Design in Innovation

Paper Objectives:

To use survey and case study evidence from the UK to review and illustrate the role of design as a creative source and as a complementary asset to technology development.

To test the significance of these relationships using econometric models

From this, to argue that design should have a prominent place in the family of innovation indicators and so:

Suggest that better measurement and modelling of design in innovation should be on NESTI's work programme over the next 10 years and outline some approaches.

Background

The role of science, technology and innovation as leading determinants of wealth creation, economic growth and productivity is universally recognised. It is also widely accepted that innovation comprises much more than science and technology and that complementary investments and assets, including skills and management are part of the functioning innovation system. And innovation can be unrelated to any sort of technology.

But indicators used to measure innovation for policy purposes are still dominated by R&D, even though it is recognised that only a minority of businesses invest in R&D themselves. When it comes to quantifying knowledge, in models of the knowledge based economy, analysts reach naturally for technology indicators such as R&D and patents. Measuring the stock and flows of these has been the lifeblood of NESTI and national agencies for a long time. The long time series of these indicators enable econometric estimation of endogenous growth models.

These factors have been partly instrumental in persuading a number of governments to set quantitative objectives for the national level of R&D expenditure or have introduced tax measures to favour private R&D spending. This is a tribute to the success of efforts over the

years to refine the concepts underlying R&D measurement on an internationally common basis, set out of course in the Frascati manual. The work of NESTI and its members has been instrumental in this and the process of refinement goes on, as can be seen from the topics covered at this conference.

Development of technology is clearly vital for long term economic growth and R&D has well known economic properties of incomplete appropriability of results that leads to a gap between private and social returns. But in policy analysis, the ready availability of technology indicators can lead to the horrors of the linear model, despite the best efforts of economists over the years to lay this beast to rest, at least when setting up theories of innovation. Again, though, the empirical literature on innovation as a determinant of economic growth and productivity is heavily populated by models using R&D as the main exogenous variable, facilitated by consistent collection of data over a long period. So we need indicators from other parts of the innovation system to ensure that policy is based on a more rounded picture. Hence this very welcome session on non-technological innovation.

The ability of businesses to make effective use of knowledge either generated within the organisation or available via spill-over mechanisms such as publications, needs complementary assets and skills. And from a national economy perspective, the right level of these assets are needed in order to internalise the research externalities.

One of the most important of these assets for business and the nation is investment in design, which plays a role in product and process development, adaptation of external knowledge and in marketing.

Oslo Manual

That new technology measures - R&D, together with international patenting do not exhaust the variables constituting innovation underlay the origin and subsequent development of the Oslo Manual, which offers definitions and guidance on data collection for a fuller set of indicators.

The 3rd revision of the Oslo manual has extensive treatment of innovation outside of or ancillary to the development or use of technology. In particular the typology of innovation events has been extended to include organisational and marketing innovation alongside the established forms of product and process. And guidance on innovation survey design is that even product and process innovation should not be tied to the TPP concept that was the

backbone of the original Oslo manual. This is intended to enable a better approach to measuring innovation in the provision of services and in service industry, which as we all know are the largest part of OECD member states economies.

Why design?

The recent Oslo manual revisions are much less radical in the treatment of the creative sources and other resource inputs for innovation, which in the Community Innovation Surveys are grouped as innovation activities and expenditures. The variables that the Oslo Manual recommends for innovation surveys to collect still has a strong production or manufacturing flavour, with R&D and licensing in of knowledge recommended for explicit coverage in surveys, but much of the resource base for innovation brigaded under a portmanteau "other market preparations" variable.

In particular, the manual remains limited in its treatment of design:

> Under the heads of defining types of innovation, it is included as an example of marketing innovation. That is, it is conceptualised largely as a decorative add on to product innovation whose real roots are elsewhere, notably, still, in R&D.
>
> In the treatment of innovation activities and expenditures, guidance on surveys does not suggest that separate identification of design should be the norm.

