

R&D Grant Evaluation

Final Report for

Scottish Enterprise

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R&D Grant Evaluation Draft Report for Scottish Enterprise

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Executive Summary

In 2004 Scottish Enterprise (SE) supported R&D in large companies through its R&D Plus programme. In 2008, in an effort to reduce customer confusion on Government support and to extend the level of support available to smaller businesses SE formed the R&D Grant programme. This programme consolidated large company R&D Plus with the Small Company Innovation Support (SCIS) and the Scottish Government's SCORE scheme.

The R&D Grant programme is open to all companies located within Scotland, or planning to establish an R&D presence in Scotland. It is a discretionary, single company grant that supports businesses to undertake development of new products or processes to the pre-production prototype stage through discretionary grants of up to 25% of eligible project costs.

Frontline was commissioned to evaluate the programme, including a full economic impact assessment. The evaluation included:

- a detailed policy review
- an assessment of market failure
- a series of stakeholder interviews
- in depth consultation with 36 companies

This evaluation looks specifically at 55 large R&D awards made between 2004 and 2009 under either SE's large company R&D Grant (R&D Plus) or since April 08, through SE's R&D Grant programme. It does not include any evaluation evidence in relation to the 100 or so smaller projects supported by SE each year, with contributions of £1.5m-£2m generating around £6-9m of BERD annually.

In total, 36 companies were surveyed from the population of 45 companies, which translate into the 55 projects covered by this evaluation. This is because some companies have received more than one award, including 37 companies who received one award, six companies who received two awards and two companies who received three awards.

Strategic case – rationale, inputs and activities

Our assessment confirmed that there continues to be barriers to innovation in Scotland based on levels of BERD as a percentage of GDP. Scotland continues to perform poorly against a range of UK and international regions/countries. Market failure continues to exist in the form of positive externalities and imperfect information, and this, combined with the hampering factors, i.e. barriers to innovation and equity issues and low levels of BERD, gives a clear rationale for continued intervention.

The programme has a clear fit with the Government Economic Strategy and will be crucial in supporting the national indicator of halving the gap in total R&D spending compared to the EU average by 2011. The programme also contributes to all three areas of activity – supporting enterprise, promoting innovation and stimulating investment.

Since the programme started in 2003/04, SE has plans to invest over £55m into 55 large R&D projects with a total project cost of over £402m. This is an over 1:6 public: private leverage.

Stakeholder views

There was overwhelming support for the continued requirement for the programme. Stakeholders agreed that the programme had been delivered extremely well with scope to refine and streamline the processes in order to speed up approvals. There was strong belief that the programme has had an impact on firms' R&D capacity and spend, their turnover and employment, and therefore that it is having a positive impact on the wider economy. In terms of public: private sector leverage the R&D Grant was recognised as currently one of the best SE interventions.

Stakeholders stated that there was substantial demand for the programme and therefore a need to increase investment. There was a lack of consensus on how this should be done in the face of budget constraints. However, there is considerable support for focusing attention on key sectors and ensuring that these are aligned with growth areas for the future. Increasing resources within the team to support increased investment should be considered.

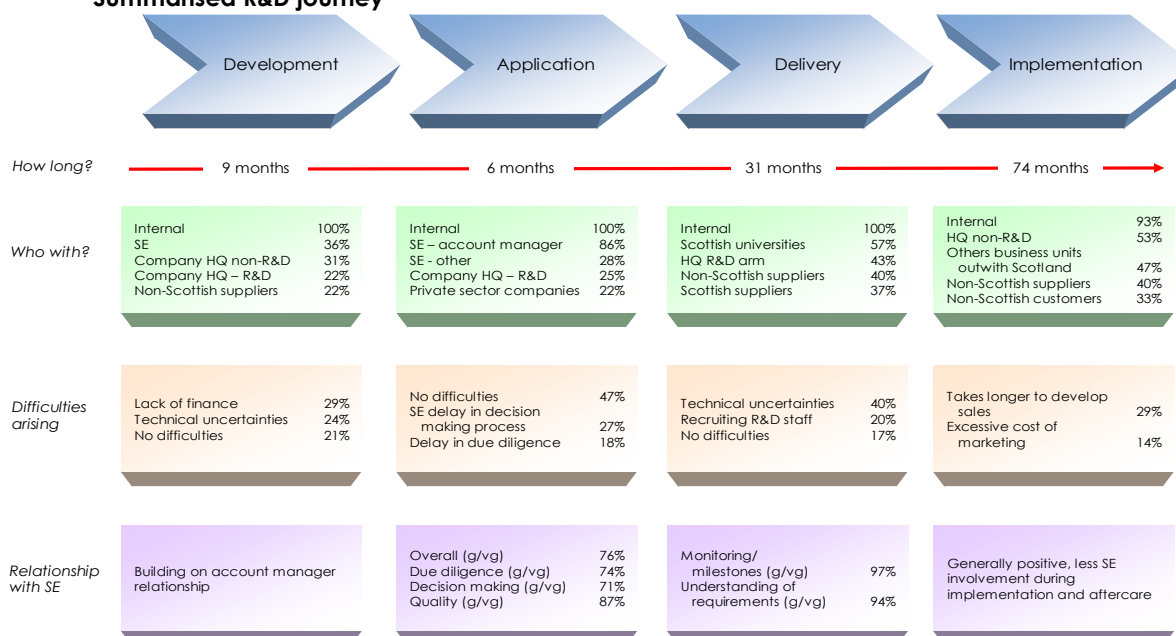
Company R&D journey

The company R&D journey covers:

- development – the point from which the project was raised until application
- application – from submitting the application to award date
- delivery – the period over which the R&D was undertaken
- implementation – the commercialisation of the R&D that was undertaken

The company journey takes almost four years from idea generation to being ready for market. In that time the company – or more specifically the unit within Scotland (supported by other parts of the group) – is central to the development of the R&D, though others are involved at key points, including SE at the application stage and Scottish universities at the delivery stage. Generally, companies did not report major barriers, though technical uncertainties were common during R&D delivery and difficulties with sales as the project moves to the implementation stage. SE was perceived positively across all stages, with particularly high satisfaction at the delivery stage.

Summarised R&D journey



Company outputs

The majority of companies have:

- secured IP – mostly patents (69%)
- introduced new products (83%) – to the company and the market (both cited by 81% of surveyed companies)
- increased ranges of goods and services (78%)
- created revenues associated with the R&D Grant (97%)
- further exploited existing markets (71%)

Companies cited a series of wider value added benefits covering synergy (ability to plan, manage and deliver R&D), catalyst (improved R&D capacity, development of a vision around R&D and follow on research) and strategic influence effects (development of a knowledge based economy) – high levels of additionality were continuously cited across all benefits and outputs. In addition, companies highlighted that they had experienced both reputational and prestige benefits as well as improved strategic positioning within their group. This is very important, with the majority of these companies being subsidiaries or branch plants, and therefore potentially mobile.

Economic impact and value for money

The economic impact calculations were based on best practice guidance in Economic Impact Assessment developed by SE. This included:

- collecting key impact variables (using SE's standard question set)
- gross to net adjustments
- adjusting for optimism bias
- grossing the sample to the population
- probability adjustments for company acquisition and loss to the economy
- cost benefit analysis

The total number of jobs either safeguarded or created as a result of the R&D Grant programme amounted to:

- 76 net jobs in 2004
- 76 net jobs in 2005
- 142 net jobs in 2006
- 432 net jobs in 2007
- 583 net jobs in 2008

If it is assumed that all these jobs are full time, these employment figures can be totalled to amount to 1,309 Man Year Equivalents (MYEs) between 2004 and 2008.

The potential employment generation at key milestone years amounted to:

- 1,642 jobs in 2009
- a peak of 4,039 net jobs in 2012 (three years on)
- around 1,659 jobs in 2019 (10 years on)

Again, if it is assumed that all these jobs are full time, these employment figures can be totalled to amount to 28,519 Man Year Equivalents (MYEs) between 2009 and 2019.

There was clear evidence of employment time additionality with 91% of companies suggesting that their 2007 employment level had been brought forward as a result of the R&D Grant.

The net GVA impact accruing as a direct result of the R&D Grant over the evaluation period 2004/5 - 2008/9, amounted to **£1.4m NPV**. This results in a benefit to cost ratio of 1: 0.08 or a return of 8 pence for every £1 invested in the programme. This is because of the long term nature of benefit realisation associated with R&D, as well as the commercialisation of early funded projects accruing outside beyond Scotland.

Net GVA impacts to date

	Costs (NPV)*	GVA (NPV)
2004	£1,912,742	£0
2005	£2,111,528	£0
2006	£3,158,871	£58,574
2007	£5,210,052	£112,646
2008	£5,511,092	£1,205,709
Total	£17,904,285	£1,376,929
Cost Benefit Ratio		1: 0.08

*Note these are the SE costs associated with the R&D element of the projects. They do not include the wider business contribution or the further ongoing costs in taking any new products to market

The potential net GVA impact between 2009 and 2019 could amount to **£640.7m GVA NPV**.

Projected net GVA impacts

	Costs (NPV)	GVA (NPV)
2009	£7,754,824	£10,404,746
2010	£6,919,185	£35,892,159
2011	£6,767,071	£31,852,986
2012	£3,408,436	£125,449,077
2013	-	£113,988,732
2014	-	£90,369,809
2015	-	£63,233,981
2016	-	£55,937,175
2017	-	£46,780,886
2018	-	£40,519,572
2019	-	£26,322,572
Total	£24,849,516	£640,751,695

*Note these are the SE costs associated with the R&D element of the projects. They do not include the wider business contribution or the further ongoing costs in taking any new products to market

There was clear evidence of GVA time additionality, though this was lower than for employment, with 50% of companies suggested that their 2007 turnover level had been brought forward as a result of the R&D Grant. The GVA time additionality would appear to be lower as many companies had still to generate the revenue benefits from their R&D projects or because the R&D itself had not been completed.

Overall, the programme presents good value for money. The indicators suggest that there is reasonable economy, high efficiency and the potential for high levels of effectiveness.

Conclusions and recommendations

The conclusions can be summarised as:

- strong strategic case for continued and increased support for R&D Grant funding
- the R&D Grant will make a substantial contribution to economic development activity in Scotland
- good maximisation of resources as the companies commit the majority of funding
- building R&D capacity across Scotland
- good intervention that can be made even better
- direct benefits are wide ranging
- developing value at the strategic level – including wider catalyst, synergy and strategic influence
- some spillover benefit
- potential impact is substantial
- value for money is excellent

Based on these conclusions the following recommendations have been made:

- need for continued and increased support with the key aims of:
 - reducing market failure
 - minimising hampering factors and equity issues
 - increasing R&D capacity and economic benefit to Scotland
- increase the number of companies supported through:
 - increased financial resources
 - improved direct control over financial resources – including extra staff to ensure the smooth running of the programme
 - exploring options for funding for TSB projects where this can generate increased value to the Scottish economy at a lower cost to SE
- continue to work closely with industry leads to support the needs of each sector and help meet increasing levels of demand
- explore the potential to provide a portfolio of support across the R&D, manufacturing and training and development needs of companies. By linking the range of support on offer there could be scope to maximise the impact on the economy
- consideration should be given to looking at different levels of grant intensity depending on the nature of R&D and subject to the project not falling below a minimum value for money threshold
- encourage account managers and innovation specialists to work more closely with companies to make greater linkages with Scottish suppliers, universities and other collaborators to enhance any spillover effects and embed foreign owned companies
- ensure that each project continues to be considered on its own merits irrespective of previous successful applications and current headquarter locations. The project's ability to generate increased R&D capacity and economic benefit to Scotland should be the key method of prioritisation
- review all the stages in the process and look to streamline. For example, a quick fix would be to reduce the number of initial approval steps, to enable the company and account manager to move forward more quickly
- provide companies with clearer information requirements at the outset to help ensure consistent standards of due diligence and economic impact assessment and minimise the need for different contractors to approach the companies for different information
- the potential for collaborative projects should be explored as a mechanism for

generating wider spillover effects and the ability to further embed companies within Scotland

The logic model that summarises the project is included overleaf.

R&D Grant Programme Evaluation Summarised Logic Model

Rationale & Fit	Inputs	Activities	Processes	Outputs	Outcomes
<p>Market Failure</p> <ul style="list-style-type: none"> imperfect information – on the returns from R&D investment positive externalities – generating wider economy benefits not captured by the company <p>Equity issues</p> <ul style="list-style-type: none"> 9 out of 12 UK regions on R&D spending 20 from 21 EU Nations on R&D spending 10 from 10 OECD nations <p>Hampering factors</p> <ul style="list-style-type: none"> 86% of surveyed companies cited cost as a barrier to R&D 	<p>Scottish Enterprise</p> <p>2003/04 - £1,774,967 2004/05 - £2,069,538 2005/06 - £3,292,159 2006/07 - £5,776,478 2007/08 - £6,324,105 2008/09 - £9,210,928 Total - £28,447,545</p> <p>2009/10 - £8,505,445 2010/11 - £8,609,604 2011/12 - £4,488,259 Total - £21,603,308</p> <p>Company Contribution (Est.) £346,999,231</p> <p>Public Private Leverage 1: 6</p>	<p>Projects funded</p> <p>2003/04 – 1 2004/05 – 1 2005/06 – 5 2006/07 – 16 2007/08 – 19 2008/09 – 11 2009/10 – 2</p> <p>Nature of R&D</p> <p>Industrial research -11 Experimental development – 17 Combination – 27</p> <p>Sectors funded</p> <p>DMET – 26 Aerospace – 6 Chemicals -6 Energy – 5 Life Sciences – 5 Construction – 2 Textiles – 1 Food & drink – 1 Other - 3</p>	<p>R&D Journey</p> <p>Idea for project ↓ Development of application ↓ SE decision on progress ↓ Due Diligence / EIA ↓ Approval process ↓ Signing of Legals ↓ Delivery of R&D ↓ Final preparation for the market ↓ Sell product</p> <p>Satisfaction</p> <ul style="list-style-type: none"> application process – 76% satisfaction due Diligence – 74% satisfaction follow on decision making – 71% satisfaction quality of support – 87% monitoring / milestones – 97% satisfaction 	<p>R&D Spend £295,606,807</p> <p>IP Generation 84% develop patents</p> <p>Innovation 83% new products</p> <p>Wider Innovation 46% New marketing plan</p> <p>Effects 88% product effects</p> <p>Revenue Generation 97% product related</p> <p>Market type 71% existing private sector markets</p> <p>Market reach 80% existing global markets</p> <p>Return on investment 1: 1.62 return 2004-19</p> <p>Value Add at the Strategic Level Synergy Catalyst Strategic influence</p> <p>Reputational Benefits 92% improved reputation</p> <p>Positioning 84% improved positioning</p> <p>Spillovers Limited knowledge and market spillovers No network spillovers</p>	<p>GVA</p> <p>Year 1 (2005) – £0 Year 3 (2007) – £171,220 Year 5 (2009) – £11,781,675 Year 10 (2014) – £409,334,438 Year 15 (2019) – £642,128,624</p> <p>Cost Benefit Ratio</p> <p>Year 1 (2005) – 1: 0 Year 3 (2007) – 1: 0.01 Year 5 (2009) – 1: 0.46 Year 10 (2014) – 1: 9.57 Year 15 (2019) – 1: 15.02</p> <p>Employment</p> <p>Year 1 (2005) – 76 Year 3 (2007) – 432 Year 5 (2009) – 1,642 Year 10 (2014) – 3,452 Year 15 (2019) – 1,659</p>

1 Introduction and Context

In 2004 Scottish Enterprise (SE) supported R&D in large companies through its R&D Plus programme. In 2008, in an effort to reduce customer confusion on Government support and to extend the level of support available to smaller businesses SE formed the R&D Grant programme. This programme consolidated large company R&D Plus with the Small Company Innovation Support (SCIS) and the Scottish Government's SCORE scheme.

The Government Economic Strategy (GES) sets out how the public sector will support businesses and individuals 'create a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth'. The strategy highlights that Scotland's low level of productivity is a consequence of shortfalls in enterprise, innovation and investment and as such the ambition for SE's Business Plan (2009-12) focuses on:

- enterprise – via responsive and focused enterprise support, helping growth companies and industries to reach their full potential
- innovation – via stimulation of innovation to support business growth including exploitation of new products, processes and technologies
- investment – helping to create the right conditions for growth companies and industries to have access to property, markets and finance to help them grow

In its ambition to aid the improvement of business competitiveness and growth, the R&D Grant programme directly supports GES targets through the creation, or safeguarding, of R&D jobs and its contribution to Business Enterprise Research and Development (BERD) expenditure.

The R&D Grant programme is open to all companies located within Scotland, or planning to establish an R&D presence in Scotland. It is a discretionary, single company grant that supports businesses undertake development of new products or processes to the pre-production prototype stage through grants of up to 25% of eligible project costs. The core eligibility criteria for the programme looks to:

- support large scale R&D projects that involve significant innovation for the company and that focus on global market commercialisation from a local base with a high level of local diffusion
- demonstrate that the R&D undertaken is of strategic importance to the company and that it complements corporate strategy
- ensure the economic rationale for assistance will include long-term capacity building and sustainability in order to improve business competitiveness through R&D
- demonstrate clear levels of economic impact, including the creation and/or safeguarding of R&D jobs

Since the inception of the programme, 20 projects have been completed (as at July 2009) with a further 40 at various stage of implementation.

1.1 Evaluation aims and objectives

SE commissioned Frontline Consultants to conduct a full evaluation including economic impact of large awards (over £100k) made under SE's R&D Grant programmes since it was first established in 2004. The purpose of the evaluation was to:

- establish the extent of market failure(s) according to published literature and confirm these through business consultation
- assess the strategic fit and contribution of the programme to the key policy documents
- comment on any changes to the strategic context over this period that may have impacted/will impact on programme performance
- assess the linkages and interdependencies with other interventions in the innovation space
- review the decision-making process for access to and the source of referrals
- review the effectiveness of current monitoring activities and assess how well the processes gather the intelligence needed to make linkages between strategic rationale, inputs, activities, outputs and impacts
- review the effectiveness of programme delivery processes and mechanisms
- review the performance of the programme via comparison of actual versus target
- assess the contribution of the programme to SE's objectives and performance measures 2009-2012
- comment on the balance of resources over time relative to SE's thematic/key sector delivery targets, wider objectives and performance targets (2009-2012) and the ability to establish cross-industry prioritisation measures
- establish key company-level performance metrics to allow contribution of project performance to overall business performance/business improvement and better understand strategic impacts at the company level
- confirm whether there is evidence to suggest SE should continue to support the project and the form the support should take
- establish overall levels of satisfaction, including how the programme complements and/or competes with other SE or wider public sector support
- assess what follow-on support businesses receive (relative to this intervention)
- identify key strengths and weaknesses of the programme and make recommendations to improve the future model of client support
- assess contribution to the equity and equality agendas
- considerations of value add at a strategic level in terms of:
 - type of innovation undertaken
 - stages in product life cycle
 - where commercialisation has/will take place and the types of markets served
 - programme level BERD undertaken, follow on BERD and overall contribution to national BERD targets
- assess 'spill over' effects at both the aggregate and key sector/thematic levels, such as:
 - the catalyst effect – follow on research and improved Scottish research capacity
 - strategic influence – contribution to the development of a knowledge-based economy through the capacity building of high-value human capital
 - synergy – improved knowledge base, knowledge networks and flows
 - absorptive capacity at both firm and economy level
 - contribution to inward investment agenda
 - direction of money flows

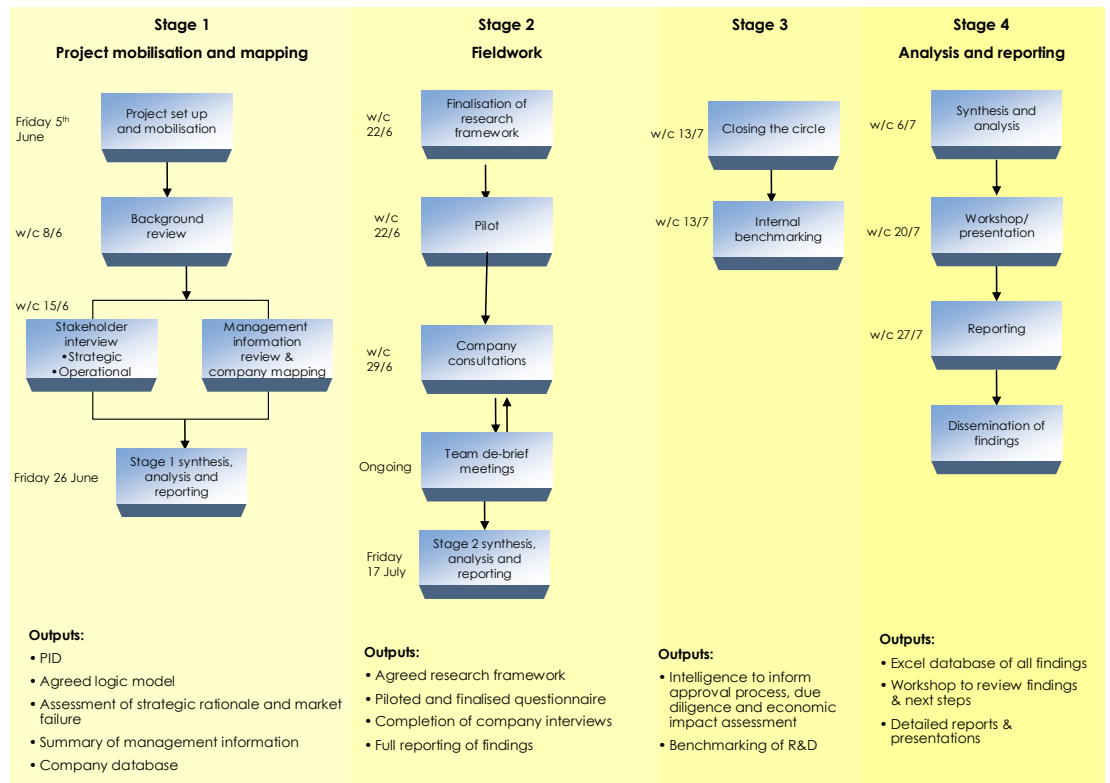
- determination of clustering advantages
- assess economic impacts presented at the aggregate level and disaggregated by key sector using company-specific data
- make comparison of impacts over time, including any revisions according to changing economic conditions
- assess 'time to impact'
- assess optimism bias
- assess impact against a range of GES measures and the contribution to targets they may achieve
- make performance and productivity comparisons against other UK regions, NUTS areas, Department for Innovation, Universities and Skills (DIUS) data
- undertake key calculations for:
 - annualised gross and net GVA and employment
 - leverage
 - cost per gross and net job
 - cost-benefit calculations and ROI
 - key measures of productivity (GVA/head, GVA/hour)

The next section describes the method followed by our findings.

2 Methodology

This evaluation looks specifically at 55 large R&D awards made between 2004 and 2009 under either Scottish Enterprise's large company R&D Grant (R&D Plus) or since April 08, through Scottish Enterprise's R&D Grant programme. It does not include evaluation evidence in relation to the 100 or so smaller projects supported by Scottish Enterprise each year, with contributions of £1.5m-£2m generating around £6-9m of BERD annually. A full list of the projects is included in Appendix 1.

Our approach to evaluating the R&D Grant programme is shown below.



Following project initiation and in-depth desk review, including an initial assessment of market failure, the extensive management and company information was gathered and assessed.

