



technology, children, schools and families

# **Work and employment challenge 'quick reviews'**

**Rob Wilson and Lynn Gambin**

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## **Introduction**

This paper was commissioned as part of a series of reviews for the Working and Employment Challenge of the Beyond Current Horizons project on the future of education. The reviews all focus on particular issues relating to work and employment. This paper provides a series of 'quick reviews'

The six topics are:

1. The importance of Science, Technology, Engineering and Mathematics (STEM)
2. Children's work
3. Entrepreneurial activity and practices
4. Innovation and intellectual property rights
5. Emerging economies in virtual worlds
6. Possible negative effects of technological developments

For each topic any relevant and necessary definitions of key terms are set out alongside an overview of the importance and relevance of each topic to the UK economy and society. This is then followed by some contextual information regarding each topic. Appropriate recent statistics are given where possible. The main issues and areas of concern for each topic are discussed. Finally, for each topic, possible future directions and outcomes are presented.

**Keywords:** science, technology, engineering, maths, children, innovation, economics

## 1. The importance of Science, Technology, Engineering and Mathematics (STEM)

### 1.1 Skills and qualifications STEM

It is well acknowledged that Science, Technology, Engineering and Mathematics (STEM) skills and work are important in all societies and economies. According to the Council for Industry and Higher Education (CIHE), the UK's capabilities in STEM underpin the economy. The importance of STEM skills is likely to grow in the future in response to technological enhancements, the need for action related to environmental concerns, and as the UK's knowledge economy expands. There are a number of concerns related to the future supply of people with STEM skills as well as the quality of these skills. Such concerns need to be addressed so that there will be sufficient, high quality STEM skills available in the labour market in the future to meet society's needs and to maintain the UK's position as a leading economy.

As the UK continues to develop as a knowledge economy, STEM education and employment opportunities are important issues to consider. The CIHE report, *International Competitiveness and the Role of Universities*, highlighted the relatively high proportion of employees in knowledge intensive service businesses that have science and engineering degrees (24%) STEM skills enhance people's ability to generate new knowledge and to identify, adapt and use knowledge that is generated elsewhere and apply it for the benefit of businesses. It is not only the sectors that have been traditionally associated with "science" skills that rely upon the benefits of employing people with STEM skills. The Roberts Review (HM Treasury, 2002) highlighted the importance of having people qualified in STEM subjects for the UK economy as a key element for the R&D, innovation, education triangle.

STEM skills are particularly important in high added value sectors. The UK software development industry, for example, employs 1 million people and produces an annual GVA of £30bn (BCS, 2006). Software development is one sector where the importance of STEM skills is obvious. However, STEM skills are relevant in most, if not all, industries. As discussed below, STEM graduates work in various sectors.

### 1.2 Supply and quality of STEM skills

According to the Roberts Review (HM Treasury, 2002) and similar reviews, the most important issue related to STEM in the UK is the supply of STEM skills and the quality of these skills. A strong supply of individuals with qualifications in STEM subjects is necessary to realise Government's ambitions for the UK. In guaranteeing this supply, all parts of the education system have a role to play – from the Key Stages of compulsory education, through to post-16/further and higher education. Various assessments suggest that the future supply of STEM graduates/postgraduates may fall short of demand, not only in the UK but also in the US and other world-leading economies. Various explanations for the problems related to the supply of graduates and postgraduates include:

- The number of students studying STEM subjects at lower levels of education greatly influences participation later on. Only 7% of pupils study triple science at GCSE<sup>1</sup>, which restricts the likely number of students who will be interested in (or capable of) pursuing further studies in such areas
- STEM subject degree programmes are seen as harder to get into than many of the alternatives. Many require maths A-level, which is under pressure in uptake at secondary level with too few students in the opinion of many
- STEM department closures resulting from declining student interest makes studying such subjects even more unattractive

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<sup>1</sup> CBI News Release, "CBI comment on SATS results for science", August 2008 (<http://207.45.116.138/ndbs/press.nsf/38e2a44440c22db6802567300067301b/41b6669429fa9af9802574a3004e10ba?OpenDocument>)

- Universities promoting STEM subjects less vigorously than others (in part due to higher costs such as expensive labs)
- High rates of growth in the number studying medicine – attracting higher quality applicants who would otherwise go for other STEM subjects.

### **1.2.1 STEM at compulsory education level**

One of the sources of the decline in the number of STEM students is simply lack of interest of young people, at school level, in studying such subjects and working in related careers. Given school students' lack of interest and therefore decreasing numbers of students undertaking study in STEM subjects at A-level, the number of suitably qualified STEM teachers is also a concern. With fewer teachers specialising in and teaching STEM subjects, there is further risk of less interest by students at school level. Furthermore, there is evidence that suggests that teachers are not interested in teaching these subjects and there is concern that teachers are not suitably qualified in STEM subjects to effectively teach the subject and to create interest in the subject areas amongst students.

According to CIHE, finding qualified teachers to teach STEM subjects is vital. The quantity and quality of STEM teachers will have impacts not only on the supply of future STEM graduates but also on the quality of these students' skills. The *Science and Innovation Framework 2004-2014* (HMT/DTI/DfES, 2004) suggests that a range of measures is necessary in order to enhance the teaching and learning of STEM subjects and to enhance the recruitment and retention of science teachers and researchers, in order to encourage more students to follow such course of study, and to thereby support the future needs of the science base and the economy for people qualified in such areas.

The Government is attempting to increase the number and quality of teachers in order to increase the number of young people choosing STEM subjects and subsequently follow a STEM-related career path. All this is seen as helping the UK compete in the global economy. With the aim of achieving this, a £140 million strategy to educate the next generation of scientists and mathematicians and help recruit and train more science and maths teachers was announced in January 2008.<sup>2</sup>

### **1.2.2 STEM in Post-16, Higher and Further Education**

The future supply of people with STEM qualifications will be determined mainly by the number of students who study such subjects after compulsory education. Of particular importance are the numbers educated to degree level and above. A great concern in the UK today is the relatively low uptake of STEM subjects at university.

There was an increase of 10% in the total number of university applications between 2002/3 and 2006/7. Over the same period, STEM applications increased by 12%. However, the balance of students studying particular STEM subjects is also a concern. There are concerns about the mix of STEM graduates being produced, with worries that there is insufficient emphasis on core science and engineering subjects. There was a fall of 15% in the numbers of engineering and technology graduates (23,300 to 19,700) over the decade to 2008.<sup>3</sup>

The number of undergraduate students who were studying physical science (Physics and Chemistry) as a proportion of all undergraduates fell from 5.5% in 1996 to 4.1% in 2000. The share studying engineering and technology fell from 9.3% to 6.3% from 1996 to 2000. However there has been encouraging increases in the numbers of applicants to STEM programmes more recently. The share of all university applications that were for

<sup>2</sup> DCSF, Press Notice 2008/0017, "£140m boost to science and maths teaching in schools", January 2008 ([http://www.dcsf.gov.uk/pns/DisplayPN.cgi?pn\\_id=2008\\_0017](http://www.dcsf.gov.uk/pns/DisplayPN.cgi?pn_id=2008_0017))

<sup>3</sup> [www.onrec.com/newsstories/21255.asp](http://www.onrec.com/newsstories/21255.asp)

maths places rose by 10% between 2006 and 2007. This share increased by 8% for mechanical engineering, 11% for chemistry and 12% for physics. There is concern though that these increases will not be sustained and that they may represent only temporary increases that will do little to guarantee a future supply of qualified STEM people.

According to NESTA, the total number of STEM graduates has increased by 10% since 1995. However, these graduates have been unevenly distributed across the STEM subjects. The number of graduates fell in engineering and technology and in the physical sciences while numbers increased in biological sciences, computer science and mathematical science.

The number of STEM graduates (excluding psychology and sports science graduates) at UK higher education institutions increased by 5% from 2002/3 to 2006/7. The number of postdoctoral graduates increased by 18% over the same period. While the UK has a relatively large number of students studying STEM subjects, it has been argued that this is due to increases in those studying IT and biological sciences rather than mathematics, engineering, and the physical sciences. This is a source of concern. The DTI (2006) have highlighted the rapid growth in supply numbers, which have increased at a rate slightly higher than the average for all subjects. However, the DTI report notes that recent increases have been concentrated in computer sciences and subjects related to medicine and biological science, rather than in engineering and technology, physical sciences and architecture.

Beyond compulsory education and A-levels, a diminished interest in studying STEM subjects is shown by students. The *Sainsbury Report* (HM Treasury, 2001) referred to low numbers of students taking science subjects following compulsory education. There have been marked decreases in the numbers of applications to STEM-related post-secondary programmes. According to the British Computing Society (BCS, 2006), there was a 50% drop in the number of applications for computer science related courses between 2001 and 2006. Problems experienced by university STEM departments, in terms of student numbers, are worst in physical and chemical sciences, engineering and maths. Biological science departments have tended to experience less difficulty on the whole but within biological sciences numbers are uneven.

CIHE has argued that in all employment sectors where STEM graduates are at a premium, there are shortages of quality graduates and postgraduates with relevant IT and general STEM skills and experiences. Since 2002, the numbers of STEM graduates, excluding Engineering graduates, has increased significantly; however, the number of these students taking STEM A-levels has declined with noticeable drops in the numbers studying mathematics, computer sciences and physics. This will have implications for the numbers of graduates to come in these subject areas.

Another significant issue related to STEM at higher levels is the gender balance of those who study such subjects. This issue has been acknowledged as a problem at all levels for a significant period. Female participation levels are much lower in some fields than in others. In 2005<sup>4</sup>, 15% of engineering and technology students were female. In the same year, females accounted for 24% of students in computer science, 38% studying maths, 41% in physical science and 64% studying biological sciences. There have been a range of initiatives launched to tackle this imbalance, with a great deal of work being put in by such groups as the UK Resource Centre for Women in Science, Engineering and Technology and Women into Science, Engineering and Construction (WISE). A number of websites have also been created to stimulate girls' interest in STEM subjects and to provide valuable information.<sup>5</sup> However, CIHE points out that these figures have

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<sup>4</sup> CIHE figures

<sup>5</sup> e.g. [www.futuremorph.org](http://www.futuremorph.org), [www.equalfuturez.net](http://www.equalfuturez.net)

remained relatively stable over a number of years, perhaps indicating that the initiatives and policies aimed at improving female participation in STEM subjects should be reconsidered.

A shortage of graduates with numerical abilities is considered to be critical by CIHE business leaders (CIHE, 2009). This shortage will only worsen in the light of the current age profile of their workforce. UK businesses and the UK in general are vulnerable to competition from other countries due to such shortages. There is also a fear that businesses and universities rely too heavily on overseas expertise rather than growing UK-based expertise. There are skill shortages across a range of STEM disciplines and in particular specialisms (such as electrical and power systems engineering, pharmacologists with particular experience). CIHE also highlights the need to address the gender balance of people in STEM.

However, it is not all bad news. The annual report, *Education at a Glance 2008* (OECD, 2008) indicates that the UK is doing better than average in supplying STEM graduates to the workforce. Amongst the OECD countries, the UK ranks 7<sup>th</sup> in terms of its supply of STEM graduates – ahead of Germany (11<sup>th</sup>), Italy (12<sup>th</sup>), USA (15<sup>th</sup>) and Spain (17<sup>th</sup>) and better than the EU and OECD averages. DfES (2006) also concludes that the UK's stock of science and engineering graduates fares well internationally, and that the quality of STEM graduates, as indicated by prior qualifications of entrants, is rising. It is important to note that without ensuring that a sufficient supply of STEM graduates is in the pipeline, the UK's relative performance on this will not improve, and may indeed slip as other countries improve.