This paper argues that strategic design input and design related modes of innovation are of wider economic importance than this treatment implies, both in the real market application of technology and as an independent creative source. This is the case in all types of industry and for all levels of innovation intensity. Some stimulus for the attempt to raise the profile of design in the context of what innovation indicators for the twenty first century cam from recent policy related exercises in the UK and I turn briefly to that now.

UK DTI review of design and creativity.

The UK, like other countries, has had an active Design promotion policy for many years, with a Design Council charged with promoting good design practice to enable competitiveness and innovation amongst UK firms. But it has not tended to have the prominence in innovation policies that is attached to new science and technology from public and privately funded R&D. A recent review by DTI economists, (in collaboration with the

UK Design Council and academic experts looked at how Design and Creativity act as sources of business performance and productivity.(DTI 1995) . Design has traditionally been perceived as an important source of comparative advantage for the UK and the review focussed in part on whether these strengths – in the design sector and the output of skilled designers- is underutilised. Added impetus has been given to these sorts of inquiry by the increasing awareness in policy circles of globalisation and the pressures this is expected to put on the international competitiveness of OECD member states. This has included a perception that science and technology, traditionally seen as their source of comparative (and absolute?) advantages are themselves becoming commoditised and highly internationally mobile. In these circumstances, establishing the continuing and sustainable sources of comparative and competitive advantage has taken on some urgency at least for the UK.

Some commissioned supporting academic studies showed the role and value of the contribution of design to innovation and its management, not only in the traditional domains of product design but also in services and the management and organisation of business processes and the innovative capabilities of organisations. For example, Bessant, Whyte and Neely (2005); Haskel, Cereda, Crespi, and Criscuolo, (2005); Swann and Birke (2005).

The authors noted a lack of systematic indicators of design in innovation even at the national level, and even a lack of a common definition, so that gauging the degree of comparative advantage through international benchmarking was hard to achieve reliably. As contributor put it, it is time for design to come out from the shadow of R&D, when it comes to innovation indicators. He even went so far as to suggest that we need a "Frascati manual" for design. (Tether, 2005). Whether another manual is the way forward is touched on briefly in the concluding section. But it seemed to the policy analysts in the UK Department of Trade and Industry that there is a gap in the range of indicators at the international level. The next part of the paper turns to what can be said about design in innovation using existing sources of data in the UK and modelling frameworks of different degrees of sophistication.

Design in Innovation

This section of the paper covers how the role of design in innovation can be measured and modelled using information that is already available, mostly in the UK. The main source of data is the UK Innovation Survey, carried out as part of the Community Innovation Survey, but the analysis also draws on the results of surveys and projects by the UK's Design Council. (Design Council , 2005). It is also grounded in real world applications of design

using some case studies of design used to innovative effect by UK firms. The breadth of coverage of modern designers is shown by the functions offered to high technology start up companies participating in a Design Council led programme to engage them with professional design expertise early in their development cycle.

Functions of Design

For a scheme devised to introduce businesses to design as a strategic tool, the UK Design Council identified and validated 6 factors where design intervention can contribute to the success of early stage technology start-ups.

Adaptive **Business** Models – to successfully evolve the business whilst continuing to explore options

Coherent **Market** Roadmaps – to develop the technology in phases, and in-line with customer needs and behaviours

Iterative Design **Processes** – to deliver sustainable and appropriate innovation into the marketplace

Open and Collaborative **Culture** – to build a spirit of innovation within a team that can adapt and respond to rapid change and drive brand building from the inside out

User **Experiences** – to connect with customers and other stakeholders, identify the right channels and produce winning solutions

Compelling **Brand** Stories – to communicate consistent, coherent and powerful messages to stakeholders, investors, channels and customers

Source: Design Council

Indicators and models.

Investment for Innovation

In the UK we ask about design expenditure as a distinct form of investment for innovation, in our implementation of the Community Innovation Survey. This provides a simple but, it turns out, very powerful variable that enables much insightful analysis of the role that design plays in the innovation processes and outturns of individual businesses and its place in the overall innovation system. It can also be linked directly to product and process innovation and to design related IP measures, to develop indicators of design related innovation and whether this mode has systemic characteristics, as well as how it relates to other factors

Figure 1 shows the shares of enterprises recording some expenditure on the range of innovation inputs included in the UK survey.

