



dti

RAISING UK PRODUCTIVITY

Unlocking the potential
of Information and
Communication
Technology (ICT)

JUNE 2007



Information age partnership

The Information Age Partnership (IAP) is a forum to provide leadership in the UK, and take maximum global advantage of the technological, economic and political developments which characterise the Information Age.

The Partnership supports high-level dialogue and debate between the Chief Executives of the UK's leading IT, Electronics, Communications and Content companies, Ministers and senior Government officials.

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Foreword

Margaret Hodge, Minister of State for Industry and the Regions
Chair, Information Age Partnership



Our future prosperity depends on our ability to become more productive. We face this challenge against a backdrop of increasing global competition and rapid technological change.

Increased productivity in the UK can be achieved through a number of mechanisms but, as this paper sets out, one way is through the effective use of information and communication technology. The evidence shows that there is a link between ICT investment and improved productivity, but simply spending more on ICT is not, in itself, enough.

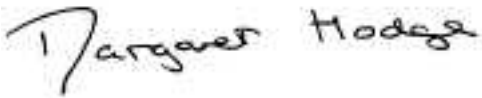
This is why this paper is so important. At its heart is a key message that higher levels of productivity can be achieved where the use of ICT is combined with changes in organisational structure and process. The best performing companies already recognise this. Travelling the country I have seen many good examples where the effective use of ICT has underpinned new and innovative business processes.

Our challenge is to get more organisations on the path to higher productivity through change enabled by ICT. This paper sets out some of the barriers to overcome and makes practical recommendations, to industry and Government, to get the most from investment in ICT.

There is already considerable activity on which to build. There is the work of Sir David Varney on transformational government and Lord Leitch's recent report on skills. This paper is intended to build upon these. There is still much to be done in all these areas and if we are to be successful, we need to understand the interdependencies that exist between these different strands.

I therefore welcome this report as a basis for ongoing action and further discussion. The Information Age Partnership, and the DTI as a member of that partnership, is committed to delivering the proposed actions. I would urge all in the public and private sector to work with us to achieve the higher levels of productivity essential to deliver the society we aspire to live in.

Finally I would like to thank all the public and private sector organisations that have contributed to the paper. In particular, thank you to the members of the Information Age Partnership and especially Clive Ansell and his BT colleagues who have led the work on behalf of the Partnership.

A handwritten signature in black ink that reads "Margaret Hodge". The signature is written in a cursive style with a large initial 'M'.

Margaret Hodge, Minister of State for Industry and the Regions
Chair, Information Age Partnership

IAP foreword

Duncan Mitchell, Vice President and Managing Director, Cisco UK and Ireland
Chair, Information Age Partnership Executive.



There is a broad consensus that the current wave of globalisation challenges governments and businesses to do things very differently. For a start we must raise UK productivity. In this context, last year the then Minister of State, Alun Michael, asked the Information Age Partnership (IAP) to work on a project with DTI to explore the role that information and communications technologies (ICT) can play in raising UK productivity.

The IAP's work programme is closely aligned to the big challenges identified by HM Treasury. I think that this report is a useful contribution to the ongoing analysis of the intensification of cross border competition and is itself a commentary on the acceleration in the pace of innovation and technological diffusion.

Let me be clear, this report is not special pleading for more expenditure on ICT but rather an attempt to change the terms of the debate. No longer is it a question of whether ICT can impact productivity but rather how and under what circumstances the use of ICT can materially increase productivity.

In looking at historical data, the report presents a cogent analysis of the links between ICT and productivity and in doing so concludes that a more useful analysis and future discussion should concentrate on the interplay between ICT and those factors contributing to total factor productivity (TFP). The report spotlights the importance of business process change and offers a number of recommendations of how to raise UK productivity growth by unlocking the potential of ICT.

I think this report offers a distinctive perspective yet it sits as an integral part of the pan-government productivity agenda. It's worth saying that the greatest benefits will come as a result of free trade and market forces and the suggestions in this report are intended to complement such an approach.

The report naturally looks backwards for evidence but its locus is the future. The report makes the case for concerted action by government and industry now. Of course, a report is just the start. But I think it's a timely one.

The Partnership is committed to playing its part in addressing the recommendations identified in this report. I look forward to working with stakeholders across the public sector in doing so and invite you to consider whether and how you can play your part.

Finally I would like to acknowledge the work of the numerous DTI officials and industry participants; in particular I would like to thank Clive Ansell, BT who has led the work on behalf of the Information Age Partnership.

A handwritten signature in black ink that reads "D. Mitchell". The signature is written in a cursive style with a large initial 'D' and a horizontal line at the end.

Duncan Mitchell, Vice President and Managing Director, Cisco UK and Ireland
Chair, Information Age Partnership Executive

Executive summary

ICT helps drive productivity

The UK must continue to close the productivity gap with its competitors and ICT has a prominent role to play in enabling business and the public sector to meet this challenge. It does so through two mechanisms:

- 'capital deepening', – where the investment in ICT improves the level of capital stock in the economy so that each worker has more available to them, and as;
- an enabler of change through the most effective application of the technology and skills, to improve efficiency as expressed through total factor productivity (TFP).

The challenge to business, and the public sector, is how best to implement process and organisational change, supported by ICT, to drive productivity improvement.

The UK can do even better.

Market forces will generally provide many of the incentives for companies to use ICT to boost productivity and make the changes to business processes. However the IAP believes there are a number of key actions to help drive productivity growth in the UK, including:

- Establish a business process centre of excellence to foster skills development and spread best practice in the effective use of ICT;
- Build on existing initiatives to encourage improvement in the ICT knowledge transfer and change management skills of owner managers of firms, IT users and IT professionals; and
- Work with the Better Regulation Executive to review the impact of regulation on the take up and use of ICT.

If the UK is to continue to improve its productivity, then effective exploitation of ICT is vital. This is something that both government and industry have to address in partnership. This report examines the economic evidence, highlights the most significant challenges and gives a strong direction on how we can address problems that contribute to the delay in realising the productivity benefits of ICT investment. The IAP is ready to offer the necessary leadership to carry forward these actions.

Chapter 1

ICT: Policy environment

1. Information and communication technology (ICT) pervades our lives. It is arguably as important this century as steam power and electricity were in others, and its impact will be more rapid. This report aims to:
 - develop a shared understanding of ICT's contribution to productivity;
 - identify the barriers that need to be overcome to maximise this contribution in the UK; and
 - propose a set of new actions, building on existing initiatives, that both private and public sector can take to raise productivity through the use of ICT.
2. The report is relevant to both public and private sectors. Increased productivity in the private sector is vital for wealth creation and economic competitiveness. Increased productivity in the public sector ensures quality services at best value.
3. This report does not exist in a vacuum. It is intended to complement and add to the extensive thinking and work that has already been done in a number of related areas. These include:
 - The Transformational Government Strategy¹ and the related Varney review² have set out the opportunities for transforming the delivery of public services and the strategy to deliver them;
 - The Leitch review³ has identified the skills required by the UK by 2020 to maximise economic growth, productivity and social inclusion, and considered the policy implications of achieving this;
 - The Crosby review⁴ is examining identity management architecture across government;
 - The Gowers review⁵ looked at the fitness of the intellectual property (IP) regime to support a thriving, knowledge-based economy. This included how IP can facilitate new business models; and
 - The National Audit Office has published guidelines on best practice in the use of ICT in the public sector.⁶

