Research Project: Interviews with firms on innovation investment

Over the Summer of 2008, kindly funded by NESTA and COINVEST, European Commission Seventh Framework Programme, grant number 217512, the ONS has lead the piloting of an "extended" R&D survey. The main extensions to the conventional R&D survey is that we aim here to ask firms about

a. R&D service life lengths,

b. "non-technical" R&D spending and service life lengths, covering areas such as software, design, training, organisational change.

This paper is an non-disclosive version of our fuller report to NESTA. In this version we present average results only for all 10 firms in our pilot. This is to avoid disclosure problems. We hope to undertake another 30 pilot interviews and report industry-level data. So the purpose of this note is to solicit comments and views from anyone interested on how we might improve the survey. Comments are gratefully received by Tony Clayton, Peter Stam (ONS, tony.clayton@ons.gov.uk, peter.stam@ons.gov.uk), Jonathan Haskel (j.haskel@ic.ac.uk).

Before proceeding, we note the following. First, due to the small sample numbers the results in this paper will of course almost certainly change. Second, where a number has been deleted a ✂ symbol is inserted. Third, the survey is a pilot survey run by the ONS and has no connection with the Community Innovation Survey or the R&D survey. Fourth, it does it have any input into the calculation of National Accounts (statistics or methods).

Introduction

A recommendation from the revision of the System of National Accounts (SNA) 1993 is to include R&D as an intangible fixed asset. This reflects the increasing role of knowledge in the economy. An increasing amount of analytical work is also being done on the possible effects of moving the asset boundary beyond just R&D and software, to include other non technical, knowledge based, activities[1], with interesting results on investment and productivity (Corrado et al 2004 and Giorgio Marrano et al 2007).

The definition of an asset within the National Accounts is to deliver benefit to the owner for more than a year; a characteristic that R&D and other non technical activities often demonstrate. The result on the production account of capitalising intangible investments is to increase the level of GDP whilst providing more detailed data on the sources of productivity growth. Net wealth is increased as stocks of intangible assets are recorded in the balance sheet; as these stocks are used up they provide capital services to the asset owner. Therefore in order to 'capitalise' intangible investment within a national accounts framework it is necessary not only to estimate the levels of stock but also the rate at which the stocks depreciate and become obsolete over time. That is, to estimate their service lives.

[1] Other non technical innovation activities includes software and computer networks, design of new products, design of new processes, employer-funded training, organisation/business process improvement and reputation and branding.

The UK Office of National Statistics (ONS) and its academic partners have undertaken considerable research into developing measures of intangible assets. Recent papers have focussed on:

- Software investment - both purchased and own account (Chamberlin 2007)
- R&D capitalisation - in support of the OECD IPPTF, (Galindo-Rueda 2007, Evans et al 2008)
- International comparisons of intangible investment - for the European Union Framework Seven programme on 'International comparison of Intangibles and growth accounting' (Haskel and Giorgio Marrano 2007)
- Innovation investment and an innovation measurement framework - for NESTA's measurement programme (Clayton et al 2008).

The purposes of this study are:

- to seek answers on asset lives, using a framework developed by the OECD
- to test whether companies can provide data on non-technical innovation activities, in addition to data provided on conventional R&D.

In the Pilot phase, reported here, we test a questionnaire developed from the OECD model used internationally through a set of preliminary structured interviews with companies that undertake technical R&D and non-technical activities in order to determine the length of asset service lives.

Methodology

Various methods have been used to try to establish intangible asset service lives. Mead (2007) undertook a review of the four basic approaches; production functions, amortization models, patent renewal models, and market valuation models - he concluded:

> "none seem completely satisfactory because they are based on strong identifying assumptions or applied to data that lack sufficient variation to separately identify R&D depreciation rates".

An alternative approach, suggested by Charles Aspden of the OECD as part of the framework of the Canberra II group, has been to estimate service lives by directly receiving information from experts working within the field of R&D. The Central Bureau of Statistics in Israel undertook a number of pilot interviews and concluded that by interviewing experts it may be possible to obtain relatively consistent responses in a business survey on the duration of R&D projects, length of application lags, and length of use in production (Peleg 2008a). In order to estimate whether service life lengths are similar internationally, the service life sub-group of the OECD IPPTF requested that other National Statistical Agencies undertake a similar survey of businesses.

Questionnaire

The questionnaire was designed using the template provided by the Central Bureau of Statistics in Israel and supplemented by contributions from the Economic Analysis, Methodology and Surveys and Administrative Sources Departments of ONS; NESTA; and Professor Jonathan Haskel of Queen Mary, University of London (the full questionnaire has been included in Annex 1).