Figure 1 Shares of Businesses with innovation investments.

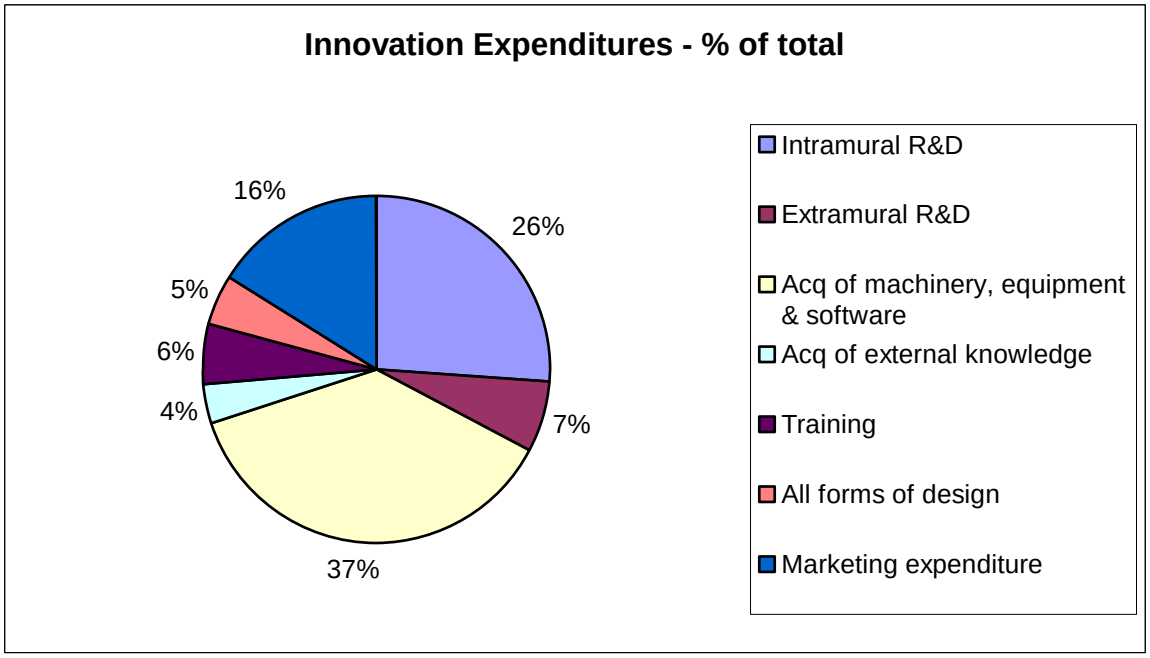
Intra-mural R&D	32%
Extra-Mural R&D	12%
Acquisition of machinery, equipment and software	47%
Acquisition of external knowledge	14%
Training in connection with innovation	42%
Design functions	19%
Marketing related to innovations	25%

Source: UK Innovation Survey 2005 (CIS4)

While more businesses recorded R&D and Capital Expenditure, some 19% recognized an explicit role for design in preparing for or implementing innovations in products or processes. It is notable that the design investment propensity does not vary significantly across industrial sectors, with a similar percentage of respondents in sectors such as knowledge intensive services and retail, reporting design activity as in manufacturing industries.

When translated into expenditure, the shares within the sum of innovation related expenditures in the UK breaks down as shown in Figure 2 . Design spending is about 5% of the total, which may seem modest, but is a higher share than external knowledge acquisition, a part of the innovation system that attracts a great deal of policy interest, certainly in the UK. So even at this level of analysis, there is evidence that design is a well defined factor in innovation in different industries.

Figure 2 Innovation Expenditures in the UK 2004



Source: UK Innovation Survey 2005. Business weighted.

It is interesting to contrast the results from the innovation survey with the findings from a recent study of the UK design industry carried out by the Design Council. That recorded industry turnover of around 5 times the scale of design investment for innovation from the innovation survey.