1 Transformational Government. Enabled by Technology Cabinet Office November 2005

2 *Service Transformation: A better service for the citizens and businesses, a better deal for the taxpayer.* Sir David Varney. December 2006. Available at http://www.hm-treasury.gov.uk/pre_budget_report/prebud_pbr06/other_docs/prebud_pbr06_varney.cfm

3 http://www.hm-treasury.gov.uk/independent_reviews/leitch_review/review_leitch_index.cfm

4 http://www.hm-treasury.gov.uk/newsroom_and_speeches/press/2006/press_51_06.cfm

5 http://www.hm-treasury.gov.uk/independent_reviews/gowers_review_intellectual_property/gowersreview_index.cfm

6 *Delivering successful IT-enabled business change.* National Audit Office. November 2006. Available at <http://www.nao.org.uk/pn/06-07/060733.htm>

- The European Commission has set up an industry taskforce with a mandate to identify major obstacles to the ICT sector's competitiveness and to the use of ICT, drawing the attention of member states to the obstacles identified and recommending possible policy responses.⁷

The report should also be read in the context of the five long term challenges facing the UK that have been identified by HM Treasury.⁸ These are:

- demographic and socio-economic change, especially increasing numbers of old people and rising expectations of public services;
- global competition, with the rise of China and India and the intensification of cross border competition;
- the rapid pace of innovation and technological diffusion, transforming the way people live and the way services are delivered;
- global uncertainty through terrorism and poverty; and
- increasing pressure on natural resources and global climate.

The effective use of ICT helps us to meet all five challenges by generating and supporting technological solutions to major global and demographic challenges. However this report focuses on the potential of ICT to increase productivity in the UK.

⁷ <http://ec.europa.eu/enterprise/ict/taskforce.htm>

⁸ Long term opportunities and challenges for the UK: analysis for the 2007 Comprehensive Spending Review. HM Treasury November 2006

Chapter 2

Links between ICT and productivity – the economic evidence

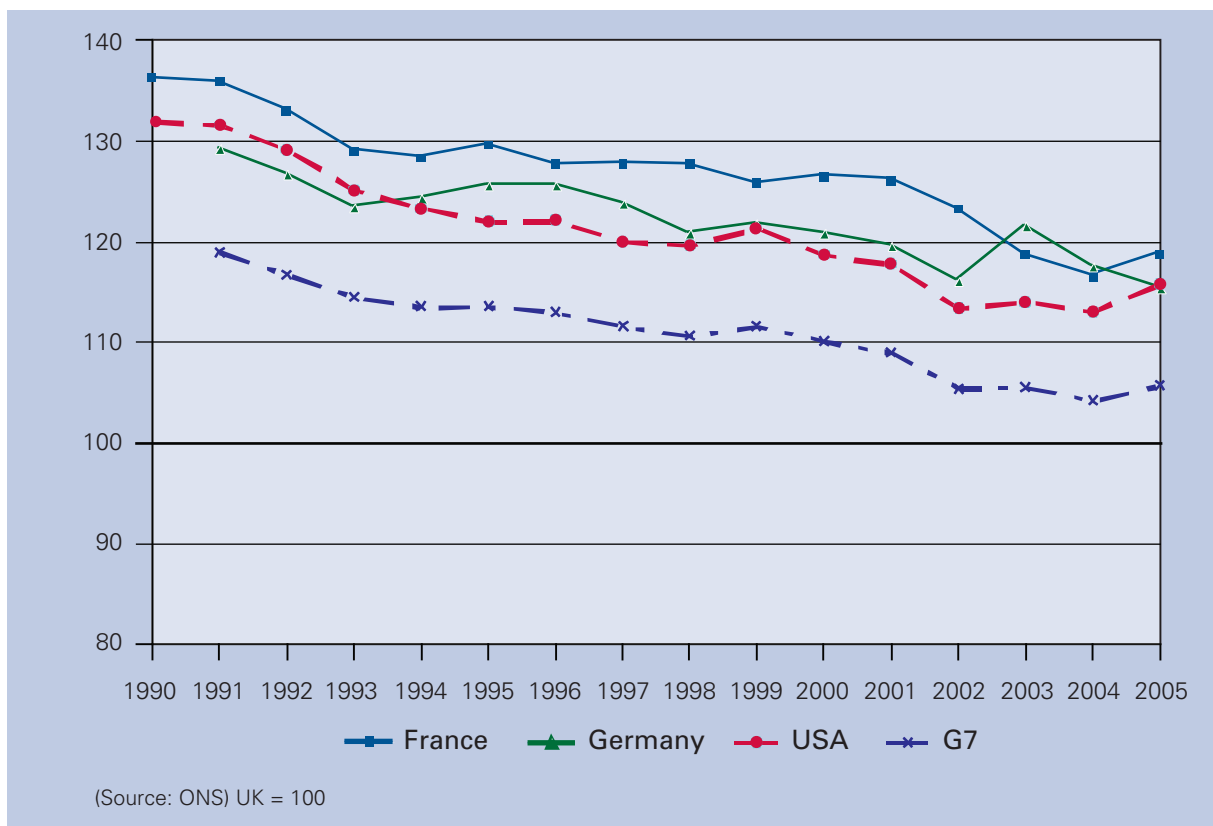
Introduction

4. Globalisation and the corresponding increase in competitive pressures are rapidly changing the context in which UK businesses operate. Business and Government must respond to globalisation by boosting the UK's competitiveness, which means raising productivity.
5. The UK has a long-standing productivity gap with its main industrial competitors (normally identified as France, Germany and the USA), but over recent years progress has been made in narrowing this gap. UK trend productivity growth over the economic cycle appears to be increasing.⁹ Progress has also been made in reducing the productivity gap with France and Germany, and the UK is the only G7 country not to have fallen further behind the US over this period (see Figure 1 below).¹⁰

⁹ PBR 2006, December 2006.

¹⁰ ONS, International Comparisons of Productivity First Release, February 2007.

Figure 1: International Comparisons of Productivity – Output per Hour Worked



6. However, improving the rate of productivity growth is a long-term challenge, as it takes time for economic reforms to take effect. The DTI has a joint overarching productivity Public Service Agreement (PSA) target with HM Treasury:
 - 'Demonstrate further progress by 2008 on the Government's long-term objective of raising the rate of UK productivity growth over the economic cycle, improving competitiveness and narrowing the gap with our major industrial competitors.'

7. The Government's approach to raising productivity centres on maintaining macroeconomic stability and implementing microeconomic reforms to address barriers in the market. As part of this approach, the Government identified five key drivers of productivity – investment, innovation, skills, enterprise and competition – under which a wide-ranging programme of reforms have been introduced.

8. The UK is making progress on all five drivers of productivity, in particular with respect to the competition regime, improving the skills base, and the success of the UK's science base. But there are still areas which need improvement, including our levels of investment and expenditure on R&D.
9. Investment in Information and Communication Technology (ICT) is part of this, with recent studies suggesting that part of cross-country differences in productivity can be attributed to poor management and investment in and use of ICT.¹¹
10. The focus of this chapter is to look at the means through which ICT contributes to productivity and the evidence supporting the role that these mechanisms play in improving economic performance.

