottingham) observes “May be tricky...often covered by confidentiality agreements.”

Jonathan Grant (RAND) “Key - this gets to the whole are of economic spillovers. Given the UK (and other countries) dependence on ‘cluster policy’ and that lack of understanding of how spillovers (a) manifest themselves and (b) are measured, this area is in need of further understanding. The current evidence is old, US centric and non-sector specific. This needs rectifying”

Richard Jennings (Cambridge Enterprise Ltd.) “So many surveys - so few conclusions and so little results! Massive mistake is to try to quantify qualitative data - societal good vs financial impact. Metrics are so treacherous and distort behaviour so easily if they are wrong.”

Matthew Bell (Frontier Economics) “.. there is a lot of econometric evidence that public and private R&D are complementary (ie one does not crowd out the other). However, lots of the evidence comes from overseas and in practice the degree of complementary and how much public spending is needed to drive private spending will be specific to sectors and the types of firms and institutions (eg their size, their global strength etc) in those sectors.”

Douglas Robertson (Praxis Unico) “Good question. NESTA estimate that 6% of SMEs contribute 50% of employment growth and similar studies are evidenced in the US - we need a focus on those firms and firm level data if we are to improve understanding and drive policy change”

Stephen Wooding (RAND) “An important question, alongside it we would need to understand how this affects the profits and spending of the companies and how the is geographically dispersed.”

Luke Georghiou (Manchester) “There are many macroeconomic estimates of the perceived association of public research expenditure with BERD, ranging from factors <1 to >2. Understanding of the within sector trends would better inform the differences in engagement, lag and scale of growth in co-investment from business in public/charitable research investment priorities. Separation of engagement of domestic and overseas businesses would provide greater understanding of the relationship between public/charitable research priorities and BERD and their contribution to health innovation and products and the direct and indirect impact on GDP during the early phases of innovation. Consideration of ‘spillovers’ and the lag effects on R&D inputs would be helpful particularly in the changing innovation models. For example, given open innovation and related industry R&D strategies, ‘spillover’ of industry R&D into public/charitable research, and back into industry via knowledge transfer and SME innovation would inform the effects of such models.”

Vincent Farrelly (Queens University Belfast) “Increasingly companies are dependent on open innovation and realizing the importance of managing the relationship with academic institutions in order to benefit in accessing & collaborating with academic researchers to help in the generation of innovative product/service. Putting user friendly systems in place to access such interactions and outcomes can help track and validate the commercial benefit of publicly/charitable funded research, and also make
more responsive the improvements and focus of organisations funding policies and criteria."

1.3.2. Is there other economic, social and statistical data that we should examine, in order to strengthen the way that health impacts are presented?

Luke Georghiou “There is certainly no consensus on the “best measure”, and the issues of knowledge and technology adoption in the NHS are very broad. However, there appear to be experimental designs that could be examined and potentially rolled out. One of those examples is MIMIT\textsuperscript{xxiv}, the Manchester: Integrating Medical and Innovative Technology. This multi-stakeholder initiative (including Trusts, Transfer organisations) is led by the University of Manchester and has established a new set of relationships in the regional health system. MIMIT actively seeks unidentified needs in clinics and connects those to scientists and firms in a moderated process. This is one pathway in which the knowledge producers can be drawn into those who define concrete needs. This matching can lead to immediate transfers of existing academic or trigger complementary scientific research that is targeted towards concrete needs. This is not a simple search for contract research funding, but a systematic need detection and matching programme whereby scientists are involved at various stages.”

Michael Whitaker (Newcastle University) “See Milken Institute's assessment of effect on US GDP of improved treatment of chronic diseases\textsuperscript{xxv}.”

1.3.3. Is uptake of research different in different areas of healthcare?

Debbie Lawlor (Bristol) advises “uptake by the NHS will always be based on a body of evidence - not one project / study and this body will almost certainly always have had funding from public, charitable and private sector. What would the value be of spending money on trying to work out just which of these three had contributed what to this body of evidence?”

Jonathan Grant “This is a well researched area (going back to the GRIPP\textsuperscript{xxvi} work in Oxford 10-20 years ago). The practical question is how do you implement 'co-production' / 'linkage and exchange' approaches that don't undermine research quality/independence, and are not seen as tokenism.”

Philip Cowen “The influence of NICE is important in demonstrating this in medicine” How do we provide greater insight into the contribution that research, and in particular publicly and charitable funded research, makes to improving healthcare and health?

Stephen Holgate (Southampton) “Case studies are a good way to do this”

1.3.4. Research and development employment

In the US the main focus of analysis following the American Recovery and Re-investment Act (ARRA) in 2009\textsuperscript{xxvii}, has been on how many jobs this additional investment has safeguarded or created. This has spurred the development of the NSF/NIH STAR METRICS project\textsuperscript{xxviii}. STAR METRICS seeks to draw information from US University human resource and finance system records to build up a picture of employment as a result of federal expenditure on R&D.
We asked “does the UK need a STAR METRICS programme or other metrics on the scientific workforce?”

Luke Georgehiou commented “The matching of university administrative records with government databases to produce standardised reports on jobs, economic, scientific and social outcomes would be marked improvement over the disparate domestic reporting methods (eg HESA, RAE/REF), and undue resources deployed to inform allocation of quality-related funding and targeting of research investment. However, any retrospective methodology awarding funds on track record may not optimise research investment towards prospective development priorities. Tagging of data for sector and within sector priorities to derive institutional research intensity, development pathways etc, alongside BERD would provide data to analyse and project towards health and GDP benefits. It would also provide data to stimulate networking between academics and industry. Further investment or sunsetting of priorities could then be more timely, and improve estimates of contribution to GDP and employment. Such numbers should only be used in high aggregation - they are much less reliable at project level.”

Beyond tracking changes in employment numbers, there is interest in a more detailed understanding of how investment in R&D helps deliver skilled people to the workforce, whether these are the right skills, and what the productivity gains are nationally. Current efforts largely focus on recording the destinations of staff either completing training schemes, or leaving grant support. For example data from MRC e-Val has shown that between 2006 and 2010 62% of staff leaving MRC funded projects and programmes remained in the academic sector, and 11% moved into the private sector. Other studies intend to track trainees prospectively (e.g. What do Researchers Do? (Vitae, 2010)xxx). Alternatively studies have traced cohorts of people who graduated in a certain year or were supported via a particular grant schemexxx.

Professor Georghiou “Fewer people supported by MRC are leaving MRC supported posts, with a high proportion remaining in the academic sector, and those (mainly PDRAs) moving into the private sector (~10%) is not rising. It would be helpful to understand why greater emphasis on business engagement has not increased mobility and, of those moving into the private sector, the proportion in domestic and overseas businesses.”

There are many processes that might cause skilled labour shortages, which in turn could be rate limiting for exploiting R&D opportunities. Most are associated, in one way or another, with ‘failures’ or ‘frictions’ in the labour market. Market failure can occur when signals, such as wages, are not adequately transmitted or are insufficient to generate adequate labour supply. Market friction can occur when signals are transmitted too slowly to be effective. If the labour market for R&D staff functioned correctly, any skills shortage would be temporary and self correcting. That is, an increase in demand would, in the short term, be accompanied by an increase in wages, which would attract more labour, alleviating the shortage and returning wages to their ‘market rate’. For a range of reasons, wages alone are unable to redress the imbalance between R&D labour supply and demand. The labour market is characterised by a range of supply constraints, not least the time taken to train new employees. These are worsened by the dynamic nature of R&D (changing areas of specialisation and requirements for emerging skills), creating a problem of lags in satisfying industry demand. Data are collected via MRC’s e-Val system about the skills in short supply for MRC funded research groups, and this largely validates efforts to build capacity using targeted training schemes in areas such as statistics and in vivo skills.

Research salaries nationally, internationally, and differences between the public and private sector are often cited as an important market factor dissuading people to train for careers in R&D, or leading to “brain drain” from the UK and/or academia. Data are available regarding the number of people training and graduating with skills in particular disciplines, but there are few data concerning the flow of skilled people into and out of
the UK, or the reasons for these moves. Recently Elsevier were commissioned by BIS to undertake an analysis of UK research publications in which these were used as a proxy for the location of researchers over time\textsuperscript{xxxi}. This gave an indication of “brain circulation” (rather than just brain "gain" or "drain"), the way that researchers moved into and out of the UK over time. The results demonstrated that there is significant mobility within the research population, which has been largely stable in number over the last five years. In addition this circulation was to the net benefit of the UK, as overall researchers returned with increased citation impact due to widened networks of collaboration and greater seniority.

According to Working Futures projections produced by Warwick University’s Institute for Employment Research\textsuperscript{xxxii}, employment in the bioscience sector will remain more or less stable through to 2020, albeit with some modest reduction in numbers over the medium term. This work also highlighted that there were differences in the potential of the pharmaceutical and medical technology sectors to provide employment over this period. The demand for skills in the pharmaceutical sector was expected to be for very highly skilled specialists, whereas the demand in the medical technology sector was estimated to be for skills that may be more abundant (e.g. electrical engineering).

1.4. Translational progress

MRC has made significant investments in translational research, including new ways to manage research programmes and partner with industry\textsuperscript{xxxiii}. It is essential that we can measure the effect that this is having and work out quantitatively and qualitatively the impact that these initiatives have made. Particularly challenging is to be able to present the impact that these investments have made over and above funding other areas of work.

We are prospectively collecting data on the output from all MRC investments, including those funded via initiatives to support translational research\textsuperscript{xxxiv}. It is expected that this information will allow detailed analysis of the contribution of MRC funded research to the development of new products and interventions, and should be helpful in estimating the overall economic impact of these initiatives.

Matthew Bell (Frontier Economics) commented on the identification of translational successes; “This is not as straightforward a question as it may appear. There are a number of very successful regions of the country (Eg Silicon Fen, the Academic Health Science Centres), there are also a number of successful companies that have been spun out of university R&D programmes, there are well known pharmaceutical successes etc. The real question is "success against what counterfactual"? Are you just looking for some case studies that say "we invested £X in R&D and created Y" or something more systematic that provides examples to underpin the analysis that is implied in questions above? Without a clear counterfactual (what would have happened in the absence of the particular investment in question) it is not possible to say rigorously whether the "success" is attributable to that investment."

Jon Sussex (OHE) comments “though this is important, a case-history based analysis is inherently unsatisfactory as a basis for future policy development. Individual case histories to find such successes would be a low priority. An overarching study that takes a more aggregate approach and is powered to enable analysis of what determines success (and to what degree) would be highly valuable though, and hence a high priority.”
Luke Georghiou (Manchester) highlights the data gathering for the REF “The inclusion of impact in the Research Excellence Framework has resulted in institutions reviewing hundreds of impact case studies. Given lag times, cases based on research in the last decade or so are likely to be selected and developed into more detailed cases. However, many cases based on more recent research with emerging impact will also be identified. This will provide a rich basis for health economists to develop exemplar successes of contribution to economic growth, and for broader understanding of the issues, barriers and successful approaches to impact.”