In 2007, just under 1 million people in the working age population in the UK had STEM qualifications at NQF level 5 and just over 2½ million had STEM qualifications at NQF level 4. Of such graduates and postgraduates, the vast majority were economically active and in employment, with only very small numbers unemployed. This reflects the patterns for those qualified in other subjects as well. A much greater percentage of people with qualifications lower than NQF level 4 are found to be economically inactive and/or unemployed. Qualifications in STEM subjects are associated with marginally greater likelihood of being economically active and in employment than is found for graduates in other disciplines, but the differences are small.

In *A Degree of Concern* (2006) and *A Higher Degree of Concern* (2008), the Royal Society provides a statistical review of trends relating to the supply of graduates with STEM qualifications. They highlight the importance of the Higher Education system in relation to the UK's economic performance, particularly in the context of an increasingly competitive and inter-connected global economy. The UK's HE system needs to equip students with the knowledge, skills and aptitudes to compete with the best in the world, while at the same time supporting much of the nation's R&D activity. The Royal Society reports recognise that the demand for and supply of STEM graduates are closely linked and that there is a need to encourage virtuous circles, where supply encourages demand and demand stimulates supply. Links between industry and universities are also a key area where more emphasis is needed to enhance collaboration and strengthen ties.

### **1.3 STEM Employment and Recruitment**

With the exception of medicine, STEM graduates go on to work in a wide variety of industries. STEM graduates and postgraduates hold just over 3 in 10 jobs across all sectors, but this ranges from over 5 in 10 in non-marketed services (including education, health and public administration and defence), to not much more than 1 in 10 for the Construction sector.

The shares of firms that employ STEM graduates are significant across most sectors. Overall, 92% of all UK firms employ people with qualifications in STEM subjects. This varies amongst sectors with the share of firms employing STEM people varying from 89% of energy and water companies, 59% of construction firms, and 48% of

manufacturers. Employers in the finance and insurance and professional services sectors also have relatively high demand for STEM skills. Highly numerate, analytical and problem-solving skills are particularly valuable in such sectors. About 61% of professional service companies and 94% of banking firms employ STEM-skilled people. Large numbers of STEM graduates have been drawn to the financial services sector owing to relatively high salaries paid out by companies in this sector for the top talent.

STEM skills play an important role in business and they are vital for research and development and innovation activity. Some 40% of employers across all sectors indicated that they require STEM skilled people to design and innovate new products and services. Value is also placed on STEM skills in sales and marketing, as well as general management roles. STEM graduates are far from limited in their career options and studying such subjects does not close doors on their future prospects.

The *CBI/Edexcel Education and Skills Survey 2008* indicated gaps in the workplace, with 59% of employers reporting difficulty recruiting STEM-skilled individuals. Some sectors reported suffering acute shortages. Experienced hires, graduates and technicians are shown to be in particularly short supply. In response to these recruitment difficulties, large firms in particular have been looking outside the UK for candidates with STEM skills. Of the large employers in the survey, 36% have looked to India and 24% to China in order to fulfil their STEM-skilled labour needs.

With firms recruiting STEM graduates from Asia there is a concern about the quality of these graduates' qualifications. According to CBI/Edexcel there is concern over the "loose definition of 'graduate' in China" and differences in language, communication skills and problem solving styles may be key barriers to getting the most out of recruiting from abroad. However, as universities in China and India develop their courses and improve the quality of their graduates, the UK recruitment of STEM-skilled candidates from these countries is likely to increase.

The quality of STEM graduates is not only a concern about those coming from abroad but is also a significant issue related to UK graduates. It is not only shortages in supply that cause recruitment difficulties for employers. There is a perception held by many employers (42% in the CBI/Edexcel survey) that those graduates that do apply for jobs do not have the right skills. This is not thought to be as great an issue for employers in the financial services sector as it is for other sectors, as finance employers tend to offer high salaries to attract the top talent. The HE system needs to ensure not only that there are sufficient numbers of STEM graduates to meet demand but also that the quality of these graduates is world-class. As the Royal Society (2006, 2008) has pointed out, the UK's HE system needs to equip students with the knowledge, skills and aptitudes to compete with the best in the world, while at the same time supporting much of the nation's R&D activity.

#### **1.4 STEM-related policies, programmes and initiatives**

A number of Government policies and initiatives have been introduced over the past decade to address the possibility of a future shortage of STEM skills in the UK labour force. The *Annual Innovation Report 2008* (DIUS) has set out HEFCE's commitment of £160 million to increase the demand for and supply of students studying strategic and vulnerable subjects. The majority of these funds is to be spent on STEM subjects. Very recently, the University of Birmingham has recently received £20 million to help fill the national skills shortage gap in science, technology and maths by hosting the National Higher Education STEM programme<sup>6</sup>. The programme is funded by HEFCE, with the aim of increasing the number of graduates with skills in STEM disciplines, in order to meet the needs of employers and to boost the UK economy. It will aim to raise the aspirations

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<sup>6</sup> University of Birmingham, Press Release, 16 December 2008  
(<http://www.newscentre.bham.ac.uk/press/2008/12/16STEMprogramme.shtml>)

of young people to entice them to study science at university level. The programme will develop innovative and transferable programmes and initiatives for expanding participation in STEM subjects in HE. The delivery phase of the programme is the three years from 2009 to 2012.

As discussed in Section 1.2 various groups and programmes have also been implemented to attempt to stimulate female interest in STEM and to address the gender imbalance that has been observed in these subjects for many years.

### **1.5 Future issues**

The value of STEM skills in the UK economy is undeniable. Innovation is considered to be one of the key drivers of productivity and economic performance and STEM skills are thought by many to be key in enabling innovation activity. The innovation gap between the EU and the US is in part (23%) attributed to the lower share of people with tertiary education in Europe's workforce.<sup>7</sup> The UK has set a target for R&D investment to reach 2.5% of GDP by 2014<sup>8</sup>. Meeting this target would require around 50,000 additional research staff. There is a danger that unless the number of graduates qualified in STEM subjects increases, this innovation gap will widen.

It is considered essential that the UK gets the supply of STEM skills right, otherwise the damage to the economy could be substantial.<sup>9</sup> According to NIESR, the UK lagging in terms of skills levels of engineers and scientists impacts negatively on the innovative activity associated with such skills. This translates further into a loss of competitiveness in terms of a loss of domestic market share, a loss of international trade share and lower levels of productivity (Mason and Wagner, 2002).

A number of developing and emerging economies, such as India and China, are adding to the level of international competition faced by the UK. In order to keep pace with the activities in such countries, the UK must increase its skill base. Globalisation, demographic change and the rapid pace of advancement in technologies exert pressure on the UK that requires immediate action in terms of ensuring the country has the capacity, including the skills base, to compete, and to avoid being left behind.

Demand for STEM skills is expected to rise. Based on *Working Futures 2004-2014* (Wilson et al, 2006), CBI (2008) suggest that by 2014, 730,000 extra jobs will require candidates with STEM skills. Growth in employment is projected to be fastest for those with the highest level qualifications. The number of those in employment with no or few formal qualifications is projected to decline. The *Working Futures 2004-2014* results generally suggest, with the exception of Medicine, that the "demand" for those qualified in most STEM subjects will grow significantly faster than the average for all subject groups.<sup>10</sup>

The age profile of the STEM workforce implies that there will be a significant need to replace those leaving the STEM workforce (as older workers reach retirement age in the coming decade). This replacement demand is at least equally important as so called expansion demands arising from projected increases in employment levels for such workers.

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<sup>7</sup> Pro Inno Europe (2005) *European Innovation Scoreboard 2005* (<http://www.proinno-europe.eu/docs/Reports/Documents/EIPR2006-final.pdf>)

<sup>8</sup> HM Treasury (2004) *Science and Innovation Investment Framework: 2004-2014*

<sup>9</sup> Brockbank, S. (2008) "The UK STEM skills shortage" The Life Science Centre.

<sup>10</sup> The projections of employment by discipline for various occupational and sectoral categories take no direct account of changes in the flows emerging from the educational system (i.e. the supply side). They therefore conflate both supply and demand influences. They indicate the numbers that might be expected if recent trends continue.

CIHE (2009) business leaders have identified a number of concerns relating to STEM. The leaders and managers of the future must be numerate. The UK is considered vulnerable as a nation due to over-reliance of businesses and university departments on STEM expertise from overseas. There are skill shortages across the range of STEM disciplines, as well as in particular specialisms (from electrical and power systems engineers to pharmacologists with *in vivo* animal experience). There is a particular need to persuade more girls to study STEM subjects. Businesses have been recruiting maths graduates from India and other Asian nations.

According to NESTA (2007), the UK's R&D expenditure lags behind international competitors, STEM graduates are increasing but demand is likely to outstrip supply and links between businesses and universities are still challenged by university funding streams and cultural differences. *Science policy needs to become more prominent, but more importantly it needs to become more sophisticated* (NESTA, 2007).

## **Possible futures**

### **Worst case scenario**

- The supply and quality of STEM graduates and postgraduates in the UK declines further
- Initiatives to improve situation do not work
- UK slips as one of world leaders in STEM graduate supply
- The innovation gap with other countries widen
- STEM related employment goes offshore, especially as STEM graduates in other countries (India, China, EU) improve, and as there is a huge supply
- Jobs that cannot be offshored that require STEM skills are awarded to foreign graduates/STEM-skilled employees
- The UK's R&D base declines
- The UK's universities slip down international rankings because of the relatively poor quality of scientific research and output in terms of STEM studies.

### **Best case scenario**

- More students gain interest in STEM subjects
- Supply issues are appropriately addressed
- Expansion of employment for those with STEM skills due to continuing trends towards innovation and green jobs
- The UK becomes a world leader in STEM skills – world leader in R&D – world leader in innovation
- More use of UK universities for international projects relevant to STEM.

### **Most probable scenario**

- number of jobs requiring STEM skills to expand due to continuation of recent trend
- financial services continue to attract STEM graduates but no longer promising sky-high salaries after the recent financial crisis
- some STEM supply issues are addressed
- industry facelift to attract more students to STEM subjects
- use of international STEM qualifications.

## 2. Children's work

The majority of research on children's work and child labour focuses on the negative side of this issue. There is much commentary concerned with the inappropriateness of child labour and how child labour often arises in response to impoverished living conditions.

In the UK context however, 'children's work' does not typically refer to the sinister exploitation of children but instead refers to children's willing participation in part-time or vacation time employment. That is not to say that exploitive child labour does not take place in this country nor that children who willingly work are not exploited in some cases, but it is not the large problem here that it is in developing countries, or in the UK in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries.

Child labour and youth employment are two very different things. While child labour has very definite negative connotations, youth employment is typically viewed as a positive experience for children while growing up. In UNICEF publications, 'child labour' conventionally refers to children working before they reach the minimum ages for employment in their country (16 in the UK). It has been redefined to refer to all young people engaged in harmful employment, whether they are school-age or older.