Even allowing for differences in coverage and for the share of industry turnover from exports, there is a substantial gap between the estimate of expenditure on design for innovation and the size of the design industry. This suggests that design is not fully seen as a strategic, innovation creating input by many businesses, a mindset that can impede the full realization of their innovation potential. The priority given to R&D as the innovation indicator, in research and policy making, will have coloured this mindset. Raising the profile of design as part of product, process and wider forms of innovation is a legitimate part of the policy framework and for this we need better indicators.

Part of the difference in estimates of expenditure may be explained by some design activity falling under other input categories in the innovation survey. It is known that the experimental development component of R&D can include design activity. Indeed respondents are asked to exclude from their design answer any spend included in their R&D figure. Similarly the category of expenditure on market preparations for innovation – a large share of the total at least in the UK – is also likely to pick up some design activity, through eg packaging and supply systems.

An idea of the extent of this can be derived from the overlap between expenditure categories and the main design related intellectual property indicators in the survey. Figure 1 shows the shares of businesses with and without expenditure under the heads on intra-mural R&D, Design and Marketing, who ascribe No importance or High importance to design registration or design complexity as means of protecting their innovations.

Figure 3 Selected innovation expenditure and intellectual property

	Design Registration		Complexity of Design	
	No Importance	High Importance	No Importance	High Importance
No Intra-mural	90%	2%	85%	2%
Intra-mural R&D	65%	11%	40%	13%
No Design	88%	3%	80%	3%
Design functions	57%	14%	34%	15%
No Marketing	89%	3%	81%	3%
Marketing related to innovations	65%	11%	45%	12%

Source: UK Innovation Survey 2005 (CIS4)

While a higher share of businesses with Design input value design based IP to some degree, there is a substantial overlap of these types of IP with new technology and marketing activity that is, design functions are "hidden" in other inputs. The degree of comparative and competitive advantage in a nation's design resources could be better determined if these functions and expenditures were made more explicit in innovation indicators.

Design and other inputs- complementarities.

The innovation survey records whether enterprises engage to some degree in a range on innovation directed business activities, which enables investigation of the degree to which these are deployed as substitutes or complements in their innovation strategies. This can be assessed on two bases. First, the conditional proability that a business engages in activites A **and** B, given that it engages in **A or B** (or both). The alternative formulation is of two conditional probabilities: the probability that the business engages in activity A **given that** it engages in B, and the probability that it engages in B, **given that** it engages in A. These are not in general symmetric.

These relationships are summarised in the Figures below. In Figure 4, a value of over 50% (in bright blue) imples that the two sorts of activity are complements. In this symmetric case, only training and Capex + software are complements, and that to a fisrly modest degree. Design shows a rather low degree of complementarity with all other activities on this basis.

Figure 4. Conditional Probabilities of innovation activities. Symmetric

	Innovation Activities - Symmetric conditional probabilities						
	Probability of both categories of investment conditional on one or other or both						
	Intra-mural R&D	Extra-mural R&D	Capex and Software	External knowledge	Training	Design	Marketing
Intra-mural R&D	100%	29%	39%	23%	40%	34%	38%
Extra-mural R&D	29%	100%	18%	25%	18%	25%	23%
Capex and Software	39%	18%	100%	24%	55%	26%	34%
External knowledge	23%	25%	24%	100%	26%	25%	25%
Training	40%	18%	55%	26%	100%	28%	39%
Design	34%	25%	26%	25%	28%	100%	33%
Marketing	38%	23%	34%	25%	39%	33%	100%

Source: UK Innovation Survey 2005 (CIS4)

The picture is very different for the assymetric conditional probabilities, set out in Table 2