A period of consultation was subsequently undertaken with a wide range of SE's strategic and operational stakeholders – a list of these is appended. The views of stakeholders were captured through a combination of face to face and telephone interviews. Stakeholders were asked to contribute their views on a range of topics, including:

- the rationale for intervention – covering detailed market failure questions as well as wider reasons for intervention
- the fit with key policy documents and other projects
- current monitoring arrangements and how these could be strengthened
- linkages with other projects/support and referral mechanisms
- issues around the equalities and sustainability agendas
- ongoing management and delivery of the project
- the key strengths and weaknesses of support
- what works – and crucially why

- challenges – and explore how these have been overcome
- the value of R&D to companies and the Scottish economy
- improvements to the scheme
- the balance of resources and how this could be improved or refined

The findings from this stage of the research were pulled together in a short report covering:

- the rationale for intervention – including market failure assessment
- the fit and contribution to key strategy and policy documents
- assessment of activities delivered (in effect companies supported)
- linkages with the other Scottish Enterprise support
- key inputs to the programme
- key process issues associated with the operation, management and delivery of the R&D scheme
- an overview of the companies
- progress towards targets and contribution to key Scottish Enterprise objectives

The findings from this report were incorporated and further developed in the final report.

In parallel with the mobilisation stage an extensive questionnaire was designed covering a range of topics, including:

- company characteristics – such as size, time in Scotland, HQ status
- market failure questions – covering detailed exploration of market failure based on the questions developed at the desk review stage
- satisfaction with the R&D Grant support – including application, due diligence, economic appraisal (where relevant), ongoing contact, follow up, improvements to the scheme and overall satisfaction
- R&D process – covering key issues at the planning, delivery and longer term effects (as outlined in the approach)
- commercial exploitation – including scope for exploitation (or actual exploitation depending on the company), type of innovation, markets served, actual outcomes (against expected outcomes outlined in the due diligence report)
- economic impact – including annual impacts, GVA from components and 10 year forward projections

This questionnaire mapped out the company's journey from the formulation of the idea, through its development and into the commercialisation stage of the product.

The questionnaire was piloted with four companies, three of which were in the commercial stages. The questionnaire was amended based on the learning from the pilot.

The companies participating in the business survey were self selected based on their willingness to participate. As a result of the tight timescales associated with the study it was necessary to contact all 45 companies out of which 36 interviews were completed. This means that there is an element of self selection in the sample, though this does account for the majority of the companies receiving assistance.

In total, 36 companies were surveyed from a population of 45 companies, which translate into the 55 projects covered by this evaluation. This is because some companies have received more than 1 award, including:

- 37 companies who received 1 award
- 6 companies who received 2 awards
- 2 companies who received 3 awards

Interviews were completed using a combination of face to face and telephone interviews. Feedback was collected and input into SNAP survey software for analysis. Economic data was exported into excel to allow for detailed impact calculations.

Throughout the process a series of team debrief sessions were held to discuss emerging findings, interview progress and maintaining consistency of questioning and coding responses. In parallel, regular feedback was provided to the project team, ensuring they were fully aware of the emerging findings and progress.

A full evaluation report, linked to the earlier mapping and stakeholder findings was produced, drawing out:

- the reality of market failure in the company base
- satisfaction with support and improvements
- progress towards targets and contribution to key Scottish Enterprise objectives
- the R&D process – covering the planning, delivery and longer term effects at the company level
- commercial exploitation – how it happens, where it happened and how long it takes to happen
- economic impact – based on the Scottish Enterprise standard question set, GVA at the company level, annualised impacts (both to date and projected to 2019/20), at a consistent price basis, discounted at 3.5% per annum and assessed against costs (cost benefits analysis)
- economic impacts by key variables – including scale of grant award, size, HQ status, level of existing R&D
- how impacts or wider benefits generated as a result of the R&D Grant contribute to a knowledge based economy; specifically the knowledge base and the potential for wider knowledge creation
- and benchmarking performance against other SE interventions, including the recent commercialisation review

The findings were presented in a workshop to the SE team prior to the finalisation of the report.

Outputs were subsequently drawn together into a final report, covering:

- the theory of market failure with the reality among the company base
- extent to which the evaluation findings position the programme with the policy and strategy context – including potential changes to ensure greater fit
- the monitoring data against the net additional benefits and BERD generated to assess if the indicators are fit for purpose
- key differences in company performance in terms of productivity per head between business units as a result of the R&D Grant and the whole company – where relevant
- drawing out comparisons with other Scottish Enterprise initiatives – including satisfaction and impact

3 Strategic Case

3.1 Summary

This section of the report provides a desk based overview of the following:

- rationale for intervention including hampering factors, equity issues and market failures
- inputs and expenditure of the programme since 2005 (based on information supplied by Scottish Enterprise)
- activities including number of projects split across the industry sectors, the nature of the R&D, number of jobs safeguarded and created (based on due diligence papers)
- strategic fit with the Government Economic Strategy, SE Business Plans and Industry Demand Statements and contribution to other SE activities

In summary:

- our assessment confirmed that there continues to be barriers to innovation in Scotland
- based on levels of BERD as a percentage of GDP, Scotland still performs poorly in comparison with a range of UK and International regions
- market failure lies in both imperfect information, largely with the financial markets, and a broader externalities argument in the company base
- there continues to be a real and clear market failure and combined with the hampering effects and equity issues gives a clear rationale for continued intervention
- since 2003/04 SE has plans to invest over £55m into 55 large R&D projects with a total project cost of over £402m – this give a leverage of over 1:6
- although a wide range of industry sectors have been supported, DMET by far has the highest proportion (47%) of awards
- 49% of awards span both industrial research and experimental development, with a further 31% focussed on experimental development only
- to date, the gross jobs safeguarded and created have been estimated from due diligence reports at 1,987 and 470 respectively
- the due diligence reports suggest that there are strong links with academia (76% of companies claim some form of interaction), followed by other local businesses (with 50% of companies claiming some form of interaction) to support the delivery of the R&D
- creating a supportive business environment is one of five priorities in the Government Economic Strategy, therefore the need to focus on increasing the proportion of R&D conducted in Scottish based businesses remains a key priority
- R&D Grant contributes to all three areas of enterprise, innovation and investment in the SE Business Plan
- there is a good fit with four priority industry sectors based on the Industry Demand Statements – DMET, life sciences, food and drink and energy (renewables)
- R&D Grant will play a crucial part in the success of the SE Innovation Policy as it provides support directly to companies and therefore makes an important contribution to one of the key measures of innovative activity: BERD
- R&D Grant support aligns with a range of other activities supported by SE including the Edinburgh Stanford Link and TrainingPlus

3.2 Rationale

The rationale for the R&D scheme reflects a number of barriers, failures and reasons for intervention. These can be grouped into three broad areas:

- hampering factors
- equity issues
- market failures

This section outlines the evidence around these areas, culminating in a clear assessment of the rationale for intervention.

3.2.1 Hampering factors

Hampering factors refer to barriers perceived or experienced by companies that lead to sub optimal outcomes in the R&D and wider innovation space. These are factors that are either an outcome of market failure or reflect wider imperfections in the market rather than structural market failures.

Data from the Community Innovation Survey (CIS), at a European level¹ suggests that the main hampering factors related to cost specifically. The main areas within this focus on the cost of innovation being too high and a lack of internal and external funds for this type of activity. This picture holds true in Scotland, where innovation costs, perceived economic risks, and cost of finance were cited the most by companies as barriers to innovation².

This suggests that companies believe there are barriers to innovation and hence R&D in Scotland.

3.2.2 Equity issues

Equity rationales are based on the logic that there is somehow an uneven distribution of activities or outcomes across a pre defined geography.

In the case of R&D, the equity rationale is associated with Scotland's low level of Business Enterprise Research & Development (BERD) spend by international standards. It is an equity issue because at a UK, European and Global level, Scotland is consistently among the poorest performers (Table A3.1). Full tables to support the analysis in this section are included in Appendix 3.

Taking intra UK differences into account, Scotland's level of BERD as a percentage of GDP amounts to 0.46% in 2007 (the latest year for which data are available), placing Scotland 9th from 12 UK nations and regions. This is less than half the UK spend in the same year and shows that Scotland is lagging some way behind the rest of the UK.

Taking intra EU differences into account, Scotland again performs poorly, coming 20th out of 31 nations (Table A3.2). BERD in Scotland amounts to around one seventh of the percentage spend in the leading nation Sweden.

Finally, taking a global overview, Scotland is 10th from 10 Organisation for Economic Cooperation and Development (OECD) nations³ (Table A3.3).

¹ Hollanders.H, Rogne.J and Sluismans.R (2008) *Policy Rationale for Innovation Support*, Inno Learning Platform

² DTI (2006) *Innovation in the UK: Indicators and Insights*, DTI Occasional Papers No. 6

³ Data was presented for 10 of the 33 OECD member countries in the Scottish Government publication – these were therefore used for comparison

Over the period 2004 to 2007 BERD in Scotland increased from £430m to £513m, however this only relates to an increase of 0.01% of GDP (see table A3.4). In contrast, BERD in the UK has steadily increased from £12,662m to £16,111m over the same time-period, an increase of 0.09% of GDP.

It is important to recognise that this measure captures R&D spend in a particular way, driven in large part by Scotland's industrial structure⁴. The National Endowment for Science, Technology and the Arts (NESTA) suggest that this is a gap in measurement rather than any real gap in relation to innovation. The UK lags behind comparator countries because of a weaker representation in areas of medium technology manufacturing where R&D expenditures are typically higher. However, as a measure of spend on BERD, as defined by the Frascati manual, it highlights the scale of the challenge in Scotland.

The initial (2003) large company R&D programme approval paper (R&D Plus)⁵ did not articulate the strategic rationale for the intervention, but did set out the Scottish context along these lines – essentially that Scotland was lagging behind and without action would fall further behind. This also suggests that despite an increased focus by Government in stimulating more R&D over the past six years, Scotland is still among the weakest performers.

However, as only a small number of awards were made before 2005/06, with a typical project duration of three years, a clear increase in BERD could not be expected until 2008/09 at the earliest.

3.2.3 Market failures

Market failure refers to a situation where the market has not and cannot by itself be expected to deliver an effective outcome⁶.

No market failure rationale was articulated when the R&D Grant was approved. However, subsequent evaluation of the scheme suggested that failures fell within three broad areas⁷:

- **risk aversion** – driven by the high failure rate of R&D and the fear of failure
- **information asymmetries** – with companies lacking the required information to access external finance, and with the technical element adding a high degree of uncertainty from an investor and company perspective
- **internal competition for R&D funds** – through distortions caused by the intervention of other UK and EU public agencies to attract R&D

However, only information asymmetries is an actual market failure, with risk reflecting an outcome from a lack of information (and other failures) and internal competition reflecting a wider market imperfection rather than structural economic failure.

A detailed review of a range of source material on market failure suggests that failures operate in particular domains of the economy in relation to R&D – especially the finance and technology domains. It also suggests that the market failures driving the need for an R&D support scheme centre on:

- **imperfect information** – largely in the finance market
- **positive externalities** – largely in the technology market

⁴ NESTA (2006) *The Innovation Gap, Why Policy Needs to Reflect the Reality of Innovation in the UK*, NESTA

⁵ Scottish Enterprise (2003) *R&D Support for Large Companies, Network Operation – Competitive Business*

⁶ HM Treasury (2003) *The Green Book: Appraisal and Evaluation in Central Government*, HMSO

⁷ EKOS (2007) *Evaluation of the Large Company R&D Plus Scheme*, Scottish Enterprise SC7917-00

Imperfect information is defined as a situation in which a company, individual or organisation is not perfectly informed about the options available to them and the costs and consequences of their decision making. This leads to incorrect assessment of the costs and benefits of their actions, in this case the decision to either fund or deliver R&D.

The literature suggests that imperfect information largely operates in the financial market, with investors unwilling to fund company R&D as they cannot readily assess either the chance of success or the scale of any return. The investor will therefore only fund R&D based on an average expected return rather than the potential actual return, attaching less favourable terms to any offer of investment⁸. This leads to risk aversion on the part of investors or financial institutions and results in underinvestment in R&D by companies. The cost factors outlined as being a main barrier to innovation therefore suggests that without appropriate action in the financial market the level and scale of R&D will be reduced.

Imperfect information will also affect the company decision making process around R&D. There is less evidence around this in the literature, but for the companies to make informed decisions around R&D they would need to understand:

- if the market supplies the information they need – on R&D costs, market size and returns
- the full costs and benefits of accessing this information – again on the costs of R&D planning and delivery and in the market size and financial return
- what information can actually be accessed
- the quality of the information provided
- the marginal costs of acquiring the information
- the marginal benefit of acquiring the information
- how to adequately process the data
- differences between perceived costs and benefits and real costs and benefits

This is a different type of market failure to that articulated in the 2007 evaluation of R&D Plus. This is because the rationale in that report suggested the information failure was asymmetric, rather than imperfect. If this were the case, one party would have more information than another.

Therefore, there does appear to be an information based failure in the market, though it is more complicated than companies simply not knowing, or one party being better informed than another, it is actually a lack of knowledge because of the complexity of the information needed to make the right decision. This affects companies and the financial institutions who may be called upon to fund or support R&D activity.

Positive externalities are defined as a situation in which one company's actions or behaviour directly impact on others welfare, which is not included in the market price for the product/process/service. This leads to under provision of R&D as essentially companies can benefit from the R&D of another company. There is therefore an underinvestment in R&D based on this theory for two reasons⁹:

- **knowledge spillovers** – firms benefit from another companies R&D at no cost by incorporating any new ideas or knowledge into their own products/processes/service
- **market spillovers** – consumers pay less than they would be willing to pay as producers cannot charge different prices for different consumers

⁸ Hollanders, et al (2008) *Policy Rationale for Innovation Support*, Inno Learning Platform

⁹ Ibid
SC7917-00

For example, a company invests in R&D, develops new knowledge which it turns into a new product and which it brings to market. This new product creates customer benefit as well as additional profit for the R&D company (defined as the full social return of R&D). However, the commercialisation of the new product provides a competitor with knowledge on the new product, through a number of possible routes:

- reverse engineering of the new product
- through investigation of any patents, which disclose knowledge on the product
- through staff members from the R&D company joining the competitor

This leads to the competitor company developing a new product along similar lines, generating wider customer benefit through increased choice and potentially reduced cost (because of competition) and generating improved profitability for the competitor company (possibly as the expense of the company who carried out the initial R&D).¹⁰

This positive externality therefore provides a disincentive to carry out R&D leading to sub optimal provision.

The overall assessment of the market failure suggests that imperfect information is one area of failure, largely operating in the finance market, and possibly within the company base along with a broader positive externality argument. This suggests that there is a real and clear market failure and combined with wider hampering factors and equity issues gives a clear rationale for intervention in the business base.

3.2.4 Market failure –The company view

The literature presents a relatively clear argument that there are two main market failures operating in relation to R&D:

- imperfect information – associated with a lack of information on the costs and benefits of R&D
- positive externalities – where other companies could benefit from the R&D delivered by another company

These factors were assessed through the business survey providing real evidence around the potential existence of market failure.

Taking imperfect information first, it was clear that there was an element of failure in this area, with 23% of companies citing information factors as a barrier to R&D. The main information factors included:

- limited availability of information on markets (17%)
- poor quality of information on markets (11%)
- limited availability of information on R&D returns (9%)

The information failure is therefore focused on the market for R&D products and the potential returns. A lack of information in this area is likely to lead to risk aversion in companies potentially reducing R&D or seeking public sector support to reduce the level of risk.

There is less clear evidence for positive externalities, with just one company suggesting barriers in this area. However, more detailed analysis suggests that the majority of companies secure IP associated with their R&D as well as using more strategic mechanisms to protect the outputs from the R&D. These indicate that companies do seek to avoid other competitors benefiting from their R&D, indicating a fear of positive externalities. This suggests there are some effects in this area – though it does not appear to be as important an issue as in the literature.

What is clear is that hampering factors around the cost of R&D are important, with 86% of companies highlighting cost as a barrier to R&D activity. This reflects the direct costs of R&D, as well as the perceived economic risk (both cited by 49% of companies).

This is important from an intervention perspective, as this suggests some form of grant assistance is needed to counter the imperfection (cost) and reduce the risk associated with a lack of information, rather than providing wider information and advice on the costs and benefits of R&D, which potentially wouldn't go far enough.

In addition, 67% of companies state that barriers are either no different or worse suggesting little market adjustment.

This suggests that there are some market failures evident, but the main barrier is actually a hampering factor rather than wider structural failure, one that is persistent over time.

3.3 Inputs

This evaluation covers 55 projects that have received R&D Grant support from SE. A list of those projects included in the evaluation has been included in Appendix 1. Total SE expenditure to date against these 55 projects amounts to more than £28.4m, an annual breakdown (unadjusted for inflation) of the figures are provided in Table 3.1. The annual actual expenditure on the R&D Grant has increased year on year between 2003/04 and 2008/09, highlighting the commitment of Scottish Enterprise in this area. This expenditure represents 52% of the total commitment towards these projects of £55,227,878, with £26,780,333 still to be drawn down as the projects continue to their fruition.

Funding contribution to R&D Grant by year

Table 3.1

Year	Actual expenditure
2003/04	£1,774,967
2004/05	£2,069,538
2005/06	£3,292,159
2006/07	£5,776,478
2007/08	£6,324,105
2008/09	£9,210,298
Total	£28,447,545

Forecast expenditure for these projects over the next three years is estimated at more than £21.6m¹¹.

¹¹ Please note this figure represents the latest forecast for all projects at the 10th of July 2009 and therefore differs from the legal commitments of £26,780,333 still to be drawn down
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Forecast expenditure on R&D Grant by year¹²**Table 3.2**

Year	Forecast expenditure
2009/10	£8,505,445
2010/11	£8,609,604
2011/12	£4,488,259
Total	£21,603,308

The figures in Table 3.2 only relate to the 55 projects currently being evaluated. This does not include any projects that were awarded assistance under the wider Scottish R&D Innovation Scheme, those recently approved or those progressing through the application process. When projects under the Scottish Research and Development and Innovation Scheme (R&D&I) or those approved more recently are included, the number of projects increases to 64 and the forecast expenditure increases as highlighted in Table 3.3. At any point in time there are typically 6 – 8 projects at the application phase.

Forecast expenditure on R&D Grant by year (all projects)¹³**Table 3.3**

Year	Forecast expenditure
2009/10	£9,244,537
2010/11	£9,371,658
2011/12	£4,988,259
Total	£23,604,454

These figures are subject to change and the 2011/12 figure will undoubtedly increase as expenditure forecasts are updated. In addition, new projects will continue to be approved adding to the actual future expenditure.

3.4 Activities

The following sections look at the various activities associated with the R&D Grant programme. The section is largely based on information collected from the 55 due diligence reports, as well as wider financial information provided by Scottish Enterprise.

3.4.1 Project cost summary

The total number of large R&D Grant awards offers made between the years 2003/04 and 2009/10 is presented in Table 3.4. This excludes awards made under the wider Scottish Research and Development and Innovation Scheme, with those projects having separate evaluation arrangements.

The 55 awards detailed in Table 3.4 involve Scottish Enterprise contributions totalling more than £55m. The total cost of these projects was estimated to be more than £402m which would suggest that the public: private leverage for the R&D programmes from SE funds is greater than 1:6. The range of ratios moves from 1:4 to 1:21 in the case of large projects receiving a small Scottish Enterprise contribution to ensure the project goes ahead within Scotland. To put this in some perspective the targeted return from Scottish Enterprise investment funds is 1:3.

2007/08 was the year where most awards were made, with 19 projects totalling close to £147m, receiving a Scottish enterprise contribution of nearly £18m (a leverage ratio of more than 1:6 from SE investment).

Total eligible costs¹⁴ throughout amount to more than £254m, 63% of total project costs throughout the 7 year period.

¹² Scottish Enterprise (2009) *Re-forecasting data 10th of July 2009*

¹³ Scottish Enterprise (2009) *Re-forecasting data 10th of July 2009*

¹⁴ Eligible costs are the areas of activity directly attributable to the specific project supported and include personnel costs, costs of instruments and equipment, costs for building and land, cost of contractual research, technical

R&D Grant cost summary*

Table 3.4

Year	Number of Projects	Total Project costs	Total eligible Costs	SE Contribution
2003/04	1	£69,025,200	£40,052,300	£7,400,000
2004/05	1	£10,000,000	£3,011,000	£752,000
2005/06	5	£32,165,088	£20,074,403	£4,993,402
2006/07	16	£50,843,381	£38,789,411	£8,595,851
2007/08	19	£147,880,140	£84,425,849	£17,627,684
2008/09	11	£89,675,518	£65,445,470	£15,265,004
2009/10	2	£2,637,782	£2,376,771	£593,937
Total¹⁵	55	£402,227,109	£254,175,204	£55,227,878

*Note these are the costs associated with the R&D element of the projects. They do not include the further and ongoing costs associated with taking any new products to market

3.4.2 Priority Industry sectors

Scottish Enterprise aims to work with businesses which have the potential to grow and are important to the economy. Key sectors are those where Scotland has a distinctive capability and where businesses in the sectors have the potential to be internationally competitive in areas with growing global demand.

The Government Economic Strategy highlights that emphasis should be placed on the following industries:

- life sciences
- energy
- creative industries
- financial and business services
- food and drink
- tourism

It also states that their assistance should be provided to technologies that support or enable their development. In addition there are a number of other sectors which SE support that make a specific contribution to the Scottish economy, including:

- chemical sciences
- aerospace
- defence & marine
- construction
- textiles
- forest industries

A breakdown of the industry sectors of the 55 projects included in this evaluation is provided in Table 3.5.

knowledge and patents, additional overheads and other operating expenses as defined in the *Scottish Research, Development & Innovation scheme, State Aid N369/2008 – United Kingdom Explanatory Notes: January 2009*

¹⁵ When all 64 projects are included the total project costs is estimated at £444,387,619, eligible costs are £295,014,122 and £63,478,528 is the expected SE Contribution

R&D Grant summary by industry sector

Table 3.5

Industry Sectors	Number of projects	Response rate (%)
Digital media enabling technologies (DMET)	26	47
Aerospace	6	11
Chemicals	6	11
Energy	5	9
Life sciences	5	9
Construction	2	4
Textiles	1	2
Food and drink	1	2
Other	3	5
Total	55	100

DMET is the by far the most prominent with 26 awards, almost half of the projects receiving assistance. There is an even split between the amount of awards made to projects in aerospace, chemical, energy and life sciences, with each receiving approximately 10% of those made.

Other industry sectors which have received support include construction, food and drink and textiles.

3.4.3 Nature of R&D

The State Aid for Scotland website¹⁶ provides an introduction to the Nature of R&D research categories, which can be grouped into two well-defined areas:

- industrial research – the planned research or critical investigation aimed at the acquisition of new knowledge and skills for developing new products, processes or services or for bringing about a significant improvement in existing products, processes or services. It comprises the creation of components of complex systems, which is necessary for the industrial research, notably for generic technology validation, to the exclusion of prototypes as covered by point 2.2. (g) of the Framework for State Aid for Research and Development and Innovation
- experimental development – the acquiring, combining, shaping and using existing scientific, technological, business and other relevant knowledge and skills for the purpose of producing plans and arrangements or designs for new, altered or improved products, processes or services. These may also include e.g. other activities aiming at the conceptual definition, planning and documentation of new products, processes and services. The activities may comprise producing drafts, drawings, plans and other documentation, provided that they are not intended for commercial use

Table 3.6 provides a breakdown of these categories, with many projects involving a combination of two:

- 27 (49%) of the projects involve a combination of both industrial research and experimental development
- 17 (31%) of the projects cite experimental development only
- industrial research is well represented with 11 (20%) of the projects involved categorised under this heading

¹⁶ <http://www.stateaidscotland.gov.uk>
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R&D Grant summary by nature of R&D**Table 3.6**

Nature of R&D	Number of projects	Response rate %
Industrial research	11	20
Experimental development	17	31
Industrial research/experimental development	27	49
Total	55	100

3.4.4 Jobs safeguarded and created

A key criterion for companies wishing to participate in the R&D Grant programme is the ability of their project to build capacity within Scotland, through both safeguarding and creating new jobs within the R&D field. The number of gross jobs safeguarded and created throughout the duration of the project is significant with 470 jobs created and 1,987 safeguarded.¹⁷ In addition, the majority of these jobs will be retained through grant offer conditions, for a period of up to 18 months beyond project completion in an R&D role¹⁸.