Youth employment, in contrast, is considered a more positive activity in which young people are consensually employed in jobs that adhere to particular laws and regulations and pose no danger or risk to the health and safety of the young person. However, even when employed in more acceptable forms of work, the employment situations of many young people and children do not always abide by all regulations.

### 2.1 'Acceptable' children's work

In the UK, many young people (under the age of 18 or 16) are engaged in various types of employment outside of their normal schooling. Survey research has consistently shown that between one-third and one-half of school age children are in paid employment at any given time. Before they leave school, between two-thirds and three-quarters of children will have held a paid job (Mizen et al, 1999). Pinpointing the actual numbers of children in paid employment in the UK however, is not straightforward due to large discrepancies in the definitions of what constitutes legal child labour and because of the degree of unseen child work. Hobbs and McKechnie (1997) reviewed various estimates of the numbers of children undertaking paid work in Britain. Their findings are summarised in Table 1

Table 1: Best estimates of children working in the UK

Best estimates of children working	
% who ever worked before leaving school	63 - 77
% working at age 15	36 - 66
% working at age 14	36 - 59
% working at age 13	34 - 49
% working at age 12	22.5 - 36.5
% working at age 11	15 - 26

**Source:** Hobbs, S. and J. McKechnie (1997) *Child Employment in Britain: A Social and Psychological Analysis*. Table 2.4, p33.

There is evidence that employment of children (or youth), especially school students, is on the rise in the UK and the USA. Between 1968 and 1991 there was a marked increase

in the rates of part-time working amongst 16 to 18 year olds in full time education in the US (Dustman et al 1996) according to data from the Family Expenditure Survey. In the Republic of Ireland in 1994, one-quarter of lower secondary students and 31% of upper secondary students were engaged in regular part-time work. The types of jobs performed vary from part-time work in shops and restaurants, to paper rounds, to babysitting. Jobs undertaken by children often comprise unskilled, manual work with unusual working arrangements which may leave children vulnerable to exploitation.

### **Regulations and legislation regarding children's work in the UK**

UK law specifies the types of work and conditions under which children or youths may be legally employed. Employers wishing to employ children under school leaving age must get a permit from the local authority. This permit must be signed by the employer and one parent of the child. Some of the key features of children and employment regulations in England and Wales are:

- **Types of work** – no one under the minimum school leaving age (16 years) is permitted to do anything more than light work. They are not allowed to do work that is likely to cause harm to the child or to do work that will affect attendance at school or participation in work experience. Children are prohibited from working in factories, construction, transport, mines and on registered merchant ships. Local authorities may impose further restrictions on the types of work children are permitted to perform.
- **Younger children** – children under the age of 13 can only work under special circumstances. Once aged 13 years, children can undertake light work. At age 16 years, a person will be classed as a young worker with different rules.
- **Hours** - For those children who are legally permitted to work, they are not allowed to work:
  - during school hours on any school day
  - for more than 2 hours on any school day or for more than 12 hours in any week in which required to attend school
  - for more than 2 hours on a Sunday
  - for more than 8 hours (5 if under 15) on any day which is not a school day or a Sunday
  - before 7am or after 7pm
  - for more than 35 hours (25 if under 15) in any week in which not required to attend school
  - for more than 4 hours in any day without a break of one hour.
  - The law does not make any prescription about the wages to be paid to children who work. Minimum wage legislation does not apply to workers under the age of 16.

### **Children's reasons for working and possible benefits and negative effects**

The motivations of children for undertaking work vary. Children are not necessarily driven to employment by poverty, although this is the reason in some cases. In the context of youth employment, children have jobs for a number of reasons that are more matters of choice than circumstance. In some cases, the work may be in an area that interests the child or they may undertake work in order to have a learning experience. Many children take jobs because of the extra money that they can earn to spend on leisure interests. A number of children who have jobs report that they enjoy their work and appreciate it because it gives them a sense of independence and also teaches them about the value of money.

The UNICEF Working Children Survey (Spring 2004) questioned students between the ages of 12 and 16 about their attitudes toward work and the involvement in employment. They found a number of children who indicated that they worked outside the hours permitted by law and a number worked longer hours than allowed. More than 40% of the young people surveyed indicated that their parents had helped them find

their job. The majority of students questioned felt that work was valuable both socially and financially. Some respondents indicated that working did add pressure to them for performance at school. For young people, over the age of 18, Mizen et al (1999) found that students are not interested in full-time work or in acquiring long-term or secure employment due to the constraints of University coursework.

In the US, it has been generally accepted for the past 30 years or so that youth employment is a standard feature of adolescent development (Mortimer and Finch 1996). There seems to be a consensus in the US that moderate levels of work, in relatively benign jobs, is beneficial for children through increasing self-reliance and independence (Mizen et al 1999). Working more than 20 hours per week however, has been correlated with a range of adolescent problems. Similarly, a study from Ireland found that working part-time was associated with underperformance at upper secondary level and was also found to be associated with increased drop-out (McCoy and Smyth, 2007). In 1999, Mizen et al noted that it was then a reliably accepted idea that "paid employment is an extensive feature of contemporary British childhood ... that extends beyond the realms of traditional 'children's work', into a range of jobs characteristic of the service sector more generally."

A MORI Poll, *Class Struggles*, carried out for TUC<sup>11</sup> found that more than 100,000 school children had played truant in order to work in 2001. Boys were more likely than girls to take such actions. The survey indicated that 1 in 4 children under 13 years of age undertook paid work. Extrapolated to the entire UK population in this age group results in a total of 289,000 working. A significant proportion of the survey's sample reported that they had worked outside legal working hours for their age group. The survey also found that most working children (31.5%) earned less than £2.50 per hour.

## **2.2 The more negative aspects of children's work**

Child labour is often considered a problem of only developing nations. However, UNICEF indicates that it is a problem in the industrialised world as well, with some children doing work that is hazardous or otherwise unacceptable. This is often the case for children who have been trafficked into the country. The EU Directive on the Protection of Young People at Work was established in 1994. This aimed to reduce discrepancies regarding youth employment in the member states. The Directive sets out minimum standards for all EU countries regarding the employment of children and young people. The UK was slower than a number of other EU countries to modify its laws in accordance with this Directive.

The fact that workers under the age of 16 are not covered by minimum wage regulations, leaves children who work open to exploitation by employers looking to cut costs. Children under school leaving age are not legally entitled to paid holiday from work. As a subset of the labour force, the child workforce has little or no bargaining power or weight in the labour market. There have been 38 prosecutions in the UK for the improper employment of children since records began in 2000 (UNICEF).

Walsh (1990) observed that one main advantage to employers of hiring students is a reduction in labour costs. Employers are able to pay students (under the age of 16) lower rates than they are required to pay workers over the minimum school leaving age. Employers may also be able to use student workers more flexibly than other segments of the labour force as these students may not accrue the necessary qualifications for some legal entitlements (Curtis and Lucas, 2000). The TUC's survey (2000) found that students were paid £4.37 per hour on average and that 3% of student workers were being paid rates below minimum wage.

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<sup>11</sup> See [www.hrmguide.co.uk/general/child\\_workers.htm](http://www.hrmguide.co.uk/general/child_workers.htm) for some highlight findings of the 2001 survey

The Commission on Vulnerable Employment has indicated that young workers, who are not entitled to the same rates of minimum wage as other workers are more likely to face exploitation. They also cite evidence that young people are more likely to face exploitation at work than are older workers. The MORI survey's findings support the notion that younger workers face exploitation. 75% of children aged 11 to 15 years were reported to work and 30% of those with term time jobs reported working for more than the maximum numbers each day. Almost a third of the sample were paid £2.50 per hour or less. Nearly 20% working during term time were paid less than £2 per hour. While illegal, 25% of children under the age of 13 indicated that they worked during the term or during summer holidays.

Despite there being a number of regulations in place to protect young workers, the vast majority (79%) of children who work in the UK do so without a permit (UNICEF). There is also evidence that a proportion of these working children are exploited by the people they work for or face hazardous working situations. Taylor (1998) found that despite having initially agreed to hours of work that would not interfere with their academic studies, many working students later found themselves feeling pressured to work less convenient hours.

Children who are trafficked into the UK face even greater risks and are more prone to being exploited than those who are more visible and 'protected' by child employment regulations. Some trafficked children are smuggled into the country for the sole purpose of employment. For others, their vulnerable position leaves them open to being exploited in work (or worse). Some work extremely long hours in poor or dangerous conditions. Some children, most notably those from China, are bonded and must work in order to pay back their bonds. In a number of cases traffickers and employers of trafficked children threaten the safety of the child or his family in his home country in order to force the child to work. Children who have been trafficked into the country to work have been found working in restaurants, on farms and factories, in criminal activities, providing domestic labour and working in the sex industry. A UNICEF study (2003) found that 250 child trafficking cases had been uncovered in the UK since 1998.

### **2.3 The future of children's work**

Focusing on the more 'acceptable' types of children's work (as discussed in Section 2.1), the numbers of children in such employment is likely to increase in the future if current and recent trends continue. Even greater increases may be seen as children seek their own financial independence, so they can fund ever increasing costs of leisure (e.g. video game consoles typically cost over £100 and games can cost anything from £20 to £80 each). Increasing competition for entry into post-secondary education and for employment opportunities later in life may also motivate children to undertake employment earlier in order to build up their learning and work experiences and to indicate their drives and ambitions.

As mentioned in Section 2.2, laws covering the employment of children in this country are not overly stringent and according to many are fragmented. The Better Regulation Task Force (2004) notes that the laws regarding child employment in the UK are relatively old, with piecemeal adaptations and local by-laws that often compound the problems that exist in interpreting and enforcing these laws. This leaves room for breaches of regulations to occur. In the future, either the laws regarding children and employment will be enhanced and greater enforcement of these laws exercised or children's employment will continue to pose potential hazards and injustices for children. If unscrupulous employers see that they can cut costs by employing young people in jobs that are suitable only for adults, then children may be exploited for the monetary gains of these people. Educating children on the protection that the law offers them in work is also necessary to empower these children in employment matters.

More positively, if employers were to engage with children's agencies, schools and government bodies, jobs could be designed that would be age-appropriate and provide good learning/work experiences for children while enhancing the performance of businesses. With the development of new technologies and the dissemination of such technologies, children may also be provided with greater opportunities to exercise their creativity and fulfil their own interests while at the same time capitalising on these things for monetary gains. One example could be that young people may work part-time, independently, to design or manage websites for other people or companies, or design or get involved in other aspects of game design and 'virtual' worlds (for further discussion see Section 5). Such 'jobs' may lead onto business opportunities or career directions for these young people in adult life.

## **Possible futures**

### **Worst case scenario**

- Children are forced to take on more paid work, even if they do not wish to do so for their own interests, in order to help support family
- children work in inappropriate jobs that are not of interest to them and pose dangers to their health, safety, development and welfare
- employers opt for cheap child workers in order to cut costs, particularly in the absence of tighter enforcement of child labour laws
- trafficked child workers continue to fly below the radar and are an unseen part of the labour force
- more use of child labour in foreign countries in order to cut costs of manufacturing and to provide cheap products to the UK.