Figure 5. Conditional probabilities of innovation activities. Asymmetric

		Probability of this category of investment for innovation						
		Intra-mural R&D	Extra-mural R&D	Capex and Software	External knowledge	Training	Design	Marketing
	Intra-mural R&D	100%	31%	73%	28%	68%	39%	51%
Conditional on this category of investment	Extra-mural R&D	82%	100%	82%	45%	73%	49%	60%
	Capex and Software	45%	19%	100%	25%	67%	28%	39%
	External knowledge	59%	36%	85%	100%	81%	43%	57%
	Training	49%	20%	77%	27%	100%	30%	45%
	Design	71%	33%	81%	37%	76%	100%	63%
	Marketing	60%	27%	74%	31%	74%	42%	100%

Source: UK Innovation Survey 2005 (CIS4)

Here there are a large number of one way only complementarities. So 71 % of those with specific Design activity also have intra-mural R&D, 81% have expenditure on Capex, 76% on Training (for innovation) and 63% on Marketing. But the probabilities of a design function conditional on other inoutes are low. That is, commitment to Design tends to pull through other innovation investments, but the inverse is not the case. A lack of complementary strategic design activity can inhibit the market potential of technology, as illustrated by an example from a project in a UK Design Council programme. Involving professional designers transformed the product and the process.

Case Study 1 *User Experiences*

A strong focus on user experiences helps technology start ups:

- enhance and accelerate product and market development activities
- secure investment in the business
- ensure end users both 'need' and 'want' the new product.

The business develops diagnostic technology for testing a range of health problems. Sensor technology is incorporated within a simple product for home-based testing by the consumer.
The business had developed a prototype plastic smart card device - from which the test section was snapped off and sent for analysis. While the device itself had been successful in bringing the basic idea to life, it did not support a viable product to market proposition.

As a result of design input, the company identified risks associated with the existing product concept and were able to plan a better route to market.

Funds were reallocated to invest in 'pre-clinical' user research to test both technological feasibility and user benefits in parallel. User feedback resulted in an entirely new product concept, to move away injection moulding to frame mounted disposable paper which was environmentally more sustainable and more cost effective to develop and manufacture.
User benefits were clearer and the move to paper based assembly halved the design budget.
The first prototypes in the new paper based format were produced in 2004 and received valuable user feedback, excited investors, and **doubled** available finance..

Source: Design Council

Design in Innovation

This section of the paper gives statistical support to the insights from the case studies by illustrative analyses of the role of design in innovation. The first block explores the interface

between design and new technology determinants of innovation. These can be seen as the creative mechanisms within the business. Subsequent sections turn to the complementarities between design and the other parts of the innovation system .

The analysis includes design based innovation in service provision and services sectors. It is possible to take a very narrow view of the design functions, that they encompass the skills, routines, and habits, that have economic applications only to appearances of goods or to engineering drawing. But the recent survey of the design industry for the UK's Design Council identified a wide range of design markets and specialist suppliers, including the design of services. This can include of course premises – shops, offices and so on, but also the full range of interfaces required for effective service provision. The focus on customer or user experience that motivates much innovation in services is not confined to the retail sector and the more general notion of experience goods is emerging as a major theme in services sector oriented economic research. One example is that website design is what differentiates suppliers – the technology behind Ecommerce is commoditised.

The Design Council survey revealed the markets for the design industry, including the use of in-house design teams. Figure 6 shows the percentages of design businesses who sell services to or are part of selected production and services sectors.

Figure 6 Design industry - user sectors

	Shares of Design Industry supplying selected sectors			
	Consultancy	Freelance	In-house	All Types
textiles, leather and clothing	1%	1%	3%	1%
wood and wood products	0%	0%	1%	0%
publishing, printing & paper	2%	2%	7%	3%
chemicals, plastic/rubber products, man-made fibres and fuels	3%	1%	4%	2%
glass, ceramic & other mineral products	0%	1%	2%	1%
metal products & machinery	2%	2%	5%	2%
furniture, jewellery & musical instruments	2%	1%	3%	1%
Manufacturing - other	5%	4%	7%	4%
Wholesale and retail	14%	13%	8%	13%
Post and telecommunications	3%	4%	1%	4%
Financial services	10%	8%	4%	8%
Other business services	10%	14%	5%	13%
Total Design Industry	12475	47379	5900	65754

Source: Design Council – *Business of Design Survey 2005*

A substantially higher share of design houses are selling into service than to production sectors,. This is further evidence that the reach of design as a major business input, with potential innovation inducing or supporting effects, is broader than its generally accepted functions in the appearance of products or in engineering drawings. Effective professional designers, working with the marketing and technology teams, can enable the transition from the technology driven to the market innovator stage for high tech firms.