3.4.5 Wider benefits

The wider benefit generated throughout the study is the amount of activity with wider players in the Scottish economy in the form of linkages with various stakeholders, including suppliers, local businesses, and academia. Table 3.7 presents the results of this analysis across these various categories based on information included within the due diligence reports.

Local linkages**Table 3.7**

Areas of diffusion	Number of projects	Response rate (%)
Suppliers	23	42
Academia	42	76
Local businesses	29	52

Base response: 55

Engagement within academia is by far the most prevalent over the course of the programme, with 76% of companies aiming to collaborate with local academia. Linkages with suppliers and other businesses are also both well represented, with 42% and 52% respectively.

Another key factor within the evaluation is the organisations' ability to generate and protect their intellectual property (IP). From the data provided, 81% of organisations successfully fulfil the criteria of IP generation, with the remainder of the businesses not involved in fundamental research, but rather in bringing together existing technologies in innovative ways.

3.5 Strategic fit

The Large Company R&D Programme (R&D Plus) began with the aim of supporting R&D undertaken by businesses in the non-SME sector and thus aiming to ensure Scotland not only retained but strengthened its company R&D capability and continued to support emerging new technology through adequate investment in R&D. Since April 2008, the grant has been consolidated with SE's Small Company Innovation Support (SCIS) and the Scottish Governments SCORE Scheme and is therefore open to firms of all sizes undertaking company level R&D.

¹⁷ Job information taken from the due diligence reports, so may not reflect actual employment

¹⁸ For SMEs the rules are different, with a grant condition of continuation in the R&D role for 6 months post project completion
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3.5.1 [Fit with the Government Economic Strategy](#)

The Government Economic Strategy has five strategic priorities one of which is to create a **supportive business environment**. Within this priority their approach has:

“A clear focus on strengthening the link between Scotland’s research base and business innovation and addressing the low levels of business R&D.”¹⁹

The Scottish Government further reinforces its support for increasing R&D activity within Scottish companies in its Science for Scotland strategy which states that:

“A key challenge for Scotland is to bring about radical change in cultures and performance to increase business research and development, and business demand for and use of the science base in ways which help support growing businesses and sustainable economic growth.”²⁰

The government recognises that a strong correlation exists between higher spending on research and development (R&D) - particularly business expenditure on R&D (BERD) – and high rates of economic growth. This is reinforced by wider research carried out by the OECD which highlights a 1% increase in BERD driving multi factor productivity by 0.13%²¹.

In addition, higher R&D expenditure demonstrates the strength of the economy, as it requires advanced levels of expertise, sophisticated skills and a supportive business environment to undertake R&D activity. Innovation is crucial for businesses to remain competitive and to provide high value products and services in a global, knowledge-based economy. Consequently, Scotland’s ability to achieve sustainable economic growth and create highly skilled, better paid jobs, will be heavily influenced by its R&D performance.

As Scotland lags behind other UK regions and OECD and EU nations, one of the main national indicators used by the Scottish Government in the National Performance is to:

- at least halve the gap in total research and development spending compared with the EU average by 2011

The Scottish Government therefore makes clear the importance of R&D activity to the economy. The R&D Grant by providing support to generate additional R&D activity in Scotland will help achieve this. Given its focus on increasing the levels of business expenditure in R&D in Scotland it will also assist in the convergence of Scotland’s R&D performance towards that of the leading OECD nations.

3.5.2 [Fit with the SE business plan](#)

The SE business plan for 2009-12 aims to support the government in delivering its Economic Strategy by focusing on three key areas of activity:

- supporting **enterprise** in growth companies and key industry sectors
- promoting **innovation** to improve productivity and achieve competitive advantage
- stimulating **investment** in both physical infrastructure and companies

¹⁹ The Government Economic Strategy, The Scottish Government, 2007, Executive summary

²⁰ Science for Scotland: A Strategic Case for Science in Scotland, 2007, pg 8

²¹ OECD (2009) OECD Work on Innovation – A Stocktaking of Existing Work, Directorate for Science, Technology and Industry
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The R&D Grant contributes to all three areas. It supports innovation within companies and enables them to enter new markets through the creation of new or significantly improved products, processes or services. During this process it provides an incentive for companies to increase the amount they invest on R&D.

SE acknowledges the need for Scotland's key sectors to enhance their ability to innovate and remain internationally competitive, in both the short term (in a difficult trading environment) and in the medium to longer term in order that they can reap the opportunities from the global upturn, when it comes.

The R&D Grant ensures that companies located in Scotland will continue to innovate and develop new products, processes or services that allow them to capitalise on current market opportunities and ensures they are well placed to take advantage of any improvement in the global economic climate.

SE's Innovation Policy reflects the need for diffusion in business innovation. It looks to bring more companies into the innovation process and increase the value generated from SE's interventions, with a much clearer 'line of sight' to successful exploitation in the market. The R&D Grant will play a crucial part in the success of this policy as it provides support directly to companies and therefore makes an important contribution to one of the key measures of innovative activity: BERD.

3.5.3 Fit with Industry Demand Statements

R&D Grant support is not restricted to specific sectors of the economy. However upon reviewing the Industry Demand Statements (IDS) produced by SE in 2008²² (which aim to identify the principal contributions to the delivery of the strategic goals for each priority industry) there is a clear fit with a number of the key sectors. These include:

- digital markets and enabling technologies (DMET)
- life sciences
- food and drink
- energy – renewables

The DMET IDS recognises that Scotland has a shortage of HQs, even where we have large companies, the majority of these have low expenditure on R&D. One of the main SE objectives is to increase Business Enterprise R&D through industry collaborative projects and targeted interventions that develop R&D capabilities across the company base. SE also aim to increase the number of technology development opportunities in companies. Given the R&D Grant is focused on increasing the level of BERD in Scotland, clear parallels exist between the two.

The life sciences IDS recommends a key area of focus should be on harnessing Scotland's commercially attractive academic strengths in stem cells and regenerative medicine. In order to capitalise on Scotland's strengths in innovation, it specifically states that SE should support company creation and growth in all areas of life sciences, for example through Proof of Concept and R&D support.

It also goes on to say that given the current economic climate, with many companies looking to cut costs, there may be a reduction in R&D spending and this is an area that SE needs to focus on more heavily by providing support to maintain current level of R&D and innovation activity. The R&D Grant will help support this by providing access to grant support for (market led) R&D investments for both small and large life science companies.

²² These were the most up to date statements at the time of the evaluation in July 2009, but have since been updated after the start of the evaluation

One of the main priorities for the food and drink industry is to stimulate increased innovation, leading to new food and health research and commercialisation facilities, attraction of global investment improved links with academia and industry that will result in new added value food & drink concepts. As part of this, development of a more effective innovation system will occur built on the following:

- innovation service – provide specialist food and drink support and advice and an entry point to other elements
- research network – bring together expertise across food and drink academic and research institutes with a focus on food & health
- Food and Health Innovation Centre – lead pan-Scotland, commercially focused research and product development

There may be scope for companies taking the outputs from collaborations in these areas even further through R&D Grant support.

The renewables IDS highlights that the focus should be on assisting the sector in demonstrating the viability of new devices and systems in Scotland and states that SE assistance in this area will include support towards R&D.

3.5.4 [Contribution to other SE activities](#)

R&D Grant support fits in with a range of other activities supported by SE. As expected given the size of the companies that receive the awards, all large R&D Grant recipients are designated relationship managed.

Based on the wider review of SE's commercialisation activities and the company mapping exercise undertaken as part of that work the following linkages have been found (Table 3.8).

Other SE activities

Table 3.8

Activity	Number of companies
Edinburgh Stanford Link	6
TrainingPlus	10
Regional Selective Assistance	12

Base response: 45 companies

Six of the companies who received an R&D Grant award also received support from the Edinburgh Stanford Link (ESL). One of the aims of ESL is to produce a sustainable research pipeline feeding from pure research through research prototypes to eventual commercial exploitation, upon which long-term, stable, economic development can be based. Given this focus, it is evident how some of the companies receiving R&D Grant support engage with the ESL.

The lack of engagement with further commercialisation support simply reflects the fact that the R&D programme was set-up to focus on large companies as opposed to SMEs, whereas most commercialisation support offered by Scottish Enterprise is only available to small and medium sized enterprises.

Ten of the companies who received R&D Grant assistance also received TrainingPlus Grants. TrainingPlus is discretionary funding awarded to businesses that enable them to develop the skills of their staff, creating a skilled, trained and adaptable workforce and a labour market responsive to economic change. It is available to any business undertaking a mobile direct investment project based anywhere in Scotland. The main objectives of the programme are to influence the standard of training and raise

the competitiveness of businesses operating in Scotland.

One of the main aims of R&D Grant support is to develop long term capacity building and sustainability to improve competitiveness through R&D. In order to achieve this support a business needs to have staff that are able to adapt to the new product/process/techniques arising from the R&D support in order ensure the commercialisation benefits of the project are achieved. Therefore, TrainingPlus should complement R&D Grant support and ensure maximisation of the benefits to Scotland.

Regional Selective Assistance (RSA) is the main national grant scheme of financial assistance to industry. It provides discretionary grants for capital expenditure and investment projects that will create or safeguard jobs in Assisted Areas of Scotland. Its main aims are as follows:

- targeting those areas of greatest need
- helping create and safeguard jobs
- supporting business investment

The rationale for developing and maintaining the RSA Scheme rests on the notion that the needs of the disadvantaged sub-regions within Scotland are best served by a 'state aid' that produces a wide range of effects at the firm level and, more importantly at the broader regional and national level.

In total, 12 of the companies who received R&D Grant support also received funding via RSA. Even though RSA provides support to larger firms via provision of capital for physical infrastructure and plant machinery and is focused on job creation and retention, it does not fund R&D capacity building or activity – which is solely the preserve of the R&D Grant scheme.

4 Stakeholder Views

4.1 Summary

In the course of the evaluation, a wide range of stakeholders were consulted, covering:

- **strategic** stakeholders – those with a strategic responsibility for taking forward the innovation brief, and some priority sector leads
- **operational** stakeholders – those involved in the conception and development of the programme, and those currently delivering the scheme
- **referral** stakeholders – including account managers, Scottish Development International and regional innovation specialists

This section covers the summarised and synthesised views of the stakeholders consulted only, it does not include wider evidence from the business survey.

A list of consultees is included in Appendix 1.

This section contains the analysis of these interviewees and covers:

- rationale and strategic fit
- project management and delivery
- approval and funding
- areas of success
- challenges and difficulties
- the future of the grant programme

In summary:

- there was agreement on the continued requirement for the programme as well as its fit with strategic priorities; there was a good fit with the priority industries
- in general the programme had been delivered extremely well, with scope to refine and streamline the processes in order to speed up approvals and allow companies to remain at the leading edge
- there was strong belief that the programme has had an impact on firm's R&D capacity and spend, their turnover and employment, and therefore having a positive impact on the wider economy. In terms of public: private sector leverage the R&D Grant programme is recognised as one of the best SE interventions
- there was overwhelming support amongst stakeholders to continue to invest in the programme, as well as to increase investment. There was a lack of consensus on how this should be done in the face of apparent budget constraints. However, there is considerable support for focusing attention on key sectors and ensuring that these are aligned with growth areas for the future. Increasing resources within the team to support increased investment would have to be considered

4.2 Rationale and strategic fit

There was recognition amongst stakeholders that the key rationale behind the programme was in closing the gap between Scotland and other countries in relation to the level of Business Expenditure on Research and Development (BERD), and in particular the relationship between the high levels of innovation in Scotland but comparatively lower levels of BERD.

Other key justifications for the programme included the need to:

- attract further foreign investment into Scotland
- encourage companies who have located in Scotland to become more 'anchored' here by undertaking new or extended research projects
- promote competitiveness and growth of indigenous companies
- encourage a culture of innovation in companies in Scotland by helping de-risk R&D thereby making it a more affordable option
- overcome the 'asymmetric information' market failure explored in Section 3
- build R&D capacity over time across the whole company base
- create and secure high value jobs
- provide a means for engaging with companies – both large and small

The programme contributes to growing Scotland's reputation as a place for conducting R&D, and builds on key strengths including a skilled labour pool and a strong academic base as a pull for foreign investment. Some mentioned that the programme was also a useful initiative for either retaining companies in Scotland or keeping them operating at their current level thereby safeguarding jobs and wider economic value.

As noted above, the programme has been a strong pull for foreign investment, and useful for working with indigenous or foreign-owned companies already in Scotland. Although other programmes exist for large companies such as RSA and TrainingPlus, neither is focused on R&D and RSA is restricted to specific geographic areas. The programme therefore offers support to large companies in a key government priority area.

Given the variety of support available for SMEs a small number of stakeholders questioned whether there was a need for the scheme to also provide grants to SMEs. However, others felt it was important for the programme to be able to have this flexibility and in practice has resulted in some SMEs receiving significant R&D Grant awards. It was noted that this recent change reflected the merging of SCIS and SCORE with the previous large company programme so as to give full coverage across the company base in Scotland.

Stakeholders generally felt that the programme represents a good strategic fit, originally with A Smart, Successful Scotland, and now with the Government Economic Strategy. In particular, it is focused on encouraging innovation, developing the knowledge base and linking businesses with academic knowledge. More specifically it makes a direct contribution to the Government's priority target of at least halving the gap in R&D spending compared with the EU average by 2011.

A small number of interviewees – including some of those with an involvement in setting up the programme – raised something of a definitional issue. Is the programme about supporting R&D, or should it be more concerned with the commercialisation of the output? In general, views were that it was right to focus on the R&D; however, understanding the potential commercial return was an important factor for both the company and SE and should not be underestimated as a tool for decision making at both levels.

In terms of the programme's fit with Scottish Enterprise key sectors, the general view was that it varied by sector. At the sectoral level interviewees highlighted the following:

- financial services – the definition of R&D used by the programme does not fit well with what would be defined as R&D in the sector
- tourism – mixed views around the definition of R&D in the sector, however stakeholders agreed that most operators are very small scale and have access to extensive wider Scottish Enterprise support
- life sciences – there is a reasonably good fit but more support for early stage clinical trials would be advantageous to tap into a current funding gap
- chemicals – the programme is a good fit, although there is the potential to do more in relation to demonstration/pilot projects
- enabling technologies – a very good fit, and high uptake already
- energy – R&D projects are very capital intensive in the sector and can therefore have high levels of spend against very few R&D jobs created or safeguarded
- digital media and creative industries – potential for definitional issues, the nature of the sector is such that R&D can be focused on service oriented innovation, which does not fit well with the technology focused basis associated with the R&D scheme
- construction – did not traditionally fit well as most firms are very small with limited focus on R&D; however, the recent push in the sector is for increased innovation which could potentially increase fit in the future
- textiles – potentially a good fit here with a strong focus on driving innovation in the sector by the textiles team

4.3 Project management and delivery

Stakeholders felt that the programme has been managed very well, and that the individuals responsible for delivery in the central team were doing a good job.

Grants are managed centrally and delivered regionally through decentralised budgets. Some felt that this disconnection between local and central management works well, while others felt that this could add delays and unrealistic expectations through having more links in the chain than are needed, particularly for larger grants.

Overall, there was satisfaction with the process and delivery. Most stakeholders felt that although there was generally a quick turnaround on a decision on whether or not a project was likely to receive support, the overall process could take too long and that this could have a negative impact on accessing a particular opportunity. Other issues that were raised included:

- inadequacies in the pre-application process, which has led to projects being put forward that were not fully appropriate or did not meet the key scheme criteria. This has been exacerbated by the differing levels of knowledge and/or confidence in the areas of R&D and innovation amongst 'referral point' staff
- too many stages in the overall process, and not enough transparency to firms about where they are and how long the process at each stage can take

The due diligence process was thought on the whole to be valuable and necessary, with adequate focus placed on potential markets, costs and project planning. Some issues were raised included:

- inconsistency in terms of the content and quality of the due diligence reports
- the length of time for the production of a signed-off due diligence report often being too long
- the process being somewhat fragmented, with too much 'to-ing and fro-ing' between contractors and companies

A small number of stakeholders felt the economic impact assessment (EIA) was not required, while others felt that it added considerable value. While this is a key area in the current Scottish Enterprise approval process, other bodies such as the Technology Strategy Board (TSB) can approve R&D projects without the need for an impact assessment. This raised the question is it really needed in Scotland? Clearly there needs to be a mechanism for ensuring good value for money, and assessing projects on their potential economic impact is integral to this. It should be noted that the additional time involved in conducting the EIA does not generally delay the approval process. In addition, the Economic impact assessment also positions the R&D grant scheme as an economic development support mechanism, through the focus on the impact on the Scottish economy, rather than a technology development mechanism.

Overall stakeholders felt that the whole process could be streamlined to facilitate quicker approvals. More guidance could be provided to people serving as 'access points' on what a typical project looks like. From there on, the process would benefit from the implementation of clearer guidance on the information requirements from the company, and the expectations in terms of response times.

4.4 Approval and funding

There was overall satisfaction with the approval and funding processes, with a few stakeholders drawing attention to:

- variation in the time it can take to gain approval (with some suggesting there was a prolonged duration in comparison to some projects with can be completed quickly) – this came out most strongly from the company-facing stakeholders
- the element of subjectivity involved in the approval process, and the fact that there is no perceived hard and fast set of rules upon which decision or priority is made – some operational stakeholders identified this issue

There was some interesting discussion of 'serial applicants', or the way in which the R&D Grant scheme could potentially work with companies on a 'programme' of R&D, rather than companies coming back for support for further projects. The efficiencies of this are clear on one hand, while there is potential to work with more companies on the other. In either case, there was support for the grant programme to be better linked in with other types of support, to enable ongoing company support beyond the initial R&D project.

In terms of funding, it was recognised by all that the availability of budget restricts the potential impact that this programme can have. There was overwhelming support for the programme, and while the level of funding up until now was regarded as having been appropriate, there were now calls for increased investment as most interviewees felt there was considerable unmet demand.

A number of stakeholders – mainly operational – commented on the need to be able to 'over-commit' on funds to account for slippage.

The maximum grant intensity of 25% attracted divided opinion. Some felt that grant

intensities should be higher to make Scotland more competitive as other areas (including regions in England) are now offering similar types of support. Indeed, some recognised that there would be scope within the current R&D approval to provide aid of up to 35% for SMEs. The aid intensities could also be increased up to 50% to fund earlier-stage research that could be more of benefit to industries in general rather than companies in particular. In the case of the latter, there was no emerging consensus that the programme should go down this road, and recognition by others that this is not what the programme originally set out to do.

Others felt that companies having to invest at least 75% of the costs of the project meant they went through their own internal approvals more thoroughly and were better organised about the research project before commencing.

The setting of company expectations accurately in respect of the grant being a maximum of 25% of eligible costs (and a function of the minimum required for the project to go ahead) and not automatically 25% of costs was mentioned by a number of stakeholders as an issue.

Finally, a small number of stakeholders expressed concern that continuing to 'sell' the grant when there are serious budget constraints could lead to further issues with managing company expectations.

4.5 Areas of success

It is clear that the programme is well regarded amongst all stakeholders. In general the programme has:

- achieved what it set out to do through assisting companies to increase their R&D spend
- generated economic value, in the form of high levels of GVA from the commercialisation of research
- created and safeguarded a significant number of jobs – in both R&D and high value positions resulting in an increased Scottish labour pool in these areas
- drawn in very high levels of leverage in comparison to other interventions and in that respect could be said to provide good value for money
- made a clear contribution to attracting and maintaining foreign investment in Scotland
- plugged a gap that previously existed i.e. the ability to part fund large company R&D activities
- been well-run, flexible and responsive to company requirements through a knowledgeable and effective central team
- impacted favourably on companies in that they have been very positive about the experience of receiving support, and as such the grant has been an excellent way of engaging with and maintaining positive relationships with companies

4.6 Challenges and difficulties

The programme is not without its challenges and difficulties. Some of these have been alluded to earlier, for example frustration with the time it takes to complete the due diligence and approval process. A number of suggestions were made around streamlining the process such as the creation of templates and the implementation of service level agreements. On the other hand one interviewee wondered if enough was being done with the due diligence process, suggesting that "potential risks get skipped over".

There was also an issue about SE's ability to commit funding, which has previously led to underspend. This occurs because SE can only legally commit a certain amount of money, but slippage in R&D meant that the legally committed money is not often used as quickly as planned. That said, there were signs that companies were now claiming payment more in line with projected milestones, possibly driven by the recession and the need to complete projects quicker. It could be that if this new trend continues it may not be possible to over commit resources on the assumption that there will be slippage in claiming payments.

There were also issues around communication and setting company expectations in relation to:

- the amount of grant they can expect
- information requirements for due diligence and approval
- timescales for decision making

While the central team are clear on the information required to make a decision and timescales relating to the grant application and approval process, our findings suggest that this is not always clear amongst staff in the regions and other referral staff. There is clearly an opportunity to improve how these requirements and timescales are communicated amongst all company facing staff (and due diligence contractors). This is also the case in relation to potential aid intensities where there is still an expectation that the companies will get the full 25%, and not just the minimum required to let the project go ahead.

Despite there being a full monitoring and evaluation framework in place for the programme, there are inconsistent approaches to data capture between the central team and the regions. While core information is consistently collected there was a view this could be better joined up across SE.

A number of stakeholders suggested that some of the wider options around the R&D schemes were not being maximised. Some examples included:

- greater use of collaborative research
- more work on projects match funded by the Technology Strategy Board (TSB)

Collaborative research was seen as an area where there had been little activity, with a lack of clarity on what could be funded and clear guidance on how to support companies to approach this. There was a suggestion that the central team were exploring ways to increase collaborative activity and this may help to ramp up more collaborative forms of R&D in the future.

Stakeholders believed that there was scope to look to the TSB as a potential source of wider funding (reducing the Scottish Enterprise contribution for Scottish R&D projects). This would also provide a greater range of options for Scottish Enterprise around just how they bring forward and support R&D projects.

4.7 Future of the grant programme

Interviewees were unanimous on the continued need for the intervention. The R&D programme was viewed as being a highly successful intervention that has had a very positive impact on the Scottish economy.

It was recognised that constrained budgets meant that a system of prioritising grant

approvals may need to be introduced in the future. Initial discussions have taken place between SE's R&D Grant team and Innovation Business Unit Group on ways to better benchmark projects to assist future production and this activity is being progressed at present. Some additional suggestions for prioritisation from stakeholders included focussing on:

- potentially 'transformational' projects
- inward investment, and particular sectors within that
- projects aligned with key sectors of the future, or alignment with a technology strategy menu for Scotland (which is currently in development, led by the Enabling Technologies team)
- potential benefit to the economy
- whether the applicant has previously received financial support

Finally it was suggested that the central team is understaffed, and that there is a need for additional support to take over the administration of grant including invoicing and payments. This would free up the time of account managers and regional innovation specialists to add value rather than do paperwork.

5 Company R&D Journey

5.1 Summary

To understand the company 'R&D journey', businesses who had received a grant were surveyed. In total 36 companies were interviewed from the 55 projects covered by the evaluation. It should be noted that not all 36 companies responded to every question, so each question has its own base response rate and these have been used to calculate percentages. In addition, where collaborations are cited any new or extended relationships are specifically drawn out where they exist.