How does ICT improve productivity growth?

11. ICT has both a direct and an indirect impact on improving productivity. These are discussed in turn below.

Capital Deepening

12. ICT has a direct impact on productivity growth through the ICT-producing sector both in manufacturing and services, for example, through the production of ICT and complementary telecommunications equipment and communications services and related activities.
13. However the direct impact is wider, through investment in ICT capital by the rest of the economy (both private and public sectors). Investment in capital potentially raises labour productivity by increasing the capacity of the economy. ICT, as a form of capital equipment, can increase economic capacity through improving the capital stock of an economy. This 'capital deepening' means that there is an increase in the average amount of plant and machinery (in this case ICT) that each worker has available to them.
14. The power of ICT equipment is continually increasing, for example through new generations of semiconductors and developments in software. Therefore continual investment is required to replace, update and increase an economy's ICT capital.

¹¹ For example, European Commission, ICT taskforce Group, Fostering the competitiveness of Europe's ICT Industry, 2006.

15. Table 1 below shows the rate of ICT investment across a number of countries over the last 20 years. There are some measurement issues associated with calculating some aspects of ICT investment (for example, software) and these are outlined in Annex A.

Table 1: ICT investment 1980-2003 – Percentage share of ICT investment in total non-residential investment, current prices

		France	Germany	UK	US
<i>IT equipment</i>	1980	1.8		2.7	3.4
	1990	2.8		6.6	6.2
	1995	2.9	4.6	8.7	8.0
	2000	3.9	7.0	9.8	8.0
	2003	3.1	5.1	7.5	6.8
<i>Communication Equipment</i>	1980	3.0		2.0	6.6
	1990	3.3		2.2	7.3
	1995	3.5	4.1	3.8	7.7
	2000	4.0	4.5	5.5	9.8
	2003	3.1	3.3	3.6	7.2
<i>Software*</i>	1980	1.3		0.9	2.7
	1990	2.7		5.5	7.7
	1995	3.5	4.6	9.2	9.0
	2000	6.2	6.0	9.7	13.9
	2003	6.4	7.0	10.7	14.9
<i>Total ICT</i>	1980	6.1		5.7	12.7
	1990	8.7		14.3	21.2
	1995	9.9	13.3	21.7	24.7
	2000	14.1	17.5	25.0	31.7
	2003	12.6	15.5	21.8	28.9

(Source: OECD Productivity Database, last updated March 2006)

16. Although the situation in the US will be discussed in more detail below, it is clear that over the time period covered here, the US has invested significantly more in its ICT capital. Recently, the UK has started to close the gap in investment in IT equipment and software, but there still appears to be a shortfall on investment in communication equipment.
17. The improved level of investment by the UK may be attributed in part to the level of macro-economic stability experienced over recent years, as uncertainty over the economic climate is key in a firm's decision to invest. In general, investment will be lower in a more volatile environment. The effect of this type of uncertainty on the relative investments in ICT and other equipment is unclear. On one hand, the general-purpose nature of ICT provides considerable flexibility for a number of options to be considered by companies for their future production. On the other hand, the technological uncertainty of ICT-related investment projects (for example the rapidity of development) may lead to a delay in some aspects of ICT investment.

An Enabler of Change

18. Investment in ICT by itself does not cause productivity growth – it is the means, not the end point. The value-added from investment in ICT comes from what it allows firms to do and how they exploit the ICT.
19. For example, ICT lowers the cost of knowledge accumulation to a firm, through providing better communications systems and opening up networks for information gathering. However, turning knowledge into higher profits and wages can require a major change to an organisational structure and lead to changes in relationships with suppliers and with customers.
20. ICT also allows firms to improve their products in ways that are not always easy to capture in the statistics. These include faster delivery, greater choice and/or customisation, customer-care and changes in quality. Commentators often refer to 'new business models', as ICT enables firms to create a more efficient, and profitable, business structure to take account of any potential market benefits. These changes need to be rooted in the production-methods and operational procedures of firms and are complementary to the investment in ICT.

21. However there is a cost to the firm of changing potentially well-established business models. Brynjolfsson and Hitt (2000)¹² suggest that firms commonly spend nine dollars on complementary investments for every dollar spent on ICT. This complementary investment also captures the costs of improving the skills profile of the firm, which will be discussed in further detail below. To an extent there will also be a degree of experimentation as firms seek to establish the best way of exploiting ICT.
22. Investment in ICT and the subsequent ability to develop more efficient business models may have implications for how markets are structured. New firm entrants potentially have an advantage as they are most likely to enter a market with products developed using the latest technology – i.e. they are starting from scratch rather than building on previous investment and technological processes. New entrants may have a competitive advantage over incumbent firms and hence may improve competition in that industry overall.
23. This could affect entry/exit rates of firms into and out of the market. In the long run, the closure of poorly performing firms and the start-up and then growth of better performing businesses contributes to the overall productivity growth in an economy.
24. High technology manufacturing and some business services, such as ICT related industries, display higher entry rates and failure rates than the average. In ICT industries, the entry of new businesses makes a stronger than average contribution to aggregate productivity growth, given that in highly innovative industries the entrants are likely to adopt the latest technologies. Evidence suggests that plants entering ICT industries have lower levels of productivity than average incumbent firms, but higher productivity than firms who leave the industry.¹³ Many studies find that firms forced to leave an industry have a lower productivity than average.¹⁴ This implies that the overall productivity of the industry rises as these firms exit.
25. This role of ICT in improving productivity growth is effectively its contribution to Total Factor Productivity (TFP) growth – i.e. the improvement in efficiency of combined capital and labour inputs.

12 Brynjolfsson, E. and L. Hitt (2000), "Beyond Computation: Information Technology, Organizational Transformation and Business Performance", *Journal of Economic Perspectives* 14(4), 23–48.

13 Bartelsman and Doms, 2000

14 Intuitively this is logical, as firms with the lowest productivity in the industry will be under strong competitive pressure. Hence they may be forced out as their business model may be unsustainable when challenged by competitors who have a higher (average) productivity.

Complementary factors

Skills

26. Effective adoption of ICT is a form of innovation. For example it can improve communications within and between businesses, and facilitate new ways of completing transactions of sales and purchases and help develop more efficient business processes. One factor in the success of incorporating ICT into businesses is the availability of particular skills at the time of initial adoption and then subsequently when the characteristics of the new technology are understood by firms.
27. Evidence suggests that having appropriate skills at the time of initial adoption of new technology is more important than for its continued use. Higher skill levels are in particular demand in the initial implementation phase because of the need to rapidly adopt organisational changes and make other necessary adjustments to maximise the advantage of bringing in new ICT. O'Mahony and van Ark (ed.) (2003), for example, found that the contribution of labour quality to labour productivity growth was more important in the US in the 1980s, particularly in the main ICT producing and ICT using sectors.
28. Beyond the initial adoption of ICT, the impact of skills levels varies between industries, and it is vital for each firm to construct their own models for implementing ICT profitably.
29. For example, in most manufacturing industries, ICT has largely contributed to the rationalising of production processes. Farooqui (2005) found that in manufacturing the introduction of ICT had the effect of reducing demand for unskilled workers whilst increasing relatively demand for highly skilled employees. Here firm investment in ICT, on some occasions replaces labour as a factor of production. Alternatively, ICT combines with labour to produce higher levels of firm output.
30. In services, however, the effect of ICT investment has tended to create extra demand for both skilled and unskilled labour. This is because:
 - The rationalising of processes and the introduction of more knowledge-intensive services has increased the demand for very highly skilled workers; and

- Adaptations or improvements since the initial investment in ICT may have, for example, made it easier to use. Therefore, in some cases, firms may be able to employ workers with lower skills.