1.4.1. Is there more that we should do to understand differences in requirements for different partner organisations?

For example large pharma, biotechnology or medical device companies, spin outs and small enterprises?

Luke Georghiou “The understanding is likely to be complex, but important, given the need of the early phase contributions of the public/charitable sector to adapt more rapidly to changes within sector, than centralised funding systems presently achieve. Perversities otherwise arise, not least adaptation to funding priorities, rather than the value development benefits of change and engagements possible. Examination of schemes from private and public investment may help inform further development pathway schemes, particularly where basic research investment becomes more centralised in fewer institutions. Examination of further creation of national, regional and institutional development pathways may be beneficial in some sectors.”

Joanne Whitaker “this is an ongoing process - it means LOTS of interactions with lots of people to find out where and if there is synergy.”

Response from CRUK “Earlier this year, the Office of Health Economics published a report, Exploring the interdependency between public and charitable research to provide evidence for the mutual benefit of a diverse range of research funders. It made inroads into providing evidence to show that if cuts were made to public funding, alternative funders, such as charities, would not be in a position to make up for the shortfall, and that the relationship between such funders leads to an additive benefit. The report highlighted that more research is needed into the potential effects of multiple funders on ‘crowding out’ and ‘crowding in’.”

1.4.2. Can we expand upon and better present the evidence for relative payback from translational investments?

Jonathan Grant “Key here is a better understanding of time lags. The “What's it worth” study showed the importance of time lags in determining the return on investment. The literature on time lags is sparse and ill defined. We need to establish a taxonomy for time lags (there is a forthcoming paper from a US group that does this effectively) and then start to collect standardise information before we can answer this”.

Matthew Bell (Frontier Economics) “Yes [...] presentation of evidence in a credible but user-friendly manner requires: a clear framework setting out the drivers and outcomes, clear presentation of the data [...] econometric analysis to determine the strength of the
links and whether they are causal, and presentation of those results in a digestible format.”

Martin Roland (Cambridge) “Should you define whether you mean the first or second translational gap?”

1.4.3. How should we track and analyse changes in strategic areas such as regenerative medicine and experimental medicine?

Kate Bishop (University of Birmingham) “Funding agencies including charities need to develop common mechanisms to capture information. [The] MRC [has] developed e-Val but a common system with NIHR and Wellcome Trust enabling tracking of researchers & clinicians across a range of agencies (including possibly NHS as a ‘delivery’ agency) would provide a better continuum.”

The ABPI highlighted the need to include stratified medicine as a strategic area, and suggested that the following questions should be asked:

“What proportion of translational research results in research that drives benefit for development innovation?

How can it be improved in understanding the end points early?

What other areas of government policy (or other factors) hinders or helps translation?

What is the longevity of assets funded by MRC, and subsequent access for translation.”

1.4.4. What should be the approach to quantify or better define the uptake of ideas?

Debbie Lawlor (Bristol) “For most areas there are data available - it just needs individuals with the data mining skills required to put together the date of first research outputs in a particular area (publications) the point at which evidence had reached a point where it should have impact (eg cumulative meta-analyses) and dates of ‘impact’ (e.g. sales of a product, up take in policy / guidelines etc.). I do not think expecting researchers or funders to start new forms of data collection will really be value for money to address this.”

Luke Georghiou “Ideas like new technologies often suffer lengthy lags to uptake, with independent re-incarnations over periods of decades. Greater understanding of the reasons for this and the often conservative and risk averse nature of academic research may be found in the records of peer review and decisions of grant awarding bodies, and the records of peer review and editorial decisions of academic publications.”

Vincent Farrelly “Better gathering, centralization and interpretation of key data in a timely manner. Such as academic and trade publications, internet, blogs, social media, patent filings. However not all relevant data would be available due to commercial sensitivity/confidentiality.”

Is there more that we should do to understand the types of partnership between academic and private sector, and the effect this has on innovation and growth?

Philip Cowen “This is an important issue because it touches on how academics should work with Industry, an activity which can attract criticism within medicine (see report by
Academics need to be supported in collaborative industrial activity and enabled to carry it out in an ethical and productive way.”

Luke Georghiou “Consideration is given too few of the diverse types of engagement, in part caused by the focus of funding agencies on IP-based development pathways. Examination of pump priming investment in sustainable development pathways within and between institutions, national and private consultancy partnerships need to be examined to foster development of the diversity and complexity of interactions.”

Vincent Farrelly “quality more than quantity is the key factor. Most assessment factors are based on number of papers, amount of funds secured, number of collaborators and similar whilst more attention should be paid to the quality of the research outcome by employing different and new metrics”.

1.4.5. Is there evidence that some research schemes/routes to funding provide a faster or higher rate of return to the economy?

Luke Georghiou (Manchester) “It would be helpful to tease out whether public-private partnerships are more or less effective than more traditional funding approaches. Government co-investments have required more detailed planning of development pathways for many years, and a wide variety of schemes have been used. Analysing reports and tracking delivery of those developments would inform this question. Records should be kept for longer than the lag times to impact in the sector.”

Vincent Farrelly (QUB) “Yes, such as medical devices, medical imaging, diagnostics. Drug discovery is higher risk and more long term but potentially has a higher rate of return to the economy”.

ABPI added “How would impact be benchmarked internationally?”

1.5 Other Priority Questions

In this section most feedback was obtained on the subject of concentrating research effort and measuring the effect of this on impact.

We asked “Medical research funding is concentrated in relatively few Universities. Would further concentration aid economic impact, or harm it?”

Cam Donaldson (Glasgow Caledonian University) “Concentration in an elite ‘club’ has already harmed quality, in my view, and perhaps economic impact. Pockets of excellence in other universities need to be encouraged. That’s where some growth might come from. But currently, they are excluded.”

Jonathan Grant (RAND) “This is an interesting question that can also be expanded: Is there a correlation between research quality and clinical practice outcomes? If so what are the implications for concentration?”

Angus Duncan (University of Bedfordshire) “The well trodden track as to whether concentration stimulates innovation or complacency.”

Richard Jennings (Cambridge Enterprise Ltd) “Critical mass does help – quality is crucial and not entirely concentrated but it happens by default if not by design - in general smart people like working together.”
Matthew Bell (Frontier Economics) “You would need to develop an approach to understand the marginal impact of additional funding to the current recipients (are there economies of scale in research, at what point are they exhausted, what would they do with the funding) and compare that to what would happen if it went to alternative universities.”

Luke Georghiou “Greater concentration of public research investment based on academic research excellence may not achieve the desired outcomes by itself, and may harm it. Current academic motivation predominantly remains academic publication impact, not least because of its dominance in winning public/charitable research investment. Existing and greater concentration of research funding should also take greater account of the existence and effectiveness of within sector impact development pathways relevant to the concentration of funding. In one respect the UK has over-concentrated to the detriment of its population. Large numbers of the least healthy segment of the population are denied regional spill-overs as a result of over-concentration of biomedical research in London.”

Michael Whitaker (University of Newcastle) “There is a law of diminishing returns in research funding because the same outputs and outcomes are used to draw down multiple grants in closely related research projects”
2. The Workshop

Around 50 attendees met on the 26th of October 2011 in London (attendee list at Annex 1). Attendees represented a range of research organisations, funders, and universities. The day was organised into a morning of expert presentations, followed by discussion groups, and finished with summaries of these discussions delivered by rapporteurs from each group (agenda at Annex 2).

2.1. Professor Martin Roland (Health Services Research, University of Cambridge)

Professor Roland outlined progress that had been made in assessing the benefits of medical research to society by research organisations.

In 2005/06 Professor Roland chaired the UK Evaluation Forum a group convened by the Academy of Medical Sciences, the MRC and the Wellcome Trust. The forum sought to bring together stakeholders in medical research, to review the existing evidence for the benefits of research, and to recommend further work in this area. The early work of the forum was published in 2006xxxvii, providing advice to funders and research organisations about the methodology for evaluation, and recommending that more research should be done in this area.

The report highlighted that medical research provides a range of benefits; new knowledge which may have applications in any/all disciplines, new treatments, better targeting of healthcare resources, better information for making health policy, improved health and economic benefit. However there was more that funders could do to evaluate impact in ways that explained this to the public and government. One useful conceptual framework which connected research investments with economic and societal outcomes is the Buxton and Hanney payback framework developed by the Health Economics Research Group at Brunel Universityxxxviii. This model has informed the structure of many evaluations of research since.

Assessing the benefits of research is complex because; there are long time lags between research and tangible outcomes, there are multiple stages in the development of a new medical product or intervention, and there are multiple contributions from different research groups funded in different ways, often across different disciplines and countries. Approaches used for assessing impact include bibliometric analysis of publication output, peer review, case studies, and econometrics. Recently the Department for Business Innovation and Skills (BIS) had worked with Elsevier to analyse the international competitiveness of the UK science basexxxix, and the results confirmed that, although the UK has just 4% of the world’s researchers, the UK produces 11% of the world’s scientific papers, and 14% of the world’s top 1% of highly cited papers. These figures are clearly encouraging, but citation impact examines only one aspect of scientific output and captures a narrow part of its impact.

Peer review is used extensively to assess impact, and will be a major component of the new Research Excellence Framework (REF)x. Professor Roland referred to peer review as “panning for gold in the valleys of uncertainty”, to emphasise how difficult this task is. The evidence that experts have to review is clearly essential to robust evaluation, and the REF will utilise quantitative material such as bibliometric data, but also extensive qualitative and semi-quantitative case studies. Challenges to reviewing this information include linking research with impact over the long time it takes for basic research to influence clinical practice, and being able to assess the impact of negative results. There
are also challenges to setting these case studies in context. As research outcomes are highly skewed it is difficult to obtain the total investment for any given impact in order to properly assess a rate of return.

RAND Europe has recently led a three-year project to learn from the past, termed project ‘Retrosight’. This project collated a large number of case studies and combined this with a standardised approach and bibliometric data to examine the characteristics of projects that led to high or low impact. The results highlighted the following:

Box 1. Factors influencing impact (taken from Project Retrosight)

- Basic biomedical research with a clear clinical motivation is associated with high academic and wider impacts
- Co-location of basic biomedical research in a clinical setting is associated with high wider impact
- Strategic thinking by clinical researchers is associated with high wider impact
- Research collaboration is associated with high academic and wider impact
- International collaboration is associated with high academic impact
- Engagement with practitioners and patients is associated with high academic and wider impacts
- Basic biomedical research collaboration with industry is associated with high academic and wider impacts
- Negative or null findings are associated with low academic and wider impacts
- Initial rejection of a subsequently accepted basic biomedical research grant may be associated with low academic and wider impacts

To assess the impact on the whole economy factors such as direct savings to the healthcare system, benefits of a healthy workforce, benefits from commercial development, and the intrinsic value to society of health gain have to be valued. This in itself is difficult, but establishing the proportion that arose due to research and development (attribution) often proves impossible to achieve with any degree of certainty.