Individual companies were included in the sample frame if they had responded to the Community Innovation Survey (CIS), confirmed they had undertaken R&D, and indicated on

the CIS form that they were willing to be contacted for further information. The companies were then grouped geographically and interviews arranged.

The initial questionnaire was trialled with ten companies from six sectors[2] in a semi-structured interview; nine face to face and one telephone. The objectives of the preliminary round of interviews were threefold;

a) to find out if a company was able to provide the information required,
b) to test the feasibility of, and solicit constructive feedback on, the questionnaire,
c) and, whenever possible, to collect data.

After the pilot phase of interviews the structure and content of the questionnaire will be reviewed and finalised. The final stage will be to collect additional data for empirical analysis. We are aiming for an overall sample of around 40 companies.

Data collection

The Pilot phase interviews were all undertaken between 10th September and 3rd October, 2008. The interview process lasted for around an hour and was interviewer led. Due to the multiple aims of the interviews a joint 'cognitive[3]' and 'survey[4]' interview technique was employed. The interview was conducted using a scripted questionnaire in order to collect data, whilst supplementary questions were asked to check the comprehension of the interviewee and to draw out additional information. In accordance with the recommendation from the Israeli survey and initial findings from the German study, the interviews were arranged with technical personnel. One R&D manager, however, withdrew from the interview process deciding that it would be better for a representative from the accounts department to be interviewed. Most interviews were taped but not transcribed[5]; all tapes were destroyed after the results were recorded.

General responses to the survey

The semi-cognitive approach to the interviews led to various suggestions for improving the design of the survey questionnaire. There was lively debate around definitions but generally the companies were comfortable with 'technical R&D' although some companies said they do 'design and development' rather than R&D. The main problem with the questionnaire was that the interviewee found it difficult to provide information for both technical R&D and non-technical activities. The majority of interviewees could answer only section A (technical R&D) or section B (non-technical activities). Only a minority of interviewees were able to answer both parts of the questionnaire.

Generally, the interviews with technical personnel were positive and open, and several interviewees said they felt that the R&D and wider intangibles agenda had been neglected. The interview with the group of accountants was less positive: the interviewees were more defensive and less forthcoming with their answers. This finding is in accordance with the

[2] Pulp, paper and publishing, chemicals, motor vehicles, trailers and semi-trailers, banking and textiles manufacturing.
[3] Cognitive interviewing techniques focus on the process of answering the question. They attempt to understand how the respondent fulfils the task of answering questions and detect any actions or understandings that are not what the designer intended.
[4] Survey interview techniques are focussed on collecting answers. Generally they are fully scripted, contain closed questions and are non-conversational as the interviewer accepts the respondent's answer.
[5] One company refused permission for the interview to be taped.

Israeli and German study which highlighted the importance of interviewing technical personnel.

The most important result from the preliminary interviews was that companies were able to provide answers to many of the questions; including estimates of R&D service life lengths – this was also a finding from the Israeli and German studies.

The concept of a three-stage service life (gestation, transition and production) was felt to be simplistic by a number of respondents; however, many of the respondents did not recognise the transition phase. The concept of a typical project was questioned by various interviewees; a general response was that a typical project does not exist as projects are individual by nature. Seven of the respondents were able to provide R&D service life estimates, although many said this was difficult; as one interviewer put it:

> "R&D investment is often used in multiple products and multiple R&D investments may be built into a single product… therefore estimating the product life-length of an R&D project can be problematic".

As technical R&D is often managed internationally, rather than nationally or at a unit basis, throughout the interview, the respondents had difficulty answering the questions from a consistent geography. The time frame for the collection of data also caused confusion to some interviewees - some questions related to the last financial year, whereas some of the R&D questions related to a period considerably longer.

Results

The remainder of the report directly addresses the responses to specific questions. The following empirical results reported should be treated with extreme caution as the preliminary interviews were completed with just ten companies, most of whom provided answers to only parts of the pilot questionnaire (and some of whom provided no data at all; only feedback on the questionnaire itself.)

Technical R&D: Types of project

Seven companies were able to provide expenditure information on technical R&D[6]. Expenditures ranged from ✂to ✂ million. International companies had difficulty separating out UK expenditure from global R&D expenditures; as a result two companies reported the companies' global expenditure on R&D. Table 1 reports the proportions of the type of research undertaken by sector, using a split between "high-tech" (engineering, chemicals) and "low-tech" (consumer goods and services). Unsurprisingly, as companies are focussed on commercialisation, basic research accounted for considerably less of the research budget than applied or experimental development research. "Low-tech" companies reported no "blue sky" research, and a greater emphasis on experimental development. However, given the very small number of responses, these results should not be taken as representative of the sectors as a whole.