The company R&D journey covers:

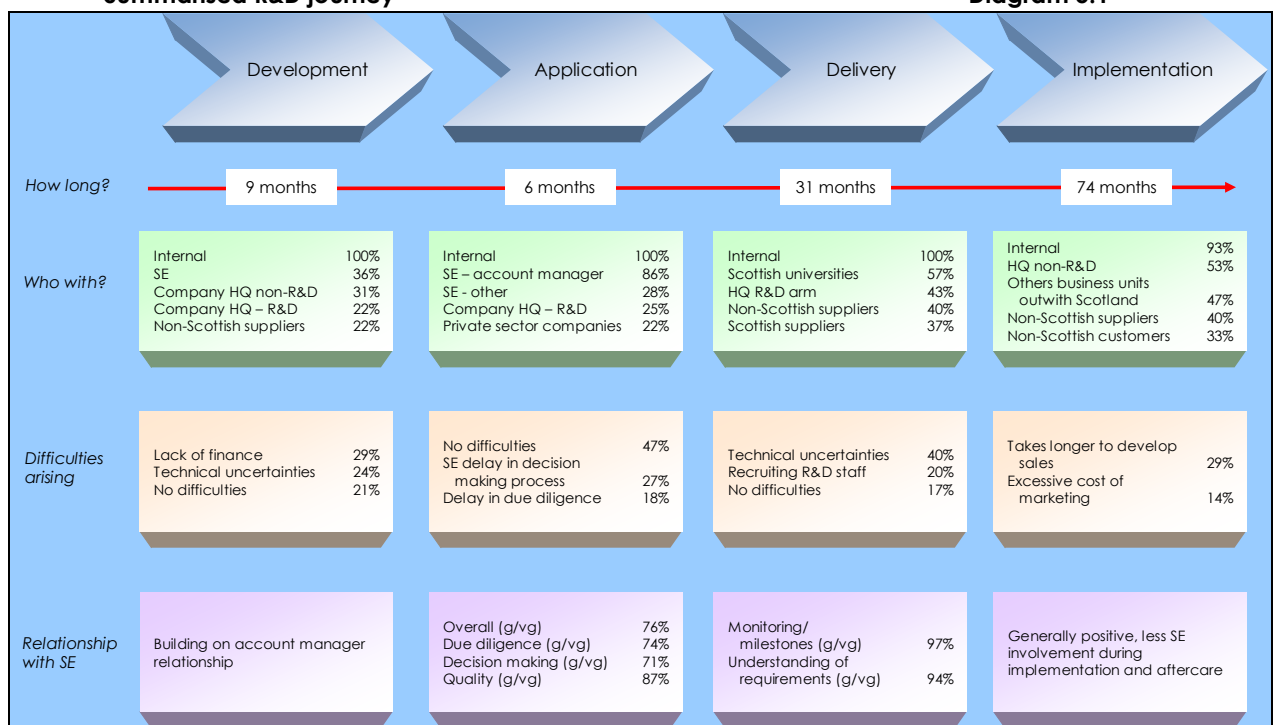
- development – the point from which the project was raised until application
- application – from submitting the application to award date
- delivery – the period over which the R&D was undertaken
- implementation – the commercialisation of the R&D that was undertaken

The journey is summarised in the diagram below which outlined the total duration from idea generation to being ready for market being almost four years. In that time the company – or more specifically the unit within Scotland (supported by other parts of the group) is central to the development of the R&D, though others are involved at key points, including Scottish Enterprise at the application stage and Scottish universities at the delivery stage. Generally, companies did not report major barriers, though technical uncertainties were common during R&D delivery and difficulties with sales as the project moves to the implementation stage.

Scottish Enterprise was perceived positively across all stages, with particularly high satisfaction at the delivery stage.

Summarised R&D journey

Diagram 5.1



5.2 Characteristics of supported companies

Of the 36 companies interviewed, the majority of these 75% (27) are subsidiaries, branch plants or branch offices of a larger parent organisation. The majority (22, 63%) are headquartered overseas. Of those, 8 are in Europe (22%) and 14 (40%) are in the United States. A fifth of the companies (8 or 22%) are headquartered in Scotland while 5 (14%) are headquartered elsewhere in the UK.

This indicates that while the R&D Grant programme is important in supporting indigenous companies to undertake high value R&D activity, it is particularly useful for supporting foreign-owned companies to either come to Scotland to undertake R&D, or to invest in R&D activity at established Scottish plants.

Most of the companies interviewed were well established in Scotland prior to applying for the grant. 28 (78%) have been trading for more than 10 years, while only 3 companies (8%) have been trading for less than three years.

In terms of scale of operation in Scotland, 16 (44%) have more than 250 employees and 12 (33%) employ between 50 and 249 employees. Of the remaining companies 7 (19%) employ between 10 and 49 people.

However, while many of the grant recipients have lower levels of employees in Scotland, their shareholding by larger corporate means that they are categorised as non-SMEs.

5.3 Existing R&D infrastructure

The following section summarises the key aspects of the existing R&D infrastructure and covers:

- investment in R&D
- range of R&D undertaken
- impact of the economic downturn on R&D spend
- utilisation of R&D Tax Credits
- R&D project objectives
- barriers to R&D activities

5.3.1 Investment in R&D

In 2008 the surveyed companies committed over £205m to R&D at the Scottish operation (see Table 5.1). This was up 1% on the position in 2006

This amounted to a median investment level of around £2 million in 2008 and ranged from £150,000 to £65million.

R&D Expenditure in R&D Grant Companies, 2006-2008 **Table 5.1**

Year	2006	2007	2008	No. change	% Change
R&D spend	£204,263,150	£212,641,329	£205,921,137	£1,657,987	1
Median value (per company)	£2,900,000	£3,000,000	£2,000,000	n/a	n/a

Projected R&D spend for 2009 was estimated at £104.3m, though a number of companies were uncertain on their expected final spend in 2009, explaining the fall relative to the position in 2008.

5.3.2 Range of R&D undertaken

The vast majority (34, 94%) of companies interviewed were already conducting in-house R&D prior to undertaking grant funded projects (see Table 5.2 below). For the majority (27, 75%) this involved the acquisition of machinery, equipment and software. A high proportion (16, 44%) were also involved in the acquisition of R&D, or the acquisition of external knowledge (22, 61%). In addition:

- 67% (24) undertook design associated R&D
- 61% (22) of companies did training associated with innovation
- 61% (22) undertook market introductions

Company R&D activity

Table 5.2

	Number of responses	Response rate (%)
In-house R&D	34	94
Acquisition of equipment, machinery and software	27	75
Design associated with innovation	24	67
Acquisition of external knowledge	22	61
Training associated with innovation	22	61
Market introductions of innovations	22	61
Acquisition of R&D	16	44

Base response: 36

5.3.3 Impact of the economic downturn

The economic downturn has had a detrimental effect on many companies' R&D spend, with just under half (15, 47%) reducing their spending on R&D activities (see Table 5.3 below), some substantially (6, 19%) and others slightly (9, 28%). However, 44% (16) of the respondents stated that their R&D spend was unaffected. One company had actually increased R&D spend citing the need to maintain high levels of competitiveness.

Effect on R&D expenditure

Table 5.3

	Number of responses	Response rate (%)
Reduced R&D spend substantially	6	19
Reduced R&D spend slightly	9	28
Made no difference	16	44
Increased R&D slightly	1	3

Base response: 32

Looking forward companies expect the downturn to have more serious implications, with 70% of the companies suggesting that they will either reduce their spend slightly or substantially (mostly slightly). Around a third expect it to be no different.

5.3.4 Utilisation of R&D tax credits

As expected with so many large multinationals and established companies already involved in R&D activity, the majority (over 60%) of companies interviewed consistently claimed R&D Tax Credits as highlighted in Table 5.4. The majority of companies (at least 20 companies in each year) were aware that they claimed Tax Credits; however, this is likely to be an underestimate as many interviewees were uncertain if Tax Credits were claimed, citing that this may occur at a UK level within their company.

Tax Credits claimed

Table 5.4

	Number of responses ²³	Response rate (%)
2008	20	57
2007	21	62
2006	20	61

Base response: 35

5.3.5 R&D project objectives

The reasons behind undertaking the funded R&D projects were wide ranging (see Table 5.5 below). The key headline objectives given were as follows:

- 32 respondents (91%) stated reasons of **competitive advantage**, with the business unit seeking competitive advantage in technology (15, 43%), within the business (14, 40%) or both (17, 49%) being the key drivers
- 29 respondents (83%) were doing the project due to **market pull**, with developing a new design to add value (24, 69%) being the most important objective here
- for 27 respondents (77%), **technology push** objectives were important, with the majority citing exploiting breakthrough technology (22, 63%)

R&D objectives

Table 5.5

Headline objectives	Number of responses	Response rate (%)
Competitive advantage	32	91
Business unit seeking competitive advantage in both business and technology	17	49
Business unit seeking competitive advantage in technology	15	43
Business unit seeking competitive advantage in business	14	40
Head office seeking competitive advantage in both technology and business	10	29
Head office seeking competitive advantage in technology	8	23
Head office seeking competitive advantage in business	8	23
Market pull	29	83
New design - using design and customisation to add value	24	69
Incremental - Continuous product/process/improvement	10	29
New business model - embedding the product inside a service	4	11
Technology push	27	77
Breakthrough - exploiting new technology	22	63

²³ Not included in these figures are the 4 business who were uncertain about whether they had claimed the R&D tax credit in any of the 3 years.
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Headline objectives	Number of responses	Response rate (%)
Applying technology - fusing different technologies with existing products/process/services	14	40
Increasing functionality of existing products/processes/services	9	26
Business as usual	26	74
Core to business at this site	20	57
Maintain existing R&D capacity	20	57
Responding to competition	25	71
Improving strategic positioning in the market place	15	43
Responding to competition - improving market share	13	37
Responding to competition - safeguarding market share	10	29
Responding to competition - regaining market share	2	6
Diversification	19	54
Need to develop new products/processes/services	17	49
Need to develop improved products/processes/services	6	17
Market repositioning	6	17
Efficiencies	18	51
Develop efficiencies in the production process	14	40
Improving profitability of products/processes/services	14	40
Knowledge benefits	17	49
Improved technological understanding of product/process/service	15	43
Informal and iterative development of product/process/service	6	17

Base response: 35

5.3.6 [Barriers to R&D activity](#)

The importance of the grant support in allowing branch plants to develop their R&D activity, and thus safeguarding the future of their R&D and other lower value activity, came through quite strongly and is highlighted in Table 5.6.

In exploring the barriers behind undertaking R&D, **cost** came out as being most important. With 30 companies (86% of respondents) citing cost-related barriers. The perceived economic risk (19, 54%) and the direct costs of R&D (17, 49%) were both particularly important here, with around half of respondents stating that these barriers existed in each case.

Skills barriers also came out as an issue – 40% of respondents (14) felt these existed. For a quarter of respondents (9) the lack of people with the appropriate R&D related skills or qualifications have been a barrier in taking forward activity. However, it is worth noting that during the interviews, the general feeling from companies was that with the exception of economic risk very little was stopping them from undertaking R&D.

Other barriers that came out strongly included:

- long time lag between investment and commercial return – (10, 29%)
- uncertain demands for new/improved goods or services – (8, 23%)
- limited information available on markets – (6, 17%)

Barriers to perceived R&D activity

Table 5.6

Headline barriers	Number of responses	Response rate (%)
Cost	30	86
Excessive perceived economic risk	17	49
Direct costs of R&D too high	19	54
Access to finance – internal	14	40
Access to finance – external	4	11
Cost of finance	3	9
Market factors	16	46
There is a long time lag between R&D and commercial return	10	29
Uncertain demands for new/improved goods or services	8	23
Market dominated by established enterprises	4	11
Skills	14	40
Lack of qualified personnel - R&D	9	26
Lack of qualified personnel – technology	5	14
Lack of qualified personnel - project managers	2	6
Lack of qualified personnel – finance	1	3
Information factors	8	23
Limited availability of information on markets	6	17
Poor quality of information on markets	4	11
Limited availability of information on R&D returns	3	9
Limited availability of information on technology	1	3
Poor quality information on R&D returns	1	3
Externalities	3	9
Fear other competitors will benefit	1	3
Company factors	1	3
We are unable to develop appropriate links with other Scottish businesses	1	3
Other Factors	1	3
Need to meet regulatory standards	1	3

Base response: 35

Although 9 (30%) of the companies felt that barriers to undertaking R&D have been getting worse over time, 11 (37%) cited no difference with a further 10 (33%) citing a reduction in barriers. These results are detailed in Table 5.7, providing a strong indication that the R&D Grant support is making a small impact on R&D and potentially starting to correct the market failure – though more evidence on this would be needed to be definitive.

Changes to barriers to R&D

Table 5.7

Change	Number of responses	Response rate (%)
Barriers have got much worse	2	7
Barriers have got worse	7	23
No difference	11	37
Barriers have reduced	8	27
Barriers have reduced substantially	2	7

Base response: 35

5.4 Development of the R&D funded projects

The following section summarises the key aspects of the development of the R&D project and covers:

- the origin of idea generation
- key collaborators involved in turning the idea into a project
- time to develop the idea into a project
- potential difficulties during this stage

5.4.1 Origin of idea generation for the R&D project

In all companies the idea for the grant funded projects emerged within the company and the vast majority (32, 89%) cited within the business unit in Scotland. For many of the multinationals, the global R&D arm (11, 31%), the headquarters (6, 17%) or another unit in the company (5, 14%) had an involvement of the development of the idea (see Table 5.8).

In some instances projects came about as a result of companies approaching SE to see what kind of R&D they could potentially get support for and then fitting potential research work into a 'project'. In other instances their Account Manager proactively approached them (8, 22%) to explore future R&D plans, and assess how SE could potentially provide support. Additional contributors at the idea stage included:

- **universities** – (4, 11%) of companies stated that Scottish universities had an input, and (2, 6%), other non Scottish universities
- **suppliers and customers** – (4, 11%) and (2, 6%) respectively

Development of idea for the R&D project

Table 5.8

Area	Number of responses	Response rate (%)
Internal	36	100
Within this business unit	32	89
Company headquarters - R&D arm	11	31
Company headquarters - non R&D arm	6	17
From another business unit within the group outside of Scotland	5	14
From another business unit within the group within Scotland	2	6
Public sector	9	25
Scottish Enterprise - account manager	7	19

Area	Number of responses	Response rate (%)
Scottish Government	2	6
Other Scottish public sector organisation	2	6
Other UK public sector organisation	2	6
Scottish Enterprise – other	1	3
Other businesses	5	14
Scottish supplier	2	6
Non Scottish supplier	2	6
Non Scottish customer	2	6
Universities/colleges	4	11
Scottish universities	4	11
Non Scottish universities	2	6
Private sector supports	3	8
Private sector consultants (business support consultants)	2	6
Professional and industry associations	1	3
Other	2	61

Base response: 36

5.4.2 [Key collaboration in turning the idea into a project](#)

In terms of turning the idea into a project, the same key players were involved. The business unit in Scotland was the main contributor (36, 100%). Company headquarters were involved in 31% (11) of projects, and the R&D arm specifically, in a quarter of cases (8). Other business units within companies but outside Scotland had a role to play in 14% (5) of the projects. The results are presented in more detail in Table 5.9 below.

Scottish Enterprise was more involved in the development of the project 36% (13) than at the idea generation stage (8, 22%). Universities supported project development in 22% (7) of cases, with the majority (6, 17%) being Scottish. In comparison to the idea generation stage:

- suppliers had a bigger role – with an increase in non Scottish suppliers from 2 to 8, and Scottish suppliers from 2 to 3
- non Scottish customers become more involved – increase from 2 to 4
- private sector consultancies were being used more – increase from 2 to 5

Collaboration to R&D project

Table 5.9

Collaborator	Number of responses	Response rate (%)
Internal	36	100
Within this business unit	36	100
Company headquarters - non R&D arm	11	31
Company headquarters - R&D arm	8	22
From another business unit within the group outside of Scotland	5	14
From another business unit within the group within Scotland	1	3

Collaborator	Number of responses	Response rate (%)
Public sector	15	42
Scottish Enterprise	13	36
Other Scottish public sector organisation	2	6
Other businesses	10	28
Non Scottish supplier	8	22
Non Scottish customer	4	11
Scottish supplier	3	8
Scottish customer	1	3
Universities/colleges	7	19
Scottish universities	6	17
Non Scottish universities	3	8
Private sector supports	5	14
Private sector consultants (business support consultants)	5	14
Professional and industry associations	1	3

Base response: 36

6 companies indicated that their relationship with SE was new or strengthened (e.g. working with an Account Manager for the first time). This provides evidence on the importance of the R&D Grant as a tool for SE for engaging and developing relationships with important companies within Scotland.

5.4.3 [Time to develop idea for project](#)

There was considerable variation in the time it took companies to develop their R&D Grant funded projects. For 16% (5) it was very quick, taking two months or less. Another 16% (5) were completed between 3 and 5 months. For 25% of companies (8) the process took between 6 and 8 months. Another quarter (8) took a year or more to develop their project (see Table 5.10).

The average time across the companies to develop the idea into a point where they can make an application to Scottish Enterprise amounted to 9 months.

Duration to developing R&D project

Table 5.10

Change	Number of responses	Response rate (%)
0-2 months	5	16
3-5 months	5	16
6-8months	8	26
9-12 months	5	16
12 months plus	8	26

Base response: 35

5.4.4 [Difficulties associated with this stage](#)

The key difficulties at the project development stage were identified as being:

- **lack of finance** – for 32% (11) companies suggested this was an issue (see

Table 5.11), and in particular internal finance (10, 29%). Some companies pointed out at this stage that they were in competition with other plants within their company (but beyond Scotland) to 'win' the R&D projects, and the grant assisted them with this

- 24% (8) cited **technical uncertainties**
- **lack of R&D skills**, an issue cited as a barrier to R&D previously, was a difficulty at the development stage for 12% (4) of companies. In some cases, skills are so specialist that they must be developed as the projects progress. In others it is a case of waiting until the right person comes along. Interestingly although technical uncertainties was a key problem, this tended not be due to lack of skilled staff, with only 3 (9%) of the companies citing this as an issue
- **market factors** can cause difficulties, in particular, changes in the market was a difficulty that arose for 15% (5) of firms. External economic conditions (3, 9%) and external market conditions (2, 6%) were also mentioned

Interestingly, the second highest proportion (7, 21%) said they experienced no difficulties at that stage and many other companies only mentioned one or two difficulties. This suggests that the development of projects is something most companies do not have severe difficulties with, which is not surprising given the size and reach of many of these firms.

Difficulties in developing R&D project

Table 5.11

Difficulties	Number of responses²⁴	Response rate (%)
Access to key variables	11	32
Lack of finance – internal	10	29
Lack of finance – external	3	9
Lack of appropriate Scottish private sector expertise	1	3
Lack of access to critical equipment	1	3
Uncertainties	8	24
Technical uncertainties	8	24
Lack of skills	7	21
Lack of skills - R&D staff	4	12
Lack of skills – technology	3	9
Lack of skills - intellectual property	1	3
Lack of skills - project management	1	3
Market factors	5	15
Changes in the market	4	12
External economic conditions	3	9
External market conditions	2	6
Company factors	5	15
No difficulties	7	21
Other internal activities were more of a priority	6	18
Other	11	32

Base response: 34

5.5 The application process

The following section summarises the key aspects of the application process and

²⁴ Note two companies indicated a lack of finance both external and internal.
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covers:

- who the company worked with during the application stage
- reason for seeking SE support to undertake the R&D
- duration of the application process
- potential difficulties arising

5.5.1 Collaborations during the application process

Similarly to the idea and project development stages, companies have gone through the application process by working with key people within their own business unit. In many cases (9, 25%) this is with the R&D department of their HQ, as well as other relevant departments (7, 19%) such as finance and legal, and other units outside of Scotland (4, 11%). Table 5.12 presents these results in greater detail.

The majority (31, 86%) continued to work with Scottish Enterprise during the application process with their Account Manager. In 10 cases (28%), another SE contact was cited, this included Regional Innovation Specialists. 11 (31%) companies commented on the fact that their relationship with SE, and with Account Managers in particular, was strengthened by going through the grant application process.

Private sector consultants were mentioned by 22% (8) of firms, most of which had very positive views in relation to the input that the due diligence consultants had in shaping the project as it went through this stage.

Working with during applying for R&D Grant

Table 5.12

Area	Number of responses	Response rate (%)
Internal	36	100
Within this business unit	36	100
Company headquarters - R&D arm	9	25
Company headquarters - non R&D arm	7	19
From another business unit within the group outside of Scotland	4	11
From another business unit within the group within Scotland	1	3
Public sector	35	97
Scottish Enterprise - account manager	31	86
Scottish Enterprise – other	10	28
Other Scottish public sector organisation	1	3
Other UK public sector organisation	1	3
Private sector supports	8	22
Private sector consultants (business support consultants)	8	22
Private research & development companies	2	6
Other businesses	5	14
Non Scottish customer	3	8
Scottish supplier	4	11
Non Scottish supplier	2	6
Scottish customer	2	6

Area	Number of responses	Response rate (%)
Universities/colleges	2	6
Scottish universities	2	6
Non Scottish universities	1	3

Base response: 36

5.5.2 [Reasons for seeking SE support to undertake the R&D](#)

Cost factors were the key reason for seeking support (as highlighted in Table 5.13). In the vast majority of cases (31, 86%), companies simply required help to meet the costs of undertaking the R&D.

Enhancing the competitiveness of the business unit against others in the group was the next most important reason in companies seeking a grant (16, 44%).

Other reasons given for seeking support included:

- bringing forward R&D activities (13, 36%)
- reducing the risk associated with the project (13, 36%)
- developing a larger project (11, 31%)

Reason for seeking SE support

Table 5.13

Reason	Number of responses	Response rate (%)
Cost factors	33	92
Help meet the cost of undertaking R&D	31	86
Head office unable to fund the project in full	9	25
Private funders unwilling to invest	2	6
Strategic positioning	23	64
Help make the business unit more competitive than others in the group	16	44
Wanted to bring forward R&D activities	13	36
Wanted to develop a larger project	11	31
Wanted to improve the quality of the R&D project	5	14
Risk reduction	11	31
Wanted to reduce the risk associated with the project	13	36
General	9	25
SE/account manager encouraged me to make the application	8	22
Other	7	19

Base response: 36

The importance of the grant support to the profile of Scottish branch plants or subsidiaries was reemphasised at this point in the interviews. 10 companies specifically mentioned that the possibility of getting grant funding improved the business unit's chance of locating the R&D project in Scotland. In addition respondents were quick to add that getting the award has strengthened the position within the company with a number of respondents indicating that they were now more competitive, improving their potential to bring future R&D projects to Scotland.

5.5.3 Duration of the application process

In the highest proportion of cases (14, 41%), the application process took 6-8 months (see Table 5.14). A similar proportion (14, 40%) got through the process more quickly, with (3, 9%) companies completing the application stage in less than 2 months. For 6% (2) companies the application stage took longer than one year. This is particularly worrying given the pace of change in some markets and specifically the need during the economic downturn to act quickly so as not to lose competitive advantage.

The average time for the application stage amounted to 6 months.

Duration of application process

Table 5.14

Change	Number of responses	Response rate (%)
0-2 months	3	9
3-5 months	11	32
6-8months	14	41
9-12 months	4	12
12 months plus	2	6

Base response: 34

Just under half of the respondents (12, 43%) felt that each stage in the process took equally as long, while around a third (8, 29%) felt that the due diligence process took the longest.²⁵

Almost half of respondents (15, 48%) felt that the application process took longer than they had anticipated²⁶. The remainder felt that it had taken as long as they thought it would have (8, 26%), or was actually quicker than they thought (8, 26%). Reasons for application taking longer than expected included:

- the company taking a while to gather information
- the due diligence process taking a while
- the process being too 'bureaucratic' or having too many stages
- hold ups at the decision-making stage

5.5.4 Difficulties during application process

Just under half (47%, 16) of companies felt that there were **no particular difficulties** with the application stage of the process (see Table 5.15). Of the difficulties that were identified 44% (15) cited SE either through decision making (9, 27%) or the due diligence (6, 18%). Delays in SE legals was also cited but only by (4, 12%) of respondents. 9% (3) also cited other internal activities becoming a priority. All other difficulties were only cited once.

Issues cited as 'other' (2, 6%) included language barriers, political issues and driving forward the project internally.