In the USA, it was an advocacy initiative of the Mary Woodward Lasker Charitable Trust, entitled Funding First, which commissioned a series of papers from leading US academic economists. These were presented at a conference in December 1999, the summary of which was entitled ’Exceptional Returns’ and included an estimate that the total economic value to Americans of reductions in mortality from cardiovascular disease averaged $1.5 trillion annually between the years 1970–1990. If just one-third of the gain came from medical research, the return on the investment would average $500 billion a year in the order of 20 times as large as average annual spending on medical research – by any benchmark an astonishing return for the investment and an estimate that made famous the Mary Lasker quote “If you think research is expensive, try disease”.

Instead of examining impacts at the whole economy level, some studies have focussed on examples where there is more data about cause and effect. For example work which values the impact of research locally or regionally. Processes may include co-funding
from industry (as the result of academic collaboration), licensing income from patents, income and employment in spin out companies, or development of brown field sites or economically deprived areas. A bottom up approach was taken by the UK Evaluation Forum in commissioning the Health Economics Research Group at Brunel University, the Office of Health Economics, and RAND Europe to collaborate on a new study on the economic return from medical research. The “Medical Research: What’s it worth?” study, published in 2008.

Box 2. “Medical Research: What’s it worth?” (Buxton et. al. 2008)

- Time series analysis of medical research funding in cardiovascular disease (CVD) and mental health (MH) research from 1975-1992
- Development and application to CVD and MH, of a ‘bottom-up’ approach to estimate health gain in terms of quality adjusted life years (QALYs)
- Analysis of UK guidelines for CVD and MH to provide indicators of lags and proportion of benefits attributable to UK
- Strong quantitative argument for investment in medical research with a best estimate of the rate of return from CVD research of 39%, and for MH research of 37%

How do we reconcile vastly different estimates of the rate of return from medical research? These estimates have ranged from 39% for the Buxton et al. study, in the case of an Australian Access Economics study in 2003 a return of 788% was reached, and in the case of the exceptional returns study the return was 20 fold. There are clearly problems with the methods used, some of which the authors of these studies clearly acknowledge.

The studies use very different methodological approaches, from the macro-economic to a mixed micro/macro economic approach. Because knowledge “spills over” and research is highly collaborative it is difficult to assign both inputs and benefits to individual countries, or programme of work. There are challenges to valuing the benefits, with widely different ways of monetising health gain, and the need to factor in changes to healthcare costs that result from delivering new treatments. Lastly the estimates, while helping to advocate investment in medical research, do not help decide where to put future investment. So far there has been no credible work that demonstrates particular areas of medical research may provide a lesser or greater economic benefit, and in any case such results would be based on past performance.

However a lot of progress has been made over the last five years. Funding agencies have pursued work to better understand the link between the research they support and impact, and interest has increased in how impact can be more rigorously assessed. A significant proportion of the REF exercise, for which UK Universities are preparing in
earnest, will be about research impact, and both the MRC and NIHR have implemented approaches systematically to capture information about the outputs, outcomes and impacts of the research they support\textsuperscript{xlvii}.

2.2. Professor Jonathan Haskel (Imperial College Business School and UK Innovation Research Centre\textsuperscript{xlviii})

Professor Haskel outlined how economists measure the effect of public investment in research and development on growth, taking a macro-economic view.

If we start with the main input to research and development, spend on this activity, we can see that research council budgets have increased almost three-fold over ten years.

\textbf{Figure 1. The Significant increase in research council spend\textsuperscript{2}}

![Figure 1. The Significant increase in research council spend](image)

But what has been the impact of this increase, and how can this be measured?

Research and development has many impacts such as the creation of new highly skilled jobs, the development of a more informed citizenship, and other improvements to quality of life. The aspect that economists focus on is the impact on private sector growth. This is still a challenging aspect to measure. If the growth of a company (for example a passenger aircraft company) is studied as an example then data can be

\textsuperscript{2} Source: BIS data. Official data on publicly supported R&D is broken down into funding for research councils, HEFC research-designated spend, civil R&D and defence R&D
collected on the changes in human capital (staff), physical assets (aeroplanes) and knowledge capital (e.g. innovations such as ticket-less boarding). Both human and physical capital are private goods traded in the market which means that information about their ownership and financial value is available. However most knowledge is a public good, and without careful protection (e.g. via patents) it can be appropriated by others. It is extremely difficult to establish all the links between the producers of this knowledge and users, even when research grants, patents, licence payments etc. are studied. In most cases fundamental knowledge is freely accessible by all and so there is no comprehensive trail evidencing its use.

Examples of how knowledge can “spill over” in unexpected ways include the route by which (it is alleged) the US plane company Northrop acquired improved methods to model electromagnetic wave reflection from surfaces. These mathematical models are reported to have led to the stealth technology incorporated in the F117-A fighter, and the knowledge is understood to have been taken from a translation of a Russian paper in 1962, the potential application of which was not locally recognised. More recently a surgical team at Great Ormond Street Hospital contacted the MacLaren formula one racing crew to see if knowledge from quick pit stops could be translated into the operating theatre. In a video analysis of the handover from the operating theatre to the intensive care unit, the pit teams worked with doctors to make the process more efficient and less error-prone.

In addition to absorbing external knowledge, private sector growth is influenced by internal research and development, and investments in training and physical capital. Analysis of the impact of public sector investment in research and development has to take account of these inputs. A measure of “total factor productivity growth (TPFG)” is calculated; the extent to which growth occurs over and above that which is due to additional investment in capital, private sector research and development etc.

![Figure 2. Correlation of market sector growth and research council spend](image-url)
Professor Haskel explained that time lags were a significant issue as translation of research into practice varies substantially between disciplines. For example engineering research can be rapidly into application, whereas medical innovations may take one to two decades to impact. As the above analysis looks at total research council spend, and total market sector growth it is an average. The time lag from research to changes in market sector growth in the above analysis is in the range of 1 to 3 years. The “macro” economic view provides strong evidence for public research and development spend boosting private sector growth. There is some evidence of declining returns, but the benefits from this investment still exceed many alternative uses of this funding. The correlation shown above has held up to additional new data on research and development spend, and controlling for other factors. The relationship between research spend and growth suggests that a cut in research council budgets of £0.5 billion might impact upon growth by as much as £0.6 billion. To better understand the ways in which research “spills over” and leads to impact, detailed work is needed on the link between the producers and users of research. In addition better data on growth and measures of impacts such as quality of life are needed.
2.3. Professor Alan Hughes (Centre for Business Research, University of Cambridge and UK Innovation Research Centre)

Professor Hughes outlined how tracing the interactions between the users and producers of research gives insight into the processes that lead to impact, and how this might be maximised. In his presentation Professor Hughes highlighted what is different about medical research compared to other disciplines.

David Willets (Minister for Universities and Science) stated in July 2010 “The surprising paths which serendipity takes us down are a major reason why we need to think harder about impact. There is no perfect way to assess impact, even looking backwards at what has happened”.

Assessing impact is challenging, even retrospectively reviewing progress is difficult (as in the proposed REF approach), let alone trying to guess where research might lead, or how impact might best be maximised (as in the research council pathways to impact).

To find out more about these issues the Centre for Business Research in Cambridge conducted a survey of all UK academics (122,000 researchers), and obtained 22,000 responses. In parallel around 2,500 businesses were also surveyed to capture the user perspective. Professor Hughes presented results from the academic survey highlighting the characteristics of health services researchers.

One characteristic that is important to determine is the extent to which researchers themselves believe their work is driven by the quest for fundamental understanding, or more applied objectives. To present this we can use “Stokes Quadrants” (Box 3).

<table>
<thead>
<tr>
<th>Consideration of Use?</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental understanding?</td>
<td>8.2%</td>
<td>21.7%</td>
</tr>
<tr>
<td>“Bohr”</td>
<td>Fundamental Research</td>
<td>“Pasteur”</td>
</tr>
<tr>
<td>“Edison”</td>
<td>Applied Research</td>
<td>70.1%</td>
</tr>
</tbody>
</table>

The data entered into the quadrants in Box 3 is drawn from the Centre for Business Research survey of academia and businesses cited above. The results show that in health sciences the majority of researchers consider that their work is applied or at least...
inspired by potential use. This is quite different to other areas of research (for example 50% of researchers in the Arts and Humanities consider their work to be fundamental).

Institutional frameworks that allow and encourage movement between quadrants are important to promote interaction between Universities and the business sector.

Box 4. The Role of HEIs in contributing to economic and social development (taken from Knowledge Exchange, Research and Teaching in Higher Education Institutions (PACEC/CBR, 2010))

Often knowledge exchange is measured purely by the number or citation impact of publications, however there is plenty of evidence to show that publications play little or no role in transferring knowledge to industry. There are many processes which are somewhat closer to users than publications, labelled in the above diagram as “problem solving”, which includes collaborative research centres with a specific remit to work with business. There is a lot of focus on commercialisation as a route from producers of knowledge to use and impact. However it is also clear that people are a significant component of knowledge exchange, and in particular post docs and students (who are at the most mobile stages of their career) can be the most important agents of knowledge exchange between sectors and quadrants. MIT for instance rates its postdoctoral workers as most important agents of knowledge exchange, far more important than patenting.

It is clear that there are many “pathways to impact”, but are there useful indicators to measure these processes? Professor Hughes broke down these processes into various types of activity.
Data from about 3,500 responses from researchers in the health sciences sector (similar to the number of responses represented in the arts and humanities sector presented in Box 5) shows significant differences in the proportion of activities associated with commercialisation. About 5% of health researchers report licensing activity, 8% had taken out one or more patents, 3% had spun out companies, and 10% had provided consultancy to the business sector.

The widest spread of interactions occurs in the group of “people-based activities”, all involve non-university audiences (with health sciences interacting most with the public sector, and engineering interacting most with the private sector, reflecting the importance of demand pull in these two disciplines), followed by the set of “problem solving activities” (“informal advice” is highlighted at the most important activity which often leads onto other interactions).

The conclusion from this work is that if you focus on a narrow range of hard commercialisation activities, then you will miss the majority of academic/business interactions.

How to capture and measure impact?

There are many challenges to capturing and measuring impact. What to measure, when to measure it? How to attribute output? Many of the activities in the modes of interaction figure above are suitable to measure as intermediate indicators. The expectation is that these processes eventually lead to impact. Intermediate indicators are needed due to the long lag time between research and impact.