In services, ICT investment appears to support and enable low skilled workers, for example in call centres.

31. Preliminary findings from an ONS/LSE study suggest that the availability of appropriate skills within the firm plays a bigger and more direct role in determining how effectively firms can achieve productivity gains from ICT investment than if skills have to be brought in from outside. Skilled workforces within firms appear to reinforce the productivity effects of ICT investment, especially in the low-ICT using industries. However, this skills effect was found to be less significant in high ICT-using industries.

Regulation

32. The underlying assumption for government intervention is that there is a failure in the market that needs to be corrected. Regulation is one way of targeting these failures, although it is clear that such interventions need to be well planned and supported by a robust evidence base. If not, then regulation can impede the product, capital and labour markets from working as efficiently as possible. The evidence discussed below suggests that regulation of both labour and product markets can inhibit investment in ICT and its associated assets.
33. Product market regulations, which may limit competition, can also limit firms in the extent to which they have the incentives and capacity to fully realise the potential benefits of ICT. This was highlighted in recent OECD work (Conway et al. 2006)¹⁵. Poorly developed product-market regulations may not allow firms to enter markets and introduce products and services that have been made possible by new ICT technology. This is particularly true in relation to the provision of services, especially across borders. Similarly, regulations may restrict the ability of firms to benefit from improved production efficiency through ICT investment, for example, restrictions by retailers on the size and location of new stores. Finally, regulation which impedes rather than promotes competition will reduce the incentive for firms to invest in new technologies (see Scarpetta et. al)¹⁶ for further discussion on the relationship between competition and productivity.

¹⁵ Paul Conway, Donato de Rosa, Giuseppe Nicoletti and Faye Steiner *Regulation, Competition and Productivity Convergence Working Papers* 509 Paris OECD September 2006.

¹⁶ Scarpetta, Stefano, Phillip Hemmings, Thierry Tresselt and Jaejoon Woo (2002) *The Role of Policy and Institutions for Productivity and Firm Dynamics: Evidence from Micro and Industry Data*, Working Paper No. 39, Paris: OECD.

ICT and the recent economic performance of the UK, US and Europe

34. The previous section looked at how investment in ICT can improve productivity growth. This section seeks to cover some of the empirical data available looking at the experiences of the UK, the US and European countries over recent years.
35. Over recent years, the US has experienced a sharp acceleration in whole economy labour productivity growth compared to the previous decade. European countries, on the other hand, appear to have fallen behind. The UK's performance, although still lagging behind the US, has significantly exceeded France and Germany, hence closing the productivity gap with them.

Table 2: Annual percentage labour productivity growth in the market sector, 1995-2003

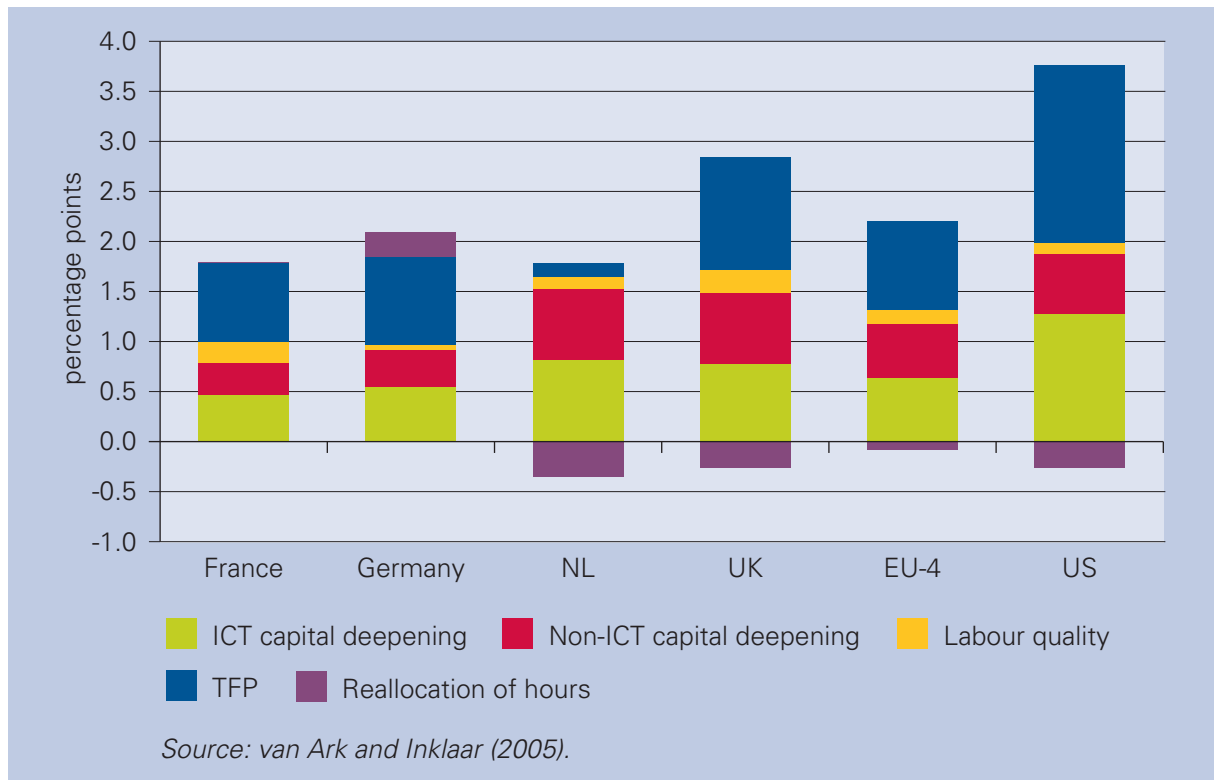
	Annual Growth, % (1995-2003)
France	1.80
Germany	2.08
Netherlands	1.41
UK	2.59
EU-4	2.12
US	3.51

(Source: van Ark and Inklaar, 2005)

36. A number of possible explanations for the US' increased growth have been suggested, including the potential role that adoption of ICT has played.
37. Figure 2 below disaggregates recent productivity performance, over the 1995 to 2003 period, into five components to attempt to explain the differing market economy labour productivity performances across France, Germany, the Netherlands, the UK and the US. The difference in productivity is explained by differences in the growth of firm investment in physical capital (both ICT and non-ICT) improvements in the quality of the workforce, improvements in the efficiency by which firms combine technology and skills (total factor productivity, TFP) and improvements in the ways capital and labour are reallocated across firms.¹⁷

¹⁷ Strictly TFP captures all factors that might have contributed to productivity growth other than increased capital investment or improved labour quality.

Figure 2: Sources of labour productivity growth, market economy, 1995-2003 (percentage points).