Difficulties

Table 5.15

Difficulty	Number of responses	Response rate (%)
No difficulties	16	47

²⁵ Base response: 28

²⁶ Base response: 31
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Difficulty	Number of responses	Response rate (%)
Scottish Enterprise Delays	15	44
Delays in the decision making process	9	27
Delays in the due diligence process	6	18
Delays in finalising legals	4	12
Lack of skills	3	9
Lack of skills – R&D staff	1	3
Lack of skills – finance	1	3
Lack of skills – technology	1	3
Company factors	3	9
Other internal activities were more of a priority	3	9
Access to key variables	1	3
Lack of finance – internal	1	3
Lack of finance – external	1	3
Market factors	2	6
Changes in the market	1	3
External market conditions	1	3
Information factors	2	6
Poor quality of information on markets	1	3
Limited availability of information on R&D returns	1	3
Uncertainties	1	3
Technical uncertainties	1	3
Other	2	6

Base response: 34

5.6 Delivery of the R&D funded projects

The following section summarises the key aspects of the delivery of the R&D project and covers:

- composition of the R&D project
- collaborations during the delivery process
- duration of the project
- sources of funding
- difficulties in undertaking R&D
- early success during R&D delivery
- additionality of support

5.6.1 Composition of the R&D project

All companies were involved in undertaking in-house R&D and the majority:

- 74%(26) acquired equipment, machinery and for software
- 69% (26) were involved in design work associated with innovation
- 66% (23) training associated with the innovation
- 57% (20) acquired external knowledge

- 51% (18) market introductions

Acquisition of R&D was lower (13, 37%), but still a high proportion of respondents, as can be seen from Table 5.16 below.

Composition of R&D project

Table 5.16

Activities	Number of responses	Response rate (%)
Acquisition of equipment, machinery and software	26	74
Design associated with innovation	24	69
Training associated with innovation	23	66
Acquisition of external knowledge	20	57
Market introductions of innovations	18	51
Acquisition of R&D	13	37

Base response: 35

5.6.2 Collaborations during the delivery process

In terms of R&D delivery (see Table 5.17), collaboration was most likely to happen between the Scottish based business unit and:

- **the R&D arm** of the HQ (15, 43%), non-R&D departments (10, 29%) and other non-Scottish business units within the group (10, 29%)
- **universities** – over half of projects involve Scottish universities (20, 57%), while non Scottish universities were involved in 8 projects (23%). This is a significant increase in the involvement of universities at the idea, development and application stage, suggesting that the specialised nature of knowledge and skills available in universities is of vital importance during the delivery stage
- the number of **suppliers** involved increased considerably at this stage with 13 (37%) citing Scottish suppliers and 14 (40%) citing non Scottish suppliers highlighting the potential for spillover effects
- as with suppliers, the involvement of **customers** has also increased, however, these have predominately been at a non Scottish level (9, 26%). This is not surprising given the international reach of these companies

These collaborations during the delivery of the R&D projects show that while there is a degree of open innovation (in effect R&D and innovation beyond the company) there is also still a high degree of closed innovation focused within the firms. This was also evident in the origination of the idea and the development of the R&D project.

Collaboration – delivery of R&D

Table 5.17

Collaboration	Number of responses	Response rate (%)
Internal	35	100
At this unit	35	100
Work with headquarters – R&D Arm	15	43
Worked with headquarters – non-R&D arm	10	29
Worked with another business unit within the group outside of Scotland	10	29
Worked with another business unit within the group within Scotland	3	9
Other businesses	21	60

Collaboration	Number of responses	Response rate (%)
Non Scottish supplier	14	40
Scottish supplier	13	37
Non Scottish customer	9	26
Non Scottish competitor	1	3
Scottish customer	1	3
Universities/colleges	20	57
Scottish universities	20	57
Non Scottish universities	8	23
Scottish colleges	1	3
Private sector supports	7	20
Private sector consultants	4	11
Private research and development companies	3	9
Professional and industry associations	2	6
Public sector	2	6
Other Scottish public sector organisations	2	6
Other	7	20

Base response: 35

5.6.3 Duration of R&D project

The length of projects ranged from 5 months to over 5 years, with the majority (21, 60%) taking 1 to 3 years (see Table 5.18 for a more detailed breakdown). The average duration for the R&D projects was 31 months, or just over two and half years.

Duration of carrying out R&D project

Table 5.18

Time band	Number of responses	Response rate (%)
0-6 months	2	6
7-12 months	2	6
1-2 years	10	29
2-3 years	11	31
3-4 years	4	11
4-5 years	5	14
5 years +	1	3

Base response: 35

A NESTA study²⁷ provides some benchmarks around the average duration of R&D projects. While the definitions are not directly comparable with the times outlined in the table above they provide some benchmarks with the R&D Grant funded projects.

The paper suggests that the average R&D project amounted to 2 years, rising to 2.3 for high tech projects and falling to 1.5 for low tech projects. While recognising

²⁷ Whittard.D, Franklin.M, Stam.P and Clayton.T (2009) *Innovation Index Working Paper, Testing an Extended R&D Survey: Interviews with Firms on Innovation Investment and Depreciation*, NESTA available at http://api.ning.com/files/wT3w9Ryf*xVTUTg9JfTstH2pEuaUkV473cMuLfaK*PHGu0P6Wl-88P9cigaXeaJcOi1O0PuveC0re50expE3YgVsx4NK5i0u/7.TestinganextendedRDsurveyInterviewswithfirmsoninnovationinvestmentanddepreciationWhittardetal.pdf

differences in definition this suggests that the R&D grant funded projects generally have a longer duration than an average R&D project.

5.6.4 Sources of funding

The majority (35, 97%) were being **financed internally**, 69% (25) of projects by their HQ and 42% (15) were using unit generated revenue. Others mentioned bank overdraft facilities (6%) or private finance (6%). A small percentage (8%) of respondents also mentioned other support from SE (in particular the TrainingPlus Grant), although this tended to be for small amounts in comparison to total project costs.

5.6.5 Difficulties in undertaking in R&D

Companies highlighted a number of difficulties in relation to undertaking the R&D. **Knowledge factors**, and specifically **technical uncertainties** were the key areas arising (see Table 5.19), with 40% (14) of companies facing this issue. **Skills** were also an issue, in particular recruiting suitably skilled R&D personnel within Scotland (7, 20%) and the lack of skills within current staff (4, 11%). Other factors causing difficulties included:

- **cost factors** – 20% of companies (7) stated these caused difficulties – this includes the cost of staff, equipment/materials, overheads and finance
- **external factors** – namely working with suppliers – were an issue for 11% (4)

Difficulties

Table 5.19

Difficulties	Number of responses	Response rate (%)
Knowledge factors	20	57
Technical uncertainties	14	40
Difficulty recruiting R&D personnel – within Scotland	7	20
Lack of skills in current R&D staff	4	11
Lack of skills in current IP staff	2	6
Lack of skills in current project management staff	2	6
Lack of information on the product/process/service	2	6
Lack of skills in current technology staff	1	3
Cost factors	7	20
Excessive cost of staff	2	6
Excessive cost of equipment/materials	2	6
Excessive overhead costs	2	6
Cost of finance	4	11
External factors	4	11
Difficulty working with Scottish suppliers	3	9
Difficulty working with non Scottish suppliers	2	6
No difficulties	6	17
Other	9	26

Base response: 35

5.6.6 Early successes during R&D delivery

Companies highlighted a number of successes at the delivery stage, these included:

- progress against plan
- getting anticipated results and in some cases sooner than expected
- revenue/sales being generated
- increased profile of their plant (and in two cases that it had been saved)
- technical developments that will help improve other processes
- developing new areas of business

5.6.7 Additionality of support²⁸

Scottish Enterprise support has been instrumental in helping companies deliver R&D activities in Scotland; over half of all projects (19, 58%) would not have happened at all in Scotland without support (see Table 5.20). Almost a fifth (6, 18%) would have been smaller and delayed, while 15% (5) would have been done later, and a further 4 (12%) would have been smaller in scale.

None of the companies that received the grant stated that the project would have gone ahead, at the same time and to the same scale with no grant. This suggests that the projects would not have gone ahead in Scotland, or in the same form without the grant.

Additionality **Table 5.20**

Scenario	Number of responses ²⁹	Response rate (%)
Project would not have proceeded at all in Scotland	19	58
Project would have been smaller and done later in Scotland	6	18
Project would have been smaller in Scotland	4	12
Project would have been delayed in Scotland	5	15
Project would have been of poorer quality	2	6

Base response: 33

5.7 Implementation of the R&D projects

The following section summarises the key aspects of the implementation of the R&D project and covers:

- protection of the R&D outputs
- getting the product to market
- sources of funding
- potential difficulties arising
- successes

5.7.1 Protection of R&D outputs

In general (see Table 5.21), most companies protect the output of their projects through **formal mechanisms** such as patents (27, 84%) and confidentiality agreements (18, 56%). **Strategic** protection methods included the lead time advantage on competitors (15, 47%), complexity of design (14, 44%) and secrecy (12, 38%).

²⁸ This section looks at the additionality of the R&D activity in Scotland – it is not the same as benefit additionality considered in the impact section 52

²⁹ Note some companies have cited more than one scenario
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Project protection

Table 5.21

Form of Protection	Number of responses	Response rate (%)
Formal mechanisms	31	97
Patents	27	84
Confidentiality agreements	18	56
Copyrights	9	28
Trademarks	8	25
Registration of design	4	13
Strategic	23	72
Lead time advantage on competitors	15	47
Complexity of design	14	44
Secrecy	12	38

Base Response: 32

The majority of companies (20, 69%) had already secured intellectual property protection on the outputs of funded projects, while others intended to do so once they got to that stage. A small number of companies highlighted that their company did not use formal approaches for protection, for fear of competitors reverse engineering, or only protecting a very specific element of the innovation.

5.7.2 [Getting the product to market](#)

For most companies, the project was still ongoing (20, 59%) as highlighted in Table 5.22. However, some companies were already able to commercialise aspects of their projects³⁰ before the completion of the project. Other companies had completed their project and were actively exploiting the output.

Where companies were still undertaking R&D or had recently completed their projects:

- the majority (23, 68%) will carry out the production/manufacturing of at least some elements of the product developed in Scotland³¹, with 5 companies specifying Scotland only
- 41% (14) will commercialise beyond Scotland and the EU only
- 32% (11) will commercialise beyond Scotland and within the EU only

Implementation of R&D project

Table 5.22

Stage of Implementation	Number of responses	Response rate (%)
The R&D will be/is being commercialised in Scotland	23	68
The R&D is still ongoing	20	59
The R&D will be/is being commercialised beyond Scotland – rest of the world	14	41
The R&D will be/is being commercialised beyond Scotland – EU	11	32

Base response: 34

Of the 15 respondents who have taken products to market, almost all were commercialising the products/processes through their own business unit (14, 93%), or in conjunction with headquarters (non R&D arm 8, 53%, R&D arm 4, 28%). A high proportion (7, 47%) were working with another business unit within their group, however this was outside Scotland (see Table 5.23).

³⁰ Please note that these companies had multiple strands to projects, some of which finalised before others

³¹ In some cases commercialisation will take place in multiple locations and not just Scotland

Suppliers continued to play a role here with non Scottish suppliers accounting for 40% (6) of projects, and Scottish suppliers 20% (3). Customers had a role, but to a lesser extent with non Scottish customers at 33% (5) and Scottish customers at 13% (2).

The role of universities in projects lessens at the commercialisation stage, with universities involved in only two projects. Scottish Enterprise has considerably less of a role to play at this stage than at any other with Account Managers providing support in only one case.

Collaboration

Table 5.23

Collaborator	Number of responses	Response rate (%)
Internal	15	100
At this unit	14	93
Worked with headquarters – non R&D arm	8	53
Worked with another business unit within the groups outside Scotland	7	47
Worked with headquarters – R&D arm	4	27
Other businesses	9	60
Non Scottish supplier	6	40
Non Scottish customer	5	33
Scottish supplier	3	20
Scottish customer	2	13
Public sector	2	13
Scottish enterprise – account manager	1	7
EU departments	1	7
Universities/colleges	1	7
Scottish universities	1	7
Non Scottish universities	1	7
Other	1	7

Base response: 15

5.7.3 [Source of finance](#)

The main source of finance to take the R&D to market was internal. 67% (10) indicated that the finance was supplied by their headquarters and 53% (8) stated unit revenue. One company indicated that SE support would be also be used at this stage.

5.7.4 [Difficulties in getting product to market](#)

Following the general trend of feedback, very few of our respondents were able to identify difficulties³². Of those who did, the following were cited:

- it took longer to generate sales than anticipated (4 companies, 33%), and one company indicated less sales than expected
- marketing costs were deemed excessive by two companies with excessive cost of sales', 'excessive cost of production' and 'cost finance' cited by a further 1 respondent each

Other factors identified (3, 21%) included company politics (see Table 5.24), the

³² Base response: 12
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changing nature of markets, customer requirements shifting and manufacturing issues
 – the production of prototypes and setting up cost effective manufacturing

Difficulties – Taking R&D to Market

Table 5.24

Difficulties	Number of responses	Response rate (%)
Sales Factors	5	36
Takes longer to generate sales than expected	4	29
Generating less sales than expected	1	7
Cost Factors	4	29
Excessive cost of marketing	2	14
Excessive cost of sales	1	7
Excessive cost of production	1	7
Cost of finance	1	7
Other	3	21

Base response: 14

5.7.5 [Successes during the implementation stage](#)

In terms of successes, at this stage companies were able to identify:

- achieving/over-achieving against targets in relation to sales
- development of higher value products
- process redesigns that can be re-used
- getting products out quicker than expected
- resolving particular technical issues that had arisen
- development of spin-off products - with shorter development times

5.8 Satisfaction with the process

Interviewees were asked to rate various aspects of the SE support throughout their journey on a scale of 1 to 5, with 1 being very poor and 5 being very good. Overall, satisfaction throughout the process was high, with most aspects of support being rated good or very good.

The following section summarises respondent views on SE support during:

- application process
- R&D delivery
- R&D implementation

5.8.1 [Application process](#)

Overall satisfaction with the application process was high: 76% (24) of respondents rated the overall process as good or very good and 19% (6) suggested the support was poor (see Table 5.25).

Almost three quarters (74% or 23 companies) rated the due diligence process as good or very good and 23% (7) suggested it was neither good nor poor. This fits well with previous findings of the value clients place on this part of the process. Despite earlier views of it taking longer, there were high levels of satisfaction with the end result. One company felt the process was very poor.

71% (22) rated the follow on decision making as good or very good and a further 16% (5) were ambivalent with the process. 13% (4) of respondents thought this to be poor, citing time taken for a decision to be made.

Overall, the quality of support provided was rated the highest with 87% (28) rating this as good or very good. A further 13% (4) were ambivalent suggesting it was neither good nor poor. This is a relatively positive set of findings given the demands made on the companies during this time.

Quality of support **Table 5.25**

Aspect of process	Very Poor (%)	Poor (%)	Neither poor nor good (%)	good (%)	Very good (%)
Application process	0	6	19	63	13
Due diligence process	3	0	23	55	19
Follow on decision making	0	13	16	48	23
Quality of support provided	0	0	13	53	34

Base response: 34

5.8.2 [R&D delivery](#)

Again, satisfaction with SE during R&D delivery was high with a reduced role for SE focused on ongoing monitoring and oversight. In relation to ongoing monitoring and milestones, 97% (33) rated SE as good or very good and one person was satisfied. For SE's understanding of their requirements, there was again extremely high support with 94% (32) rating this as good or very good (see Table 5.26).

Quality of support **Table 5.26**

Aspect of process	Very Poor (%)	Poor (%)	Neither poor nor good (%)	Good (%)	Very good (%)
Monitoring/milestones	0	0	3	47	50
Understanding of requirements	0	0	6	47	47

Base response: 32

5.8.3 [R&D implementation](#)

Although a limited number of companies were at the implementation stage, support from Scottish Enterprise was rated fairly positively overall. In terms of support for implementation, 3 rated good or very good and 4 were ambivalent.

SE aftercare was viewed more positively with 7 companies rating good or very good, and 3 being ambivalent as highlighted in Table 5.27.

It is worth noting here that a number of companies did not expect continued support, viewing it as their role to take their product to market.

Scottish Enterprise support**Table 5.27**

Aspect of process	Very Poor	Poor	Neither poor nor good	Good	Very good
SE support for implementation	0	1	4	2	1
SE aftercare	0	0	3	6	1

Note – absolute values used due to small sample of respondents

6 Company Outputs

6.1 Summary

This section of the report provides an overview of:

- R&D impact reporting framework
- R&D expenditure
- intellectual property
- innovation
- innovation benefits
- the return from R&D
- strategic added value / knowledge benefits
- R&D influencing factors

In summary:

- the total spend associated with the R&D projects amounts to £295.6 m – of which £199.5 m will be new money to the economy brought in from beyond Scotland
- in total 69% of companies have secured some form of intellectual property protection, with patents representing the most common form
- 83% of companies have introduced new products, with 81% of these being new to the market
- wider innovation was less common across the surveyed companies, though 46% did suggest they would introduce a new marketing plan associated with the R&D
- 88% of companies cited product oriented effects, with 78% suggesting this was an increased range of goods and services
- 97% of companies suggested that the revenue associated with the R&D Grant funded projects were product related, with 87% specifically suggesting that this was due to new products
- the main market for the R&D products was existing private sector markets, cited by 71% of companies
- the main geographic reach of products was global – covering existing markets
- there were a series of wider value added benefits covering synergy, catalyst and strategic influence effects – with high additionality when benefits were realised
- companies suggested that they had experienced both reputation/prestige benefits as well as improved positioning within their group
- the companies generally only have limited linkages with suppliers, while virtually all companies claimed to have no competitors in Scotland
- there are likely to have been a small degree of knowledge spillover effects and a limited degree of market spillovers arising from the companies who have accessed the R&D Grant

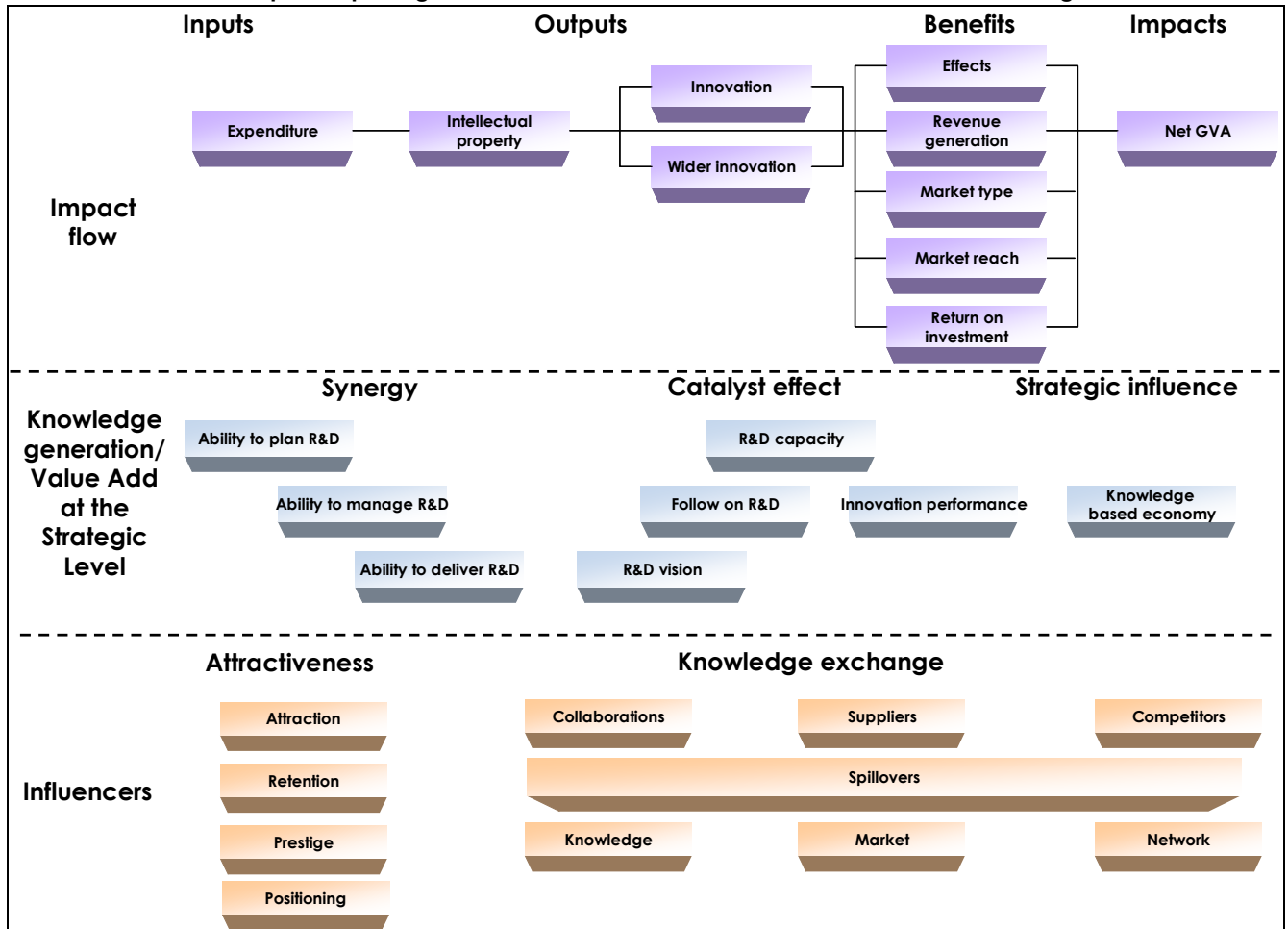
6.2 R&D impact reporting framework

In order to understand the benefit flow arising from R&D investment, a model of the impact chain was developed in order to accurately track the flow of direct benefits, value add at the strategic level (or knowledge based benefits) and key influencers (see diagram 6.1). The model followed the basic principles laid out in the UK Economic Impact Reporting Framework³³, developed by the Department for Business Enterprise and Regulatory Reform, but taken forward with the specific issues associated with R&D in companies.

³³ BERR (2007) *Measuring Economic Impacts of Investment in the Research Base and Innovation – A New Framework for Measurement*
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R&D impact reporting framework

Diagram 6.1



6.3 R&D

R&D covers the level of investment associated with the surveyed company's projects, where the investment originates from and the types of activity supported.

6.3.1 R&D investment

R&D investment was the starting point of the impact reporting framework. In total, the R&D delivered by the companies will amount to around £295.6m between 2004 and 2014³⁴. Scottish Enterprise contributed 13% of this total, or £38.6m.

The additional R&D spend, based on the companies response to the question on what would have happened without the R&D grant award, amounted to around £227 million, around 77% of the total company spend on the projects. While the question set provided similar prompts to the BERD survey undertaken with businesses to arrive at a figure for R&D, it was not possible to verify the extent to which this was an exact match. As such the £227 million represents the additional R&D spend arising from the R&D grant award and a proxy for BERD. This suggests the R&D grant scheme is making a small positive contribution to the BERD target in the national performance management framework.

³⁴ The projected end date of the last project based on the timescales outlined in the Due Diligence reports SC7917-00

The source of the funding is also important. In total 67% of the R&D funding came direct from a headquarters beyond Scotland (see Table 6.1). This suggests that around £199.5m is entirely 'new' money to the Scottish economy, in that it is not simply recycled profit or reuse of revenue generation within Scotland. Around one quarter of the R&D money came from within Scotland, while 1% came from private finance sources.