[6] Three companies were able to provide data for non-technical activities, whilst two companies were unable to supply expenditure details at the interview but stated that they would be able to provide non-technical activities expenditure post interview.

Table 1: Proportion of technical R&D spend by type of project[7]

	Basic (blue sky)	Applied	Experimental development
	✂	✂	✂
All firms	**4%**	**43%**	**53%**

Technical R&D: Sources and structure

The sources and structures of R&D production and management varied from company to company. The responses suggested that businesses are prepared to use a combination of internal and external sources, resourced from different geographies, to achieve the optimum outcome. The comments below give a better insight into the management of R&D at the company level:

> "…it was undertaken across a number of departments internationally"
>
> "…there is a dedicated R&D site internationally but design was undertaken across a variety of sites internationally. We also buy in R&D from suppliers and do a lot of collaborations with both universities and other small companies"
>
> "…we have a dedicated department in the UK and source some from outside the company"
>
> "…we have a dedicated department in the UK and internationally as well as sourcing from outside the company"
>
> "…R&D is undertaken in the UK across a number of departments, we also source from outside the company"
>
> "…R&D is undertaken in the UK across a number of departments; machinery is brought in from outside the company"

The complex structure of production and ultimate ownership has implications for estimating service lives. If R&D is produced in the home country but owned abroad, either through outright sale or affiliate transfer, the estimates of service lives are less relevant for the nation's capital stock - it may therefore be more appropriate to interview companies that only own and use R&D in the domestic market.

A subsequent question on the source of technical R&D, reported in Table 2, shows that over half of the companies' technical knowledge was produced on 'own account' from UK internal sources and nearly three quarters came from internal sources in and outside the UK. Just over a quarter came from external sources; 11% was generated from free sources such as the internet and networking with peers - 14% was generated outside of the business, some of which will have been imported. There is a suggestion that companies in "high-tech" industries internalise more R&D than "low-tech" companies.

[7] Data are unweighted unless stated otherwise, and may not add up to 100% due to rounding.

Table 2: Source of technical based knowledge in the business (2007-08)

	Technical R&D done in the business, in the UK	Technical R&D done in the business, outside the UK	Licensed / purchased technical R&D from outside the business	Technical ideas / knowledge freely available outside the business
"High-tech"	✂	✂	✂	✂
"Low-tech"	✂	✂	✂	✂
All firms	**57%**	**19%**	**14%**	**11%**

Of the technical R&D undertaken internally, ✂of the ✂companies who answered this question reported that between ✂and ✂% of technical R&D expenditure led to the output being patented; the average for the ✂companies was 10%. The findings are similar to the German study that reported only a fraction of their R&D was patented. One company said they were unable to estimate the proportion of R&D expenditure that led to the creation of patents, whilst another company said that it varied widely year to year and that patenting was managed from the group HQ.

Four of the seven companies estimated that almost the entire technical R&D was used internally (i.e. used in the production process and not sold/licensed to another company). Two companies estimated that just ✂ per cent was sold/licensed; all of this was traded outside the UK.

Of the R&D that was undertaken within the UK, ✂ companies reported that over ✂of R&D expenditure was used in products/services sold in the domestic market, one company reported a ✂split between the domestic and international market and three companies reported over ✂was used in the domestic market. ✂of the ✂companies reported a split between the domestic and international market totalling 100%. ✂

Successful and unsuccessful R&D

Interviewees were asked whether they monitor and measure successful and unsuccessful R&D[8] - in nearly all cases the companies reported that they do but in one case the respondent stated:

> "there was no such thing as an unsuccessful project as you learn from all projects whether they are commercialised or not".

Most companies had internal procedures to monitor R&D projects and systems in place for closing down projects once it became clear that the project would not meet its objectives - this finding mirrors that of the Israeli survey. The companies' strategies for minimising unsuccessful projects ranged from only undertaking experimental development projects, which resulted in near 100% success rates, to undertaking a high proportion of unsuccessful projects but which only accounted for a low proportion of overall expenditure. The companies achieved this paradox through tight project management controls by ensuring that projects are regularly assessed and shut down early if they are unlikely to meet their objectives. Companies who undertook blue sky or large scale projects often undertook these with external funding and/or with project partners in order to minimise the risk to the company.

[8] The 'at cost' approach to valuing R&D includes measuring expenditure on both successful and unsuccessful R&D.

Feasibility and duration of service lives for technical R&D

The interviewees all felt that it was possible, albeit difficult, to estimate service lives of a project. The interviewees said they were qualified to comment on projects that they had knowledge of but were uncertain as to whether these projects could be thought of as typical. In general, the interviewees said that the concept of a typical project itself maybe flawed as companies undertook various different types of projects (short/medium/long term; process and product innovation; new products and product development).