38. The UK's disaggregated performance shows a relatively strong TFP performance (contributing 1.13 percentage points to labour productivity growth, compared with 0.79 in France and 0.88 in Germany). The UK also out-performs France and Germany in firm investment in ICT equipment (capital) and non-ICT capital.
39. The figure also shows that the most important contribution to US superior productivity growth over the full period was that made by improvements in TFP. The second most important contribution was investment in ICT capital. Although it is not shown on the chart, there was a sharp contrast in the relative contributions of ICT investment and TFP to US productivity growth in the period 1995 to 2000 in comparison to the subsequent period from 2000 to 2003. This has prompted questions over the relationship between these two factors.

40. Van Ark and Inklaar (2005) suggest that between 1995 and 2000, 75% of whole economy labour productivity growth in the US was due to direct ICT contribution. This is through US firm innovation in producing new products that embody ICT (ICT production) and other US firms investing in these ICT products (ICT capital). However, they also state that between 2000 and 2004, the direct contribution of ICT has dropped sharply to around 30%. The contribution from TFP, on the other hand, increased from under 20% between 1995 and 2000 to over 50% in the subsequent three years. Insofar as the TFP growth in other sectors can be attributed to the use of ICT, the direct ICT contribution alone would have underestimated the overall impact of ICT.
41. Table 3 below picks up the importance of the ICT producing and market services sectors to productivity growth and the contrasts across countries. It shows that the UK experience is much closer to France and Germany in the productivity contribution made by ICT producing sectors. In contrast, however, the UK and the US market services sector accounts for 50% and 58% of labour productivity growth respectively between 1995 and 2003. This compares with a much lower 7% in France and 16% in Germany.

Table 3: Industry contributions to labour productivity growth, 1995-2003, percentage points

	Fr	Ger	NL	UK	EU4	US
Market Economy labour productivity growth	1.80	2.08	1.41	2.59	2.12	3.51
<i>Of which:</i>						
ICT producing sector	0.71	0.84	0.41	0.87	0.83	1.15
Market services	0.12	0.34	0.63	1.29	0.57	2.02

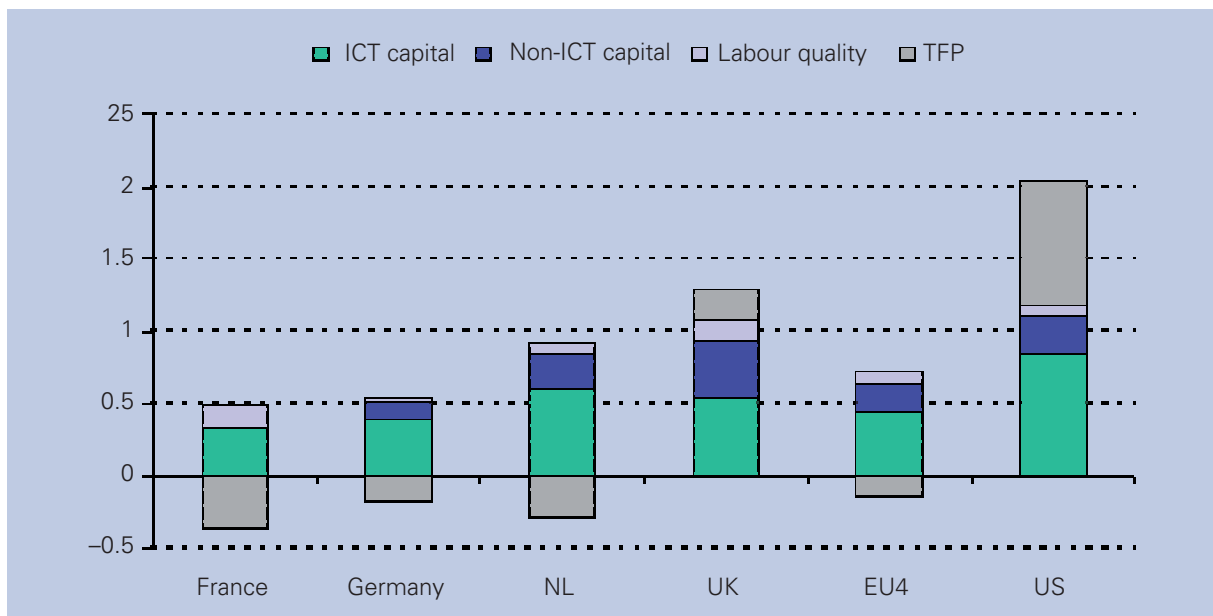
(Source: van Ark and Inklaar, 2005)

42. The contribution from the ICT-producing sector is stronger in the US for two reasons. First, US productivity growth in this sector was faster than that experienced in the EU. The production of ICT equipment exploits superior knowledge and embodies this performance improving technology. In the US, a very sizeable proportion of these productivity benefits were captured by the

producers of ICT equipment.¹⁸ Secondly, ICT-producing manufacturing sectors (with the most rapid growth) accounted for a more significant share of total value added in the US than in the EU (2.7% against 1.3% in 1999)

43. Figure 4 below disaggregates the market services sector further to analyse the sources of productivity growth. The market services sector includes some of the intensive ICT-using industries. In fact, most of the difference in market services productivity growth can be traced to about six industries concentrated in trade and finance. Part of the difference in productivity growth can be explained by the fact that wholesale trade, retail trade and securities trade were larger sectors in the US than in Europe. Faster productivity growth within each industry, however, was the most important factor.
44. The results show that only UK and US market services firms have managed to extract positive TFP growth out of their investment in ICT technology. The US, however, was four times more successful than the UK in doing so.

Figure 4: Sources of labour productivity growth*, market services sector, 1995-2003



(Source: van Ark and Inklaar, 2005)

18 O'Mahony and van Ark (2003) shows that the EU does not always underperform. Performance in ICT producing services shows the EU ahead of the US 1995-2001, particularly in the important sector of telecoms services (8.9% against 6.9% average annual growth). In computer services the corresponding figures also favour the EU (1.6% against -4.4%). In 1999, the share of total economy value added in these sectors was 2.7% and 1.7% in the EU and 2.5% and 2.0% in the US respectively.

45. The difference in overall productivity growth rates in market services sectors suggests that there has been a slower diffusion of ICT technology in the EU. O'Mahony and van Ark (ed. 2003) estimates labour productivity growth in the US' ICT using services sector at 5.3% on average per annum between 1995 and 2001, compared with only 1.8% achieved in the EU.
46. The residual or TFP variable includes everything unexplained together with measurement errors. One of these errors is the omission of some forms of investment in assets complementary to ICT capital. The findings of Corrado et al (2005) suggest that investment in these complementary areas contributes to explaining divergent US and EU productivity performance, although it is clearly difficult to separate this from other factors.

Conclusions

47. The analysis above demonstrates the potential role of ICT in driving forward productivity growth. Investment in ICT has both a direct and indirect impact on productivity growth – directly through improvements to capital stock (i.e. capital deepening) and indirectly as an enabler of change and complementary investment.
48. Empirical evidence shows the potential contribution that ICT can make to productivity growth, citing in particular the experience of the US over recent years. The evidence also suggests there has been a greater diffusion of ICT in some sectors through the US economy than has been seen in the EU and greater capitalisation on the benefits that ICT investment can bring.
49. At all levels, ICT can enhance productivity and business performance, but only when combined with complementary investment in order to maximise the potential opportunities that ICT can bring. This additional investment covers a wide range of areas, including improving the skills base and organisational structuring, which provide opportunities for efficiency gains, making firms more competitive.