Company R&D project expenditure by source **Table 6.1**

Year	Number	% of total
HQ - Outside Scotland	£199,515,254	67%
SE Contribution	£38,458,348	13%
Business Unit – Scotland	£29,207,993	10%
Group - Outside Scotland	£13,071,189	4%
HQ – Scotland	£11,943,179	4%
Private Finance	£3,410,844	1%
Total R&D Spend	£295,606,807	100%

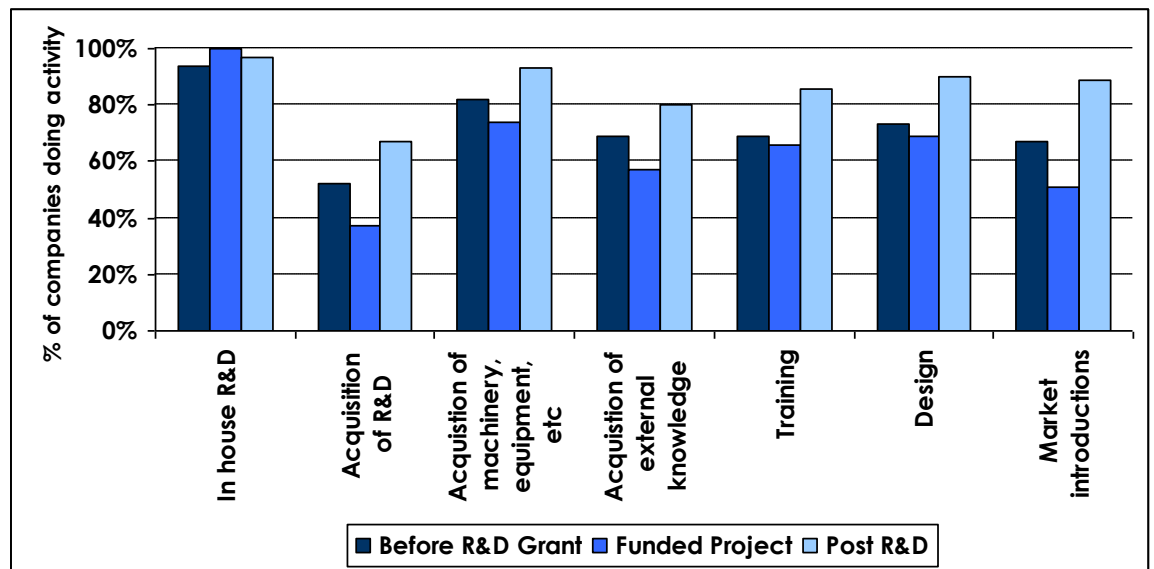
6.3.2 R&D activity

The type of R&D activity carried out by the companies before, during and after the R&D Grant funded project was considered (see diagram 6.2).

The journey shows a clear broadening of scope of R&D from before the R&D grant award to the period after the R&D grant funded activity has been completed. There is steady improvement across all areas including:

- market introductions of innovation rising from 67% of companies carrying out activity pre award to 89% post award (22 percentage point increase)
- training and design associated with innovation, each showing an increase in the proportion of companies carrying out the activity after the completion of the R&D grant funded activity
- acquisition of R&D, increasing from around half of the companies carrying out the activity before the R&D grant award to over 60% after the completion of the R&D grant funded activity

R&D activity before during and after R&D Grant award **Diagram 6.2**



It must be recognised, however, that some companies would have done this activity anyway. When companies were asked in they would have done this activity anyway:

- around a third of companies would have done in house R&D, acquisition of R&D and acquisition of machinery, equipment, etc anyway
- around a quarter of companies would have done acquisition of external knowledge, training and design associated with innovation anyway
- less than a fifth of companies would have done market introductions of innovation anyway

6.4 IP generation

Intellectual property covers the formal mechanisms by which a business can protect its inventions or elements of R&D outputs.

In total 69% of the companies had secured some form intellectual property (IP) protection. As discussed in Section 5.6.1 the main formal mechanisms were recorded and included:

- patents, cited by 84% of the companies
- confidentiality agreement, cited by 56% of companies

A lower proportion cited other mechanisms (see Table 6.2) such as copyrights (28%), trademarks (25%) and registration of design (13%).

Formal Intellectual Property Protection

Table 6.2

	Number of responses	Response rate (%)
Patents	27	84
Confidentiality agreements	18	56
Copyrights	9	28
Trademarks	8	25
Registration of design	4	13

Base response: 32

6.5 Innovation

Innovation represents a potential output from the R&D process. This covers both technological innovation and wider innovation.

6.5.1 Technological innovation

Technological innovation covers the introduction of new or improved products, processes or services.

Product effects were cited most by companies with:

- 83% (30) of companies had introduced **new products**, covering
 - 81% (29) who had introduced new products to the market
 - 81% (29) who had introduced new products to the company
- 67% (24) of companies who had introduced **improved products**, covering:
 - 64% (23) of companies who had introduced new products to the market
 - 61% (22) of companies who had introduced new products to the company

- 56% (20) of companies either have or will introduce **new processes** and **improved processes**, covering
 - 56% (20) of companies either introducing or planning to introduce new processes to the company
 - 53% (19) of companies either introducing or planning to introduce improved processes to the company

Only a minority of companies introduced new services as a result of their R&D Grant programme (see Table 6.3). This reinforces the views of stakeholders that the grant is focused on more traditional product and process innovation, rather than service sector innovation.

Technological innovation

Table 6.3

	Number of responses	Response rate (%)
New Products	30	83
New to the company	29	81
New to the market	29	81
New Processes	20	56
New to the company	20	56
New to the market	15	42
New Services	9	25
New to the company	9	25
New to the market	9	25
Improved Products	24	67
Improved to the market	23	64
Improved to the company	22	61
Improved processes	20	56
Improved to the company	19	53
Improved to the market	14	38
Improved services	9	25
Improved to the market	9	25
Improved to the company	7	19

Base response: 36

These figures were compared with results from the fourth UK Innovation Survey³⁵, which suggested that around 22% of Scottish enterprises were product innovators, while 16% were process innovators. This indicates that the companies who had received the R&D Grant were more likely to develop technological innovation than other Scottish based companies.

6.5.2 Wider innovation

Wider innovation moves beyond the technological innovation model and considers wider domains of innovation activity, which drive the process and exploitation of technological innovation. This can include strategic changes to the organisation of business or its functions, in order to achieve gains in competitiveness through efficiency or service improvements.

Around 46% (13) of the companies highlighted they will or have developed a new marketing plan as a result (see Table 6.4), with 29% (8) updating an existing plan. In addition:

- 29% (8) of the companies have either introduced or plan to introduce a new corporate strategy on the back of the R&D grant award
- 29% (8) of the companies have either introduced or plan to introduce an improved organisation structure as a result of the R&D grant award

These changes appear to exist because the new products developed as a result of the grant are either in demand from the market (market pull) or technologically advanced (technology push). This means new strategies, plans and people are needed to ensure their full exploitation.

Wider Innovation

Table 6.4

	Number of responses	Response rate (%)
New marketing plan	13	46
Improved organisational structure	8	29
New corporate strategy	8	29
Updated marketing plan	8	29
Updated corporate strategy	6	21
New organisational structure	5	18
New advanced management techniques	3	11
Improved advanced management techniques	2	7

Base response: 28

6.6 Innovation benefits

Innovation can lead to a range of benefits within companies. These can range from simple innovation effects to target customers and markets. This section considers:

- R&D effects
- revenue generation
- market type
- market reach

6.6.1 R&D effects

The main effects from innovation amongst the R&D companies focus on **product oriented effects**, with 88% (28) of companies citing benefits in this area (see Table 6.5). These included:

- an increased range of goods and services, cited by 78% (25) of the companies
- entered new markets, cited by 69% (22) of the companies
- increased market share, cited by 63% (20) of companies

In addition **process oriented effects** were cited by 63% (20) of companies. These included

- improved flexibility of production or service provision, cited by 47% (15) of companies
- reduced costs per unit produced or provided, cited by 47% (15) of companies

Finally, 56% (18) of companies cited **other effects**, including

- 41% (13) citing reduced environmental impacts
- 38% (12) citing increased value add
- 13% (4) citing improved health and safety

These findings suggest that the introduction of new and improved products were leading to positive effects in the product sphere. They also highlight that the benefits are not restricted to these areas and cover wider effects.

R&D effects

Table 6.5

	Number of responses	Response rate (%)
Product oriented effects	28	88
Increased range of goods and services	25	78
Entered new markets	22	69
Increased market share	20	63
Improved quality of goods & services	16	50
Process oriented effects	20	63
Reduced costs per unit produced or provided	15	47
Improved flexibility of production or service provision	15	47
Increased capacity for production or service provision	14	44
Other effects	18	56
Reduced environmental impacts	13	41
Increased value add	12	38
Improved health and safety	4	13

Base response: 32

6.6.2 Revenue generation

Companies were asked about where revenue or cash savings were made as a result of the R&D Grant programme.

Again, **product effects** dominated the response, with 97% (33) of companies stating that revenue would come from this area (see Table 6.6), including

- new products/process/services, cited by 85% (29) of the companies
- improved products/processes/services, cited by 59% (20) of companies

Process revenue was cited by 32% (8) of the companies, including

- cost reductions in existing products/services, cited by 29% (10) of businesses
- wider productivity gains not directly related to products, cited by 12% (4) of businesses

New exploitation, focused on licensing revenue was also cited by around a quarter of respondents. This involves new mechanisms for generating value from the R&D that are different from more traditional product or process oriented effects.

Again, this highlights the strong focus on product effects arising from the R&D Grant support.

Origin of revenue

Table 6.6

	Number of responses	Response rate (%)
Product related	33	97
New products/process/services	29	85
Improved products/processes/services	20	59
Profitability gains	11	32
Process revenue	11	32
Cost reduction in existing products/services	10	29
Wider productivity gains (non direct product related)	4	12
New exploitation	8	24
License revenue	8	24

Base response: 34

6.6.3 Market type

The main customer group of the companies was explored, which provided a broad indication of where there was a potential demand for innovative products.

The main target customer was existing business to business markets in the private sector (in effect business to business activity) cited by 71% (20) of companies, closely followed by new markets in the private sector (19, 61%). Generally, less than a third of the companies were focusing on markets in either the public or consumer sectors as evident in Table 6.7.

These findings were broadly in line with those in the 2005 UK innovation survey³⁶, with private markets dominating (the main customer for 57% of all enterprises), followed by consumers (the main customer for 31% of all enterprises) and then the public sector (the main customer for 11% of all enterprises).

This suggests that the companies have a strong focus on the private sector, but also that there is a potentially greater demand for innovative products or at least are servicing a greater demand for innovative products) by the private sector rather than the public or consumer markets.

	Number of responses	Response rate (%)
Private sector – existing markets	22	71
Private sector – new markets	19	61
Public sector – new markets	10	32
Public sector – existing markets	9	29
Consumer market – existing markets	7	23
Consumer market – new markets	6	19

Base response: 31

6.6.4 Market reach

The main geographic market for the companies was existing global markets (or more precisely markets beyond but also including Europe), with 80% (24) of companies highlighting this as their main geographic market (see Table 6.8). Around two thirds of companies suggested either existing EU markets or new global markets. New local markets (in effect within Scotland or the rest of the UK) were cited least by companies. It is widely believed that exposure to wider markets – including overseas markets has a positive effect on innovation.³⁷

These results fit with the assessment of geographic markets outlined in the 2005 UK Innovation Survey, with world markets being dominant (main geographic market for 35% of all innovative companies) followed by UK markets, local/regional and finally European markets.

	Number of responses	Response rate (%)
Other Rest of World – existing markets	24	80
Other EU – existing markets	20	67
Other rest of world – new markets	20	67
Local (Scottish) – existing markets	19	63
Other UK – existing markets	18	60
Local (Scottish) – new markets	16	53
Other UK – new markets	15	50
Other EU – new markets	15	50

³⁶ DTI (2006) *DTI Occasional Paper No.6 – Innovation in the UK: Indicators and Insights*

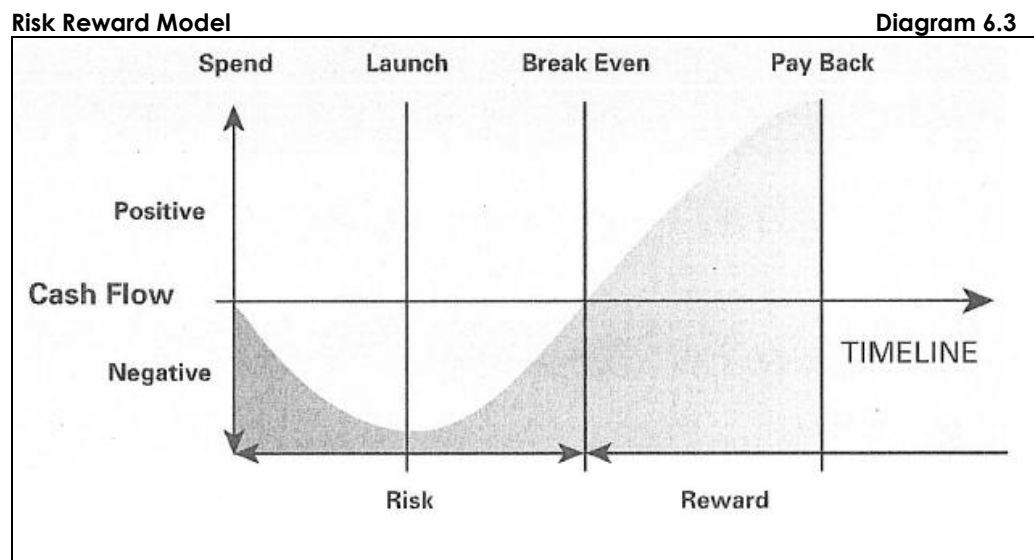
³⁷ Ibid
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6.7 The return from R&D

The revenue generation and potential revenue generation amongst the companies was used to assess the risks and rewards of R&D.

Diagram 6.3 below shows the classic risk reward profile of R&D investment, essentially reflecting:

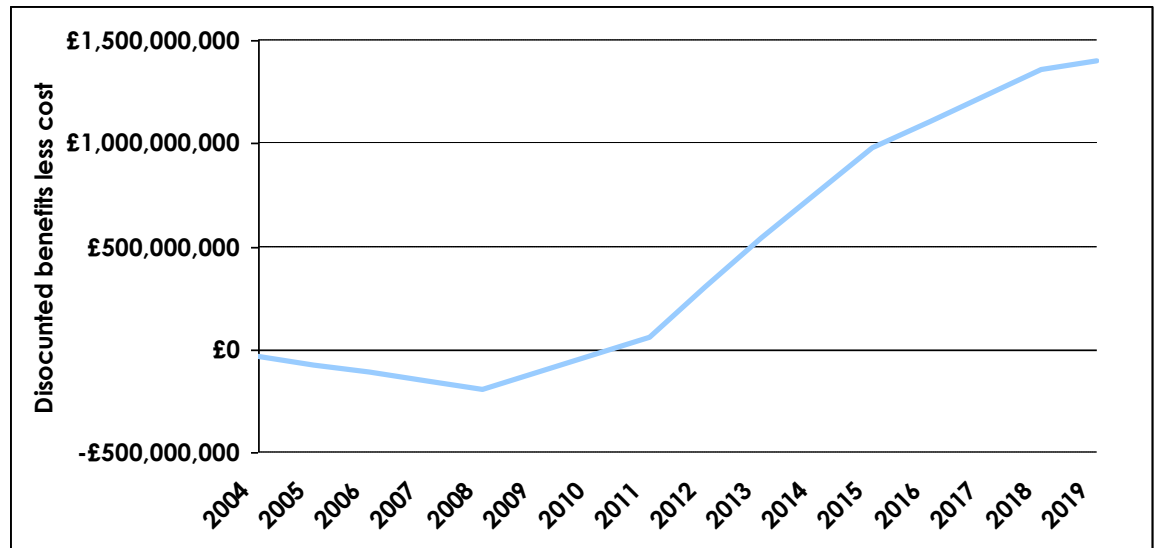
- a period of risk covering:
 - the investment in the delivery of the R&D
 - the launch of the new product and the cost associated with production and release
- a period of reward, covering:
 - early sales and then breakeven as revenue exceeds costs
 - pay back over time as the product delivers revenue over the longer term



This model was used to test the level of risk (in effect investment in R&D and then the cost of making sales) and reward (in effect revenue generation) from the 36 companies surveyed. Diagram 6.4 outlines the profile over a 16 year time horizon.

The chart shows that the companies are expecting to generate a return substantially greater than the initial investment. A discounted cost benefit analysis suggests a ratio of 1: 1.62, or £1.62 of revenue for every £1 of investment in R&D over the period 2004-2019³⁸. Given that a number of companies already have advanced orders in place for new products this suggests the returns to the companies could be substantial over the long term and highlights the potential of R&D to deliver benefits to companies.

³⁸ Note this is Gross
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6.8 Knowledge generation – Value add at the strategic level

A wider benefit associated with R&D spend was the generation or enhancement of company competency or knowledge in relation to R&D. This was placed in the context of value add at the strategic level, covering:

- **synergy** – covering an improved knowledge base and potential for knowledge creation
- **the catalyst effect** – covering follow on research, technical development and innovation
- **strategic influence** – covering the development of a knowledge based economy through capacity building and high value human capital

These concepts were then discussed in relation to the extent to which they have been achieved as a result of their R&D grant award. This is considered in terms of no additionality, low additionality and high additionality .

6.8.1 Synergy

The synergy effects were defined as covering improved company competency around the ability to plan, manage and deliver R&D. In each case companies were asked to assess the additionality of the benefits as a result of the R&D Grant (in effect the extent to which they are driven by the R&D Grant in ways that would not have happened anyway)

Overall, 36% (12) of companies suggested that they had realised a significant long term impact around their ability to plan R&D, with 21% (7) suggesting it was a significant short term impact. Just 27% (9) of the surveyed companies suggested there had been no impact in this area (see Table 6.9). For some companies this reflected their own considerable experience in R&D.

There was high behavioural additionality associated with the ability to plan R&D activities. When asked 56% (14) suggested that they would not have realised the benefit without the R&D Grant (or high additionality). A further 44% (11) indicated some additionality in planning R&D activities.

Company ability to plan R&D activities Table 6.9

Ability to plan R&D	Number of responses	Response rate (%)	Additionality of impacts	Number of responses	Response rate (%)
Significant impact long term	12	36	High additionality	14	56
Significant impact short term	7	21	Some additionality	11	44
Some impact	10	30	No additionality	0	0
No impact	9	27			

Base response: 33

Base response: 25

In relation to company ability to plan R&D, 38% (13) of the surveyed companies indicated that there had been some impact around their ability to manage R&D (see Table 6.10), though 27% (9) did state that they had experienced a significant long term benefit. Around one third of the companies stated there had been no improvement in this area.

There was high behavioural additionality associated with the ability to manage R&D activities. When asked 44% (12) of those citing benefits suggested that they would not have realised the improved abilities without the R&D Grant.

Company ability to manage R&D activities Table 6.10

Ability to manage R&D	Number of responses	Response rate (%)	Additionality of impacts	Number of responses	Response rate (%)
Significant impact long term	9	27	High additionality	12	44
Significant impact short term	3	9	Some additionality	11	41
Some impact	13	38	No additionality	4	15
No impact	11	32			

Base response: 33

Base response: 27

In total, 38% (13) of surveyed companies indicated they had realised a significant long term impact around their ability to deliver R&D (see Table 6.11), with 41% (14) suggesting some impact. Just 15% (5) of companies stated that there was no impact in this area.

There was high behavioural additionality associated with the ability to deliver R&D. When asked 60% (18) of those citing benefits suggested that they would not have realised the benefit without the R&D Grant award. No company indicated that these benefits would have happened anyway.

Company ability to deliver R&D activities Table 6.11

Ability to deliver R&D	Number of responses	Response rate (%)	Additionality of impacts	Number of responses	Response rate (%)
Significant impact long term	13	38	High additionality	18	60
Significant impact short term	5	15	Some additionality	12	40
Some impact	14	41	No additionality	0	0
No impact	5	15			

Base response: 34

Base response: 30

Overall, 34% (11) of surveyed companies highlighted a significant long term impact around the ability to manage knowledge to improve innovation performance (see Table 6.12). Around one fifth of companies stated that there were no impacts in this area.

Behavioural additionality was high with 42% (11) of the companies indicating that they would not have realised the benefits without the R&D Grant award. Just 8% (2) believed that they would have realised the benefits anyway.

Company ability to manage knowledge to improve innovation performance Table 6.12

Ability to manage knowledge to improve innovation performance	Number of responses	Response rate (%)		Additionality of impacts	Number of responses	Response rate (%)
Significant impact long term	11	34		High additionality	11	42
Significant impact short term	5	16		Some additionality	13	50
Some impact	12	38		No additionality	2	8
No impact	7	22				

Base response: 32

Base response: 26

These findings suggest that the R&D Grant programme has generated a substantial knowledge or competency benefit as a result of the support. The implication is that there is an improved knowledge base and potential for knowledge creation.

6.8.2 The catalyst effect

The catalyst effect was defined as covering a long term vision for R&D, improved R&D capacity and follow on R&D activity. In each case companies were asked to assess the additionality of the benefits as a result of the R&D Grant.

In total 38% (12) of companies indicated there was a significant long term impact around the development of a long term vision around R&D and innovation (see Table 6.13). A further 31% (10) suggested there was some impact, with around one fifth stating no impact.

Behavioural additionality was high, with 46% (13) of companies suggesting that they would not have realised the benefits without support, while 50% (14) indicated they would not have realised all the benefits.

Development of a long term vision around R&D and innovation Table 6.13

Development of a long term vision around R&D / innovation	Number of responses	Response rate (%)		Additionality of impacts	Number of responses	Response rate (%)
Significant impact long term	12	38		High additionality	13	46
Significant impact short term	4	13		Some additionality	14	50
Some impact	10	31		No additionality	1	4
No impact	7	22				

Base response: 32

Base response: 28

In relation to improvements around innovation capacity, 47% (16) of companies highlighted there had been or will be a significant long term impact (see Table 6.14). Just 12% (4) of companies stated that there has been or will be no improvements in this area.

Behavioural additionality of benefits was also high, with 56% (18) indicating they would not have realised the benefits without the grant and 41% (13) suggesting some additional benefit achievement.

Improved R&D capacity

Table 6.14

Improved R&D capacity	Number of responses	Response rate (%)	Additionality of impacts	Number of responses	Response rate (%)
Significant impact long term	16	47	High additionality	18	56
Significant impact short term	8	24	Some additionality	13	41
Some impact	9	27	No additionality	1	3
No impact	4	12			

Base response: 34

Base response: 32

Company views on development of follow on R&D and innovation was also positive, with 64% (12) of companies highlighting a significant long term impact (see Table 6.15). Just 12% (4) stated that there were no impacts in this area.

Additionality of benefits was also high with 50% (15) of companies indicating that they would not have realised these benefits without the support. Just 7% (2) of those citing benefits suggested they would have achieved them without support.

Development of follow on R&D and innovation

Table 6.15

Developing follow on R&D / innovation	Number of responses	Response rate (%)	Additionality of impacts	Number of responses	Response rate (%)
Significant impact long term	21	64	High additionality	15	50
Significant impact short term	6	18	Some additionality	13	43
Some impact	5	15	No additionality	2	7
No impact	4	12			

Base response: 33

Base response: 30

6.8.3 Strategic influence

Strategic influence is defined as the sum of the wider value add at the strategic level components or the development of a knowledge based economy.

Companies highlighted that staff recruited to R&D Grant funded projects were making a wider contribution to company R&D efforts. Overall, 87% (26) of companies stated that staff had already made a substantial contribution to wider company activities (see Table 6.16), while a further 10% (3) had contributed slightly. One company said that staff recruited from the R&D Grant programme would be unlikely to make a contribution to other R&D activities.

Contribution of staff to other projects

Table 6.16

	Number of responses	Response rate (%)
Have already contributed substantially	26	87%
Have already contributed slightly	3	10%
Have made no difference to date but likely to in the future	1	3%
No unlikely to contribute	1	3%

Base response: 30

The implication was that the R&D Grant goes some way towards developing knowledge based economy. Companies cited a range of added value at the strategic level, innovation and wider benefits, including:

- **investment in R&D** focused on the R&D projects but also including wider spend in Scotland
- **improved knowledge** around planning, managing and executing R&D projects as well as better management of information for innovation performance
- **improved sustainability** including R&D capacity, a long term vision around R&D and a desire to develop follow on R&D projects
- **development of innovation and wider innovation** including new and improved products as well as new marketing plans
- **wider benefits** including product and processes effects and revenue

6.9 R&D investment influencing factors

There are a number of elements of the R&D Grant award that help position Scotland better for R&D investment – covering both inward investors and indigenous companies focused on:

- attraction
- knowledge exchange
- spillovers

6.9.1 Attraction

One of the main factors believed to influence R&D investment covers the attractiveness of Scotland to overseas investment, the extension of existing inward investment and investment by Scottish companies.