### **Best case scenario**

- employers engage with schools to create work opportunities that enhance the well-being and development of children
- children choose whether to work or not, without the stress of having to work out of financial necessity
- through work, children's entrepreneurial skills are developed and they acquire skills that help them in later life and ultimately contribute to the country's economic performance
- trafficking and exploitation of children in work is drastically reduced due to improved regulation and enforcement.

### **Most probable scenario**

- reorganisation of laws relating to children's work
- more public awareness of child trafficking and the use of these children in work which should pressure authorities to further clamp down on such activity
- the dissemination of information through the internet may result in children being more aware of their rights which would empower them in the labour market
- children may become more aware of the potential benefits of work and may seek out opportunities that meet their own interests, while giving them some financial independence.

## **3. Entrepreneurial activity and practices**

### **3.1 Importance of entrepreneurial activity in the UK**

Enterprise is noted as one of the five key drivers behind productivity growth in the UK. Entrepreneurial activity takes many forms and makes a substantial contribution to the country's economy. Stel et al (2005) found that nascent entrepreneurship positively impacts GDP in rich countries (see also Davidsson, 2006). The Lisbon Agenda considers raising regional entrepreneurship levels to be one of the main policy instruments to

tackle Europe's problem in keeping up with productivity growth by existing and emerging economic powers.

### 3.2 The UK's entrepreneurial performance

Entrepreneurship has become a common notion in today's British popular culture. Television programmes like the BBC's *Dragons' Den*, and other reality programmes that follow fledgling companies or show individuals competing for start-up funds, have become more common and gained huge numbers of viewers. The aim of such shows and the media coverage of entrepreneurial activity is to stimulate interest and further activity. However, sometimes this exposure can downplay the real risks and the level of skill and knowledge required to start a successful business.

According to HM Treasury (2008) report, *Enterprise: Unlocking the UK's Talent*, there has been considerable progress in promoting an enterprising economy over the past 10 years. Business survival rates are higher than ten years ago (92% of new VAT registered businesses are still registered after one year and 71% after three years). Productivity growth in small firms has been greater than that in large firms since 1998.

In 2005, the number of young people indicating aspirations to start up in business was 200,000 greater than in 2002. There are currently a record number of businesses operating in the UK. There were 4.5 million businesses in the UK at the start of 2006 which was more than 750,000 more than in 1997. There are a number of reasons for the significant increase in business numbers, including:

- the rise in population
- influx of entrepreneurial immigrants
- the development and roll out of modern telecommunications, and
- tax incentives for smaller companies.

It is important to note that more businesses does not necessarily mean that the UK is more 'entrepreneurial', as research by the University of Sheffield found that the business start-up rate per 1,000 inhabitants fell between 1997 and 2004.<sup>12</sup> This research also found evidence that some private sector entrepreneurial activity is crowded out by the public sector.

While the World Bank has ranked the UK second in Europe, and in the top ten countries in the world, on measures of ease of doing business, the UK lags behind the US in some indicators. The US has 20% more businesses per head than the UK. A significant part of this gap is explained by considerably lower rates of women's enterprise activity in the UK. The rate of growth exhibited by new businesses once they are established is also greater in the US than in the UK. Some 40% more US businesses achieve high growth than do UK businesses. More than a third of established businesses in the UK have no ambition to grow.

The fear of failure is also greater in the UK than in the US. In the US, 23% of people say that such fear would prevent them from starting a business, while 36% of people in the UK indicate fear of failure as a barrier to starting a new business (GEM, 2007). In the early part of the current recession, start-up activity in the UK appeared to have remained resilient in the UK.<sup>13</sup> There was a decline in the Spring of 2008 which resulted in the numbers for the year being only marginally lower than they were in 2007. In the three months to September 2008, the number of new businesses that started up fell by

<sup>12</sup> R. Tyler "Saving small firms has become big business in Westminster", [thetelegraph.co.uk](http://www.telegraph.co.uk/finance/comment/3982481/Saving-small-firms-has-become-big-business-in-Westminster.html), 29 December 2008, (<http://www.telegraph.co.uk/finance/comment/3982481/Saving-small-firms-has-become-big-business-in-Westminster.html>)

<sup>13</sup> The Telegraph, 5 January 2009. "Start-ups remain resilient despite recession" (<http://www.telegraph.co.uk/finance/yourbusiness/4125906/Start-ups-remain-resilient-despite-recession.html>)

just 4% to around 129,000. Barclays has reported no significant decline in the number of people wanting to start their own ventures going into 2009. Despite this resilience to date, the number of start-ups in 2009 is expected to fall significantly (Barclays).

The UK has a higher proportion of adults starting their own businesses than other European countries, and the UK's levels of entrepreneurial activity are better than those in continental Europe. The UK also has better sustainability ratios (ratios of established businesses to start-ups) than the US and Canada. In the UK, the proportion of people operating established businesses is 93% of the start-up rate, indicating that the majority of ventures are successful.

The GEM UK 2007 indicates that there are regional differences in the levels of entrepreneurial activity taking place in the UK. In 2006, London, the South East, the South West and the East Midlands had the highest levels of early stage entrepreneurial activity in 2006 but they experienced declines in 2007. While three of these four regions remained the highest activity regions in 2007, the decline in early stage entrepreneurial activity in the East Midlands was sufficient to decrease the regions ranking to 8th place. There were increases in early entrepreneurial activity in Scotland, the North East, Northern Ireland, Yorkshire and the Humber, the North West and the West Midlands. The West Midlands had the 4<sup>th</sup> highest level of activity in 2007.

There was an increase in entrepreneurial activity in the Northwest from 4.6 to 4.9% between 2006. This region is observed to have higher levels of entrepreneurial activity amongst 18 to 24 year olds than the UK average (4.7% vs 3.8%).

The GEM UK 2007 report also notes gender differences in early entrepreneurial activity with men more likely to be engaged in such activity than women. In 2007, this difference between the sexes was greatest in Northern Ireland. The South West had the highest level of female entrepreneurial activity in 2007 at 4.6%. Men are also found to have more positive attitudes towards entrepreneurial activity than women.

### **3.3 The future**

According to the *Global Entrepreneurship Monitor United Kingdom 2007 Monitoring Report* (GEM UK, 2007), the UK has generally positive attitudes towards entrepreneurial skills and the perception of start-up opportunities compared to the other G8 countries. The monitoring report compares Global Entrepreneurship Monitor (GEM) measures of entrepreneurial activity in the UK with participating G7 countries, and the large industrialised or industrialising nations of Brazil, Russia, India and China (BRIC). It also summarises entrepreneurial activity within Government Office Regions of the UK

The Government has done much to develop awareness, aspirations and motivations regarding enterprise. Amongst young people aged 14 to 30, there has been a 22% increase since 2003 in the number who intend to start a business and a 50% increase in the number taking part in enterprise training activities.

According to CIHE, the competitive capability of the UK will rest more than ever on enterprise and innovation in products, services and management. CIHE emphasises that developing entrepreneurial graduates is essential to future success of the UK economy.

*Enterprise: Unlocking the UK's Talent* outlines some of the future challenges and opportunities that the UK may face in terms of optimising the economic and wider benefits of enterprise for the UK. The Government has a vision of a society in which the contribution of entrepreneurs and enterprise is encouraged and valued and therefore wants to encourage a culture of enterprise. The UK needs to improve some people's perceptions, particularly with reference to the country's relatively high 'fear of failure'. Countries with higher rates of fear of failure tend to have lower rates of entrepreneurial activity. In developing a culture of enterprise the Government has made a number of

policy proposals including actions regarding insolvency rules, starting a women's enterprise campaign, and starting a Global Entrepreneurship Week.

In order to position itself in good stead, the UK also needs to ensure that it has sufficient enterprise knowledge and skills to meet future challenges and opportunities. The Government has committed a further £30 million to extend enterprise education from secondary schools into primary and tertiary education. The Government is also taking steps to increase workforce skills training and to improve access to business support.

The availability of finance to people who want to start up businesses is also an important factor which is proving a great challenge given the current economic downturn. At the beginning of 2009, the Business Secretary, Lord Mandelson, has pledged £35m for start-ups in North West with the ambition that "nurturing and protecting start-ups and young businesses through this downturn will lead us into the upturn that will follow". Barclays increased the amount of lending to small and medium enterprises by 6% to about £15 billion in the past year and has pledged to make at least a further £1.5 billion available to this group of businesses in 2009.

In the future there are many potential opportunities on which an enterprising nation may capitalise. New business opportunities will come from the development and growth in countries such as China, India and Brazil. The disposable incomes of people in these countries will grow, creating export opportunities for the UK. These new markets have already been proving fruitful. Between 2002 and 2006, UK exports to China and India increased by, on average, 19% and 14% per year, respectively.

The development of the UK as a Knowledge Economy also presents opportunities for entrepreneurial activity. New technologies and services themselves present opportunities for new businesses to develop or for established businesses to grow. New industries will also be created, such as green industries. The environmental goods and services sector in the UK has an estimated turnover of £25 billion and employs 400,000 people.<sup>14</sup> New technologies that will need to be developed for the low-carbon economy will present potentially lucrative opportunities for people wishing to start a business.

## **Possible futures**

### **Worst case scenario**

- the credit crisis and financial downturn worsen, resulting in very limited financial support being available for start-ups, young businesses and SMEs
- the UK fails in its attempts to promote a culture of enterprise and lacks the skills, knowledge and attitudes necessary to take advantage of future opportunities
- growth becomes restricted due to inadequate entrepreneurial performance.

### **Best case scenario**

- women's entrepreneurial activity rates increase substantially and help to close gaps with the US
- the UK's culture of enterprise attracts more outside investment in UK businesses and increases the number of foreign businesses being set up and operated in the UK
- young people see starting their own businesses as viable options for future careers
- UK start-ups and SMEs increase their ambitions for growth and make strategic decisions to achieve growth.

### **Most probable scenario**

- women's involvement likely to increase

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<sup>14</sup> HM Government ([http://www.hmg.gov.uk/newopportunities/opportunities/future\\_opportunities.aspx](http://www.hmg.gov.uk/newopportunities/opportunities/future_opportunities.aspx))

- credit and finance moderately constrained in the short to medium term
- after the financial downturn, lenders are likely to be more careful than before in lending criteria used to evaluate start-up business' and SMEs' applications for borrowing. This would not necessarily be a negative outcome as suitable criteria may ensure that the majority of businesses that start up are likely to succeed
- enterprise education to take more prominent role in young people's education, thus enhancing the entrepreneurial skills and knowledge base of the future workforce.

## **4. Innovation and intellectual property rights**

### **4.1 The importance of innovation**

Like enterprise, innovation is also considered one of the five key drivers of productivity. BERR defines innovation simply as the "successful exploitation of new ideas." This includes all innovation, including non-technological. According to BERR, innovation is central to better jobs, economic growth and prosperity. Innovation is vital to increasing the UK's competitiveness, improving the economy and increasing the quality of life. Innovation can also help to meet challenges such as climate change and pollution.

For businesses, innovation can result in sustained or improved growth, through enabling entry into new or different markets, and through improving day to day performance. Businesses may innovate through product innovation, process innovation and strategic innovation. For consumers, innovation is important in creating new or improved products and services, with greater value for money, and in improving the overall standard of living.