Impacts are highly skewed, only a small proportion of projects will translate into impact over the long term. This is well known in the pharmaceutical industry in which costs of
Around $850 million\textsuperscript{iv} are quoted to bring a new drug to market, the development process may take 12 years from research to launch\textsuperscript{v}, and the success rate from first in man studies to registration for new drugs is only 11\%\textsuperscript{vii}. In calculating the efficiency of the process “failures” have to be factored in (those projects that do not appear to lead to outcomes). If we start from an impact, then our view of the events that led to this are likely to have large selection bias. It may be helpful to view research policy in a similar way to the view that venture capitalists have. Venture capitalists have to deal with the risk of uncertain returns by building a diverse portfolio, and so will develop detailed criteria upon which to select potential investments.

Who do you attribute the impact to? There are many different funding agencies concerned with medical research, including globally “footloose” and powerful multi-national industry funders (large pharmaceutical companies), a substantial publicly funded contribution (from NIHR, MRC and the other research councils of more than £2 billion per year), and significant charitable support for research (approximately £1 billion per year).

For any marker of intermediate impact, for example a key policy document, hundreds of inputs can be evidenced as influencing that policy, or connected to those strong outcomes. All these will have arisen, if they can be traced, as the result of multiple overlapping investments. Without an approach to link outputs to inputs then it is impossible to calculate the return on investment. A much cited study\textsuperscript{viii} by Comroe and Dripps published in 1976 examined 10 key advances in cardiovascular medicine and found that these could be linked to 600 research papers, but over 40\% of these had little to do with cardiovascular medicine, many arose not from faculties of medicine but departments of chemistry, engineering, physics, botany etc.

The linear model of translation is an over-simplification, as exemplified in the Buxton/Hanney payback framework\textsuperscript{lix} for assessing the outcomes from research; research frequently stops, feeds back to earlier stages in the pathway and there are iterative cycles of development. The “Medical Research: What’s it worth?” study highlighted the long lag time for impacts to arise (estimating an average of 17 years for interventions in cardiovascular disease).

We can present some of these processes in Box 6:
An important issue shown Box 6 is that of “complementary assets”. If an innovator has access to the necessary skills and resources to commercialise a discovery locally then this will contribute greatly to the “stickiness” of that discovery. If the complementary assets lie outside of the UK then the impact will most likely be realised outside of the UK. For example in opto-electronics, if the main application for innovations is in flat screen technology, and manufacturing of flat screens is dominated by industry in the far east, then this is where the value will be added. The UK Government may take less interest in supporting research where the benefits lead to impacts such as jobs and investment outside of the UK. Although this does not take account of unexpected outcomes from such research, the presence of complementary assets may be an argument for backing research.

As we move from the left hand side of the pathway in the slide above, to the right the importance of complementary assets increases. Unless the right business interactions are in place and the complementary assets are controlled, by the time that outcomes should be translated to impact, then this vital step will not occur, or the discovery may be imitated elsewhere. So an important consideration is how to provide the right institutional arrangements to attract actors with the right complementary assets to the UK, something which is part of the rationale for the new UK technology innovation centres (TICs).

Funding agencies have to carefully consider supporting more applied work; does this simply substitute for the private sector backing more high risk work? Is there a trade off between Universities supporting more applied work and businesses supporting less? Counterfactuals have to be considered – what would have happened if investments were made in a different way?
It is clear that the MRC is gathering a lot of data on behavioural change and activities associated with academic/business interactions via its e-Val system. In order to understand how research leads to impact both quantitative and qualitative information are needed, and Professor Hughes suggested that changes in behaviour which modify the interactions between academia and industry should be monitored closely.

2.4. Professor David Clarke (Head of Business Development, The University of Manchester)

Professor Clarke outlined how The University of Manchester promotes and measures translation and impact, as an example of how a large organisation views its impact.

Professor Clarke explained that the University actively promotes individual researcher engagement with translation. This is part of the institution’s vision and strategy. Applied and translational research and knowledge transfer activities are given parity of esteem with fundamental and curiosity driven research, having an impact on promotion and career development within the University. The University assists its researchers in managing potential conflicts of interest and provides direct incentives and investment. These include a generous share of revenue to originators\textsuperscript{LXI} and the UMIP Premier Fund\textsuperscript{LXII}.

In addition the University maintains a data base of all research-active staff (E Scholar repository) which includes; research outputs, research expenditure, research students, and social and economic impacts (including patenting, licensing, creation of spin-out companies, securing venture capital investment, policy development, public engagement, social responsibility, global health etc.). This information is used to help manage business relationships more effectively across the value chain.

<table>
<thead>
<tr>
<th>Box 7. Business relationship at the University of Manchester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategy</strong></td>
</tr>
<tr>
<td><strong>Leadership</strong></td>
</tr>
<tr>
<td><strong>Objectives &amp; value</strong></td>
</tr>
<tr>
<td><strong>Prioritise</strong></td>
</tr>
<tr>
<td><strong>Resource</strong></td>
</tr>
<tr>
<td><strong>Risk assessment</strong></td>
</tr>
<tr>
<td><strong>Relationship management plan</strong></td>
</tr>
</tbody>
</table>

35
In addition to tracking individual researchers, the University manages a large number of translational centres (these are shown in Box 8). The process of monitoring and review the progress of these centres produces a large amount of information about activities and outputs. All these centres have strategic goals and KPIs agreed, with progress monitored by a governing board and regular reports to external sponsors.

**Box 8 Pan-institutional/regional translational centres at the University of Manchester**

- Manchester Academic Health Science Centre (MAHSC)
- Manchester Cancer Research Centre (MCRC)
- Manchester Collaborative Centre for Inflammation Research (MCCIR)
- Manchester Integrating Medicine & Innovative Technology (MIMIT)
- NW Institute for BioHealth Informatics (NIBHI)
- mHealth Innovation Centre
- NW Centre of Excellence for Biopharmaceuticals (COEBP)

This generates a large amount of management information (examples of the indicators used in managing these centres are shown in Box 9). Output information such as intellectual property by type (Box 11) and information on spin out companies (Box 12), and overall metrics on economic output (Box 13) can be compiled, but to judge performance appropriate benchmark data is needed.

**Box 9. Example Translational Centre KPIs**

- People: world leaders recruited, volume of fellowships, researchers, research-enabled post-registration qualifications
- Enabling capital investments eg: informatics & population databases, biobank networks, imaging, robotics, predictive development & simulation tools, biostatistics
- IP: disclosures, patent grants, licenses, spin outs, venture funding, share sales
- Business collaborations: alliances through to business assists
- Projects supported: initial funding, leveraged funding, follow on investment
- Lag time to investigational products
- Patients engaged in trials
- Products launched
- Uptake: regional, national and international
- Marketing phase education & consultancy; health professional workforce, population, health technology and economics research
International benchmarking – how well is the UK performing, and how well are UK institutions performing?

Professor Clarke highlighted the recent BIS/Elsevier report concerning the international competitiveness of the UK science base, which showed that the UK had the highest share of highly cited papers for its share of researchers, or for its spend on research and development. However better international benchmarking is needed across a range of other outputs. There are some comparisons of patenting and licensing across countries (see Box 10), but little data on any other kind of output. From the data in Box 10, it can be seen that share sales are significantly different between the UK and US. It is benchmark data like this which helps to focus attention on areas for which it is possible to improve performance, or at least better appreciate why there is variation.

**Box 10 Comparison between US and UK licensing activity (Financial Year 2007/8 – 2009/10 averages against research spend for knowledge transfer)**

<table>
<thead>
<tr>
<th>Per £1m research spend</th>
<th>Disclosures</th>
<th>Licence royalties</th>
<th>Share sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>0.8</td>
<td>£13k</td>
<td>£10k</td>
</tr>
<tr>
<td>US</td>
<td>0.9</td>
<td>£60k</td>
<td>£1.4k</td>
</tr>
</tbody>
</table>

**Box 11. Breakdown of Intellectual Property activity at the University of Manchester**

Intellectual property is tracked from academic units into market sectors, and profiled over a rolling 3 year period, as there can be significant variations within any one year. For example medical disclosures from Manchester can be broken down as follows, showing those areas where there is more patentable activity:
Box 12 Manchester successful spin out companies in the medical sector

Manchester/Imperial College joint spin out. Mass-produce consistently high quality quantum dots for consumer products and biomedical applications (Prof Paul O’Brien): £4.1M private equity funds

Recently launched first device for treating bladder weakness, affecting 1 in 3 women - electronic tampon stimulating the pelvic floor muscles, 84% women improved in a few weeks (Prof Jackie Oldham): £5m venture capital

Dysphagia affects about 50% of stroke patients. Phagenesis is developing a device to stimulate the brain to improve swallowing (Dr Shaheen Hamdy): £6m venture capital.

Healthcare acquired infection trace detection for hospital surfaces (Dr Harmesh Aojula): £570k NIHR SBRI, £2.5m venture capital.

Professor Clarke highlighted that metrics such as numbers of spin outs and patents may not mean a great deal. What matters is whether a spin out company thrives, or a patent is successfully licensed. For University of Manchester Intellectual Property (UMIP) one overall impact is that the group makes a small, but positive return on investment, but there is a need for better benchmarking with others to judge how good this return is.

Box 13 Overall Economic Impact of UMIP

<table>
<thead>
<tr>
<th>Metric</th>
<th>Manchester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research spend</td>
<td>£190m per annum</td>
</tr>
<tr>
<td>IP disclosures</td>
<td>350 per annum</td>
</tr>
<tr>
<td>Proof of principle projects</td>
<td>30 per annum</td>
</tr>
<tr>
<td>Spin-outs</td>
<td>5 per annum</td>
</tr>
<tr>
<td>Licences</td>
<td>40 per annum</td>
</tr>
<tr>
<td>Venture funding (3rd party)</td>
<td>£27m per annum</td>
</tr>
<tr>
<td>Major equity exit events</td>
<td>2 per annum</td>
</tr>
<tr>
<td>Originator share</td>
<td>85% (50% after 1st million)</td>
</tr>
<tr>
<td>UMI3 share &amp; license sales</td>
<td>£3.6m per annum</td>
</tr>
<tr>
<td>UMI3 share – cost</td>
<td>£1.3m</td>
</tr>
</tbody>
</table>
Preparation for the Research Excellence Framework

Professor Clarke outlined the work underway in preparation for the REF in 2014 (see Box 14), and asked, could this information be more widely used to understand impact in the UK?