All three are vital to the Scottish economy. Inward investment is particularly significant as it brings new money into the economy that might not exist otherwise. Recent work by the Welsh Economy Research Unit³⁹ suggests inward investors are particularly valuable because of:

- the flow of technical capabilities to domestic firms
- improvements in productivity of domestic firms (as staff move from foreign owned companies to domestic firms)
- purchasing linkages and knowledge flows into the domestic supply chain
- improvements in wage levels as foreign firms drive up wage rates
- improved productivity in the economy – driven the competitive pressures of competing with more efficient foreign owned firms

³⁹ Cardiff Business School (2009) A Review of the Economic Evidence and the Determinants and Effects of Foreign Direct Investment, Welsh Economy Research Unit – Document available at <http://wales.gov.uk/docs/dfm/research/090617foreigndirectinvestmenten.pdf> 71

While this highlights the potential benefits of FDI, there is also some evidence cited that suggests there can be negative effects, as well as positive, showing the need for a balanced portfolio of support to foreign and domestic firms around R&D activity.

Companies were asked about potential reputational/prestige benefits associated with the R&D investment as well as how this potentially changed the positioning of the unit (see Table 6.17).

In relation to reputation and prestige benefits:

- 49% (17) of surveyed companies suggested there had been significantly improved reputation or prestige as a result of the R&D Grant award
- just 9% (3) of the surveyed firms suggested it had made no real difference

In addition this appeared to lead to improved positioning of the unit within the business with:

- 56% (19) of the businesses reporting improved positioning of the unit within the business
- just 6% (2) suggesting the R&D Grant award made no difference to the positioning of the unit if it was part of a group

Reputation/prestige benefits and positioning **Table 6.17**

	Reputation/Prestige		Positioning of the Unit	
	Number of responses	Response rate (%)	Number of responses	Response rate (%)
Significantly improved	17	49	19	56
Improved	15	43	13	38
Neither improved or reduced	3	9	2	6
Reduced	0	0	0	0
Significantly reduced	0	0	0	0

Base response: 35

Base response: 34

In addition, many companies, and stakeholders believed that the grant was a key mechanism in either retaining or attracting R&D function to Scotland.

Many companies indicated that the high costs of R&D in Scotland (mainly driven by high labour costs) meant it was not a favourable location for R&D, and they therefore had to compete with other business units (many of them lower cost and in some cases with more practical links to the R&D function). This was highlighted in the additionality section, with clear evidence that without the grant many R&D projects would have gone ahead in Scotland.

This suggests that the R&D Grant helps to improve the attractiveness of Scotland as a place to carry out or continuing developing R&D. Given that Scotland has been relatively successful in attracting R&D projects in the past⁴⁰, Scotland was the 5th rated destination for R&D projects from 15 comparator locations with a 4.5% market share, any improvement in the reputation can only enhance the offering.

6.9.2 Knowledge exchange

Knowledge exchange factors are believed to be a wider benefit of R&D investment and activity as well as a driver of R&D in its own right. These cover general collaborations, engagement with suppliers and interaction with competitors. These can be more formally considered as key spillover benefits – considered in more detail in section 6.9.3 below.

⁴⁰ Botham.R and Clelland.D (2005) *Corporate Headquarters in Scotland: Their Nature and Contribution to Scotland's Economic Development*, Scottish Enterprise SC7917-00

It was apparent that relationships with key suppliers were relatively limited in a Scottish context, with 59% (16) of companies suggesting that the minority of their supplies in terms of value came from within Scotland (see Table 6.18 below). In addition, 19% (5) of companies each stated that either half or the majority of their supplies, in terms of value, came from within Scotland.

Location of main suppliers

Table 6.18

	Number of responses	Response rate (%)
The minority of my supplies, in terms of value, come from within Scotland	16	59
Around half of my supplies, in terms of value, come from within Scotland	5	19
The majority of my supplies, in terms of value come from within Scotland	5	19
None of my supplies, in terms of value, come from within Scotland	1	4
All my supplies, in terms of value come from within Scotland	0	0

Base response: 27

Competitors are also important in terms of wider spillover effects. However, the companies stated that virtually none of their competitors were based within Scotland (see Table 6.19). Overall, 67% (20) of the companies surveyed believed that they had no competitors based within Scotland. While the remaining third suggested the minority of their competitors were based within Scotland.

Location of competitors

Table 6.19

	Number of responses	Response rate (%)
None of my competitors are based within Scotland	20	67
The minority of my competitors are based within Scotland	10	33
All my competitors are based within Scotland	0	0
The majority of my competitors are based within Scotland	0	0
Around half of my competitors are based within Scotland	0	0

Base response: 30

6.9.3 Spillovers

As highlighted earlier, the companies work with a range of wider suppliers, customers and universities in the delivery of their R&D projects. This gives rise to potential wider benefits amongst the Scottish company base – or spillover effects.

There is much talk in economic development literature around spillovers, though few studies define or clarify exactly what a spillover is. In this study spillovers are defined as the social rate of return as well as the wider private return enjoyed by the innovating company, its competitors, suppliers and collaborators⁴¹.

In order for a spillover to be realised the wider company must realise some form of benefit from the engagement with the innovating company. A recent evaluation of smaller R&D grants to companies in England provides some context on the level of benefit realised⁴². The evaluation suggested that some effects were felt amongst just under half of the customers, in relation to market effects and around one third of the suppliers and universities in relation to knowledge effects. The overall implication is that less than half of any engagements will lead to potential wider spillover effects.

⁴¹ The definition is adapted from Jaffe.A (1996) *Economic Analysis of Research Spillovers, Implications for the Advanced Technology Program*, Advanced Technology Programme Research

⁴² PACEC (2009) *Evaluation of Grant For Research and Development and Smart*, London Development Agency (with the other English RDAs) and the Department for Innovation, Universities and Skills
SC7917-00

Spillovers can take three forms⁴³:

- knowledge spillovers
- market spillovers
- network spillovers

Knowledge spillovers are about how knowledge created by one agent can be used by another without compensation. It can take place as a result of:

- abandonment of research – showing that a particular route is not productive or worthy of investigation
- patenting – by presenting information that something can be done in a particular way
- staff movement – through staff moving from one organisation to another
- commercial release of a new product – with competitors reverse engineering the product and developing their own product

These mechanisms are likely to be evident in suppliers, universities and competitors. To be relevant to the Scottish economy, these groups need to be based within Scotland. The proportion of companies working with Scottish suppliers and universities across the period of R&D activity (from development to implementation) is outlined in Table 6.20 below.

It is only at the delivery of R&D and implementation stage where there are likely to be any real degree of knowledge spillover effects in relation to suppliers, with 37% and 20% of companies working with Scottish based suppliers at these two stages.

Again, It is likely to be at the delivery stage where there are expected to be any real degree of knowledge spillover effects in relation to universities, with 57% of companies working with a Scottish university at this stage.

This suggests that there is scope for some knowledge spillovers in the Scottish economy, though as many are likely to be lost to Scotland based on the geographic reach of the companies.

Knowledge Spillovers **Table 6.20**

R&D Stage	Location of organisation	Supplier	University
Development	Scotland	9%	19%
	Beyond Scotland	25%	9%
Application	Scotland	6%	6%
	Beyond Scotland	6%	3%
Delivery	Scotland	37%	57%
	Beyond Scotland	40%	23%
Implementation	Scotland	20%	7%
	Beyond Scotland	40%	7%

Market spillovers are about the benefits of an invention being felt by other agents (customers) other than the innovating firm. These benefits can include:

- cheaper products
- greater functionality of products
- a wider range of goods and services

⁴³ Jaffe.A (1996) *Economic Analysis of Research Spillovers, Implications for the Advanced Technology Program*, Advanced Technology Programme Research SC7917-00 74

Market spillovers are likely to be felt by customers. To be relevant to the Scottish economy the customers need to be based in Scotland. The proportion of companies working with Scottish customers across the period of R&D activity (from development to implementation) is outlined in Table 6.21 below.

There are likely to be very few market spillovers in Scotland across all the stages. Even at the implementation stage, just 13% of companies are working with a Scottish customer. This largely reflects the target market for any new product, processes. Or services, which is global in scope rather than local. This suggests that there are few market spillovers arising from the R&D scheme within Scotland.

Market Spillovers

Table 6.21

R&D Stage	Location of organisation	Customers
Development	Scotland	3%
	Beyond Scotland	13%
Application	Scotland	6%
	Beyond Scotland	8%
Delivery	Scotland	3%
	Beyond Scotland	26%
Implementation	Scotland	13%
	Beyond Scotland	33%

Network spillovers are about the generation of commercial value being dependent on the development of a set of related technology. They are achieved largely in areas, such as computing, where technology is developed with multiple uses (such as an operating system running a range of separately developed applications). Network spillovers are likely to be evident in competitors. To be relevant to the Scottish economy the competitors would need to be based in Scotland. As none of the R&D companies were working with Scottish competitors, or carrying out collaborative research it is likely that there are no network spillovers associated with the R&D Grant programme.

Overall, there is some evidence that suggests there is scope for the R&D scheme to be generating some knowledge spillover and limited market spillovers in the Scottish economy, however, these effects are likely to be small relative to the scale of R&D activity.

7 Economic Impact and Value for Money

7.1 Summary

This section of the report provides an overview of:

- the approach adopted to calculate economic impact
- employment impacts
- GVA impacts (both realised to date, 2005/6 to 2008/9, and projected to 2019/20)
- value for money (VFM)

In summary:

- the impact assessment is consistent with best practice guidance outlined by Scottish Enterprise as well as HM Treasury Green Book standards
- there was a peak of 583 net jobs either created or safeguarded in 2008
- there is expected to be a peak of 4,039 jobs either created or safeguarded as a result of the R&D Grant in 2012
- there is clearly employment time additionality, with 91% of companies suggesting employment has been brought forward in some way
- GVA impacts to date amounted to £1.4m NPV, a cost benefit ratio of 1: 0.08 between 2004 and 2008
- there could be an total impact of £642.1m NPV, a cost benefit ratio of 1: 15.02 between 2004/5 and 2019/20
- half of the companies suggested that their turnover had been brought forward, though 50% suggested the R&D Grant had made no difference
- impact is driven by companies who received between £500,000 and £1m, large companies, those headquartered in other parts of the UK, companies trading for over 10 years in Scotland and energy firms
- the indicators suggest that there is reasonable economy, high efficiency and the potential for high effectiveness to be achieved suggesting the R&D Grant programme represents good value for money

7.2 Approach to impacts assessment

The economic impact calculations were based on best practice guidance in Economic Impact Assessment developed by Scottish Enterprise⁴⁴. This included:

- collecting key impact variables (using SE's standard question set⁴⁵)
- gross to net adjustments
- adjusting for optimism bias
- grossing the sample to the population
- probability adjustments for company acquisition and loss to the economy
- cost benefit analysis

7.2.1 Key impact variables

Key impact variables consider in assessing the impact of Scottish Enterprise intervention to the economy included turnover, employment and GVA.

Turnover was collected from the companies on an annual basis over the last four years (from 2004/05) as was employment. These same variables were also captured at key milestone years going forward to 2019/20.

⁴⁴ Scottish Enterprise (2008) *Additionality and Economic Impact Assessment Guidance Note, A Summary Guide to Assessing the Additional Benefit, or Additionality of and Economic Development Project or Programme*, Appraisal and Evaluation Team

⁴⁵ Scottish Enterprise (2008) *Additionality & Economic Impact Assessment Guidance Note: Appendix 2: Standard Questions and Standard Reporting Outputs*, Appraisal and Evaluation
SC7917-00

GVA was developed by subtracting the cost of bought in goods and services (excluding employee costs) on an annual basis over the last four years from the annual turnover level (or using company turnover to GVA ratios developed from the specific companies UK annual accounts).

The turnover and employment data collected was only that associated with the R&D grant award. While organisational turnover within Scotland was also collected, this was for wider reference rather than the basis of the impact assessment. The turnover and employment figures that are adjusted for additionality are based only on the revenue and employment directly associated with the R&D grant award.

7.2.2 Gross to net adjustments (additionality)

In order to understand the full impact of the R&D Grant programme there was a need to assess the additionality of the intervention. In effect what has happened that would not have happened anyway.

The additional benefit of an intervention is the difference between the reference case (what has happened anyway) and the intervention case (the position when the intervention has been implemented).

In order to fully understand additionality all results were adjusted from gross results to net economic impacts. This included adjustments for:

- deadweight – what would have happened anyway
- leakage – the extent to which the benefits are generated outside of Scotland
- displacement – the extent to which the benefits are coming at the expense of other Scottish based businesses
- substitution – the extent to which one activity is simply substituted for another
- multipliers – the positive downstream effects created through spending on supplies and the wider wages generated from these downstream effects

The adjustments made to each of these factors were based on information supplied by the individual companies and therefore varied on a company by company basis. However, to provide some context to these variables the average value for each was included for reference.

Deadweight was calculated by asking companies how different their turnover and employment associated with the R&D grant award (or product) would have been without the Scottish Enterprise R&D grant award. Note this is different from activity additionality (at the project level), rather focusing on benefit additionality (or the extent to which revenue and employment associated with the R&D grant funded project is additional to what would have happened anyway). The average values for turnover, GVA and employment deadweight at key years are highlighted in Table 7.1 and 7.2 below:

Turnover & GVA Deadweight

Table 7.1

Year	Average Deadweight Value
2004	-
2005	-
2006	90%
2007	78%
2008	86%
Milestone Year (projections)	Average Deadweight Value
2009	54%
2010	49%
2012	58%
2014	64%
2018	68%

For example, average turnover and GVA deadweight in 2008 was 86%, this meant that 14% of turnover in that year would not have occurred without grant support.

Levels of deadweight likely reflect the complexity of the development process (through to supporting successful exploitation) and the 'investment' required by businesses, across a series of drivers, to ensure value release of new products and processes. The magnitude of *net* impacts (cited later in this chapter) dovetail with complementary product offerings in the innovation space, suggesting appropriate levels of deadweight cited here. Furthermore, the high levels of return on investment and impact to the economy result from the scale of benefits generated rather than additionality, which fits well with the aspiration for such businesses: that while intervention is key in supporting businesses undertake these innovative projects (acting as an enabler and/or catalyst) the private sector is not heavily dependant on the public sector for its successes.

Employment Deadweight

Table 7.2

Appraisal	Average Deadweight Value
2004	50%
2005	92%
2006	95%
2007	75%
2008	73%
Milestone Year (projections)	Average Deadweight Value
2009	79%
2010	82%
2012	84%
2014	84%
2018	84%

For example, this highlights that average employment deadweight for 2008 was 73%. This means that 27% of that year's employment would not have occurred without grant support.

Displacement was applied consistently to employment, turnover and GVA based on the location of the companies direct competitors (and adjusted based on the growth of the market they operate in). For the R&D Grant programme the average displacement amounted to 9% in 2007. This meant that most companies are suggesting that they have virtually no competitors in Scotland.

Leakage was applied to employment, turnover and GVA, with an average value of 3% for employment and 21% for GVA and turnover.

GVA and turnover leakage was calculated to take account of the complex money

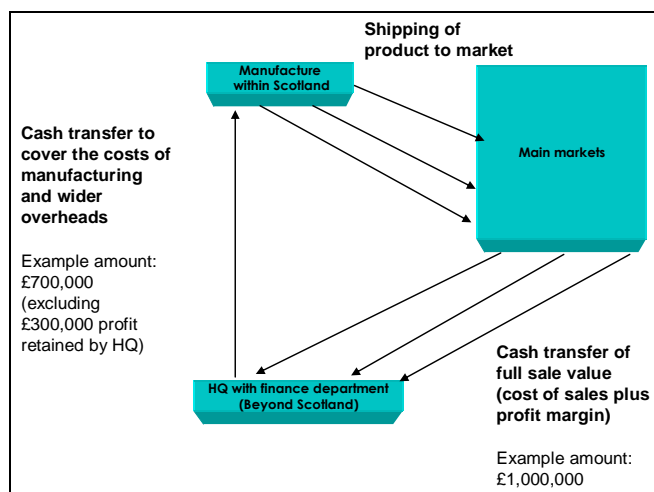
flows associated with the R&D grant award companies at the request of the R&D&I team. This was to ensure that value generated beyond Scotland was not simply included as part of the overall impact

The overseas ownership of the companies means that some of the products developed as a result of the R&D grant are manufactured in Scotland. However, the plants don't always bring in the revenue associated with the sale of the product, which instead goes directly to the head office or a finance unit beyond Scotland. This means that the company may only receive a transfer of finance to cover the staff, equipment and wider overhead costs associated with their operation rather than the full sale value of the product they produce.

This means that only the wages and depreciation can be counted toward the GVA as the profit is retained where the finance department is located (beyond Scotland) or transferred on the headquarters (beyond Scotland)). This flow of money means that some of the benefit is generated. This is illustrated in Diagram 7.1 below.

Money Flows and Leakage of Benefit Beyond Scotland

Diagram 7.1



As such the leakage estimates were based on the proportion of GVA that was accounted for by profit, based on annual accounts submitted to Companies House, of the company at the UK level. This provides a further caution to the results based on the real flows of money associated with the companies

Employment leakage was based on the proportion of staff associated with the R&D programme who lived outside of Scotland.

Substitution was assessed by asking the companies about the extent to which they have replaced one activity with another (or employees for another) to benefit from public sector assistance. No company appeared to do either of these, leading to average substitution values of 0% for turnover, GVA and employment.

Multiplier values were sourced from the Scottish Input Output multiplier tables based on the full 4 digit Standard Industrial Classification code of the company. These were matched with Type 1 and 2 multipliers for output (in the case of turnover), GVA and employment (giving direct, indirect and induced effects). The average Type 2 multipliers amounted to 1.99 for employment, 1.65 for turnover and 1.85 for GVA.

7.2.3 Adjusting for optimism bias

In order to avoid potentially over counting projected impacts, all projected figures were adjusted for optimism bias.

This is the systematic tendency for project owners, in the public or private sector, to overestimate the benefits that will be generated from a project and to underestimate the costs. It is expected that most companies will overestimate what the return will be, in terms of commercial sales or income, from the R&D investment.

Company projections have therefore been adjusted for optimism bias by benchmarking potential future GVA per head against the top performing companies as recorded in the Department for Business, Innovation and Skills Value Added Calculator⁴⁶

Where GVA projections were above those of the top performing companies in the broad sector figures were adjusted down to be directly in line with those estimates. Where companies had advanced orders no adjustment was made for optimism in this way, even where they were above the ranges expected from the top performing companies.

In addition a further wholesale 10% optimism bias adjustment was made to provide a cautious impact estimate.

7.2.4 Grossing the sample to the population

The sample of 36 was grossed to the total population of 55 on a proportional basis based on the number of projects supported and the number of companies interviewed on their project. Each interview focused on one project, even if the companies had accessed multiple grants for multiple projects. This way the results could be grossed up on a project by project basis.

A different grossing factor was developed for each year ensuring that all potential impacts generated by the programme were captured in a systematic manner. As the population was not randomly selected, but self selected it is not possible to estimate the margin of error attached to the grossed up results, instead it needs to be recognised that there may be an element of positive bias in the grossed results.

For example, in 2006 20 of the 55 projected had been supported (15 in that year and 5 in previous years). The company survey covered 13 interviews around these projects (9 from that year and 4 from previous years). This therefore amounted to a grossing factor of 1.54 (or 13 interviews on projects divided by 20 projects supported to date).

This approach was used in each year building a grossing factor which was applied to all impacts and summed to give an overall annual total that was used to build the cost benefit model.

7.2.5 Probability adjustments for company acquisition and loss to the economy

Once the results were adjusted for additionality, the net impact results were also adjusted for any potential loss of companies (in effect closures of the Scottish operation) or acquisition (in effect companies being bought over and either moving manufacture overseas or changing the operation to a pure focus on R&D).

The probability adjustments applied for both employment and GVA impacts assumed

⁴⁶ http://www.innovation.gov.uk/value_added/default.asp?page=59
SC7917-00

there could be 22 company closures (around 45% of the evaluation company base), or 2 per annum between 2009 and 2019. This was based on research into the nature and contribution of headquarters to Scotland's economic development which found that around 60% of the 1994 stock of HQs had left Scotland by 2004⁴⁷.

In addition, the level of acquisition was set at a modest level, assuming one acquisition in which a companies Scottish operation would be lost every 3 years, amounting to 3 over the period to 2019.

7.2.6 Cost benefit analysis

The adjusted net results were imported into the Scottish Enterprise cost benefit calculator.

Costs were collected for the 55 projects, using data supplied by Scottish Enterprise. The data covered the amount of grant awarded to companies to date as well as projected spend to 2012.

The results were discounted as per UK HM Treasury Best practice guidance at a rate of 3.5% per annum. For the R&D programme the base year was 2004/5, representing year zero for the evaluation. All impact figures were converted to 2007 prices for ease of comparison to other recent review and evaluation projects⁴⁸.

7.3 Employment impacts

Employment impacts cover the net additional jobs attributed to the R&D grant, representing a key variable of company development. The employment impacts need to be considered on an annual basis, as they cover both safeguarded and created jobs and cannot therefore simply be aggregated.

7.3.1 To date

The total number of jobs either safeguarded or created as a result of the R&D Grant programme amounted to:

- 76 net jobs in 2004
- 76 net jobs in 2005
- 142 net jobs in 2006
- 432 net jobs in 2007
- 583 net jobs in 2008

If it is assumed that all these jobs are full time, these employment figures can be totalled to amount to 1,309 Man Year Equivalents (MYEs)⁴⁹ between 2004 and 2008 (see Table 7.3).

Net employment impacts to date

Table 7.3

	Net jobs
2004	76
2005	76
2006	142
2007	432
2008	583
Total	1,309

⁴⁷ Botham,R and Clelland,D (2005) *Corporate Headquarters in Scotland: Their Nature and Contribution to Economic Development*, Scottish Enterprise

⁴⁸ Project this will enable comparison with are the ITI licensee Economic Impact Assessment, Evaluation of GTI Business Connections Project and the Commercialisation Programme Review

⁴⁹ MYEs represent a unit measuring the work of an individual in a year assuming a certain number of working days are completed

These impacts include wider effects amongst the participating companies (direct effects), wider supplier effects (indirect effects) and wider wage effects associated with the companies and their suppliers (induced effects).

It is possible to separate these effects out in 2008 directly amounting to:

- 338 direct jobs (58% of the total net impact)
- 121 indirect jobs (21% of the total net impact)
- 124 induced jobs (21% of the total net impact)

7.3.2 Projected

Companies were also asked to assess potential future employment associated, either with the ongoing R&D or the associated commercialisation of the product/process/service developed.

The potential employment generation at key milestone years amounted to:

- 1,642 jobs in 2009
- a peak of 4,039 net jobs in 2012 (three years on)
- around 1,659 jobs in 2019 (10 years on)

Again, if it is assumed that all these jobs are full time, these employment figures can be totalled to amount to 28,519 Man Year Equivalents (MYEs) between 2009 and 2019.

The employment figures increase substantially from the impacts to date as from 2009 (see Table 7.4) a number of the companies are planning to, or starting to manufacture the products associated with their R&D grant funded programme. This means that a number of jobs are either created or safeguarded as there is a shift from R&D to manufacturing.