Innovation is an increasingly important issue, as companies who do not innovate will not maintain their competitiveness because if they themselves do not innovate than someone else will do so and will gain an advantage. Businesses may need to innovate for a number of reasons (DIUS 2008):

- to gain competitive advantage or to respond to competition
- to create efficiencies
- to improve customer satisfaction
- to reposition the business in the market, and
- to comply with new regulations.

These factors, and a number of others, motivate businesses to innovate and may also influence the level and type of innovation undertaken by businesses.

Those companies that adopt innovations created by others, or who seek to innovate themselves, face a number of potential advantages and opportunities. For innovating companies and individuals, Intellectual Property Rights (IPR) is a vital issue that comprises an important part of their business operation and strategy.

### **4.2 UK's innovation performance**

The UK is identified as an Innovation Leader in the 2007 edition of the European Innovation Scoreboard, placing the UK in the leading group with Japan, US and several EU countries. The 2005 UK Innovation Survey results indicated that 57% of UK enterprises were involved in innovation activity. The 2007 UK Innovation Survey showed an increase in activity to 64% of firms. Product or process innovations have been implemented by around a quarter of businesses, while around a third of enterprises have undertaken some form of strategic innovations. A positive correlation was found between firm size and innovation activity. Extending the concept of innovation activity to cover enterprises that invest in preparing for future innovation, or amending their organisational structures and strategies, results in 66% of UK businesses being considered innovators over the UK Innovation Survey 2007 survey period (2005-2007).

A much greater share of economic activity and employment was found in businesses that innovate. Almost 45% of employment was found to be in businesses having one or more forms of strategic innovation. The DIUS survey indicates that there are both regional and sectoral differences in the level of innovation taking place in UK businesses. The largest share of innovators with plans for future product or process innovation was found in knowledge intensive services. The 'other services' sector was found to have the lowest share of businesses with innovative inclinations (54%). Construction witnessed the greatest increase in innovation activity between the 2005 and 2007 CIS surveys. The lowest share of innovation active businesses was found in the London (55%) while the

greatest share was found in Eastern England (69%). Where no innovation activity was indicated, the DIUS surveys in 2005 and 2007 found the most influential factor to be market conditions limiting the need for innovation.

The fourth Community Innovation Survey (2007) ranked the UK 12<sup>th</sup> in the EU in terms of the percentage of all enterprises that are innovation active among all enterprises. In 2007, 43% of all businesses in the UK were innovation active. Higher rates were found for Germany (65%) and Ireland (52%) while the EU27 average (42%) was just below the UK figure, as was the rate in France (33%).

The DIUS *Annual Innovation Report 2008* overviews the UK's performance in innovative activity. In terms of businesses' investment in research and development (R&D) (a fundamental component of innovation), the UK ranks 5<sup>th</sup> in the G7 countries. R&D performed by the largest companies increased by 5% from 2005 and 2006 in real terms. The UK's number of US patents granted per head is ranked 5<sup>th</sup> in the G7. In 2006, the UK spent 1.75% of GDP on R&D, representing a 4% real increase since 2005.

DIUS has set out a number of the strengths and weaknesses of the UK innovation system. These strengths and weaknesses are detailed in Table 2.

Table 2: Summary of strengths and weaknesses of the UK innovation system

<b>Strengths</b>	<b>Weaknesses</b>
Research base	
Substantial public investment in high quality UK research base	Business investment in R&D (but possibly due to sector mix)
Increased exploitation of publicly funded research although limited technology diffusion from the research base	
Business innovation	
Some successful high tech sectors and a sizeable population of high tech SMEs	Significant minority of non-innovating businesses
Strong non technology based innovation in high value added sectors	Rate of business start-up and SME growth still lag behind US
One of world's leading financial and business services centres	Variability in innovation performance and capability across the UK
An open economy	
Effective framework conditions for innovation	
Innovation in public services	
Some world leading examples of new delivery of services and policy making	Incentives often work against innovation
Builds on strong culture of public management and efficiency	Insufficient skills to innovate successfully
	Weaknesses in spreading good practice
Innovative people	
Excellent universities with rising participation	Low business demand for skills in some parts of the economy
Strengthened public engagement	Overall skill levels of the UK population lag behind international leaders
	Increasing overall supply of STEM skills but concerns over numbers coming through in some disciplines
	Management skills and practices
Areas where further information is needed to assess UK performance	
Demand for innovation	
Barriers to user-led innovation	

Source: DIUS (2008) Innovation Nation – Background analysis: strengths and weakness of the UK innovation system. Table 1.

### **4.3 Intellectual Property Rights**

According to the *Gowers Review* (HM Treasury, 2006), “in today’s economy, knowledge capital, more than physical capital, will drive the success of the UK economy.” In light of this, intellectual property (IP) rights are more important than ever before. With technological advances and increased capabilities to freely share information, IP rights are vital to protect the work and competitiveness of companies and Governments. IP rights are bound by the regulations set internationally but they are of significant concern for the UK as a nation as they are essential to ensuring that the benefits from innovation that takes place in the UK are reaped by the country.

The Community Innovation Survey identifies a number of innovation protection methods which, some of which may be considered forms of intellectual property rights. These methods include:

- Registration of design
- Trademarks

- Patents
- Confidentiality agreements
- Copyright.

According to the 2007 survey, confidentiality agreements were considered to be of high importance by 18% of businesses. The proportion of respondents attaching high importance to the measure of innovation protection increased for all methods between the 2005 and 2007 surveys<sup>15</sup>. This may be indicative of a greater need to protect businesses' innovative and intellectual property or could indicate the increased awareness of this need and of ways to ensure protection.

The *Gowers Review* set out an intellectual property system meant to be fit for the digital age. The review suggested strengthening IPR enforcement through a number of avenues. The review also suggested ways to support businesses in relation to IPR and how to set out IPR while maintaining a balance between freedoms and protection. Since the *Gowers Review*, Trading Standards officers have been given powers of search and seizure in relation to certain kinds of offences which include copyright violations. In 2008, the Government pledged a further £5 million to assist Trading Standards officers to undertake these new duties.

It is important the IP rights regulations and laws are themselves innovative and that they change over time to reflect the risks and security issues associated with IP and new developments. The UK's Intellectual Property Office has published a consultation regarding IP which was concerned with four main issues: access to works, incentivising investment and creativity, recognising creative output, and authenticating works. The Strategic Advisory Board for IP Policy (SABIP) was launched in effort to consider the strengths and weaknesses of IP in the context of a rapidly changing environment. SABIP recognises that growth rates are higher in the creative sector than in the economy as a whole and that rapid technological change and globalisation have brought into question many aspects of the existing copyright system. SABIP considers the development of a copyright agenda for the 21<sup>st</sup> century as timely and necessary. *Digital Britain* also identified IP as a key issue for the UK's digital economy.

#### 4.4 The Future

According to BERR "success in the future will come from businesses increasing the added-value of their products, processes and services." Given this future importance, nine strategic EU priorities for innovation have been set out (see table 5.1).

Table 3: Strategic EU priorities for innovation

<ol style="list-style-type: none"> <li>1. Creation of an effective IPR framework</li> <li>2. Creating a proactive standard-setting policy</li> <li>3. Making public procurement work for innovation</li> <li>4. Launching Joint Technology Initiatives</li> <li>5. Boosting and growth in lead markets</li> <li>6. Enhancing closer cooperation between higher education, research and business</li> <li>7. Helping innovation in regions</li> <li>8. Developing a policy approach to innovation in services and to non-technological innovation</li> </ol>
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<sup>15</sup> DIUS (2008) *Persistence and change in UK innovation 2002-2006*

## 9. Risk capital markets

Source: BERR (see [www.berr.gov.uk/dius/innovation/page38831.html](http://www.berr.gov.uk/dius/innovation/page38831.html))

The future of innovation, especially technological innovation, in the UK is closely linked to developments in the supply and quality of STEM workforce<sup>16</sup>. STEM-skilled people are necessary for R&D and for scientific innovation to take place. Should the fears over the supply of STEM graduates not be confronted and allayed, the future of innovation in the UK will be tightly constrained. However, if the UK keeps up its supply and quality of STEM workforce, then the country will be well placed to take advantage of future opportunities that innovation activity may provide.

The future will present numerous opportunities for innovation of which the UK Government and businesses will want to take full advantage. New customers, production patterns, technologies and expectations will provide great opportunities for employment, businesses and even new industries<sup>17</sup>. It is important then that the UK continue to innovate and to increase its capacity to innovate in order to ensure it is ready to take advantage of future opportunities.

The increasing importance of the environmental agenda is one area that will certainly pose further opportunities in the future. As consumers continue to make businesses aware of their concern for the environment and their desire for 'green' products and services, businesses will need to come up with new ways of working and new or modified products and services to meet these tastes. Companies whose products/services are not capable of been 'greened' will either go out of business or will have to come up with innovative solutions to move into other sectors. The green consumer will also require new, to date unheard-of products that will fit in with greener living. This demand will provide opportunities for existing businesses to enhance their own products/services to fill this requirement or to create new products/services to fit the need.

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<sup>16</sup> See section 1 for more on the importance of STEM and its implications for innovation

<sup>17</sup> Cabinet Office (2008) *Getting On, Getting Ahead*

## **5. Emerging economies owing to technological change**

This section looks at types of emerging or new economic activities that may constitute significant areas of work and activity in the future. These emerging economies were probably unimaginable for most people 5 to 10 years ago. However, as video games and virtual worlds become more sophisticated and increasingly allow people to interact online, their prominence in everyday life will increase as well. Also, as internet access and people's interest in technology has increased other opportunities have arisen.

Some of the issues to be discussed here include the opportunities presented by massive multi-player online role-playing game (MMPORG) and the use of virtual or synthetic worlds for business and leisure purposes. These are not yet mainstream activities but by the time that people born since the late 1980s are in work and form the majority of the labour force, these relatively novel opportunities and ways of working may become widely used and accepted and contribute significantly to employment and GDP.

### **5.1 Virtual/synthetic worlds**

Virtual worlds are computer based simulated environments intended for users to inhabit and in which users interact through avatars. Virtual worlds are shared spaces that allow multiple users to take part simultaneously. Things take place immediately in the virtual world once an action has been taken by a user. Virtual worlds are not completely alien concepts as they have much in common with the real world. Forces like gravity and cause and effect are exhibited in both, and things like the economy and market are important features of virtual worlds.

Virtual worlds offer new ways for groups of people to interact, exchange information and conduct business over the internet. There are a number of types of virtual worlds serving various purposes. Some virtual worlds are gaming worlds (eg World of Warcraft and other MMORPG). Other virtual worlds are mainly operated for social networking and online communities (eg There.com). Virtual worlds are sometimes created to facilitate immersive education, or corporate collaboration. Business oriented virtual worlds support a wide range of activities including e-commerce, virtual events, marketing and branding, customer service and interaction, recruitment, advertising, and product demonstration. Virtual worlds may be used to build customer loyalty and to gain valuable feedback through focus groups.

These worlds also create new opportunities for business, providing venues for customers to socialise, collaborate, purchase goods, train and play. While relatively new, virtual worlds represent a significant opportunity for business and economic benefits to the economy. In the US, there has been significant investment in virtual world-related companies over the past few years. According to Virtual Worlds Management, venture capital and media firms invested more than US\$425 million in 15 virtual world-related companies (with US\$50 million concentrated in just two acquisitions) in the fourth quarter of 2007. There were investments of US\$493 million invested in virtual world-related companies in the first three quarters of 2008 with US\$148.5 million in 12 virtual world-related companies in the third quarter. Of these investments, the greatest shares are in companies with entertainment spaces (.e meant for leisure and entertainment use rather than education or business). Over US\$1 billion was invested in 35 virtual world operations in the year to October 2007.<sup>18</sup> While these are large sums of money, they are still dwarfed by corresponding investments in the real economy.