<table>
<thead>
<tr>
<th><strong>CASE STUDIES</strong></th>
<th>~ 1 per 10 FTE returned (any fewer scored unclassified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underpinning context</td>
<td>Research insight/findings, researchers, dates</td>
</tr>
<tr>
<td>Research outputs referenced</td>
<td>Grants, sponsors, value, period, investigators</td>
</tr>
<tr>
<td>Economic impacts</td>
<td>Cost effectiveness, service change</td>
</tr>
<tr>
<td>Commercial impacts</td>
<td>Sales, turnover, employment, licenses market authorisation, KTPs, adoption</td>
</tr>
<tr>
<td>Policy &amp; practitioner services impacts</td>
<td>Evidence of change to policy, legislation, regulation; measured improvements in services or practise</td>
</tr>
<tr>
<td>Societal impacts</td>
<td>Public involvement, change in attitude, equality</td>
</tr>
<tr>
<td>Reach &amp; significance</td>
<td>Process, relative contribution, beneficiaries, nature, dates &amp; evidence of impact</td>
</tr>
<tr>
<td>Corroboration sources (to be available for audit)</td>
<td>Public domain, confidential (if listed), factual statements of beneficiaries</td>
</tr>
</tbody>
</table>

At Manchester there are 2157 eligible staff (517 medical), 48% university staff and 55% medical staff report impacts, totalling 2996 impacts from University staff and 1015 from medical staff.

More than 250 case studies will have to be reviewed initially using internal review panels. Good quality studies will be selected and researched further to gather adequate evidence. It is estimated that the process will take 16 man years and cost £1.5m at the University of Manchester alone.
<table>
<thead>
<tr>
<th>Issues to consider</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Institutional memories are short and hence it is challenging to track long term impacts retrospectively, especially when people have left or retired.</td>
</tr>
<tr>
<td>• Claims made by academics need to be substantiated and this is requiring a substantial investment. Until we have passed through one iteration, we will not know the required level of proof.</td>
</tr>
<tr>
<td>• Do we have the right balance of retrospective versus prospective processes to inform public investment in research?</td>
</tr>
<tr>
<td>• How could institutional data be aggregated to inform actual and prospective impact?</td>
</tr>
<tr>
<td>• Could institutions cooperate to aggregate and analyse data to inform the next Spending Review process ahead of REF?</td>
</tr>
<tr>
<td>• Could public sponsors cooperate, as sector impact crosses their research funding boundaries and often benefits from multiple sponsors?</td>
</tr>
<tr>
<td>• Could a STAR Metrics approach be adapted longer term to measure the effects of research on innovation and competitiveness to improve business engagement and block grant allocation?</td>
</tr>
</tbody>
</table>
2.5. Breakout group 1 – Macro economics

This group was asked to discuss economic impact from the “Macro” economics point of view, taking a lead from Professor Haskel’s presentation.

Some of the discussion points from Professor Haskel’s presentation were:

- There is a need to learn from other disciplines, for example engineering research has consistently had a close link with industry, does the design of institutions or other infrastructure matter?
- Does the appetite for risk vary in different subjects? How can we measure this? If the degree of multi-disciplinarity, long-term commitment, and the flexibility afforded to researchers differs under different schemes and in different fields, can we learn from this?
- Can we differentiate the impact of capital vs recurrent investments?
- Are there international comparators that might be helpful? For example what occurs in countries where no research and development is done (where results from elsewhere are relied upon)?
- Does the movement of people between sectors modify impact? How important is mobility to growth?
- The NHS is crucial to the translation of research into impact.

Dr Wissenberg explained that the link between research and impact is an area of common interest across the research councils and very much on the RCUK impact group agenda.

The group started with a discussion of GDP, how this estimate of national income is constructed, how consistent it is with measures in other countries, and how it is an incomplete measure. Attendees noted the interest in providing estimates for impact not included in GDP, such as “well being” indexes. While the ONS are working on this, the measures will not be ready until after the next spending review. There is clear Government interest in such a measure and it may be helpful for research councils to see how such data could link to their activities.

In the earlier discussion EQ-5D was referred to, which is another measure of health outcome. The NHS is starting to use approaches based on the EQ-5D of health outcomes for patient reported outcome measures (PROMs) in non emergency surgery, so this may be a usable outcome measure in future.

Attendees discussed whether the Treasury used any estimates other than GDP. There was interest in the USA regarding monitoring employment, but economists there were concerned that these efforts would simply displace jobs rather than bring economic benefit, and the focus should be on firmly on overall growth.

“Economic rent” is another concept which is used by the Treasury. It looks at the opportunity costs of an investment. For instance comparing the return gained by employment in the research sector with employment and capital investment in other sectors. This is better than simply accepting that job creation is good, it matters what sort of employment is created. There is good evidence that employment in the pharmaceutical sector generates positive economic rent, in other words more GDP than
if the same people were employed doing something else. At present this approach suffers from a lack of good comparator data from other sectors.

As well as “happiness” there are other difficult to measure qualities, such as an educated population (often measured as the proportion of the population gaining particular qualifications).

Attendees also discussed the correlation that Professor Haskel presented, acknowledging that correlation doesn’t mean causation, and that the challenge was to continue to remove factors that don’t contribute to the effect, using more detailed data. Attendees highlighted that any estimate had to survive scrutiny with common sense. The “Medical Research: What’s it worth?” study had the advantage of advancing very reasonable estimates of rates of return, but also having strong evidence of causative links between the research and changes in medical practice. This would be a weakness of purely macro-economic “top-down” approaches, without at least some case study data to lend credibility to the estimates.

Attendees discussed some of the routes by which health research is thought to lead to impact, in group four there would be discussion of new health interventions invariably costing more to introduce and the importance of capturing savings from health research, not just health gain. The importance of looking at results that lead to cost savings was highlighted, not just positive findings which had led to streamlining processes and procedures, but also negative results that resulted in stopping research or practices which otherwise would continue to cost.

There might be the possibility of detecting such changes at the whole economy level, for example changes in sales, claiming benefits or visits to clinics. However determining causation would be a large challenge, how to disentangle changes in policy and changes in practice?

Attendees were particularly concerned with the specific interests of Treasury, while wellbeing is something that the public is interested in, the part of the economy that can be taxed is encompassed by GDP, so why would Treasury be interested in other measures? Attendees were disappointed that the Treasury’s new chief scientist could not attend the workshop, but those that had interacted with Treasury had formed the impression that Treasury’s interests were sophisticated and did indeed extend beyond those items that are straightforward to value. The priority for Government is to find ways to stimulate economic growth, and all options are being explored to achieve this.

Attendees discussed the issue of the “counterfactual” – what would have occurred in the absence of funding for research?

Case studies are powerful arguments, for example the ABPI highlighted that many top grossing pharmaceutical products came from UK research. In such case studies it is possible to present the economic impact for the companies involved, but it is less clear what the economic impact is to the UK. This is more the subject of breakout groups 2 and 3, but Professor Hughes referred to the large pharmaceutical companies as “globally footloose” i.e. they can take their investment elsewhere easily.

International comparisons also could work well, Professor Haskel presented the correlation between UK research and development spend and growth – are there comparable relationships in other countries, and do we have a stronger relationship between local R&D and growth?

If public funders channel money into particular areas then this may help to highlight the importance of those areas and stimulate donors to add their support, or it may signal
that these areas are being addressed and leave charities to fill gaps elsewhere. This is referred to as “crowding in” or “crowding out”.

Wider leverage into the science base, particularly overseas investment and private sector funding is important. As is also funding in kind – access to facilities and expertise from overseas and the private sector, although these investments are difficult to value, they are significant.

The group struggled with the issue of balance spent on capital and resource, are there measures for the return on investment from funding capital projects (in the ESRC’s case this may be supporting long-term availability of key data sets, for the MRC this may include cohort studies, sample banks, large equipment etc.). It would be very useful to have strong arguments regarding the different contributions that capital and recurrent investments have, and very informative for the support of research to know that an appropriate balance is being struck across the UK in different disciplines.

Spillovers, international ‘leakage’, attendees picked up on Professor Hughes’ point about complementary assets. If the NHS is buying products in which there is no UK intellectual property, then this is simply a cost. If the NHS is adopting technologies discovered in the UK, then there is a contribution to GDP – even if the manufacturing is done overseas. The NHS clearly has potential to create a large demand for new products.

Discussion of absorptive capacity, is there something that funders can do to improve the pull from industry, the demand for their research? One suggestion related to the kind of people trained, and the links that trainees make to the private sector during their early career – more “entrepreneurial”, another suggestion was that this was the role of TSB. NESTA has published helpful work on capturing other processes that contribute to innovation (innovation index).

Better, faster, cheaper – new processes/treatments, reduce 17 year development timescale (by better regulation\textsuperscript{xvi}), or provide savings. Much of these are outside of the control of research councils.

It was suggested that the ”Medical Research: What’s it worth?” study could be built upon, by widening this to several other significant disease areas. This may provide greater insight into the factors which lead to impact, influence lag times and maximise return on investment.

2.6. Breakout group 2 – Microeconomics, capturing the benefits of specific research investment

How does public and charitable research stimulate business investment in research, total and inward investment to the UK, and employment? Is there more to understand about what promotes engagement between academia and industry? Can we improve quantification of changes not easily monetised (such as changes in skills in the workforce and uptake of new ideas), and better explain successes in health research?

The group emphasised that demonstrating a causative link between research and output was key, and it was hard to get that from qualitative data. Analysing the connection between producers and the users of research was at the heart of Professor Hughes’ presentation. The MRC had accumulated a great deal of output and outcome data via MRC e-Val which should be capitalised upon.

The group also drew a distinction between what MRC needs to know, and what government needs to know. The MRC needs to ask detailed questions about its performance, for which the evidence may be incomplete, and should have room to
explore options internally. The needs of Government may be less granular, evidence for externally published analysis should be robust, and MRC should have prepared policy responses if necessary.

The group discussed the recent EPSRC capability review, which is a bold step to prioritise areas of research that had drawn significant comment from the community. The group agreed that better ways to present the performance of particular subject areas would be helpful. Citation analysis opened a very narrow window on performance. For example the recent Elsevier/BIS report identified lots of ‘competencies’ in health and medical research in UK (compared to other countries), and access had been provided to the raw data so that these can be explored in detail. However, identifying clusters of quality papers on similar subjects, while of interest, gave little insight into the scale of investment, extent of translation, rate of progress etc. Information on all these aspects and more would be needed to make defensible choices about areas to give priority to.

It was agreed that all stakeholders needed to find a way to obtain a better view of health and economic gain. For example if the production of new medical devices and diagnostics is examined, what processes have the largest impact on progress and eventual success? Is it local organisation (such as geographical concentration and linkage of research producers and users), is it directed versus response mode funding (the degree of active management, flexibility afforded etc.), or is it the intervention of technology intermediaries (such as technology transfer organisations)? To analyse the contribution of these complex factors will require careful comparisons between research supported in different ways and between research organised in different locations. Do we have good measures/ways of tracking the “stickiness” of ideas. For example do results from international collaborations “stick” here, or go elsewhere? There is a lot stated about the amount that UK research groups leverage from the EU Framework Programmes for example, but is there lasting impact from these investments in the UK? Can we establish whether the translational outputs that funding agencies collect arise from directed investments, from basic research, or entirely by chance? We have the tools to begin this work with MRC e-Val, and initiatives by other funding agencies aimed at identifying outcomes and impacts systematically. In particular publication of REF impact statements should provide a rich dataset to exploit, although it was unclear as to the detail that would be provided concerning funding inputs. HEFCE expects this data to be publicly available by 2015, although with some redaction.