As various types of R&D have different service life lengths, an important conclusion drawn from the first round of interviews is that the types of R&D should be tightly defined within the questionnaire. To enable a more meaningful estimate of service life length, data should also be captured to enable an expenditure weighting for the different types of R&D. This conclusion is in accordance with the preliminary results from the German study.

A number of interviewees stated that the three stage breakdown was simplistic and did not reflect how R&D was managed within their company. One company specified a five stage approach to R&D service life within their company; 'idea generation, opportunity assessment, technical feasibility, scale up and customer trials'. A number of the companies did not recognise a transition phase, stating that the transition phase would be built into the development phase in order to limit the delay of going into production. This reflects the findings of the Israeli study which reported the length of the application lag was quite short in many cases. This is also in accordance of the findings of Kashani et al (2000) who examined the role of innovation and its contribution to the performance of brands of sixty major European companies - they concluded:

> "speed to market appears to be an important contributor to brand performance. Our research indicates that the elapsed time from an innovation's initial review to its market launch is negatively correlated with market share, i.e., the shorter the process, the higher the anticipated growth in market share".

Table 3 documents the results from the service lives using a weighted average by number of projects. Our findings are similar to the Israeli study in that all companies that undertook technical R&D were able to provide data for the service lives, and almost in all cases the respondents undertook different types of R&D which had different service life lengths.

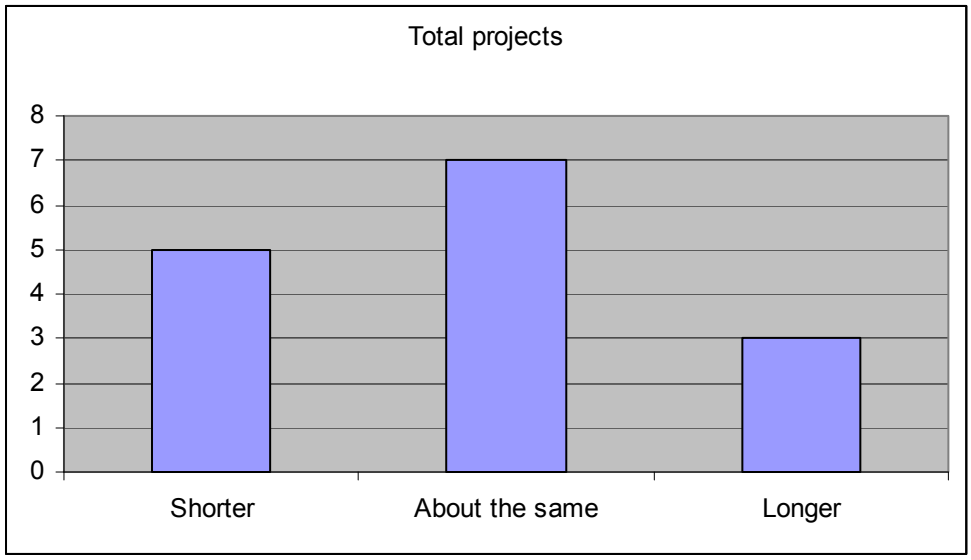
Table 3: Average R&D service lives weighted by number of projects

	Length of development lag in years	Length of transition lag in years	Length of use lag in years	Total length in years
"High-tech"	✂	✂	✂	✂
"Low-tech"	✂	✂	✂	✂
All projects	**3.4**	**0.4**	**8.5**	**12.3**

On average, the length of a technical R&D project service life was a little over 12 years. This is within the estimates identified in the academic literature and used in other national satellite accounts. The length of the service life seems to be connected with the complexity of the project and the legal environment in which the R&D operates. R&D projects in the "High-tech" sector have longer lives than in the "Low-tech" sector, apart from the transition phase.

Interviewees were then asked to comment on whether they thought the length of the phases of the service life were shorter, about the same, or longer than their competitors - the results are reported in Figure 1.

Figure 1: Estimation of how the company's R&D service lives compared to the 'industry norm' by number of companies



Across the three phases of service life lengths, in general, companies estimated that R&D would have either a shorter or similar life length to the industrial norm[9] - approaching 50% of respondent thought that service life lengths were about the same. This result offers support to the statement in the Israeli's study:

> "respondents thought that service lives were similar for specific types of R&D, so that collection of information on service lives from experts could be sufficient".