Second Life is a relatively common example of a virtual world. Second Life was created by Linden Lab and opened to the public in 2003. Since its launch it has gained more than 2 million members. This three dimensional virtual world is accessed through the internet. Users download a client program and through this they can create avatars (characters) and other items (houses, furnishings, etc). Members of the Second Life world pay

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<sup>18</sup> Bailey, D. "Real dangers lurk in virtual worlds", [www.computing.co.uk](http://www.computing.co.uk)

membership fees. This virtual world has its own virtual and economy with a currency, Linden dollars (\$L), that has traceable exchange rates with money in the real world (\$US).

Users interact in many ways in the Second Life virtual world. More savvy users create various items which they can sell/rent to other Second Life inhabitants. Residents can take part in numerous activities, in public or private, in the Second Life world. There are group activities, learning activities and more unsavoury activities taking place in Second Life.

While Second Life is a fairly well-known virtual world, it has not been without its problems since its launch in 2003.<sup>19</sup> A number of companies have entered the Second Life environment hoping to capitalise on marketing and advertising opportunities. This has proved relatively unsuccessful. Other problems have been encountered due to the sometimes fuzzy line separating virtual activities from reality. Second Life has shut down casinos due to the prohibition of online gambling in the US. Tax authorities in the US also have difficulty determining the appropriate tax treatment of money generated through such virtual worlds as Second Life. The use of virtual worlds for unlawful or unsavoury activity is also a problem and there have been cases in Second Life where things such as real child pornography have been exchanged between members.

Second Life's membership is high. However, there is concern that interest has been waning. The number of active members is believed to be much lower than the total number of members. Restrictions placed on this virtual world because of its notoriety are having effects on its popularity. The availability of other virtual worlds with free membership, such as There.com<sup>20</sup> and yoowalk.com, or with different foci increases the level of competition faced by Second Life.

## **5.2 Economic and business opportunities presented by virtual worlds**

A number of business opportunities have come from the existence of virtual worlds such as Second Life and massively multi-player online role-playing games (MMORPG) such as World of Warcraft. These new environments present opportunities:

- for real business processes to occur in the virtual world
- for new employment opportunities to be generated in the real world through satisfying demand for various virtual commodities
- for producing and expanding these types of environments and games, and
- for policy proposals to be investigated through virtual 'experiments'.

Companies such as Intel, Cisco, IBM, Stanford University and Diageo all hold regular internal and occasionally external meetings of their employees avatars in virtual worlds.<sup>21</sup> Military and emergency services have also been using virtual worlds and simulation games that enable training.

Forbes.com set out 10 ways to make real money in virtual worlds. Virtual worlds allow for people to make real-world money as<sup>22</sup>:

1. Gold Farmer – considered an 'easy' way to make money, involves spending a lot of time playing games with the sole objective of collecting as much of the game's currency (typically gold coins) or weapons. The gold, weapons or other items are then sold to other gamers (with less time to play) through onsite trading (eg ebay). This is a popular pursuit in Asia where companies have been found to pay

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<sup>19</sup> Dell, K. "Second Life's real-world problems" [www.time.com](http://www.time.com)

<sup>20</sup> Basic membership is free in There.com but a premium membership requires payment of monthly fees.

<sup>21</sup> Sawabey, P. "Serious business in virtual worlds" (2007) [www.information-age.com](http://www.information-age.com)

<sup>22</sup> Forbes.com (2007) "Ten ways to make real money in virtual worlds" ([www.forbes.com/2006/08/07/virtual-world-jobs\\_ex\\_de\\_0807virtualjobs.html](http://www.forbes.com/2006/08/07/virtual-world-jobs_ex_de_0807virtualjobs.html))

employees to work shifts of eight hours or more and then sell the accumulated wealth to players in Europe or America. According to Edward Castronova, trading of real dollars for gold pieces is more than \$1 billion each year.<sup>23</sup>

2. Prostitute – the world’s oldest profession has infiltrated the virtual world, perhaps even more than it is practiced in the real world. In Second Life, prostitutes receive Linden dollars for services rendered online. This game currency can then be exchanged with others for real money. In 2007, a sex business in Second Life sold for US\$50,000 on ebay.
3. Power Leveller – this involves playing games to advanced levels on behalf of other players who do not have enough free time to advance in the game as they would like to. EZGamers for example, will log into a game as a person’s character and play on their behalf. Prices charged for this service vary but a full 24 hours of focused play would cost about \$25.
4. Merchant – games and environments like Second Life often allow for users to create unique virtual items such as clothing, weapons, home furnishings which they may then sell in game for virtual currency or elsewhere online (eg ebay) for real money.
5. Designer – Second Life users and other similar virtual worlds often desire custom-designed clothes to create beautiful avatars. Manufacturing virtual designer goods is relatively easy and the manufacturing costs are zero. While virtual clothing sells for relatively little virtual currency, bulk selling adds up and can result in real money gains. Listings for clothing and furniture can be found on ebay.
6. Architect – Similar to the idea for designers, people in games like Second Life, particularly those who spend much time in virtual worlds, like having nice virtual things and a home is one of these. Often the residents do not have the ability or want to build/design these things themselves so third parties may create an opportunity through selling such to players. Pre-built buildings in second life are traded on the game’s SL exchange with a castle, for example, selling for the equivalent of \$53.
7. Gambler – this operates in pretty much the same way in virtual worlds as in real life. Virtual winnings can be exchanged for real world currency. A number of Las Vegas casinos had set up operations on Second Life but in 2007, gambling was abolished from Second Life as US laws prohibit online gambling and the treatment of virtual world gambling came into question.
8. Beggar – most online games allow players to give others in the game money or goods. While most players would give very little, if one has enough time, one could accumulate enough virtual goods/currency to exchange for a more substantial amount of real money.
9. Selling your character – once players are bored with a game, and if they have advanced sufficiently in that game, they may choose to sell on their virtual character to other players. A student at the University of Virginia sold his World of Warcraft character on ebay for \$1,200.
10. Landlord – property is available on Second Life (and other similar virtual worlds) but the most desirable properties are bought up very quickly. Virtual landlords, with sufficient land, may sell property to new players. In Second Life, this activity has netted relatively large sums of money for a number of individuals. One Second Life property trader reportedly owns virtual property worth US\$250,000.

### 5.3 Open Source technology

Open Source is an approach to design, development and distribution offering practical accessibility to a product’s source (goods and knowledge) (Wikipedia). The most commonly known type of open source product is software. According to the Open Source

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<sup>23</sup> [http://www.econtalk.org/archives/2008/01/edward\\_castrono.html](http://www.econtalk.org/archives/2008/01/edward_castrono.html)

Initiative, the definition of open source does not just apply to access to software's source code but also to the distribution terms of which must meet the following criteria<sup>24</sup>:

- Free distribution
- Source code
- Derived works
- Integrity of the Author's source code
- No discrimination against persons or groups
- No discrimination against fields of endeavour
- Distribution of license
- License must not be specific to a product
- License must not contaminate any other software.

The open source (OS) approach has been empowered by advances in ICTs and the proliferation of internet to homes and businesses. The term is now used with reference to software, hardware and user generated content. The OS approach involves the free sharing of code (in the case of software) which people can use, amend and change for their own purposes. The source code, as set out above, is free for use and redistribution and there is nothing to prohibit people from using it as a basis for the development of a product that they go on to market commercially.

This approach is becoming more and more mainstream, with significant economic impacts. The Standish Group International estimated that open source software (OSS) cost traditional software companies US\$60 billion in 2008. The global loss due to use of proprietary software rather than OSS is estimated to be more than US\$1 trillion per year with losses in the US thought to be at least US\$400 billion.<sup>25</sup>

Perhaps the most well known example of OSS is Linux, an operating system that was first introduced in the early 1990s. The Linux Foundation values the Linux ecosystem at US\$25 billion. It is used all over the world in applications such as the New York Stock Exchange, mobile phones, supercomputers and consumer devices. In a White Paper<sup>26</sup>, the Linux Foundation (2008) estimated that building the Fedora 9 distribution of Linux would have cost US\$10.8 billion had it been a more conventional proprietary development. Developing the Linux kernel alone is valued at US\$1.4 billion.

The use of OSS in enterprises is becoming more commonplace, particularly in response to the possible cost savings that such software presents. Government too is moving towards more widespread use of OSS in order to save money. The feasibility of OSS use in schools has also been highlighted by the British Educational Communications and Technology Agency (Becta, 2005). However, to date, the Government has not modified its procurement policies in order to capitalise on the use of OSS.

The viability of open source hardware is also coming to the fore. OS hardware, typically computing and electronics hardware, is designed, developed and distributed in a similarly collaborative manner as OSS. Free information is shared on the hardware's design, schematics, guides, associated software and so on. These details are then free to be developed further by users, and by-products can typically be sold. *Arduino* is an example of a company based on open source hardware. This company produces the Arduino circuit board, the design of which they have made open source. This allows

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<sup>24</sup> See <http://www.opensource.ac.uk/mirrors/www.opensource.org/docs/definition.html> for full definition

<sup>25</sup> BBC online, "Calls for Open Source Government" by Maggie Sheils (<http://news.bbc.co.uk/1/hi/technology/7841486.stm>)

<sup>26</sup> McPherson, A., B. Proffitt and R. Hale-Evans (2008) "Estimating the Total Development Cost of a Linux Distribution" The Linux Foundation (<http://www.linuxfoundation.org/publications/estimatinglinux.php>)

others to produce copies of the board, redesign it and sell boards which copy the Arduino board design. The only caveat is that subsequent versions/creations based on the Arduino board must be on the board's original *Creative Commons* license, so that new versions are equally free and open as the original.

The idea of open source software and hardware implies very different business models than the conventional development of such products. In the case of open source hardware, one way in which companies operate is in producing 'kits' that enable consumers to build the product themselves and to make alterations/changes as they require. *MAKE* magazine is devoted to DIY technology projects and has detailed 60 open source hardware projects in 2008.<sup>27</sup>

Open source inventors/designers may often launch their projects without concern over how to make money from them. The inventors of projects (software or hardware) that become widely used often then become the main point of expertise for users, which may lead to opportunities for consultancy and development services in a more conventional manner. An alternative economic approach regarding open source hardware is that companies may create such hardware and market it. This hardware will then be copied by competitors but the inventor of the open source hardware should have the capacity to stay ahead of competitors, given the feedback and suggestions they receive from the user community. This is particularly true for quality issues as the original quality of such hardware may not be replicated by competitors, thus the inventor can stay ahead on quality grounds.

Related to open source hardware, or at least to users' capabilities to make changes to and copy new technologies, is the idea of reverse engineering. Individuals may reverse engineer products to figure out how they work and how they can enhance and change these products to suit their purposes and to use them for other applications. This can be a negative issue for companies as it undoubtedly involves some illegal copying of products, however, for others it may extend the usefulness and thus market life of other products, resulting in greater incomes for some companies.