Chapter 3

Improving the UK performance

50. Taking into account the conclusions of Chapter 2, what can the UK do to further improve its productivity growth? The IAP has identified a number of barriers that hamper this growth:
- Businesses and policymakers often lack detailed and specific understanding of how the use of ICT, when combined with organisational and process change, can improve business performance;
 - Many businesses also lack the capacity or skills to effect successful process change. This not only impacts on the individual firm, but more widely, within the supply chain;
 - Legal and regulatory requirements may constrain the ability of firms to change and bring in new processes; and
 - There may be inadequate incentives, particularly in the public sector, to procure ICT effectively and to realise productivity gains.

The rest of this chapter sets out the case for specific actions to overcome these barriers.

Business process innovation

- **The private sector and Government should establish a Business Process Centre of Excellence to foster skills development and spread best practice**

51. If productivity growth can be improved through the use of ICT supporting business and process change, then a combination of skills are required to implement and manage this transformation. These include technical and managerial skills along with 'softer' skills such as leadership, changing corporate culture, measures and incentives.
52. These combined skills are rare in the UK and usually have to be imported, or else they exist in international organisations operating in the UK. Broadening and deepening the UK's skill base to manage business, process, people and technology together is essential for future prosperity.

53. The IAP proposes a Centre of Excellence, drawing together academic expertise to support both Government and industry, to build UK capacity in these skill sets. The Centre would accelerate and sustain the business process skills agenda and provide a critical mass of expertise beyond that which any organisation could achieve on its own. It would encompass:

- **best practice** in business process innovation and change, documenting the very best examples of process-led ICT-intensive projects;
- **development of tools**, such as case examples, metrics, benchmarks, and inventories of experts and technology tools for business process and change;
- **promoting awareness of the significance of business process thinking**, particularly for SMEs;
- development of strategies to deal with the rapidly emerging **“skills ladder”** issue in the IT workforce, including creating cross-company, MBA-style programmes for fast-track IT professionals, and linking them to professionals in other disciplines, which are seminal to business change (e.g., human resources or commercial professionals); and
- establishing a **skills development** environment for the UK’s Chief Information Officers (CIOs) and the creation of a new capability set for Chief Process Officers (CPOs).

Skills

54. There needs to be further action, building on existing initiatives, to improve the capabilities of owner/managers of firms, IT professionals and IT users so that decision makers can make the changes necessary to exploit technology and professionals can more effectively combine commercial and technical competence. Specifically we need:

- **More flexible skills frameworks – accelerating current activities to incentivise individual re-skilling (e.g. industry accepted technician skills and work based development for young people) and continuous professional development;**
- **Greater incentives – building capacity for providers and brokers to promote the ITQ user qualification, drawing where possible on funding from Train to Gain; promoting the variety of ICT career opportunities and facilitating re-skilling in mid-career.**

55. The ability of organisations to manage and exploit the technology depends on them having the requisite skills internally, or at least readily available in the marketplace. There are three broad constituencies whose needs have to be addressed:

- The owner/manager of the firm;
- The employees; and
- The ICT professionals.

The IAP makes its proposals against the background of the Leitch recommendation that the UK commit to becoming a world leader in skills by 2020.

56. e-skills UK Sector Skills Agreement for IT¹⁹ has already set out a strategy and action plan based on four objectives:

- To improve the attractiveness of technology careers, to grow the number, quality and diversity of new recruits;
- To prepare the future workforce, by ensuring that the ICT-related curriculum in schools, colleges and universities is relevant and appropriate to the needs of business;
- To develop the existing workforce to exploit new technology for improved business performance and productivity with specific priorities for business managers and leaders, IT professionals and IT users; and
- To put the voice of employers at the centre of qualifications and curriculum content and reform.

57. The IAP warmly supports these objectives but e-skills UK now needs to be empowered and resourced by the new employer-led Commission for Employment and Skills to deliver. We identify specific areas below where we believe action needs to be accelerated.

Actions aimed at owners and managers of firms

58. The proposed Centre of Excellence is intended to disseminate leading edge expertise in process change. However there are also existing opportunities to deepen the skills of owners and managers such as the SME Leadership and Management Programme and the Business Link Business Performance Diagnostic. Managers need to have a better understanding of the role ICT can play and develop a more strategic approach to its deployment and exploitation through:

¹⁹ e-skills UK is the Sector Skills Council for IT and telecoms. The sector skills agreement for IT can be accessed at www.e-skills.com/ssa. There are separate action plans for England, Wales and Scotland.

- embedding in existing training provision, a thorough understanding of the strategic business benefits of ICT and the necessary skills to exploit the productivity benefits; and
- enhancing e-skills UK's Business IT Guide to meet the needs of medium-sized companies as well as micro businesses and piloting the enhanced Guide in the South East England Development Agency (SEEDA) through Business Link advisers and other mechanisms such as the National Skills academies.

These proposed actions work with the grain of existing UK policy, capitalising on investment in existing mechanisms and structures thereby avoiding the creation of a new product at a time when business support is being streamlined nationally.

Actions aimed at employees

59. By 2008, some 7.6 million people will need to enhance their IT skills.²⁰ The ITQ user qualification and e-skills Passport can help achieve this but their implementation needs to be faster and broader. Current take-up of IT user qualifications is inadequate. The IAP therefore proposes, with e-skills UK, to:

- develop a best practice delivery model for the ITQ and to ensure this is rolled out through the Train to Gain brokerage network; and

The IAP also proposes that Government itself should set an example in the take-up of the ITQ/e-skills Passport.

60. The pooling of training has proved successful in some other skills areas and can lower costs and the barriers to entry for user businesses, especially SMEs. The IAP sees scope for:

- Pooled IT user skills training facilities, supported by e-skills UK and aimed specifically at jobseekers, delivered off or on-line to create a pool of potential recruits with basic skills.

This would provide a quick means of upgrading the skills for jobseekers/returners/career changers.

These proposed actions would also work with the grain of UK policy, helping to maximise investment to Train to Gain and its brand.

20 *IT Insights: Trends and UK Skills Implications*. e-skills UK/Gartner November 2004. Op cit.

Actions aimed at ICT professionals

61. Business needs access to IT professionals with the appropriate technical and business skills. The key to developing high level skills for ICT professionals lies in more effective links between the higher education system and industry. The IAP proposes action to encourage the HE sector to contribute to continuing professional development in the ICT sector. The IAP wants to see:
- universities working with industry to develop advanced modular courses and to increase industry investment in advanced skills development;
 - The Higher Education Funding Council for England and Research Councils providing greater incentives to universities to link their provision across business and IT departments, including both undergraduate programmes and research;
 - companies widening availability of placements and vacation employment opportunities for students;
 - clear signposting of existing provision where it meets employer needs;
 - the establishment of clear development pathways for IT professionals, including a new IT Technician's Award,²¹ work-based degrees and a post-degree continuing professional development programme developed in partnership between employers and universities and led by e-skills UK.
62. Additionally, the Leitch review foresees that every young person with the right qualification should have the opportunity of an apprenticeship place. This may be a challenge for SMEs, who may lack the range of IT functions to allow apprentices to complete all the necessary elements, or the administrative capacity to manage a relationship with an FE college. The IAP believes consideration should be given to forming Group Training Associations, based on a model developed by SEMTA (Science, Engineering, Manufacturing Technologies Alliance), to enable placements with other employers to cover all elements of an apprenticeship. The Associations could act as intermediaries to administer apprenticeships, deal with funding and arrange placements.