Non-Technical activities: Types of project

In the Pilot phase, only ✂ companies reported non-technical expenditure detail, so we are not able to present a split between sectors. Investment in non-technical activities ranged from ✂ to ✂ million. Table 4 shows that all non-technical activities received investment by at least one company although the proportions varied considerably; 'design of new and improved services' received the lowest proportion on average. Due to the close alignment of the 'design' indicators, it was suggested that that 'design of new products and services' should be combined. If the results of these two questions were combined, investment in employer-funded training would lag considerably behind all other non-technical activities.

Table 4: Proportion of non-technical spend by type of project

	Software and computer networks	Design of new and improved products	Design of new and improved services	Employer-funded training	Organisation / business process improvement	Reputation and branding
All firms	**12%**	**18%**	**3%**	**6%**	**29%**	**32%**

[9] The respondent estimated the industry norm.

Non-technical activities: Sources and structure

When asked about the sources of non-technical knowledge, ✂ companies were able to provide data. Table 5 reports that slightly less than 40% of non-technical knowledge comes from UK internal sources and just over two-thirds from internal sources in total. This is similar to the finding on technical R&D. The remaining third comes from external sources. As with technical R&D, companies in "High-tech" industries internalise more innovation activity than other companies.

Table 5: Sources of non-technically based knowledge (2007-08)

	Spending on knowledge done within the business, in the UK	Spending on knowledge done within the business, outside the UK	Spending on knowledge sourced from outside the business	Ideas / knowledge freely available outside the business
"High-tech"	✂	✂	✂	✂
"Low-tech"	✂	✂	✂	✂
All firms	**38%**	**27%**	**20%**	**14%**

Non-technical activities: Average service lives

Data for average service lives were collected from ✂ firms in the pilot stage, with a total of ✂ projects discussed. The average length of service life for non-technical activities is seven years, considerably lower than that for technical R&D (Table 6). One interviewee stated

> "a number of the projects are short term…even the longer projects are only 18-24 months in duration".

One interviewee in the "high-tech" category reported that, unlike technical R&D, some of the projects identified within non technical activities are ongoing projects without a definable output. This respondent declined to split service lives between the 3 stages but was able to estimate an overall service life. Data for the separate stages in the "high-tech" category have been suppressed to preserve confidentiality.

Table 6: Average non-technical service lives

	Length of development lag in years	Length of transition lag in years	Length of use lag in years	Total length in years
"High-tech"	✂	✂	✂	✂
"Low-tech"	✂	✂	✂	✂
All projects	**0.4**	**0.3**	**5.8**	**6.6**

Conclusions

- The response from the large majority of companies was positive. There was agreement from the interviewees was that the R&D agenda had been neglected.
- When collecting R&D data, it is important to interview managers with a technical background.

- More effort is required to locate the correct people for non-technical activities. This is likely to include managers with technical knowledge, managers with a business change perspective or very top level management.
- A clearer distinction should be made between technical R&D and non-technical activities in the questionnaire.
- The concept of a three stage service life was said to be simplistic although companies were able to provide service life estimates within this framework.
- To improve estimates of service lives an expenditure weighting should be collected.

- Lessons learned from the Pilot phase are as follows:
  - Provide an advance copy of the questionnaire as the questions on non-technical activities are likely to require input from multiple people (and departments).
  - The questionnaire has been amended to provide clearer definitions and more examples, and to clarify geography and timeframes.
  - The distinction between design of new products and of services has been dropped.
  - A distinction has been introduced between service lives of "own account" projects and "bought-in" projects, where the service life is entirely in use.
  - The questionnaire has also been amended to collect expenditure weighting information for R&D and non-technical projects.

The revised version of the questionnaire is attached as Annex 2. Early use of the revised questionnaire and lessons learned from the Pilot suggests that the changes made are effective. Interviews now tend to yield more data for both technical R&D and non technical innovation investment. As of early December 2008, a total of nineteen interviews have been completed, with several more booked. These have yielded twelve companies able to give data about twenty-five technical R&D projects and thirteen companies able to give data about twenty non-technical projects.

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Annex 1 Questionnaire – Pilot Phase

Script for Interview

Introduction: Thank you for agreeing to help us with this exercise. I am <interviewer> from <organisation> and this is <introduce second interviewer if appropriate>.

Explain purpose: Within the Office for National Statistics, we are looking to improve the way R&D and other non-technical activities are measured within a National Accounts Framework. In future, potentially, R&D and other non-technical activities will be treated as investment in the National Accounts. This will provide a better understanding of the fundamental sources of economic growth, which is central to formulation of public policy.

As part of this process we are going out to businesses to find two things; firstly to better understand how they manage R&D and other non-technical activities, and secondly find out how we can make the survey as easy as possible for businesses to complete.

As we explained on the phone, the interview should last no longer than an hour, is that still OK with you?