Case Study 2.

Compelling Brand Story

Simple and **compelling brand stories** help technology start ups:

> attract press and investment interest
> attract people to recruit
> hold their own amongst much larger businesses
> communicate the benefit of obscure, complex and unproven technologies

The Business develops a new kind of fuel cell that can turn hydrogen or hydrogen containing substances into electricity and heat. They have a product that could exploit an emerging market for more environmentally friendly heat and power sources. The market is expected to mature in five to eight years.
The initial focus was on the technology performing at an optimum. Design input through the **Innovate pilot** helped to reduce commercial risk by challenging assumptions about target markets and users and by exploring whether earlier product introductions could be achieved in existing markets.

Equally it helped to focus the business on the benefits of the technology to ***potential customers and end users***. Using design techniques such as ideation and scenario building the team created new ideas and in areas such as mobile refrigeration systems, off-grid applications in developing economies.
Additionally, the business focused on their corporate and product brand strategy, shifting the emphasis of their position from a R&D based university spin out selling technology, to a innovation venture selling future power solutions. They invested in new materials to communicate their brand values and identity to potential customers and were soon able to float.

Source: Design Council

Design and technology indicators.

The UK innovation survey records design as an activity with associated expenditures, but, like CIS in other countries, collects information on design related IP – the importance of design registration and of complexity of design. Together, the three variables can be used to define a "design led" approach to innovation. In a similar vein, a subset of firms engages in R&D activity, intra or extra-mural and assigns some importance to patents to protect their innovations. The use of one or more of these can be defined as a "technology led" mode. Of course, there is a substantial overlap between the two sets

of firms. The majority of technology led innovators are also design users, often as a complementary investment, to translate R&D results into new and improved products and processes. The combined mode can be defined as "design inclusive". Figure 7 shows the shares of UK businesses who adopt the three modes.

Figure 7 Design and Technology led modes

	Not Design led	Design led	Total
Not Technology led	59.5%	7.3%	66.8%
Technology led	9.2%	24.0%	33.2%
Total	68.7%	31.3%	100.0%

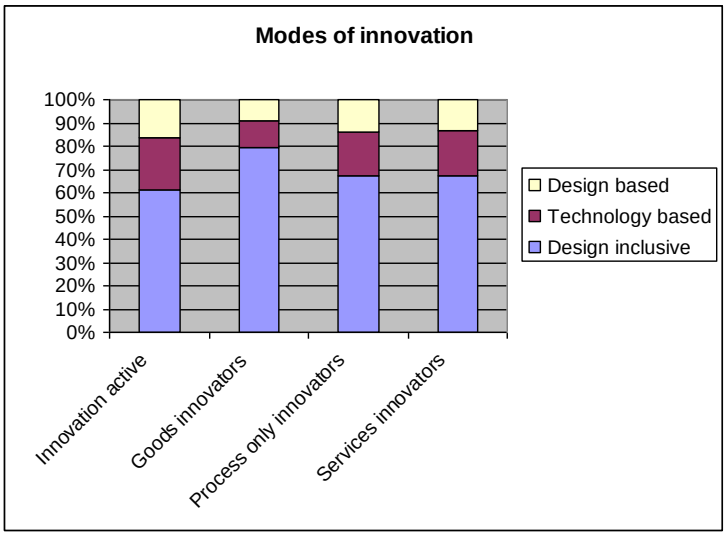
Source: UK Innovation Survey 2005 (CIS4)

These modes are defined excluding other types of input in order to focus on technology development and design functions as the formal creative sources for innovation and to bring out the role of design as an innovation generating investment substantially complementary to technology.