²¹ The proposed IT Technician's Award would be offered by FE colleges, and would lead to a recognised qualified technician status. e-skills UK is keen to accelerate its development and implementation, to help those SMEs that lack the resources to develop their own IT staff. This will not only help SMEs reduce the risk of recruiting unqualified IT professionals but also to provide a route for existing employees to acquire IT technician skills

Science, Technical, Engineering and Mathematics skills

63. Underpinning all actions to develop advanced professional skills is the need to reverse the decline in science, technology, engineering and mathematics (STEM) students. Research indicates 150,000 new recruits are needed in IT each year both for new posts and replacements but only 20,000 students graduate in computer science each year from universities and there is strong demand from other sectors for graduates in numerate disciplines.²²
64. Government and industry need to consider further incentives to encourage students to take up STEM disciplines at all levels building on the recently launched pilot initiatives in chemistry, physics, maths and engineering (with funding of £18 million), to raise demand from students from as wide a variety of backgrounds as possible to study STEM subjects in higher education. Building on this, the IAP is setting up industry campaigns to:
- promote the image of ICT as an attractive area to study and work in, led by Intellect in conjunction with e-skills UK
 - help provide up-to-date careers advice that is also imaginative, led by e-skills UK
 - explore the scope for an IT version of the “Power Academy”,²³ which has proved successful in attracting students to courses in power engineering in universities.

The regulatory framework

- **Launch a review of the relationship between data protection legislation and emerging ICT-based business models**
 - **Work closely with the Better Regulation Executive to ensure regulation does not have unforeseen consequences on the take up and use of ICT**
65. The regulatory framework can hinder the take up of ICT. The IAP believes that there are some key areas that may require attention, in particular data protection.
66. Current data protection legislation was not designed with new, online transaction models in mind. The IAP endorses the principles underpinning the UK’s data protection legislation, but believes the time has come to review whether the current mechanisms are adequate to ensure they can continue to be applied effectively and appropriately in the changing e-business environment.

²² *IT Insights: Trends and UK Skills Implications*. eSkills UK/Gartner November 2004. www.e-skills.com/ssa.

²³ See <http://www.iee.org/poweracademy/>

67. The IAP therefore calls for a review of the relationship between data protection legislation and emerging ICT enabled business models. Acknowledging the need to uphold the principles underpinning the regulatory framework on privacy, this review will need to examine how existing legislation is implemented and take a more holistic view of the viability of the existing EU legislative approach in a world where cross-border flows of personal information are the business norm.
68. More widely, the IAP welcomes the Government's current "Better Regulation" programme, in particular the strong focus on regulatory simplification and coordinated enforcement. The IAP welcomes the opportunity presented by the programme to suggest ideas for simplification and regulatory reform where regulation adversely impacts on ICT take up and intends to work closely with the Better Regulation Executive, particularly in the area of impact assessments.
69. The same issues apply at the European level and should apply to all regulations that impact on the exploitation of ICT, not just those aimed directly at ICT production or use. Directives and regulations need to be consistent with each other and with the objectives of the Lisbon strategy. Given the evidence that exploitation of ICT is linked to productivity, this should be a priority at political level within the EU. In particular, the European Commission and the member states, with industry, should develop codes of practice and business process standards that readily allow companies to ensure they are compliant with the relevant regulation.

Improving incentives

- **Consideration of new incentives to encourage public sector bodies to make productivity gains by allowing them to keep a proportion of the savings**

70. The market will, for the most part, incentivise companies to make the necessary investments. However that mechanism is largely absent for the public sector, so other ways need to be found.
71. The Spending Review (SR) process and the Government's Invest to Save programme already allows public sector bodies to invest in and benefit financially

from programmes that enhance productivity or efficiency. Nevertheless, much of the public sector has not invested in ICT-enabled process change. In some instances where it has done so, it has taken longer than a single SR period to bed in the changes and realise the benefits (e.g. Passports Agency).

72. The IAP suggests that public sector bodies focus on the potential of ICT-enabled process transformation and that the Government provide more compelling incentives for them to do so. One method might be to require departments to appoint a senior Chief Process Officer, with experience in ICT and organisational issues, to conduct a process review before each SR round, to identify areas where real (ICT- and other-enabled) process changes could yield productivity and efficiency gains. The IAP also recommends that public sector bodies should ensure that the senior managers and the employees involved all understand and share in the benefits of transformational change.
73. The IAP recognises that deploying ICT to drive change is a challenge and the public sector has had a number of high profile cases where projects have failed. But others, attracting far less publicity, have been successful. The NAO²⁴ has recently highlighted some of these successes and has drawn up a list of questions departments should ask themselves before embarking on ICT-enabled business change (see box) and made eight recommendations. The IAP would like to see the NAO's set of questions embedded in the Gateway Zero Process.

²⁴ *Delivering successful IT-enabled business change*. National Audit Office. November 2006.

Nine Key Questions for departments embarking on major IT-related change

Ensuring senior level engagement

1. Is the board able to make informed judgments about the department's capacity to manage change?
2. Does the department have in place a decision making structure that will ensure strong and effective leadership of the IT-enabled business change?
3. What incentives exist to drive performance?

Acting as intelligent client

4. Does the department have the necessary programme management skills?
5. What is the natural division of duties between the Programme and Project Management Centre and the Chief Information Officer?
6. How will the Department establish and promote an open and constructive relationship with suppliers?
7. How clear is the department about the business process that it is seeking to change or develop?
8. Does the technology exist to deliver the change?

Realising the benefits of change

9. Beyond immediate technical success, how will wider benefits be secured?

74. The IAP believes that that the recommendations outlined above will address issues identified through the evidence base. It considers there may be one other area of particular relevance to Government that might be considered, namely the use of ICT to improve policy making and delivery. This is not a new, understanding the role of ICT in supporting policy making was outlined in a report by the Cabinet Office in 1999,²⁵ but it remains important.
75. The Treasury/DTI report on productivity, published to coincide with the 2006 Budget, restated the critical role that the public sector has in supporting productivity growth and the interdependency of the private and public sectors in this respect. Investment in, and delivery of, public services have a direct impact on the growth potential for the whole economy.²⁶
76. The role of technology in helping achieve improved public services has been recognised in a number of publications, most recently the Transformational Government Strategy and the Varney review. There are many areas – health and education being two highly visible examples – where the use of technology is integral to achieving policy objectives. However, to be effective, the ICT component must be built in to the policymaking process at the earliest possible opportunity.
77. Therefore, in addition to the significant work that is already being done in all departments, the IAP proposes the following:
- greater use of ICT to facilitate the policy process – through online forums and policy blogs; multiple platforms for consultation purposes; interactive citizen/business engagement; and building on the widespread availability of, and access to, broadband services; and
 - the creation of an “experience sharing network” between the public and private sectors in the area of electronic delivery of services, as a method of contributing to the proposed development of Directgov and Businesslink.gov.

²⁵ *Professional Policy Making for the Twenty First Century*. Cabinet Office. September 1999.