#### **5.4 Future opportunities**

The future opportunities presented by open source technologies are numerous. The newly installed US president has already commissioned Sun Microsystems to assess the implications of open source for Government and to make recommendations on how it can optimise the benefits of OS technologies. The British Government has performed analyses of the feasibility of OSS for schools (see *Becta* above) and for Government departments and agencies. However, its use is not yet universal in Government. As individuals, businesses and governments increasingly look to cut costs, open source technologies will become more mainstream, thus reducing profitability of proprietary software companies. Perhaps such companies will become redundant in the future?

Open source technologies also present opportunities to address inequality in society, especially for developing countries. Open source results in software and hardware being cheaper and more widely available thus poorer countries may be able to catch up with the technologies that are used in richer countries as open source is used in more and more applications.

The 10 ways to make money in virtual worlds described above (Section 5.2) are likely to continue, and many may take on more significance in the future as games become more and more popular and as more people in the world increase their levels of disposable income.

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<sup>27</sup> "Open source hardware 2008 - The definitive guide to open source hardware projects in 2008" ([http://blog.makezine.com/archive/2008/11/draft\\_open\\_source\\_hardwa.html](http://blog.makezine.com/archive/2008/11/draft_open_source_hardwa.html))

According to Zhao et al (2000), virtual worlds present greater opportunities for human-centric work than do the more traditional ways of working and workplaces. Personal motivation and the satisfaction of personal decision-making are common features of online communities. As more human-centric work becomes more valuable to many people and seen as a more productive means of working by many, the organisational forms in online environments may be more commonly used for work than they currently are.

The types of virtual worlds that exist in the future will help to shape the opportunities that may arise from them. Current investment trends in virtual world-related companies shows that more investors are becoming interested in virtual worlds for youth and children. Virtual worlds for these groups, such as Club Penguin (owned by Disney), are popular, with growing memberships. There is a definite market here. There are even online payment systems such as Ukash being developed for children who usually don't have credit cards which are the most used type of online payment method. There is also a version of Second Life explicitly meant for teenagers aged 13 to 17<sup>28</sup>.

From entrepreneurs to large multinational corporations, interest in virtual worlds is growing quickly. In the future, the corporate use of virtual worlds looks set to grow for activities such as meetings and staff training. Use of virtual worlds for such activities could help businesses to improve their productivity through reducing costs. Virtual activity could also save them time, money and resources. As companies use virtual worlds to generate revenue through marketing, branding and advertising, new and innovative forms of interactive advertising will arise. This could possibly compete with the use of typical real-world advertising media such as posters and billboards. Virtual worlds may also enhance collaboration through flexible application sharing.

In the future, hybrid types of virtual worlds are likely to arise for gaming, social networking, immersive education, corporate collaboration, business activities and focus groups. While no one predicts that virtual worlds will replace real physical interactions, they may enhance such meetings and will enhance the 2-dimensional internet.

With increased use of virtual worlds and increased opportunities to make real money from such worlds, it is inevitable that some people will take advantage of opportunities to commit crime in these virtual worlds. Already, child pornography has been exchanged in virtual worlds. The use of more online trading with real world money may also lead to increased opportunities for identity theft and fraud. Harassment and bullying that takes place online may also have significant real world impact on individuals, particularly vulnerable people such as children. The negative aspects of technological advance are discussed in Section 6.

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<sup>28</sup> <http://teen.secondlife.com> – basic membership is free in this version of Second Life

## **6. Possible negative effects of technological development**

While technological developments are generally considered to be of great benefit to society and the economy, there are also often negative effects associated with advances in technology and the proliferation of such technologies amongst the population. Almost all technological developments have some negative social and economic effects in today's world. Whilst the monetary value of some negative social effects may be difficult, near on impossible, to measure, it is possible that the negative side of technology advancement can sometimes outweigh the positive effects. Whatever the impact, the negative implications of advances in technology are important and should not be dismissed.

### **6.1 Work and the workplace**

#### **6.1.1 Telecommunications – remote working and offshoring**

Most technological advances impact on the nature, form and content of work, and on the workplace itself. Some of the negative impacts particularly affect how work is performed and the productivity of workers. Developments in telecommunications, such as the widespread use of internet networks and the resulting increase in the ability of employees to work remotely has been hailed largely as a benefit to businesses and workers. In an ideal world, remote working gives employers virtually the same access to their employees they would have if they were working onsite, and employees can produce the same output remotely as they could if in the office. For employees, remote working can help solve problems created by conflicting work and home responsibilities by allowing for more flexibility of the work environment.

However, in some cases, remote working can create problems for both employer and employee. The quality of work may be an issue, as there may be difficulties with some employees working with no supervision, or there may be some things that simply cannot be done as well away from the office as they could be done onsite (eg collaborative work or work requiring physical outputs). For employees, being remotely connected to one's work sometimes results in increased working hours as workers may be 'on-call' and are expected to be reached whenever needed for work purposes. For some people the technologies that allow them to work from home (or wherever) may be frustrating. The division between work and home life may be blurred by such working situations. People who work from home or elsewhere outside their company's environs may also miss out on the social interaction that occurs with colleagues and clients in the workplace. This interaction can also be beneficial for knowledge sharing and the generation of ideas. Working remotely does not typically permit such informal and/or unplanned interaction to occur.<sup>29</sup>

Developments in telecommunications have also allowed some companies to move particular departments that do not require face-to-face contact with customers/users to remote or overseas locations. This has been a big development for customer service departments, particularly in the banking sector. Customers in the UK who call their bank to speak to someone about customer service issues may speak to a representative who is actually sitting at a desk in India or Canada. There have been many complaints from consumers voicing dissatisfaction with such service. But offshoring these and other services helps companies to cut costs. If customers are displeased enough to stop doing business with a company then that is a significant negative outcome for the company. From the view point of employees in the UK, offshoring business functions puts some people here out of jobs.

#### **6.1.2 Robotics and automation**

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<sup>29</sup> The use of virtual meeting places for work purposes (as discussed in section 5) is thought to present a possible solution to this problem as in theory it allows for people's avatars to meet and discuss things without planning to do so.

Other advances that have impacted on work are robotics and manufacturing machinery that permits much of the manufacturing process to be automated. Automated bank machines and store checkouts have also been important cost-reducing technologies that have grown popular. Such technologies have allowed many companies to improve productivity significantly. On the negative side, however, many people have lost jobs due to automation. From a social perspective, the use of machines for banking (eg ATMs) and retail shopping (eg self-serve kiosks) may also be considered to have a negative impact on people's day to day social interaction. The use of automated systems for customer services is also considered a negative development in many people's opinions.

### **6.1.3 Use of internet at work**

While the internet has benefited work and business in a number of ways, the personal use of internet by employees while at work is less beneficial to worker productivity and companies' bottom lines. The CBI (2008) conducted a survey that indicated that employees' personal use of the internet while at work costs employers in the UK as much as £10.6 billion each year. The average UK employee spends 1.5 hours per week, or ten days per year, using the internet at work for personal reasons. Employers estimate that 4.4% of working time is lost in this way, with an average annual cost of £939 per employee.<sup>30</sup>

## **6.2 Social effects**

### **6.2.1 Cyberbullying/cyber-harassment**

#### **Definitions and forms of cyberbullying**

The Department for Children Schools and Families (DCSF), in its Guidance on preventing and responding to cyberbullying, states that cyberbullying is "the use of Information and Communications Technology (ICT), particularly mobile phones and the internet, deliberately to upset someone else". According to the website [www.stopcyberbullying.org](http://www.stopcyberbullying.org), cyberbullying is:

*when a child, preteen or teen is tormented, threatened, harassed, humiliated, embarrassed or otherwise targeted by another child, preteen or teen using the Internet, interactive and digital technologies or mobile phones. It has to have a minor on both sides, or at least have been instigated by a minor against another minor.*

If an adult is involved or becomes involved in such a matter, it is then termed 'cyber-harassment' or 'cyberstalking'.

According to a government study in the UK<sup>31</sup>, more than one third of children aged 12 to 15 have faced some sort of cyberbullying. Cyberbullying/harassment is a serious matter that did not exist before various telecommunications technologies were created and became readily available and accessible to young people and children. While bullying and harassment are not new phenomena amongst children and teenagers, the means through which such activity may take place have changed dramatically with the advent of mobile phones and affordable internet services. Children and young people are very capable in using the latest telecommunications technology, and many have significant presence on the web. Cyberbullying can involve a number of actions on the part of the bully, including: posting false or embarrassing information about the subject of the

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<sup>30</sup> CBI Press Release "Over 90 minutes a week spent on personal websurfing at work" (<http://www.cbi.org.uk/ndbs/Press.nsf/0363c1f07c6ca12a8025671c00381cc7/94d596bf6bcd69708025745e003b722b?OpenDocument>)

<sup>31</sup> *Cyberbullying – Safe to Learn: Embedding anti-bullying work in schools*, DCSF (2007).

bullying on Facebook, MySpace or Bebo profiles, sending threatening or degrading emails or text messages directly to the subject, or circulating embarrassing information about the subject to others via text or email. In some cases, the bully may steal the victim's password and send inappropriate or embarrassing messages to others or may use the victim's password to inappropriately change the person's profile.

A related term 'happy-slapping' describes a fad in which someone unexpectedly physically attacks another person and the assault is recorded, typically on a mobile phone's video camera. These videos are often circulated to others via phone or email, and sometimes the 'happy-slapper' posts the video on the internet.

#### Statistics

The incidence of cyberbullying varies considerably between surveys and depending on the age group in question. Estimates vary from 11% to over 30%. Goldsmiths carried out research for the Anti-Bullying Alliance (ABA) in 2006 which found that 22% of 11 to 16 year olds had been victims of cyberbullying. According to the MSN cyberbullying report in 2006, 11% of 12 to 15 year olds in the UK had experienced cyberbullying. In a four year study on bullying, Noret and Rivers found that 15% of the more than 11,000 children in their sample had received nasty or aggressive text messages and emails. This demonstrated a year on year increase in the number of children subjected to bullying through new ICT. In research conducted as part of the DCSF cyberbullying information campaign, it was found that 34% of 12 to 15 year olds had been victims of such activity. Despite discrepancies in the actual percentages of young people who are victims of cyberbullying, the overall conclusion is that this problem is significant in the lives of many children in the UK and other countries.<sup>32</sup> Furthermore, with the increasing use of ICT by children and the greater importance that such technologies have in this generation's daily activities, cyberbullying is likely to continue to be a growing problem.

#### Legislation and policy

As a form of bullying, cyberbullying is covered by the range of education law that deems bullying unacceptable and outlines that the school community has a duty to protect its members (students, teachers and staff). The *Education and Inspections Act (EIA) 2006* sets out some legal powers which are more directly related to cyberbullying. It gives head teachers the power to regulate, to a reasonable extent, the conduct of pupils when they are situated away from the school grounds. This is particularly relevant for cyberbullying as it is very likely to take place outside of school but it has definite ramifications for school life. Some cyberbullying activities may be deemed criminal under a variety of different laws, including the *Protection from Harassment Act 1997* and the *Public Order Act 1986*.