Modes and Outcomes.

The three modes defined above can be used as an analytical framework for a range of innovation outputs. Do the users of the three modes achieve different types of innovation in the market place or in the business itself?

Figure 8 shows how various forms of innovation are spread between these modes. The design inclusive approach is more common across all the levels shown here, but more so in the case of innovation in goods.

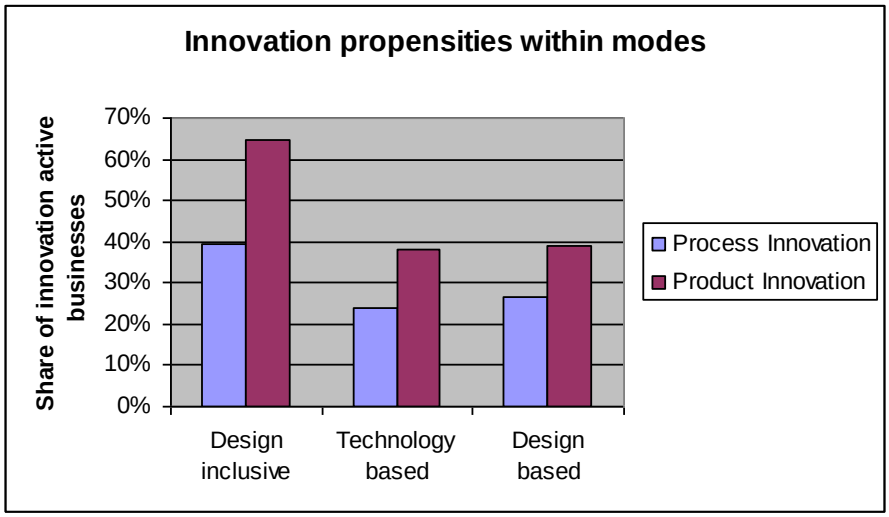


Source: UK Innovation Survey. Based on enterprises who use one of the modes.

There are significant shares of businesses in all innovation categories who specialise in technology or in design as the internal creative driving force for their innovations.

Figure 9 shows the propensity to product and process innovation by the three modes. This analysis indicates again that the design inclusive mode, with complementary technological and design related investment, is associated with higher propensities to innovate contemporaneously than basing creative inputs of new technology or design alone. There is though little difference between innovation propensities between the latter modes.

Figure 9 Innovation propensities by mode



From this, albeit simple bi-variate analysis, we can see that design based or inclusive indicators can add materially to understanding innovation outcomes. Do the relationships survive more rigorous statistical testing?

Design and the innovation system.

This section extends the empirical analysis by applying econometric models that enable the relationships between innovation and the design input to be quantified, conditional on other inputs and on industry and regional patterns.

Econometric Models – Design and other inputs

The relationships between Design as an input and the various dimension of innovation output that have been explored so far in simple bi-variate forms, using data from the UK innovation survey can be modelled using appropriate econometric techniques, which control for the

effects of other inputs and other conditions of the innovation system. The results reported below are of experimental probit regressions, where various measures of the propensity to and intensity of product or process innovation are "explained by" design and other innovation activities. The Tables report only the estimated parameter values for the marginal effects of a change of 1 unit, in effect from "off" to "on" for the binary versions of the set of innovation input activities collected in the UK survey, together with tests of significance – standard errors and "z" scores. The full models also include the sources of information for innovation used by respondent enterprises, together with sector and regional dummies and the co-efficents are not reported here.

Product Innovation

These results show the effects of each of the measured inputs on the propensity to product (good or service) innovation, defined as a product at least new to the enterprise. The effect of some investment in design is positive and statistically significant. The parameters on intra-mural R&D and market preparations are both larger and more significant. But design is a distinct input to basic product innovation.