Explain what will happen: In a couple of minutes, I will begin to ask you a number of scripted questions. I will also be asking you some supplementary questions as we go through the short questionnaire, some may seem really obvious questions but there are just a few things that I need to check (they're not trick questions!).

Also, to save me taking notes, I will be using a tape recorder – would that be OK with you?

Confidentiality: Everything you say is confidential, the recording will be destroyed as soon as we've used it. The tape will only be used by the ONS project team when compiling the report; a transcript of the tape will NOT be made and your company will not be identified within the report. Only certified members of the project team will hear the recording prior to its destruction.

Questions: Do you have any questions?

Interviewer	
Company	
Job Title of Interviewee	

R&D is defined as by investigation or experimentation, the outcome of which is new knowledge (with or without a specific practical application), enhanced materials, products, devices, processes or services.

This survey is in two parts and seeks to obtain information about:

a. Technical R&D: R&D to build new knowledge to resolve scientific and technological uncertainty. For example, invention of a new laser to read a CD would be technical R&D.

b. Non-technical activities: Spending to build new non-technological knowledge to support the commercialisation of new knowledge in your business. This might include: software, non-technical design of new products (e.g. market research and package design for the laser), non-technical design of new processes (e.g. the design of the assembly of production for the new laser), and also spending by businesses in training, organisation/business process and reputation and branding.

We are interested in learning more about your expenditure in the last financial year.

A. Technical R&D

Technical R&D is spending to resolve scientific and technological uncertainty.

1) What categories of R&D projects go on in your business? Examples could include basic (e.g. blue sky research without any particular application or use in view), applied (pursuit of new knowledge directed primarily towards a specific practical aim or objective) or experimental development (drawing on existing knowledge, which is directed to producing new products or processes or to improving substantially those already produced or installed).

	Type of R&D project
1	
2	
3	
4	

2) Approximately how is technical R&D spending in your business divided between the different types of R&D outlined above?

	Proportion of technical R&D spending
1	%
2	%
3	%
4	%

3) Do you monitor overall expenditure on technical R&D whether it is successful or not?

Yes ☐

No ☐

If yes, as a proportion of total expenditure how much was successful

%

4) How much did you spend on technical R&D in the last financial year?

£

5) How much of your technical R&D activity, in terms of expenditure, do you sell or license?

Domestically	%
Internationally	%

6) How much of your technical R&D expenditure gives rise to patents (share in all technical R&D expenditure)?

%

7) The table below attempts to better understand time lapses from starting a specific technical R&D project, to developing a usable concept, to moving into production, through to the point where it no longer provides competitive advantage.

Description

i) Development: Gestation period - length of period of production of R&D (time lag between the start and completion of R&D projects)

ii) Transition: Application period - length of time passing between the end of the R&D phase of the project and the start of the use of the R&D in commercial production

iii) Use: Length of the period that the R&D is used in commercial production

Using the table below, please select at most three technical R&D projects and fill out the time lapses. In the case of purchased R&D please just fill out the use row.

Technical R&D projects					
		Details on stages in the "life" of project			
No.	Description of the type of project	Stage	Information needed	Time in months	comments
1		Development	Average time in development		
		Transition from development to production/operation	Average timegap between end of development and use in product/operation		
		use in production/operation	Average length of time from start of use to end of use		
2		Development	Average time in development		
		Transition from development to production/operation	Average timegap between end of development and use in product/operation		
		use in production/operation	Average length of time from start of use to end of use		
3		Development	Average time in development		
		Transition from development to production/operation	Average timegap between end of development and use in product/operation		
		use in production/operation	Average length of time from start of use to end of use		

8) In your opinion, how does the whole service life of the projects (includes all three development, transition and use stage outlined in the table above) compare to those typically found in your industry?

	Shorter	About the same	Longer
1	☐	☐	☐
2	☐	☐	☐
3	☐	☐	☐

Comments:

9) Can you describe how technical R&D is undertaken within the structure of your business?

a. Within a dedicated R&D department…

in the UK ☐

internationally ☐

b. Across a number of departments…

in the UK ☐

internationally ☐

c. Sourced from outside of your company ☐

Comments:

10) How much of the technical R&D done in the UK by your company, in terms of expenditure, is used

In domestic market	%
Abroad (either by an affiliate or sold)?	%

Comments:

11) What proportion of technically based knowledge in your business that is new in the past financial year comes from:

Technical R&D done in the business, in the UK	%
Technical R&D done in the business, outside the UK	%
Licensed / purchased technical R&D from outside the business	%
Technical ideas / knowledge freely available outside the business	%

B Non-technical Activities

Spending to build new non-technological knowledge to support the commercialisation of new knowledge in your business.