Representatives from BIS highlighted that it was useful for government to understand the timeframes involved in research progressing to impact, and the variety of funding inputs used by medical research. Case studies prepared by the Wellcome Trust were highlighted as particularly good examples, these included detailed timelines and credits to relevant funding inputs

The group discussed the fact that while there were many potential analyses, what results would most change what we do? It would be helpful to know for instance roughly the proportion of research that succeeds in its objectives, what proportion can be linked to public and private translational activity, and what proportion generates impact. It is assumed that a very small proportion of projects account for a very large proportion of eventual economic impact, but can we more accurately estimate this? This is key to deciding whether additional investment in translational work is delivering more than would otherwise result from response mode funding.

A major hurdle to these analyses is obtaining some idea of the activity in the private sector, and what has influenced this. Professor Hughes highlighted that the R&D spend of large Pharmaceutical companies dwarfs combined expenditure from all small companies, and so it is data from these (few) large Pharmaceutical companies that is needed. It would be helpful to be able to disaggregate the business expenditure on research and development (BERD) figures, and worth raising with BIS, ONS and others whether this is possible (although the group agreed that this information was likely to be
confidential). It was also noted that other factors outside of direct investment in R&D were important to innovation. The most influential work in this area is the NESTA innovation index (capturing investment in software, branding etc.).

Another point in Professor Hughes’ presentation was whether or not a UK presence in a particular area of manufacturing should feedback to inform choices about research investments. For example UK investments in flat screen technology research were unlikely to benefit UK industry, as the dominant manufacturers of flat screen televisions were overseas. This of course ignored potential tangential applications or spin offs from this research, which might “stick” here. Feedback in the other direction was also important, were there areas of strength in UK manufacturing which should be better connected to UK research?

BIS have recently announced the first Technology Innovation Centre (TIC) in high value manufacturing\textsuperscript{lxviii}, can ways be found to identify helpful partnerships between this centre and medical device/instrument research?

The group discussed ways in which research papers that industry considers important could be identified. Often research cited in patents was used to determine this link. For example this month saw the first delivery of the new Boeing 787 Dreamliner aircraft with much news coverage of the fact that the aircraft is 20\% more fuel efficient than others, and reportedly cost $32 billion to develop. Boeing is a US firm that will have drawn on global research, and outsourced manufacture of many components around the world. What proportion of this product is reliant on UK research, and what proportion is reliant on UK manufacturing?\textsuperscript{lxix}

The group highlighted that analysis should be widened beyond long term translation of research in the pharmaceutical sector to medical discoveries that have translated quickly (for example surgical interventions, medical devices etc.). Building up these case studies might give a better picture of the breadth of translation, where there are university strengths and where does the research funding come from?

Medical research should be able to draw upon a wide range of impacts on quality of life through to process improvements. If these were realistically valued then they usually worked out to have significant economic impact, and there were plenty of examples of these case studies connecting with Government.

The ABPI had highlighted the usefulness of international comparators, and the group suggested that there would be mutual benefit in collaborating with organisations (for example DFG in Germany or one or more US Universities) to directly to work on an analysis in this area. Such a study would need to gather detailed and standardised information on the conditions for support of research, and how well this research had progressed, translated and led to impact.

### 2.7. Breakout Group 3: Measuring translation

Alongside exploration of the performance of translational programmes themselves, what are the “uncertainties” in the UK innovation system that should be explored? Is there more we should do to track the influence of areas seen as key to growth (such as experimental medicine and regenerative medicine)? Where might changes in industry R&D policies, or changes in scientific opportunity affect performance of translational schemes and are these changes measurable?

What external (i.e. not under RCs’ direct control) factors in the University sector (tech transfer policies; NHS interactions; international collaboration; concentration and clustering) are most important to assess?
The attendees were asked what were the important issues around evaluating translation that are important both in terms of assessing the impact and also guiding how a research funder or a research organisation should be supporting it.

Translational research is an area where the development timelines can be long, intermediate indicators of progress are needed (for example stages of development for products). The usual drug discovery pathway, which begins with a basic science discovery and proceeds to validation in a human model, then onto early clinical trials etc. provides a set of defined milestones, but it is difficult to assess the impact of these outcomes until the product or intervention has been introduced into practice. Professor Hughes had presented a slide which showed the ease of attribution getting harder and harder the further you get towards application. This emphasised that capturing enough of the relevant inputs in order to calculate a rate of return is challenging.

There are processes that are expected to accelerate translation, or increase chances of success, these processes matter to industry and include such things as a good collaborative culture, mobility between academe and the private sector etc. A greater understanding of how industry measures success, and good data on these processes would be helpful.

While academic research proceeds very differently to research in the private sector, contrasting these may help. Is there detailed enough information about a large enough number of translational research projects in academia to identify where time might be saved, and research and development made more efficient? Thinking may be too dominated on the drug discovery paradigm. One challenge will be to think about all the non-drug discovery translational research that’s going on and how progress with this can be evaluated.

A clear explanation of the difference being made to translational research is needed for Government, they need detail on the initiatives that have been taken to support this field and what has been delivered as a result. Good measures of greater efficiency and effectiveness are helpful (creating more, and more accurate “shots on goal”); how the process is accelerated (faster/easier development of novel therapies, diagnostics etc.), barriers removed (such as the “translational gaps” identified in the Cooksey review), the flow of people and information improved and more outputs and outcomes produced. Some of these differences are likely to be behavioural (e.g. communication between disciplines or researchers involved in different parts of the translational pathway, as measured by collaboration metrics).

The Government is primarily going to be looking for evidence of impact on economic growth. Approaches like that outlined by Professor Haskel, to quantify the influence that research has on productivity, are likely to be helpful.

For public funders, impacts might include the influence this work has on attracting companies to invest in the UK, as well as health gain. For charitable funders, who answer to their donors, the focus is largely on the difference that the work is making for patients, and in particular for those areas of medicine not served well by the private sector (e.g. so called “orphan” diseases) which give a distinctive niche for the funder. Interest in measuring health gain is therefore shared across the charitable and public research sectors. Being able to report that research has led to improved quality of life, lower levels of worklessness, savings in the health service, or more effective prevention is helpful. Of interest will be the current Nicholson review

One aspect that has not been addressed is measuring the impact of negative results, the emphasis is usually on reporting “forward” progress. Research findings that result in terminating projects; such as failure to validate biomarkers, or unpromising clinical trials save significant time and resources. How can these kinds of non-positive but very important research outcomes be captured?
Case studies were discussed as a way of recording and presenting information which should help present a journey. These should describe the underpinning international research, the detailed output, and who is affected by it. The production of impact case studies for the REF exercise is likely to provide a step change in the information available and the assessment of this qualitative information. An important aspect of this is involvement of users to validate and assess the level of impact. The Manchester Cancer Research Centre\textsuperscript{xxi} was cited as an example of a development which has been strongly supported by AstraZeneca (because it links the hospital, university and existing research institutes in this field to streamline academic/private sector interactions) and therefore presents a powerful case study of structural changes which may accelerate translation.

2.8. Discussion group 4 – The impact of medical research on health services

What is the best evidence we can draw upon concerning the contribution that research makes to increasing life expectancy and quality of life? Can we identify which sorts of research have been most important, and whether high research investment in a country matter for quality and length of life?

Are “common sense” or populist approaches to increasing quality life supported by the economic benefits and costs of extending quality life? Where are the conflicts?

The group focussed on measuring health gain and impact on health services. Attendees discussed the use of quality adjusted life years (QALYs). These are a measure of the quality of life gained from different interventions, but not an estimate of the economic value. The cost of providing treatment per QALY gained is used as a measure of cost effectiveness. Treatments that cost more than £30,000 per QALY are normally not recommended for use in the NHS. Willingness to pay approaches value an additional quality life year significantly higher, and QALYs are not stratified by factors such as age.

In discussing how to improve upon these measures the group debated spill-over effects, which were clearly important to economic impact. However by definition these effects were not just in the area of health services and health care. Whereas it was possible to track some of the linkages between medical research and new medical interventions it would be challenging to detect the application of this knowledge in all/any other field. This could only be done at a crude aggregated level, but better information regarding spillover effects in the UK would be important.

The group also identified the need to find international comparators, and ways to contrast the situation with pathways to impact in other sectors.

It was suggested that the “Medical Research: What's it worth?” study could be widened to other substantial areas of healthcare, but that the MRC would need to be convinced of the benefit of re-running the analysis in terms of the information this would provide about lag times and factors that influence translation. It was also noted that some policy documents (for example those that advise on public health or education) have the potential to impact upon a larger proportion of society than clinical guidelines. However there may not be measures of the benefits from these interventions analogous to the QALY measure.

The potential of the Quality Outcomes Framework (QOF)\textsuperscript{xxxii} to be a source of data on the reach and significance of health research impacts was discussed. The national indicators in the QOF refer to relevant research and guidelines. It may therefore be possible to link research to data from the QOF on changes in practice.
The group highlighted the importance of “negative results”. The focus tended to be on the small proportion of projects that strongly linked to positive results and outcomes (such as new treatments or commercialisation). This neglects the majority of research results that are incremental, are confirmatory, or deter further research in particular areas. Research that results in changes in direction, by eliminating lines of enquiry early, or research that shows current practice is not beneficial, may yield significant cost savings. Research that shows something is not optimal, or fails to demonstrate a development should progress any further, is often not examined for its impact. The group suggested that more work should be done on the impact of “negative” findings.
2.9. Economic Impact Workshop – discussion group summaries

Group 1 – Macro economics

- Important to consider wellbeing alongside GDP (when measures for this have been constructed)
- There is little data on international comparisons, so it would be helpful to apply an econometric approach across countries with contrasting mechanisms for supporting research
- Studies will need to examine all funding sectors; charitable, public and private
- It will be helpful to find ways to measure the different contributions that capital, recurrent research funding and investments in training make to impact
- Cost savings should be considered – not just looking at what we’re doing, but can we do it better.
- Speed to impact – are we getting better at this and seeing reductions in lag times.
- Investigate the effects of stability of funding over time – steady funding vs variable funding, and how does this effect impact.

Group 2 – Micro economics

- Can we compare the success of directed and non directed research?
- What is helpful to BIS and Government? How can it change MRC strategy/research behaviour?
- Don’t look at the data as the starting point, think about what questions we should be asking first.
- Five main suggestions for further research:
  - What is the proportion of translational output arising from strategic initiatives and how much is shaped by response mode funded work?
  - Are there examples of how research has influenced the medical device and diagnostics industry in the UK? Can we expand upon the knowledge of translation in these fields, and provide case studies of development pathways faster than the 17 years?
  - How much of the health gain from new innovations can be attributed to research?
  - More qualitative studies to explore innovation and exploitation
  - How successful are other countries in translating science into new products and growth, are there differences that might inform policy in the UK?