²⁶ *Productivity in the UK 6: Progress and New Evidence*. HM Treasury and DTI. March 2006.

Chapter 4

Concluding remarks

78. There are a number of factors that can contribute to improved productivity, one being the effective use of ICT. Companies which are successful in the deployment of ICT use the technology as a factor of production rather than as an objective in its own right. Effective application of ICT can reduce the time, risk and resource expenditure necessary in order to ensure business improvement
79. Successful firms measure the cost of change and reduce it to a minimum. They do this by focusing on metrics relevant to their business objectives, including cycle time, product design time, lead time, time to market, response time (to customers), just-in-time, strategy-to-execution time and restructuring time. For example, in one firm the “process design to production” time and cost could be one hundred times greater than in another firm. Effective deployment of ICT is an important enabler in achieving improvements across all these metrics.
80. To achieve productivity improvement, businesses should be encouraged to invest in ICT that supports integrated process change. Process-based infrastructures are changing the way ICT is designed and sourced. Leading firms are building systems that separate ICT infrastructure services from higher-level business process services. They are encouraging ICT suppliers to provide a stable infrastructure able to support and foster change at the business level.
81. The nature of globalisation puts increased importance on the need for increased productivity growth. While there are signs that UK productivity performance has picked up in recent years, there clearly remains potential for improvement. In the UK economy, the responsibility for each company’s productivity rests with itself. In this report, the IAP has set out steps that it believes industry can take to help facilitate change that will promote higher productivity.
82. These issues apply also to the public sector, although the scale and breadth of the public sector and political considerations make them more complex. Government represents a significant part of GDP and its own services can contribute to

productivity growth in the wider economy. Investment levels in ICT in the public sector have been good but the effectiveness of implementation and translation into higher productivity are less reliable. The NAO's recent report will help but there is real scope for sharing knowledge between the private and public sector so that best practice can be identified and acted upon.

83. New public policy approaches can have an impact, positively or negatively, on the performance of UK-based companies and their ability to embrace change. This study has identified new public policy approaches in a number of areas and called for reinforcement of some existing ones. The implementation of the current cycle of Zero Based and Efficiency Reviews and the Comprehensive Spending Review offer a timely opportunity for the necessary concerted action.
84. The chief lesson of this report is that ICT investment has the potential to drive productivity only as an enabler of business change: companies investing in ICT need to ensure that the benefits of their investments are fully exploited and where possible are at the heart of driving change within the company. The challenges are large but so are the rewards. As an illustration, an increase in productivity growth in the UK of one percentage each year has the potential to increase GDP by an additional £10 billion, with the benefit increasing each year. The best efforts of the public and private sectors combined are needed. This reports sets out the path.

Measurement Issues and ICT

International comparisons of productivity are often complicated by measurement issues. National statistical offices often calculate the value of different aspects of their economies using different methodologies. This is particularly true with respect to the expanding use of ICT and the growing importance of the knowledge economy, which have posed new challenges to the statistical systems in tracing output, employment and productivity changes accurately.

The general measurement issues can be summarised as:

1) *Measuring ICT volume both as an output and an input*

The capabilities of ICT equipment has vastly improved over the past few decades. Traditional methods of sampling and calculating price indices for these goods do not adequately account for the rapid change in product quality. This will almost certainly underestimate the rate of price decline and through that, the rate of ICT output growth and the accumulation rate of ICT as an input. This affects the productivity estimates relating to these goods.

2) *Structural shift towards the service sector*

Traditionally the output of the service sector is more difficult to measure accurately than manufacturing output. The growing importance of the service sector in the developed economies increases the importance of the measurement error at the aggregate level. Furthermore, the increased use of ICT most likely has deepened these measurement problems by rapidly expanding product types and the dimensions in which products can be differentiated and customised.

3) Calculation of software investment

Countries may be moving at a different pace in capitalising software investment in their national accounts and methods may vary too. Data sources are the individual country's national statistical offices except for the UK, which is sourced from Groningen Growth and Development centre (GGDC). The GGDC incorporates adjustments to software investment, and in turn their series deviates from the official ONS services. Even so, the figures presented here are still lower than latest revisions to the ONS software series (see Chesson and Chamberlain, 2006). On the latest revised figures, UK software investment was around 14.5% of GFCF in 2003, which brings the UK on par with the US.

(Additional source: O'Mahony and van Ark (ed.))

Annex B

Glossary

CIO	Chief Information Officer.
CBI	Confederation of British Industry.
CSR	Comprehensive Spending Review. This is a long-term and fundamental review of government expenditure, examining the key trends and challenges that will shape the next decade and assessing how public services will need to respond. It will report in 2007.
DEFRA	Department for the Environment, Food and Rural Affairs.
DfES	Department for Education and Skills.
DTI	Department of Trade and Industry.
e-skills UK	The sector skills council for IT and telecoms.
HEFCE	Higher Education Funding Council for England. HEFCE is a non departmental public body that distributes public money for teaching and research to universities and colleges.
IAP	Information Age Partnership.
ICT	Information Communication Technology. #ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form.
ICT capital deepening	Investment in more or superior ICT
IPR	Intellectual property rights
ITQ	The National Vocational Qualification for IT Users which demonstrates staff competence in the use of IT in the workplace. It is offered at levels 1, 2 and 3. In Scotland, the qualification is called the Scottish Vocational Qualification in Using IT.

KTNs	Knowledge Transfer Networks. These have been set up by government, industry and academia to facilitate the transfer of knowledge and experience between industry and the science base. They bring together diverse organisations and provide activities and initiatives that promote the exchange of knowledge and the stimulation of innovation in these communities.
LSC	Learning and Skills Council. The LSC is a non departmental public body responsible for planning and funding high quality education and training for everyone in England other than those in universities
LSE	London School of Economics.
NAO	National Audit Office.
OFCOM	The independent regulator and competition authority for the UK communications industries, with responsibilities across television, radio, telecommunications and wireless communications services
ONS	Office of National Statistics
SEEDA	South East England Development Agency
SEMTA	The sector skills council for science, engineering and manufacturing technologies
SMEs	Small and medium-sized businesses
SSDA	Sector Skills Development Agency. The SSDA is a non departmental public body responsible for funding, supporting and monitoring the network of Sector Skills Councils.
TFP	Total Factor Productivity. When analysing productivity, this is the residual that cannot be attributed to specific inputs or factors of production and is often used as a proxy for operational efficiency

Acknowledgements

The Information Age Partnership would like to thank the following organisations that contributed to this report.

British Computer Society

BT

Cabinet Office

Cap Gemini

CBI

Cisco

CJIT

CSC

Department for Constitutional Affairs

Department for Culture Media and Sport

Department for the Environment, Food and Rural Affairs

Department of Trade and Industry

DETINI

Scottish Office

Department for Education and Skills

Department of Health

e-skills UK

HBOS

HM Treasury

IBM

IET

Intellect

Learning and Skills Council

LogicaCMG
M & S
Microsoft
Motorola
National Audit Office
Nortel
OFCOM
OGC
Office of National Statistics
Patent Office
Qinetiq
Reuters
SAP
Small Business Service
SEEDA
SSDA
UKTI
Welsh Assembly

Notes

First published June 2007. Department of Trade and Industry. www.dti.gov.uk

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