The Government has undertaken a number of initiatives in attempts to raise awareness and reduce the incidence of cyberbullying, particularly amongst children and teenagers. Guidelines for dealing with cyberbullying have been published by DCSF.<sup>33</sup> A number of organisations have websites devoted to providing information on cyberbullying and information on the help that is available to victims and their families.<sup>34</sup> *Directgov* also provides information for young people in relation to cyberbullying, its effects, how to prevent it and where to get help.

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<sup>32</sup> Recent studies in the US, Poland and Japan have found similar results to those in the UK (see Gardner, W. (2008) "Cyberbullying: a whole-school community approach" ChildRight, February 2008: pp. 25-28. According to Smith et al (2005) studies have shown that 13 per cent of children in Australia have been exposed to cyberbullying by year 8 while in the US 42 per cent of 9 to 13 year olds had been bullied online and 53 per cent admitted that they had bullied someone else online.

<sup>33</sup> *Cyberbullying – Safe to Learn: Embedding anti-bullying work in schools*, DCSF (2007).

<sup>34</sup> For example, [www.stopcyberbullying.org](http://www.stopcyberbullying.org), [www.kidscape.org.uk/cyberbullying/](http://www.kidscape.org.uk/cyberbullying/)

### **Effects of cyberbullying**

While bullying is not a new phenomenon, cyberbullying is a relatively new concept with impacts on its victims that are also additional to those suffered by victims of 'traditional' bullying. Use of ICT to bully and harass enables the bully to reach more people fairly easily and quickly whereas traditional bullying is a more face-to-face, one-on-one activity. Reaching more victims means that the problem of cyberbullying may have greater overall impacts. The ease with which information can be shared in cyberspace also means that embarrassing or hurtful rumours, pictures or information related to victims can be shared with large numbers of people furthering the harm that this exposure causes.

New ICT also permits bullying to take place at times when face to face contact is impossible thus cyberbullying may be perpetrated 24 hours a day, 7 days a week. This results in the victim having no reprieve from the bullying and feeling vulnerable wherever he/she may be. New technologies also allow for increased anonymity of bullies, again creating more vulnerability for victims.

The effects of cyberbullying on victims vary. Depression, anxiety and other mental health issues may arise from cyberbullying. This can affect victims' performance in school and relationships with others. In some cases, the negative behaviour escalates to the point where there is actual physical violence or harassment between the bully and victim. A number of cases have come to light in the media of young people committing or attempting suicide after being victimised by cyberbullies.

Workplace cyberbullying and harassment can have financial consequences for the victim and the organisation as it can lead to absenteeism and reduced productivity. Where the bullying affects the victim to the extent that they resign from their position the victim and his family may suffer financial hardships which may contribute to the break down of relationships.

With today's young people and younger generations being considered 'digital natives' they are more adept at using ICT and other new technologies. These technologies are increasingly a part of their daily lives such that their virtual lives and real lives merge. With such increased use come increased opportunities for cyberbullying to take place. In the workplace, cyberbullying and harassment is increasingly problematic as ICT technologies become commonplace in most organisations. As social networking websites, video sharing websites and blogspaces become increasingly common and accessible, the incidence of cyberbullying and its impacts on victims may become more widespread and increasingly serious in nature.

#### **6.2.2 Education sector**

Advances in technology, like the internet and its wide coverage and ease of access, have had profound effects on education both in terms of content and how subjects are taught. Classrooms now have more than just blackboards and chalk. Electronic whiteboards, digital projectors and things like PowerPoint presentations are common means of delivering information to students in the classroom. While these new teaching aids have been considered improvements there may be some students for whom these devices lack the personal touch that they require to learn effectively.

The proliferation of home internet connections and the use of the internet by producers of knowledge to disseminate their work freely/widely has increased the opportunity for students to commit plagiarism if they are so inclined. Other technological developments however, have improved the tools available to teachers and providers to detect such plagiarism. Cheating in examinations using mobile phones for texting answers is also a relatively recent phenomenon made possible by developments in telecommunications technologies. A survey conducted by the student newspaper, Varsity, found that just

under half of undergraduates who took their poll had submitted someone else's work under their own name. Law students were found to be the most likely to plagiarise (62%).<sup>35</sup>

Advancing technologies have also had some negative impacts on the quality of students' education. Text messaging, for instance, and the abbreviated slang many people use in texts is thought to have had a negative effect on many young people's and children's ability in spelling and grammar. There have been ideas put forth that the system of spelling and grammar in the English language should change to accommodate text language rules, however, the general consensus appears to be that text messaging has had a negative effect on the literacy of some young people and children.

### **6.2.3 Identity theft and internet fraud**

In 2000, CNN reported that the internet and online commerce was allowing criminals to use false identification to commit crimes. Since that time, increased use of authentication and other security measures have helped to mitigate the risk of identity theft and other forms of online fraud. However, in 2005, Dr. Emily Finch of the University of East Anglia asserted that increasing use of technology actually worsens identity theft and that human vigilance is the best defence against identity fraud<sup>36</sup>. Criminals themselves use technology to their advantage to clone bank and credit cards, steal people's personal identification numbers (PIN), to produce counterfeit money, to produce false travel documents such as passports and find ways of circumventing technological security measures.

Phishing is the process by which a person or persons fraudulently attempts to obtain sensitive or confidential information including usernames, passwords and financial details by representing oneself as a trustworthy company or person in email or other electronic communications. Phishing emails often take the form of an email from 'your bank' requiring you to verify your password. Many phishing scams fraudulently represent themselves as originating from banks, financial institutions, social networking sites and IT administrators within companies. Data breaches in 2008 have been estimated to have cost companies £700 billion worldwide. Phishing scams and trojan keystroke loggers were found to be behind UK online bank fraud in 2004 that totalled around £12 million.

### **6.2.4 Terrorism**

The internet and cheap mobile phones have allowed for some terrorist networks and for individuals with extreme views to communicate, increase membership and support, coordinate actions, and raise funds. The number of terrorist sites increased exponentially over the last 10 years from less than 100 to more than 4,800 two years ago.<sup>37</sup> However, these numbers likely underestimate the true presence of such sites and information online. Terrorist websites can offer information on constructing bombs or can serve as virtual training grounds for terrorist activities. A number of terrorist groups and extremists have their own websites with discussion pages where members/viewers share their opinions and ideas related to terrorism with the hopes of raising membership and morale. Terrorist networks use the internet and related technologies in a number of ways to benefit their organisations. According to the United States Institute of Peace contemporary terrorists use the internet in eight different ways:

1. psychological warfare

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<sup>35</sup> Guardian.co.uk "Universities review plagiarism policies to catch Facebook cheats" (<http://www.guardian.co.uk/education/2008/oct/31/facebook-cheating-plagiarism-cambridge-varsity-wikipedia>) 31 October 2008

<sup>36</sup> Thomson, I. (2005) "Technology accused of aiding ID theft – Another blow to ID cards", [www.vnunet.com/2141845](http://www.vnunet.com/2141845).

<sup>37</sup> Kaplan, E., "Terrorists and the internet" (<http://www.cfr.org/publication/10005/#2>). Updated 8 January 2009.

2. publicity and propaganda
3. data mining
4. fundraising
5. recruitment and mobilisation
6. networking
7. sharing information, and
8. planning and coordination.

Recent examples of the use of the internet and other new ICT by terrorist organisations includes the development of a new generation of encrypted software called "Mujahidden Secrets 2". This software gives security to users that allows them to communicate freely through email without being observed by intelligence agencies or authorities. It has also been reported that Al-Qaeda want to create an online Jihad University.<sup>38</sup> There is also evidence of online gambling being used by terrorist networks to launder money and videos, blogs and virtual training platforms are believed to be used for recruiting and training terrorists.

### **Legislation and policy relating to terrorism and the internet and ICTs**

The *Terrorism Act 2006* prohibits the encouragement of acts of terrorism and the dissemination of terrorist publications. This Act deems inciting terrorism over the internet a criminal offence and those found guilty of such an offence may be jailed for up to seven years.

One of the key priorities related to preventing terrorism that is set out by in the European Union Counter-Terrorism Strategy is to "develop common approaches to spot and tackle problem behaviour, in particular the misuse of the internet."

### **6.2.5 Pornography, sexual predators**

With its free flow of information and connections between users all over the world, the internet has become an ideal forum for finding, viewing and sharing pornographic material. Most readily available statistics regarding pornography on the internet come from the US. The number of pornographic webpages in the US has been found to be 244.7 million while in the UK the number is estimated around 8.5 million. The internet pornography industry in the US had revenues of US\$2.5 billion in 2005 and US\$2.84 billion in 2006.<sup>39</sup>

Whether or not adults' use of pornography is a bad thing is a very subjective matter; the exploitation of children in pornography and their exposure to pornographic material on the internet is generally agreed to be unacceptable. As children are starting to use the internet at younger ages and as they are more and more knowledgeable about use of the internet and other technologies, it is very likely that many young internet users come across pornographic material at some time. In the US, the average age at which a child is first exposed to internet pornography is estimated to be 11 years. Approximately 90% of 8 to 16 year olds have viewed pornography online.<sup>40</sup> The likelihood of children accidentally encountering pornographic images online is elevated by the links between children's characters and pornographic websites.

The use of children in pornography and the exchange of child pornography on the internet are perhaps the most disturbing issues. According to the Guardian, the number

<sup>38</sup> Harding, T. (2009) "Terrorists launder cash through online gambling" Telegraph.co.uk ([www.telegraph.co.uk/scienceandtechnology/technology/4060727](http://www.telegraph.co.uk/scienceandtechnology/technology/4060727))

<sup>39</sup> Statistics from Internet Filter Learning Centre (<http://www.internet-filter-review.toptenreviews.com/internet-pornography-statistics.html>)

<sup>40</sup> Statistics from Internet Filter Learning Centre (<http://www.internet-filter-review.toptenreviews.com/internet-pornography-statistics.html>)

of websites offering child pornography to UK internet users increased by 75% in 2005.<sup>41</sup> In 2003 the National Centre for Missing and Exploited Children (US) estimated that 20% of all internet pornography involves children. The US Customs Service estimated that 100,000 websites offer illegal child pornography. As of December 2005, child pornography was a US\$3 billion per year industry.<sup>42</sup>

The widespread availability and large use of pornography on the internet is thought by a number of people to lead to breakdowns in families and relationships. In 2003, two-thirds of the 350 divorce lawyers who attending a meeting of the American Academy of Matrimonial Lawyers indicated that the internet was a significant factor in divorces with excessive interest in cyberporn being an issue in more than half of such cases.<sup>43</sup>

Grooming children for sexual exploitation or other harmful treatment has also been propagated through new technologies. Internet and online communication has proven to be a common means used by some people to make contact with young children (and older people as well) with the ultimate aim of exploiting the subject. Grooming involves befriending and gaining the trust of a child for the purposes of creating a situation where the child may be sexually exploited. Chatrooms, virtual worlds, and email communication are commonly used methods of contact and the anonymity such forms of communication afford to people has allowed many to pose as other children in order to enhance the level of trust between them and potential victims.

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<sup>41</sup> "Massive rise in child porn sites"  
(<http://www.guardian.co.uk/technology/2006/feb/26/news.childrenservices>) 26 February 2006.

<sup>42</sup> [www.internet-filter-review.com](http://www.internet-filter-review.com)

<sup>43</sup> [www.divorcewizards.com](http://www.divorcewizards.com)

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