Definitions

Software and computer networks - Includes purchased and own account (in-house) software development and computerised database and computer networks, but excludes spending covered under technical R&D.

Design of new products and processes - Design functions for the development or implementation of new or improved goods, services and processes. Design in the technical R&D phase of product development should be excluded.

Employer-funded training – All internal or external training for your personnel.

Organisation/business process improvement - Including purchased consultancy services and in-house investment of managerial time spent on improving the effectiveness of business organisations.

Reputation and branding - Including all spending on advertising and market research.

1) How much did you spend in the last financial year in each non-technical activity?

(if you find it easier to indicate a total and then proportions please do so)

	Total expenditure
Software and computer networks	£
Design of new and improved products	£
Design of new and improved services	£
Employer-funded training	£
Organisation / business process improvement	£
Reputation and branding	£

2) What proportion of non-technically based knowledge in your business that is new in the past financial year comes from:

Spending on such knowledge done in the business, in the UK	%
Spending on such knowledge done in the business, outside the UK	%
Spending on such knowledge Licensed / purchased ideas/knowledge from outside the business	%
Ideas / knowledge freely available outside the business	%

3) Can you describe the typical time lapse from starting a specific non-technical project, to developing a usable concept, to moving into production, through to the point where it no longer provides competitive advantage? Roughly how long does each phase take?

Non-technical projects					
		Details on stages in the "life" of project			
No.	Description of the type of project	Stage	Information needed	Time in months	comments
1		Development	Average time in development		
		Transition from development to production/operation	Average timegap between end of development and use in product/operation		
		use in production/operation	Average length of time from start of use to end of use		
2		Development	Average time in development		
		Transition from development to production/operation	Average timegap between end of development and use in product/operation		
		use in production/operation	Average length of time from start of use to end of use		
3		Development	Average time in development		
		Transition from development to production/operation	Average timegap between end of development and use in product/operation		
		use in production/operation	Average length of time from start of use to end of use		

Annex 2 Revised Questionnaire

ONS Interviewer	
Company	
Job Title of Interviewee	

These questionnaires are about research and development that is both technical and non-technical. Here are some definitions and examples to help:

a. Technical Research and Development is defined as original investigation to acquire new knowledge in order to resolve scientific or technological uncertainty.

b. Non-technical R&D is work to support the commercialisation of new knowledge in the business and/or changes in the process and organisation in the business itself.

Example. Consider the steps in the sale of a new DVD player.

1. An improved mechanism for the laser that reads the DVD. This is technical R&D (i.e. R&D resolves scientific or technological uncertainty).
2. Pre-production market research. Non-technical R&D (i.e. non-technical since it is not trying to resolve scientific or technological uncertainties).
3. New software to improve the working of the DVD. Non-technical R&D.
4. Advertising and branding spend to support the product. Non-technical R&D
5. New business process to change the way the product is produced and sold. Non-technical R&D.

We are interested in learning more about your expenditure relating to your companies UK operations – if you are unable to provide a breakdown at the UK level please specify at what level you are responding.

Level of response (if not UK):

A. Technical R&D

Technical R&D is spending to resolve scientific and technological uncertainty.

3) What categories of Technical R&D projects go on in your business? Examples could include basic (e.g. blue sky research without any particular application or use in view), applied (pursuit of new knowledge directed primarily towards a specific practical aim or objective) or experimental development (drawing on existing knowledge, which is directed to producing new products or processes or to improving substantially those already produced or installed).

	Type of R&D project
1	
2	
3	
4	

4) Approximately how is technical R&D spending in your business divided between the different types of R&D outlined above?

	Proportion of technical R&D spending
1	%
2	%
3	%
4	%

3) How much did you spend on technical R&D in the last financial year?

£

4) Over the past ten years, how much of your technical R&D expenditure gave rise to patents (share in all technical R&D expenditure)?

	%

5) What proportion of technically based knowledge in your business that is new in the past financial year comes from:

Technical R&D done in the business, in the UK	%
Technical R&D done in the business, outside the UK	%
Licensed / purchased technical R&D from outside the business	%
Technical ideas / knowledge freely available outside the business	%

6) How much of your technical R&D activity, in terms of expenditure, did you sell or license in the last financial year?

Domestically	%
Internationally	%

7) Can you describe how technical R&D is undertaken within the structure of your business?

a. Within a dedicated R&D department…

in the UK ☐

internationally ☐

b. Across a number of departments…

in the UK ☐

internationally ☐

c. Sourced from outside of your company ☐

Comments:

8) How much of the technical R&D done in the UK by your company, in terms of expenditure, is used

In domestic market	%
Abroad (either by an affiliate or sold)?	%

Comments:

9) The table below attempts to better understand time lapses from starting a specific technical R&D project, to developing a usable concept, to moving into production, through to the point where it no longer provides competitive advantage.