Group 3 – Translation

- Need for intermediate markers of translational progress
- Need to expand understanding of how translation varies in different fields of research.
- How has the translational agenda effected translation? Can we show that this has made a difference and if so, how?
- There are incentives for universities (REF), charities, and public funders to collaborate in this area, all want to see an improvement and better understanding.
- Case studies could be useful to highlight bottlenecks and issues, and these should have input from users.
- Negative results are important and studies that examine their contribution to impact will be helpful.
- Interdisciplinarity is important, and we need to be able to measure its impact and track advantages, internationally.
• The Frances Crick Institute will be a test bed for some of the things discussed today

**Group 4 – Health Services**

• Need to continue to build on the joined up approach with MRC, NIHR etc, and also involve the devolved nations.
• What more can we do to influence the time lag from research to impact, we need to highlight the processes that lead to faster than 17 years translation.
• Need to better capture the links between research and impact, especially internationally.
• Spill overs – ways to track and study them (both to and from the private sector).
• What can we do in the short term?
  o Repeat the ‘What’s it worth?’ work for other areas – cancer/liver disease/diabetes?
  o Look to capture the downstream impacts of representative “negative” results (It is suggested that speedy translation and negative results may potentially be linked).
• Ideally we need QALY data for specific areas of the population, eg over 65s.
• Multidisciplinary research – we know this aids research ’speed’ but can we be more precise.
• Examine whether a detailed survey of researchers, and how they spend their time, might identify linkages between research and impact.
• Can we use electronic health records to better understand quantify the impact of health research?
2.10. Recommendations for further research

The options open to the MRC for future action include:

- Commissioning specific research studies. In a similar way to the conduct of the "Medical Research: What’s it worth?" study a detailed tender document is prepared, and an expert steering group formed to oversee the work at regular intervals.
- Call for proposals. A more open highlight notice is used to call for proposals from the research community for studies which address a particular issue.
- Networking and collaboration. Actions to facilitate closer working between the MRC and stakeholders such as the ONS or CBI, who were not represented at the workshop, to identify areas of joint interest.
- Closing gaps in availability of data, for example via new surveys or extraction and coding of existing data so that it can be usefully exploited for analysis.

Based on the outputs of the workshop and the consultation there was a clear interest in applying micro-economic approaches to a range of different issues, in particular to the study of the rate of progress and impact of translational research. It may be possible to leverage MRC e-Val data as a source of information on activity across the MRC funded portfolio to achieve this, with additional interviews with those central to discoveries and realising subsequent impact. Promising areas include studies focussing on medical devices and diagnostics, which would deliver information about the economic impact of these products, and also timelines for translation that may be significantly shorter than the average drug development pathway. There was also interest in setting up an international comparison study, in collaboration with an organisation such as DFG, the Max Planck Institutes in Germany, or MIT in the US. In addition the need to provide more UK-relevant and current estimates of spill-over benefits from medical research was discussed.

At its meeting in December, MRC Strategy Board agreed to convene an expert panel to prepare and launch a call for proposals early in 2012, and consider applications. The aim will be to award funds to support a small portfolio of studies of 1-3 years in duration. The ESRC are supportive of the initiative, and have agreed to nominate experts for the panel. Collaboration will also be sought with the other research councils, NIHR and medical research charities.
The likely approaches, focus, and importantly what we would seek to deliver from such studies is set out in the table below:

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Examples of the focus for potential studies</th>
<th>What will studies deliver?</th>
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<tr>
<td>&quot;Macro&quot; economic approaches (correlations between inputs and outputs at the whole economy level. Strengths include the ability to capture spill-over benefit, disadvantages include challenges in showing causation)</td>
<td>Estimates of spill over effects from medical research that are relevant to the UK economy</td>
<td>Additional case study material which highlights medical research progress, includes valuations of impact, and identifies principles that can be applied to developing future case studies.</td>
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<td>&quot;Mixed&quot; approaches (combining macro econometrics and bottom up studies linking research with output (c.f. &quot;Medical Research: What’s it worth?&quot;)</td>
<td>Contrasting research in the UK with (for example) translational research initiatives in Europe or the US</td>
<td>Policy recommendations relevant to the MRC strategy, in time for the refresh/review of the MRC strategic plan</td>
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<td>&quot;Micro&quot; economic approaches (studies that connect the producers and users of research, exploiting surveys and databases of output such as MRC e-Val)</td>
<td>Translational research effectiveness (rates of commercialisation, product development etc. over time, what proportion of the translational output of the MRC portfolio arises from basic research or directed/non-directed research)</td>
<td>International/cross funder comparisons of different environments/policy approaches which highlight ways to maximise impact</td>
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<td>Medical devices and diagnostics (the research origins of products, time to market, and value of impact)</td>
<td>Information on the rate of progress – “then and now”</td>
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<td></td>
<td>Pharmaceutical and biotechnology industries (trends and origins of new products)</td>
<td>Critical success factors, and improved intermediate indicators. Learning from missed opportunities or negative results</td>
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<td></td>
<td>How has medical research impacted upon quality of life?</td>
<td>User/beneficiary views on the contribution of academic research and MRC’s input into this.</td>
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## Annex 1: Workshop Attendees and Breakout Groups

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<th>Professor</th>
<th>Neil</th>
<th>Department for Business, Innovation and Skills</th>
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<td>Craig Scottish Government Health Directorates</td>
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<td>Cross Department for Business, Innovation and Skills</td>
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<td>Djukanovic University of Southampton</td>
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<td>Dolby Wellcome Trust</td>
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<td>Farrelly Queen's University Belfast</td>
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<td>Pearson British Heart Foundation</td>
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<td>Louise</td>
<td>Wren Medical Research Council</td>
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Breakout group 1
Astrid Wissenberg (ESRC)
Jon Sussex (OHE)
Tony Peatfield (MRC)
Sonja Marjanovic (RAND)
Jackie Hawkins (University of Birmingham)
Sarah Harrop (MRC)
Helen Bodmer (BIS)

Breakout group 2
Helen Cross (BIS)
Kevin Dolby (Wellcome Trust)
Paul Hubbard (HEFCE)
Jeremy Pearson (BHF)
Gill Rands (Cambridge University)
Ian Viney (MRC)
Declan Mulkeen (MRC)
Sarah Main (MRC)

Breakout group 3
Chris Watkins (MRC)
Rob Lang (MRC Technology)
Stephen Holgate (University of Southampton and Chair MRC Population and Systems Medicine Board)
David Clarke (University of Manchester)
Vincent Farrelly (Queen’s University Belfast)
Peter Leadlay, (University of Cambridge)
Louise Leong, (Association of the British Pharmaceutical Industry)
Karen Booth, (University of Sheffield)
Peta Stevens (University of Cambridge)
Caroline Fenwick (Department for Business, Innovation and Skills)
Aoife Regan (Cancer Research UK)
Ratko Djukanovic (University of Southampton)

Breakout group 4
Peter Craig (Chief Scientists Office, Scotland)
Wendy Ewart (MRC)
Nicola Mitchell (consultant)
Iain Cameron (University of Southampton)
Elizabeth Pollitzer
Martin Buxton (Brunel University)
Martin Roland (University of Cambridge)
Sheila Bird (MRC Biostatistics Unit)
Nick Church
Beverley Sherbon (MRC)
David Kryl (National Institute for Health Research, NIHR)
Annex 2: Workshop Agenda

MRC Workshop on economic impact

41 Portland Place, London

26th of October 2011

Contact economicimpact@headoffice.mrc.ac.uk

10.00 Registration
10.30 Welcome from Sir John Savill (Chief Executive, Medical Research Council)
10.40 Aims and objectives of the day (Dr Ian Viney, MRC Head of Strategic Evaluation)
10.50 Professor Martin Roland (Health Services Research, University of Cambridge)
11.20 Professor Jonathan Haskel (Imperial College Business School)
11.50 Coffee break
12.05 Professor Alan Hughes (Cambridge Centre for Business Research)
12.35 Professor David Clarke (Pharmacy and Pharmaceutical Sciences, The University of Manchester)
13.05 Discussion
13.15 LUNCH
13.45 Instructions for breakout groups
14.00 Breakout discussions
15.30 Feedback from break out groups
16.00 Summary and Close (Dr Wendy Ewart, MRC Director of Strategy)
References


iii The Worry Report: Increasing the Economic impact of the Research Councils (July 2006) was the report of the Research Council Economic Impact Group, chaired by Peter Worry, to the Director General of Science and innovation at BIS (then DTI). The report can be found at [http://www.vitae.ac.uk/cms/files/DTI-Worry-Report-July-2006.pdf.3072.download]

iv The Science of Science & Innovation Policy (SciSIP) program was established at NSF in 2005 in response to a call from Dr. John Marburger III for a "specialist scholarly community" to study the science of science policy. Over 120 awards have been made totalling $62m to date (further details of the awards made can be found here [http://www.nsf.gov/awardsearch/progSearch.do?SearchType=progSearch&page=2&QueryText=&ProgrOrganization=&ProgOfficer=&ProgEleCode=7626&BooleanElement=true&ProgRefCode=&BooleanRef=true&ProgProgram=&ProgFoaCode=&RestrictActive=on&Search=Search#results]).

v The majority of NSF SciSIP funding has supported national surveys of research activity and collection of data on the scientific workforce (See Thinking through SciSIP [http://scisip.weebly.com/index.html]).