Projected net employment impacts at milestone years **Table 7.4**

	Project net jobs
2009 (this year)	1,642
2010 (next year)	1,500
2012 (three years from now)	4,039
2014 (five years from now)	3,459
2019 (10 years from now)	1,659

It is also possible to separate out the direct indirect and induced effects at the peak employment year in 2012 amounting to:

- 544 direct jobs (13% of the total net impact)
- 2,487 indirect jobs (62% of the total net impact)
- 1,008 induced jobs (25% of the total net impact)

7.3.3 Time additionality

In addition to the quantifiable employment impacts companies were also asked about time additionality in relation to the generation of jobs.

There was clear evidence of employment time additionality. This included:

- 91% of companies who suggested that their 2007 employment level had been brought forward as a result of the R&D Grant, or:

- 32% suggesting it had been brought forward by up to 1 year
- 18% suggesting it had been brought forward by over 2 years
- 41% suggesting it has been brought forward by between 1 and 2 years
- 9% of companies who suggested the R&D Grant had made no difference to their 2007 employment level

The employment time additionality may be driven by the ability of companies to recruit new staff as a result of accessing grant support, because without it they would not have been delivering the R&D and therefore not grown, and in some cases may have seen employment fall.

7.4 GVA Impacts

An estimate of 'impact' is the ultimate effect of the project on the economy, or in this case, its contribution towards economic growth. This is measured as the net increase in gross value added (GVA) accruing as a direct result of the programme.

7.4.1 To date

The net GVA impact accruing as a direct result of the R&D Grant over the evaluation period 2004/5-2008/9, amounted to **£1.4m NPV**. This results in a benefit to cost ratio of 1: 0.08 or a return of 8 pence for every £1 invested in the programme and highlights the long term nature of benefit realisation associated with R&D (see Table 7.5), as well as the commercialisation of early funded projects accruing outside beyond Scotland.

Net GVA impacts to date

Table 7.5

	Costs (NPV)*	GVA (NPV)
2004	£1,912,742	£0
2005	£2,111,528	£0
2006	£3,158,871	£58,574
2007	£5,210,052	£112,646
2008	£5,511,092	£1,205,709
Total	£17,904,285	£1,376,929
Cost Benefit Ratio		1: 0.08

*Note these are the SE costs associated with the R&D element of the projects. They do not include the wider business contribution or the further ongoing costs in taking any new products to market

These impacts include wider effects amongst the participating companies (direct effects), wider supplier effects (indirect effects) and wider wage effects associated with the companies and their suppliers (induced effects).

It is possible to separate these effects out in relation to the total impact between 2004 and 2008 amounting to:

- £821,939 direct effects (60% of the net total)
- £319,403 indirect effects (23% of the net total)
- £235,587 induced effects (17% of the net total)

7.4.2 Projected

The potential net GVA impact between 2009 and 2019 could amount to **£640.7m GVA NPV** (see Table 7.6). This is driven by a small number of the companies starting to manufacture and sell the products associated with the R&D Grant scheme. In two cases this is the starting point from contracts already won reflecting the scale of benefit achievement where the R&D is successful and effective channels to market

have been developed and customer demand is being met.

This highlight the potential scale of benefits arising over the long term as R&D projects are completed and taken to market.

Projected net GVA impacts

Table 7.6

	Costs (NPV)*	GVA (NPV)
2009	£7,754,824	£10,404,746
2010	£6,919,185	£35,892,159
2011	£6,767,071	£31,852,986
2012	£3,408,436	£125,449,077
2013	-	£113,988,732
2014	-	£90,369,809
2015	-	£63,233,981
2016	-	£55,937,175
2017	-	£46,780,886
2018	-	£40,519,572
2019	-	£26,322,572
Total	£24,849,516	£640,751,695

*Note these are the SE costs associated with the R&D element of the projects. They do not include the wider business contribution or the further ongoing costs in taking any new products to market

It is also possible to separate out the direct indirect and induced effects based on projected GVA between 2009 and 2019 amounting to:

- £184,935,066 direct GVA (29% of the net total)
- £323,674,440 indirect GVA (51% of the net total)
- £132,142,189 induced GVA (21% of the net total)

This highlights the scale of the indirect and nominally induced benefits associated with the companies. While the average Type 2 multiplier for GVA, for example, is 1.85 there are a seven companies with a GVA multiplier above 2, including:

- 5 companies with a multiplier value of 2.16
- 1 company with a multiplier of 3.08
- 1 company with a multiplier of 5.38

This reflects the capital intensive nature of the activities of some companies and their reliance on wider supply purchases.

In addition, these values then get carried forward when the impact figures are grossed from the sample to the population driving a substantial indirect effect and wider effect.

7.4.3 [Whole period impact 2004-2019](#)

An assessment looking at the whole 2004-2019 time period was completed to provide a full impact estimate of the investment in R&D funding to date (see Table 7.7). The cost benefit ratio increased from 1: 0.00 in the first year of the scheme to a peak of 1: 15.20 over the whole period, with cost benefit breakeven possible around 2010 (or year 6 of the scheme).

Net impacts at milestone years 2004-2019

Table 7.7

	Cumulative Costs (NPV)*	Cumulative GVA (NPV)	Cost Benefit Ratio
Year 1 (2005)	£4,024,270	£0	0.00
Year 3 (2007)	£12,393,193	£171,220	0.01
Year 5 (2009)	£26,659,109	£11,781,675	0.46
Year 10 (2014)	£42,753,801	£409,334,438	9.57
Year 15 (2019)	£42,753,801	£642,128,624	15.02

*Note these are the SE costs associated with the R&D element of the projects. They do not include the wider business contribution or the further ongoing costs in taking any new products to market

7.4.4 Time additionality

In addition to the quantifiable GVA impacts cited above companies were also asked about time additionality (in relation to the generation of revenue, as a proxy for GVA).

There was clear evidence GVA time additionality (proxied from turnover generation), though this was much lower than for employment. This included:

- 50% of companies who suggested that their 2007 turnover level had been brought forward as a result of the R&D Grant, or:
 - 15% suggesting it had been brought forward by up to 1 year
 - 15% suggesting it had been brought forward by over 2 years
 - 10% suggesting it has been brought forward by between 1 and 2 years
- 50% of companies who suggested the R&D Grant had made no difference to their 2007 turnover level

The GVA time additionality would appear to be lower as many companies had still to generate the revenue benefits from their R&D projects or because the R&D itself had not been completed.

7.5 Impact breakdowns

The R&D Grant GVA impacts were broken down by a range of different variables to assess where the net additional value was being generated.

The main variables and largest contributors (between 2004 and 2019) are outlined in Table 7.8 below.

Potential Contribution to Impact 2004-2019

Table 7.8

Main Contributor to Impact	Contribution to Impact	Percentage of the Population
SE Contribution between £500,000 and £1 million	75%	30%
Large companies (250+ staff)	88%	43%
Trading 10 years plus in Scotland	98%	76%
Headquartered in other part of the UK	78%	14%
Energy sector	70%	11%

This suggests that impact is being driven by a small number of firms with particular characteristics.

7.6 Value for money

In order to understand value for money there is a need to understand three broad factors around the delivery of the project, covering:

- economy
- efficiency
- effectiveness

7.6.1 Economy

Economy is concerned with the overall cost of the inputs (in effect the project) and if these were reasonable.

The R&D scheme has invested around £28.4 m between 2004 and 2008 on 55 large R&D projects, giving an average cost per project of £517,228. There is a balance of £26.8m still to be drawn down against these existing commitments over the next 3 years. The nature of the scheme, with a specific focus on large companies, makes economy comparisons difficult. There is a high cost per project, but this reflects the size of the companies who engage with the programme.

There were a number of inbuilt mechanisms that indicate that economy was a strong consideration at set up, including:

- eligible costs being capped at 25% - even though the threshold was higher in other countries
- Scottish Enterprise covering eligible costs only – focused only on specific R&D rather than all the costs
- the Scottish Enterprise contribution covering only what is needed to make the project go ahead, rather than offering a simple maximum contribution
- the need for companies to maintain employment for 18 months, generating benefits for a further 18 months post completion of R&D at the companies expense

These factors suggest that there is a high level of economy associated with the R&D scheme.

7.6.2 Efficiency

Efficiency covers the extent to which the inputs have led to the desired outputs. The main output associated with the scheme is R&D spend as measured by BERD, though there are also benefits around formal IP generation, development of innovations and wider innovation.

The total expected spend on the 55 projects covered by this evaluation amounts to around £402 million. Of this Scottish Enterprise is expected to commit £55 million. This could therefore amount to a public private leverage ratio of over 1: 6, above the target set in the Scottish Enterprise business plan for investment funds of 1: 2 to 1: 3 suggesting a high level of efficiency.

In addition, a number of other core outputs have been achieved, including:

- 83% of surveyed companies either have or will produce new products as a result of the programme (while other have developed new and improved processes and services)
- 84% of surveyed companies have secured patents associated with the R&D funded project (as well as wider IP such as trademarks, copyrights, etc)

This suggests a high level of efficiency, with more R&D generated than invested in the programme and companies generating innovations and intellectual property as well

as wider knowledge improvements.

7.6.3 Effectiveness

Effectiveness covers the extent to which the outputs have led to the desired outcomes. The main outcome associated with the scheme covered national productivity, or GVA.

The impact assessment suggested that impacts achieved to date were relatively low, with a cost benefit ratio of 1: 0.08. To date effectiveness was therefore low, though this reflects the time lag between delivery of R&D and generation of commercial returns. Other schemes focused on R&D and the development of new products/process or services have generated similar returns, including:

- the GTI Business Connections project, with a return of 1: 0.10⁵⁰
- the ITI licensee companies, with a return of 1: 0.18⁵¹

When potential future economic benefits are included the scheme could generate a return of 1: 9.57 by 2015 and 1: 15.02 by 2019. The two comparator projects utilising similar methods and covering a 14 year assessment period, were expected to achieve a return over time of around:

- 1: 5.70 by the GTI Business Connection project by year 14
- 1: 5.93 by the ITI licensee companies by year 14

These findings suggest that if future projections come to fruition the R&D scheme will deliver a high level of effectiveness.

⁵⁰ Frontline Consultants (2009) *Evaluation of the GTI Business Connections Project*, Scottish Enterprise

⁵¹ Frontline Consultants (2009) *ITI Licensee Companies Economic Impact Assessment*, Scottish Enterprise SC7917-00

8 Conclusions and Recommendations

The following section provides the conclusions and recommendations arising from the evaluation.

8.1 Strong strategic and economic case for continued and increased support for R&D Grant funding

The rationale for the R&D Grant programme reflects a number of barriers, failures and reasons for intervention. These can be grouped into:

- hampering factors – companies cite innovation costs, economic risk and cost of finance as the key barriers to innovation
- equity issues – in comparison with a range of international and UK wide nations and regions, Scotland continues to perform poorly in terms of BERD as a percentage of GDP
- market failures – a detailed review suggests these continue to operate in particular domains of the economy in relation to R&D, including imperfect information largely in the finance market and positive externalities largely in the technology market

In addition, companies and stakeholders agree that there is continued demand for the R&D Grant which is the only support of its kind for large companies, having absorbed SCIS and SCORE for small companies and R&D Plus for large companies.

In addition, with a spend of over £28m to date and commitment of over £55m the R&D Grant is a big cost to SE. That said, R&D is a long term gain and the intervention needs to be viewed in a similar way as impacts have the potential to be substantial in the future:

- GVA – to date net GVA amounted to £1.4m NPV, with the potential to increase to £640.7m NPV by 2019
- employment – over 1,300 to date (MYEs), with the potential to increase to over 28,500 (MYEs) between 2009 and 2019

When comparing all of these projections with other SE commercialisation support, the R&D Grant is very likely to be one of the exemplar projects, with very high impacts on the Scottish economy.

On a more cautionary note, the majority of these impacts are likely to be generated by a small number of companies, and although all have been based in Scotland for over 10 years, there is no room for complacency and effort should be maintained to ensure Scotland remains a viable business location.

The earlier leverage of over 1:6, the high levels of GVA and employment as well as a strong strategic case, all provide indicators that this is a good project. The value for money assessment confirms this with:

- economy – the inbuilt mechanism at the set-up, including capping levels of support at 25% and only supporting the eligible elements of R&D, suggests high levels of economy
- efficiency – public private leverage ratio of over 1:6 compared to an SE target for investment funds of 1:2 to 1:3, along with the generation of IP, new innovations and wider innovation, suggests a high level of efficiency
- effectiveness – low levels of GVA at present with a cost benefit ratio of 1:0.08,

while potential future economic benefits could generate returns of 1:9.57 by 2015 and 1:15.02 by 2019. This suggests a potentially high level of effectiveness over time

These results demonstrate that the project provides an excellent value for money solution, despite the high levels of initial investment required.

This real and clear market failure, combined with the wider hampering factors, equity issues, continued demand and clear evidence of a potential economic return to the Scottish economy, underpinned by value for money, gives a clear rationale for continued intervention.

Recommendation 1

Need for continued and increased support with the key aims of:

- **reducing market failure**
- **minimising hampering factors and equity issues**
- **increasing R&D capacity and economic benefit to Scotland**

Recommendation 2

Increase the number of companies supported through:

- **increased financial resources**
- **improved direct control over financial resources – including extra staff to ensure the smooth running of the programme**
- **investigating ways to maximise inputs from the TSB to R&D projects in Scotland where this can generate a higher leverage ratio for SE and increased value to the Scottish economy**

8.2 The R&D Grant will make a substantial contribution to economic development activity in Scotland

The R&D Grant has a strong and clear fit with Scottish economic development policy. The Scottish Government makes clear the importance of R&D activity to the economy and the need to increase BERD and reduce the gap with other countries.

SE focuses on three key areas to deliver its economic strategy – enterprise, innovation and investment – with the R&D Grant contributing to all three. In addition, there is good fit with the four priority industries of DMET, life sciences, food and drink and energy. There are also links to other sectors, such as chemicals and aerospace where there continues to be a strong demand for support.

R&D Grant also fits with a wide range of SE supported activity. All companies that received awards are account managed, and a high proportion received other forms of complementary support including TrainingPlus and RSA.

Recommendation 3

Continue to work closely with industry leads to support the needs of each sector and help meet increasing levels of demand.

Recommendation 4

Explore the potential to provide a portfolio of support across the R&D, manufacturing and training and development needs of companies. By linking the range of support on offer there could be scope to maximise the impact on the economy.

8.3 Good maximisation of resources

To date, the SE input to the R&D Grant amounts to £28.4m with a total legal commitment of over £55.2m across the 55 projects with a total cost of more than £402m. This substantial investment has a minimum leverage ratio of 1:6 which far exceeds target of SE intervention of 1:2 to 1:3 set out in the SE Business Plan. This high level of leverage continues to emphasise the importance of this programme to the Scottish economy. Companies cite this funding as helping them de-risk and reduce the financial burden of R&D and as a result they spend substantial monies – a high proportion of which is new or significantly more than would have been spent in Scotland.

Recommendation 5

Consideration should be given to looking at different levels of grant intensity depending on the nature of R&D and subject to the project not falling below a minimum leverage ratio of less than 1:2.

8.4 Good intervention that can be made even better

All stakeholders were in agreement that the intervention was well managed and respected the knowledge and experience of the core team. Some stakeholders highlighted issues with the length of, for example, due diligence and approval. However, companies provided little evidence of this, with the majority positive about the R&D application and decision making processes. The general consensus was no need for radical change, but to encourage the team to review the overall approach and look for areas where efficiencies could be made, thereby making the intervention even better for the companies. This could be particularly important during the current recession, when current supported companies have shown signs of increasing the need to draw down support and meet milestones more quickly.

Recommendation 6

Review all the stages in the process and look to streamline. For example, a quick fix would be to reduce the number of initial approval steps, to enable the company and account manager to move forward more quickly.

Recommendation 7

Provide companies with clearer information requirements at the outset to help ensure consistent standard of due diligence and economic impact assessment and minimise the need for different contractors to approach the companies for different information.

Recommendation 8

Provide account managers with a one page summary user document on the information requirements for companies.

8.5 Direct benefits are wide ranging

Already the R&D Grant has produced extensive company benefits. Examples include:

- new money into the Scottish economy and/or increased R&D spend
- extension of R&D activities into new areas
- generation of a wide range of IP
- new products and breakthrough technologies
- wider process and service innovation that has often been applied to existing/new products/processes

Ultimately, the majority of companies have suggested that they will create revenue that is significantly greater than their investment. R&D gives them a real return and this support enables them to drive R&D forward in a less risky way.

The company benefits did not diminish if companies had received more than one grant award. In addition, the leverage ratios, outputs and outcomes generated are equally positive in these circumstances.

Recommendation 9

Ensure that each project continues to be considered on its own merits irrespective of previous successful applications and current headquarter locations. The project's ability to generate increased R&D capacity and economic benefit to Scotland should be the key method of prioritisation.

8.6 Developing value at the strategic level

The R&D Grant has created a platform for generation or enhancement of company competency or knowledge in relation to R&D. These can be split into three levels:

- synergy – the R&D Grant has generated substantial knowledge or competency benefit resulting in an improved knowledge base and the potential for further knowledge creation
- catalyst effect – the R&D Grant has encouraged companies to think long term about R&D and innovation as well as improved their R&D capacity. In the majority of cases, additionality of these benefits was high
- strategic influence – there has been significant impact on the staff that have been supported by the R&D Grant programme, with all but one company stating that staff have already made a contribution to other company activities

The implication is that R&D Grant has made substantial progress in developing a knowledge based economy in Scotland.

8.7 Some spillover benefit

Since its creation in 2003 the R&D Grant has supported a wide range of both indigenous and foreign owned companies to establish, improve and build R&D capacities and capability in Scotland. In addition to jobs being created and

safeguarded, the R&D Grant has:

- created increased R&D knowledge and capability
- encouraged spillovers – knowledge and market
- improved strategic positioning of subsidiaries and branch plants

Ultimately, the R&D Grant has played a key role in improving the internal and external competitiveness of participating companies.

To date spillover benefits are minimal, occurring predominantly at the knowledge and market levels and not at the network level. Knowledge spillovers have occurred during the delivery and implementation of the R&D, with companies citing some links to Scottish suppliers and Scottish universities. Links with Scottish customers (in effect market spillovers) were less evident, predominately due to these companies operating within global markets.

Until such times that that collaborative research is undertaken, network spillovers are unlikely to be evident.

Recommendation 10

Encourage account managers and innovation specialists to work more closely with companies to make greater linkages with Scottish suppliers, universities and other collaborators to enhance any market and knowledge spillover effects and embed foreign owned companies.

Recommendation 11

The potential for collaborative projects should be explored as a mechanism for generating wider network spillover effects.

Appendix 1

R&D Company List

R&D Company List

Name	Interviewed
Agilent Technologies	Yes
Alba Bioscience Ltd	Yes
Alexander Dennis Ltd (project one)	Yes
Analog Devices Ltd	Yes
Artifium	Yes
Aviagen Group Ltd	Yes
Ciba Specialty Chemicals & Pigment Limited	Yes
Coherent Scotland Ltd	Yes
CTS Corporation UK Ltd	Yes
D A Group (UK) Ltd	Yes
Dialog Semiconductor	Yes
Doosan Babcock Energy Limited	Yes
DuPont Teijin Films UK Limited	Yes
Falcon Food Services Equipment Ltd	Yes
FMC Technologies Ltd	Yes
Freescale Semiconductor UK Ltd.(project one)	Yes
Fujifilm Imaging Colorants UK Ltd (electrophotography)	Yes
Gates Power Transmission Ltd	Yes
Honeywell Control Systems Ltd	Yes
IBM United Kingdom Limited	Yes
Ineos Olefins	Yes
Invitrogen Limited	Yes
Linn Products Limited	Yes
National Semiconductor (UK) Limited	Yes
NCR Financial Solutions Group Ltd (project one)	Yes
Philips Lighting	Yes
Picisel Technologies Limited	Yes
Pyreos	Yes
Rainbow Technology Systems Ltd	Yes
Rolls Royce Marine	Yes
Rolls Royce PLC (East Kilbride)	Yes
SASOL Technology (Pty) Ltd	Yes
SELEX Sensors & Airborne Systems (Galileo market diversification)	Yes
ST Microelectronics (project one)	Yes
Toshiba Medical Visualization Systems Europe	Yes
United Wire Ltd	Yes
Albion Automotive Limited	No
Alexander Dennis Ltd (project two)	No
Atmel (UK) Ltd	No
Don & Low Ltd	No
Freescale Semiconductor UK Ltd. (project two)	No
Fujifilm Imaging Colorants UK Ltd (Inkjet)	No
Goodrich Corporation	No
GR Advanced Materials Ltd	No
Hoover Ltd	No
Ineos Manufacturing Scotland	No
NCR Financial Solutions Group Ltd (project two)	No
Rolls Royce PLC (Inchinnan)	No
RS Biotech Laboratory Equipment Ltd	No
SELEX Sensors & Airborne Systems (Burst Illumination lidar)	No
SELEX Sensors & Airborne Systems (DIRCM)	No
Simclar International Ltd	No
ST Microelectronics (project two)	No
Vascutek Limited	No

Stakeholder Consultees

Stakeholder Consultees

Name	Organisation
Elaine Morrison	Scottish Enterprise
Simon Wallace	Scottish Enterprise
Ian McCoull	Scottish Enterprise
Andy McDonald	Scottish Enterprise
William Corr	Scottish Enterprise
Kirsty Boe	Scottish Enterprise
Douglas Brown	Scottish Enterprise
Jan Reid	Scottish Enterprise
Andrew Henderson	Scottish Enterprise
Caroline Strain	Scottish Enterprise
Derek Dougall	Scottish Enterprise
Jemma Fletcher	Scottish Enterprise
Tom Tumilty	Scottish Government
David Hartley	Scottish Enterprise

R&D International Comparisons

BERD as a % of GDP by UK region

Table A3.1

Nation/Region	Spend as a % of GDP (2007)	Position
East of England	3.58	1
South East	1.78	2
North West	1.58	3
East Midlands	1.19	4
South West	1.18	5
West Midlands	0.93	6
North East	0.68	7
Northern Ireland	0.55	8
Scotland	0.46	9
Wales	0.45	10
Yorkshire	0.42	11
London	0.38	12
UK	1.13	n/a

Source: Business Enterprise R&D in Scotland 2007, Scottish Government

BERD as a % of GDP by EU countries

Table A3.2

Nation	Spend as a % of GDP (2007)	Position
Sweden	2.66	1
Finland	2.51	2
Austria	1.81	3
Germany	1.77	4
Denmark	1.66	5
Luxembourg	1.36	6
France	1.31	7
Belgium	1.30	8
United Kingdom	1.15	9
Netherlands	1.03	10
Czech Republic	0.98	11
Slovenia	0.87	12
Ireland	0.88	13
Norway	0.88	14
Spain	0.71	15
Portugal	0.61	16
Italy	0.55	17
Estonia	0.54	18
Hungary	0.49	19
Scotland	0.46	20
Malta	0.39	21
Croatia	0.33	22
Turkey	0.30	23
Lithuania	0.23	24
Romania	0.22	25
Latvia	0.19	26
Slovakia	0.18	27
Poland	0.17	28
Greece	0.15	29
Bulgaria	0.15	30
Cyprus	0.10	31
EU (15 countries)	1.24	n/a
Euro area (15 countries)	1.19	n/a
EU (27 countries)	1.18	n/a

Source: Eurostat

BERD as a % of GDP by OECD countries**Table A3.3**

Nation	Spend as a % of GDP (2007)	Position
Sweden	2.66	1
Finland	2.51	2
USA	1.93	3
Germany	1.77	4
France	1.31	5
UK	1.13	6
Canada	1.05	7
Ireland	0.88	8
Italy	0.55	9
Scotland	0.46	10

Source: *Business Enterprise R&D in Scotland 2007*, Scottish Government

BERD in Scotland and UK 2004-2007**Table A3.4**

	Scotland		UK	
	£m	% of GDP	£m	% of GDP
2004	430	0.45%	12,662	1.04%
2005	506	0.51%	13,734	1.08%
2006	461	0.43%	14,561	1.08%
2007	513	0.46%	16,111	1.13%

Source: *Business Enterprise R&D in Scotland 2007*, Scottish Government