Description

iv) **Development**: Gestation period- length of period of production of R&D (time lag between the start and completion of R&D projects)
v) **Transition**: Application period - length of time passing between the end of the R&D phase of the project and the start of the use of the R&D in commercial production
vi) **Use**: Length of the period that the R&D is used in commercial production

Using the table below, please select at most three technical R&D projects and fill out the time lapses. In the case of purchased R&D please just fill out the use row.

Technical R&D projects for own use						
			Details on stages in the "life" of project			
No.	Type of R&D project	Proportion of R&D expenditure	Stage	Information needed	Time in years	Comments
1			Development	Average length of time in development		
			Transition from development to production/operation	Average length of time between end of development to start of use of the R&D asset in production/operation		
			Use in production/operation	Average length of time from start of use of the R&D asset in production until end of use		
2			Development	Average length of time in development		
			Transition from development to production/operation	Average length of time between end of development to start of use of the R&D asset in production/operation		
			Use in production/operation	Average length of time from start of use of the R&D asset in production until end of use		
Technical R&D purchased from others						
			Details on stages in the "life" of project			
No.	Type of R&D project	Proportion of R&D expenditure	Stage	Information needed	Time in years	Comments
1			Use in production/operation	Average length of time from start of use of the R&D asset purchased until end of use		
2			Use in production/operation	Average length of time from start of use of the R&D asset purchased until end of use		

8) In your opinion, how does the whole service life of the projects (includes all three development, transition and use stage outlined in the table above) compare to those typically found in your industry?

	Shorter	About the same	Longer
1	☐	☐	☐
2	☐	☐	☐
1	☐	☐	☐
2	☐	☐	☐

Comments:

B Non-technical R&D

Non-technical R&D is spending to support the commercialisation of new knowledge in your business, or spending to develop new business processes or organisation**.**

Definitions

Software and computer networks - Includes purchased and own account (in-house) software development and computerised database and computer networks, but excludes spending covered under technical R&D.

Design of new products and services - Design functions for the development or implementation of new or improved goods, services and processes. Design in the technical R&D phase of product development should be excluded.

Employer-funded training – All internal or external training for your personnel.

Organisation/business process improvement - Including purchased consultancy services and in-house investment of managerial time spent on improving the effectiveness of business organisations.

Reputation and branding - Including all spending on advertising and market research.

1) How much did you spend in the last financial year in each of these categories of non-technical R&D? (if you find it easier to indicate a total and then proportions please do so)

	Total expenditure
Software and computer networks	£
Design of new and improved products and services	£
Employer-funded training	£
Organisation / business process improvement	£
Reputation and branding	£

2) What proportion of non-technical R&D in your business that is new in the past financial year comes from:

Spending on such knowledge within in the business, in the UK	%
Spending on such knowledge within the business, outside the UK	%
Spending on such knowledge bought from outside the business (e.g. licensed / purchased ideas/knowledge) (either in or outside the UK)	%
Ideas / knowledge freely available outside the business	%

5) Using the table below, can you describe the typical time lapse from starting a specific non-technical project, to developing a usable concept, to moving into production, through to the point where it no longer provides competitive advantage? To help answer the questionnaire:

   a. Estimates are acceptable
   b. You may wish to set out your answer by considering up to three non-technical projects. It would be helpful if they were typical of say, design, software and business process re-engineering projects in your location but they might be projects involving more than one subcategory of non-technical activities, in which case please indicate this.

Non Technical R&D projects for own use						
			Details on stages in the "life" of project			
No.	Type of R&D project	Proportion of R&D expenditure	Stage	Information needed	Time in years	Comments
1			Development	Average length of time in development		
			Transition from development to production/operation	Average length of time between end of development to start of use of the R&D asset in production/operation		
			Use in production/operation	Average length of time from start of use of the R&D asset in production until end of use		
2			Development	Average length of time in development		
			Transition from development to production/operation	Average length of time between end of development to start of use of the R&D asset in production/operation		
			Use in production/operation	Average length of time from start of use of the R&D asset in production until end of use		
Non Technical R&D purchased from others						
			Details on stages in the "life" of project			
No.	Type of R&D project	Proportion of R&D expenditure	Stage	Information needed	Time in years	Comments
1			Use in production/operation	Average length of time from start of use of the R&D asset purchased until end of use		
2			Use in production/operation	Average length of time from start of use of the R&D asset purchased until end of use		