vi Growth Review (Department for Business Innovation and Skills and Treasury, 2010) [http://www.bis.gov.uk/policies/growth/growth-review]

vii In July, 2011, the Council for Industry and Higher Education (CIHE) and the UK-Innovation Research Centre (UK-IRC) launched a Task Force to answer the question: how does the UK maximise the value of publicly-funded research? The CIHE and UK-IRC believe that by uniting leading figures in industry and academia they will deliver an answer. [http://www.cihe.co.uk/cihe-ukirc-launch-a-new-task-force-on-enhancing-value-in-the-uk-research-base/]

viii The BIS Growth Review calls on business and industry to challenge Government Departments on the measures they are taking to allow the private sector to flourish. Details can be found here [http://www.bis.gov.uk/policies/growth/growth-review]

ix In the MRC 2011/12 – 2014/15 Delivery Plan it is stated that "We plan to revisit and update our formal economic analysis of the impact of medical research by 2013, building on our previous partnership based approach." [http://www.mrc.ac.uk/consumption/idcplg?IdcService=GET_FILE&dID=30667&dDocName=MRC007642&allowInterrupt=1]

x Details about the MRC consultation on economic impact can be found at [http://www.mrc.ac.uk/About/Consultations/index.htm]

xi In June 2009 Government created a £150 million UK Innovation Investment Fund (UKIIF) with a £25 million minimum investment committed to Life Sciences. The UKIIF will target small growing businesses, start ups and spin outs, including pre-profit and pre-revenue stages of development. Good progress has been made in establishing the Fund and leveraging additional funding. UKIIF will ensure that venture capital is available by early 2010 to invest in innovative UK businesses in key industries such as Life Sciences. Government’s objective was to raise investment that matched its £150 million investment at first closing. This target has been exceeded with £175 million...
leveraged in additional money by the end of 2010.
http://www.bis.gov.uk/policies/innovation/business-support/ukiif/about

xii The UK Government has invested in two major new bioincubators: £11.7 million into a £37 million facility in Stevenage and £12 million into a £24 million facility in Edinburgh. These bioincubators are aimed to stimulate growth by attracting new business start-ups to the UK.
http://www.bis.gov.uk/policies/innovation/business-support/ols/areas-of-work/infrastructure-projects

xiii The Government has committed £200m to establish a network of technology innovation centres to be managed by the Technology Strategy Board over the current spending review
http://www.bis.gov.uk/assets/biscore/innovation/docs/b/10-1234-blueprint-for-technology

xiv In December 2009 the Pre-Budget Report announced the introduction of a "Patent Box" applying a reduced rate of Corporation Tax to income from patents from April 2013, to strengthen the incentives to invest in innovative industries and ensure the UK remains an attractive location for innovation. The Treasury is currently consulting on the introduction of these measures.
http://www.hm-treasury.gov.uk/consult_patent_box_stage2.htm

xv The Innovation Index from NESTA takes a broad look at measuring innovation including “hidden innovation” – technological/organisation change which previously was difficult to capture
http://www.nesta.org.uk/areas_of_work/economic_growth/the_innovation_index

xvi The UKTI states that the UK attracts almost 10% of global investment in the pharmaceutical industry ("Life Sciences, The UK: Collaboration for success" UKTI and the Office for Life Sciences 2010, http://www.nisw.co.uk/getattachment/18fa162e-8575-4e43-a400-2f473ebebf868/Life-Sciences-the-UK-Collaboration-for-Success.aspx , page 02)


xix Patient access schemes are special ways Pharmaceutical companies can propose to enable patients to gain access to high costs drugs. The Patient Access Scheme Liaison Unit (PASLU) has been set up by NICE to work with manufacturers who are considering a patient access scheme for their drug or treatment. Details can be found at
http://www.nice.org.uk/aboutnice/howwework/paslu/patientaccessschemesliaisonunit.jsp

xx National Institute for Clinical Excellence http://www.nice.org.uk/aboutnice/

xxi Professor Simon Capewell is involved in the MRC/EU funded IMPACT programme examining why cardiovascular disease mortality rates have recently halved in the UK, the USA and elsewhere (how much is due to modern cardiological treatments as opposed to risk factor improvements), and why CVD rates are increasing in China and Eastern Mediterranean countries.
http://www.liv.ac.uk/psychology-health-and-society/staff/capewells.htm

xxii A new pathway for the regulation and governance of medical research, Academy of Medical Sciences, 2011.


xxiv MIMIT™ is the first international affiliate of the Center for Integrating Medicine & Innovative Technology (CIMIT®). Boston, USA http://www.mimit.org.uk/ These centres seek to foster collaboration between engineering and life science laboratories and clinicians, with the aim of accelerating translation of improved medical interventions.

xxv
The Milken Institute study, "An Unhealthy America: The Economic Impact of Chronic Disease," details the enormous financial impact of chronic disease on the U.S. economy — not only in treatment costs, but lost worker productivity — today and in the decades ahead. It also describes the huge savings if a serious effort were made to improve Americans’ health.

http://www.chronicdiseaseimpact.com/

GRiPP “Getting Research into Practice and Purchasing”

Summary of the American Re-investment and Recovery Act, 2009
http://www.whitehouse.gov/assets/documents/Recovery_Act_Overview_2-17.pdf

NSF/NIH STAR METRICS programme http://sites.nationalacademies.org/PGA/fdp/PGA_057189

Vitae is supported by RCUK and has published a series of papers on the destinations, salary and satisfaction etc. of graduates using data from a Higher Education Statistics Agency (HESA) survey (Destinations of Leavers from Higher Education, DLHE and the follow up to this the “L DLHE”). The Vitae publication "What do researchers do?" can be found at http://www.vitae.ac.uk/researchers/1272-290131/What-do-researchers-do-Doctoral-graduate.destinations-and-impact-three-years-on.html

The MRC, in collaboration with Professor Patrick Maxwell, traced around 60 clinical training fellows from the class of 1991. Ten years on 36% have academic positions as clinical professors, and 17% are fellows of the academy of medical sciences, 10% have posts in industry.

http://www.bis.gov.uk/policies/science/science-innovation-analysis/uk-research-base


Further information on MRC’s translational research strategy can be found at http://www.mrc.ac.uk/Ourresearch/ResearchInitiatives/Translationalresearch/index.htm

Further information on the outputs and outcomes from MRC research can be found at http://www.mrc.ac.uk/AchievementsImpact/Outputsoutcomes/index.htm

Exploring the Interdependency between Public and Charitable Medical Research, Office of Health Economics, 2011.

The Royal College of Physicians published its “Guidance on collaboration between healthcare professionals and the pharmaceutical industry” in November 2011 http://www.rcplondon.ac.uk/sites/default/files/guidance-on-collaboration_0.pdf


Buxton, M. and S. Hanney, How can payback from health services research be assessed? Journal of Health Service Research and Policy, 1, 1996, 35–43.


The broad framework for assessing the impact of research in the 2014 REF and the weighting of the three elements in the assessment (outputs, impact and environment) are set out in the following HEFCE publication http://www.hefce.ac.uk/research/ref/pubs/2011/01_11/
Additional quality life years are often valued using "willingness to pay" methods. However, people will place a very high "value" on additional life years leading to values of $100k to $5m in the USA. In the UK, the standard QALY value used by NICE is often referred to, where one quality adjusted life year is valued at about £30k. A value above this is not cost effective for the NHS.

In 2009, the MRC implemented MRC e-Val, an online database to capture feedback from researchers that held MRC support since 2006. MRC e-Val now contains structured data on output from approximately £2.5billion of MRC spend between 2006 and 2011, from 4,000 grants, fellowships and Unit Institute research programmes. Results from MRC e-Val are published at www.mrc.ac.uk/e-Val2010. NIHR implemented the RAND developed RAISS system in 2010.

The UKIRC (http://www.ukirc.ac.uk/) is a joint venture between the Centre for Business Research at the University of Cambridge and Imperial College Business School to further research and knowledge exchange on innovation policy and practice. The UKIRC is funded by the Department for Business Innovation and Skills, the ESRC, National Endowment for Sciences, Technology and the Arts (NESTA) and Technology Strategy Board (TSB).


"The scientific Basis for the support of biomedical research" Comroe and Dripps Science (1976). This study looked at the origin of the top ten cardiovascular treatments in the preceding 30 years. The study was cited by Lord Krebs in his evidence to the House of Commons Innovation, Universities, Science and Skills Committee (2008/09; HC 168/1) and in "A Vision for UK Research 2010" CST 2010 as a "recent" study as it was referred to in Sir William Paton's book "Man and Mouse: animals in medical research" (published 1984). Comroe and Dripps stated in 1977 "We believe much more research needs to be done on the nature of research and its application so that data from objective studies can be applied to all types of biomedical research."


Complementary assets are assets, infrastructure or capabilities needed to support the successful commercialization and marketing of a technological innovation, other than those assets fundamentally associated with that innovation. The term was first coined by David Teece who suggested that "imitability" (how easily an innovation can be copied by others) and complementary assets could be used to predict who is likely to ultimately profit from an innovation.

The University of Manchester provides 85% of revenue arising to originators up to first £1 million plus any re-invested into research, then 50% to originators.

The University of Manchester Intellectual Property (UMIP) has established a Proof of Concept fund for early stage investments the UMIP Premier Fund (UPF). UPF is a fund of £32M that makes late-seed stage investments in the £250-750k range, with both the intention and capacity to provide follow-on investment up to £3m. It is managed by MTI firms. http://www.umip.com/investors.htm

STAR METRICS - Science and Technology for America's Reinvestment: Measuring the Effect of Research on Innovation, Competitiveness and Science, is a multi-agency venture led by the National Institutes of Health, the National Science Foundation (NSF) and the White House Office of Science and Technology Policy (OSTP) https://www.starmetrics.nih.gov/

The Office for National Statistics launched its consultation into National Well-being Measures on 31/10/11, this can be found at http://www.ons.gov.uk/ons/rel/mro/news-release/measures-of-well-being/nwb1011.html


The Health Research Authority is planned as the new regulatory authority for health care research. The aim is to rationalise and streamline the governance of research and speed up the approval process for research projects. The new authority was recommended in 'A new pathway for the regulation and governance of health research' (published in January 2011 by the Academy of Medical Sciences). The report was prepared by a working group, chaired by Professor Sir Michael Rawlins FMedSci, convened in response to an invitation from Government to review the regulation and governance of UK health research involving human participants, their tissue or their data.
The Wellcome Trust has produced a series of “Research Profiles” with timelines that acknowledge multiple funding contributions to research. These can be downloaded from http://www.wellcome.ac.uk/Funding/Biomedical-science/Funded-projects/index.htm.


Boeing report that the 787 Dreamliner has 70% of its parts manufactured in the USA. http://www.boeing.com/commercial/787family/programfacts.html, but other reports detail the contribution of UK research and manufacturing to the aircrafts design and revolutionary carbon fibre parts with estimates of up to 25% of the plane having UK involvement – “How Boeing’s 787 Dreamliner is best of British” http://www.thisismoney.co.uk/money/markets/article-2054303/CITY-FOCUS-How-Boeing-s-787-Dreamliner-best-British.html#ixzz1dOLI3fdm8

The Nicholson review, part of the Growth Review, is assessing how the adoption and spread of innovation can be accelerated throughout the NHS http://www.dh.gov.uk/en/Aboutus/Features/DH_127943

The Manchester Cancer Research Centre http://www.mcrc.manchester.ac.uk/about/

The Quality Outcomes Framework (QOF) is a component of the General Medical Services contract for general practices, introduced from 1 April 2004. The QOF rewards practices financially for the provision of quality care, and helps to fund further improvements in the delivery of clinical care. The QOF contains a set of national indicators, which are drawn from the best available evidence in the expectation that this will for example improve the management of chronic conditions and result in fewer hospital admissions. http://www.ic.nhs.uk/statistics-and-data-collections/supporting-information/audits-and-performance/the-quality-and-outcomes-framework/qof-information/introduction-to-qof

One recommendation from the “Medical Research: What’s it worth?” study was to improve upon the 30% rate of return estimated from spill-over effects from public and charitable medical research, which was derived from a literature search and models largely based on US data.