Dependent = PRODINOV

Independents	dF/dx	Std. Err	z
Intra-mural R&D*	.170	.010	17.25
Extra-mural R&D*	.037	.012	3.04
Plant, equipment & software*	.039	.009	4.24
External Knowledge*	.034	.011	3.02
Training for innovation	.036	.009	3.93
Design functions	.059	.011	5.46
Market preparations*	.189	.011	18.67

Process Innovation

In the case of innovation in process , design is also a positive and statistically significant input, although with a lower parameter value than in the case of product innovation. For process, the largest input effect on propensity to innovate is from capital and software expenditure.

Dependent =PROCINOV

Independents	dF/dx .	Std. Err	z
Intra-mural R&D*	.055	.008	7.6
Extra-mural R&D*	.036	.009	4.2
Plant, equipment & software*	.122	.007	17.3
External Knowledge*	.015	.008	1.9
Training for innovation*	.062	.007	9.0
Design functions*	.033	.008	4.3
Market preparations*	.043	.007	6.1

Novel Product Innovation

The intensity of innovation is measured in the survey in a number of ways. This table reports the estimated relationship between novel (new to market) product innovation and the binary input variables. Design remains a positive and statistically significant factor in explaining the difference between novel and follower forms of innovation. Interestingly some other inputs either have a negative sign or are not significant. The acquisition of external knowledge, the subject of much policy activity in many countries, loses significance in the novel innovation equation.

Dependent = Novel Product Innovation (given Product Innovation)

Independents	dF/dx	Std. Err.	Z
Intra-mural R&D*	.138	.018	7.3
Extra-mural R&D*	.054	.019	2.8
Plant, equipment & software*	-.051	.019	-2.6
External Knowledge*	.027	.019	1.4
Training for innovation*	-.010	.018	-0.6
Design functions*	.071	.018	3.9
Market preparations*	.124	.017	7.2

Summarising:

Engaging in design as part of the innovation process is associated with significantly higher probabilities and intensities of innovation, with marginal effects on the probabilities of product, process and novel product innovation around the values of 0.3-0.7. These translate

into around 15 – 20% higher propensity and intensity of innovation than those who report no distinct innovation related design investment.

Conclusions - Ways forward for NESTI work programme.

This paper has demonstrated, using data from the UK, that design, even measured very simply, can be shown to be a key constituent of innovation investment and complementary to traditional technology factors. It is doubtful that the UK is unique in this respect, so there is a good case for developing some explicit treatment of design in the family of innovation indicators under NESTI auspices. This concluding section notes, very briefly, some (non-exhaustive) options for taking this forward. The future work programme suggestions below have in common the need for an operation definition of design for survey purposes. This is a much disputed topic and one reason why progress in understanding the role of design and other complementary investments in innovation has made slow progress is that discussion quickly gets caught up in arguments about the true meaning and scope of reference of the term. But the „true" meaning of innovation itself, as well as knowledge, information, even R&D and other key variables in the innovation measurement area are equally disputable. But usable concepts for measurement purposes have been thrashed out. So it seems possible to do the same for design. Lines of inquiry could include identifying the functional specialisations of staff or departments, or the possession of design qualifications.
However the aim here is not to pre-empt that conclusions of a discussion on how to define design for indicator purposes but to suggest that we should have that discussion as part of developing indicators for the twenty first century.

Some possible contexts for the discussion and for supporting work streams include:

Longer term

Frascati for Design

This session is about non-technological innovation. Although the analysis has tended to high-light the complementarity of design and technology, there may be a case for a distinct guidance manual on the measurement and interpretation of non-technological innovation, including design.

Include functional analysis in the Frascati manual and the R&D surveys- try to quantify the design element in R&D.

Possible amendments or annexes to Oslo manual.

Amend guidance on how design should be treated in in innovation definitions and expenditure categories.

Introduce a distinct design based innovation concept.

Include an Annex on measuring Design investment and applications

Shorter term

Forthcoming Surveys

Encourage colleagues in research and statistics agencies involved with innovation surveys to include design investment in the next run of their survey.

Analysis

Investigation and analysis projects under NESTI auspices should include modes of innovation, including design related forms where data or proxies are available, in the models to be examined. One example would be in the projected joint NESTI/SWIC project on the impacts of innovation.

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