CLOSE THE GAP WORKING PAPER 3

‘Women: the missing link?’

A discussion paper on occupational segregation within science, engineering and technology

Close the Gap, 2010

Introduction

The Commission on the Status of Women is a functional Commission of the United Nations Economic and Social Council.

Each year there is a meeting of the Commission, commonly referred to as CSW, which charts progress within states on progress to deliver the Beijing Platform for Action, agreed at the 4th World Conference on Women. It is also attended by thousands of NGOs, who work within the margins of the conference to encourage action on inequalities.

Each year, CSW takes as its theme a section of the Beijing Platform for Action (BPfA). The theme for 2011 is the ‘access to and participation of women and girls in education, training, science and technology’, and will include discussions on ‘the promotion of women’s equal access to full employment and decent work’.

CSW will be exploring one of the key challenges facing the Scottish economy; occupational segregation. Tackling occupational segregation is one of the areas of Ministerial Priority for Gender Equality, and a commitment to ensure women and men can fully access and participate in the labour market economy will help facilitate sustainable economic growth for Scotland. This paper will explore further the phenomenon of occupational segregation and its impact on business, the economy and women, and in doing so will reflect on the systemic discrimination that limits women’s participation in the labour market.

What is occupational segregation?

Occupational segregation by gender refers to the inequality in the distribution of women and men across different occupational categories and job types. Labour market statistics show that women and men are in different jobs, dominate in particular sectors and indeed, are channelled into different jobs.

Occupational segregation is most often discussed in relation to horizontal segregation, where women and men are clustered into specific jobs types. For example we find women dominate catering, cleaning, caring, cashiering (retail) and clerical (administration) jobs, which are frequently referred to as the '5 Cs.' Moreover, these same job roles are strongly associated with low status, and therefore low pay. The relationship between female-dominated occupations and low pay is complex, but there is a strong suggestion that 'women's work' is systematically undervalued within labour markets (see Women and Work Commission, 2006; European Commission, 2009 and TUC, 2008). Vertical segregation, or the 'glass ceiling', refers to the clustering of women in lower positions within organisations and their relative absence from senior management and executive positions. For example, only 5 of the FTSE 100 companies have female CEOs and only 12 per cent of directors in the FTSE 100, including non-executive directors, are women (The Independent, 2010).

One of the key impacts of occupational segregation is on pay. Walby and Olsen analysed the factors which underpin the gender pay gap, the difference in pay between women and men and they found that occupational segregation and the 'part-time working effect' contributed substantially to the gender pay gap (Walby and Olsen, 2004; European Commission, 2009). The pay gap in Scotland is currently 11.9 per cent when we compare men's average full-time hourly pay earnings with women's average full-time hourly pay earnings and is 33.6 per cent when we compare men's full-time and women's part-time average hourly earnings (ONS, 2010).

Theoretical explanations of occupational segregation

Neoclassical economists consider the gender segregation of the labour market as an outcome of the way in which women and men obtain skills and knowledge and build their human capital. Employers, according to this theory, will choose the most attractive, and least risky, labour option to meet their demand.

This argument assumes that women and men have equitable access to resources and opportunities to make rational investment decisions to increase their productivity and therefore labour market value throughout their career. Over time, the cumulative effect of women and men making 'rational choices' in relation to the resources available to them, will inevitably lead to a labour market which reflects those patterns of choices.

As a result women will pose the greatest risk to employers because they are more likely to take long breaks from participating in the labour market, to start family or care for relatives, and at the same time are less likely to be able to sustain their investment in skills, knowledge and training. Even after substantial investment, the value of those skills will depreciate over periods of absence or during periods of working in lower valued, part-time work.

However, feminist economic thinkers recognise the flaws in this approach to analysing occupational segregation and present a more nuanced structural analysis. They suggest that 'neoclassical economic analysis fails to situate the 'choice' of women and men in relation to their labour market value to wider social and cultural expectations and assumes that women and men are equal at the point of entry to the labour market' (McKay, 2010). For example, historically women's access to education in the UK has been limited, but gradually over the past 60 years has this changed. The expectations and roles of women were firmly based on the assumption that their primary responsibility is to look after the household; unvalued and unpaid reproductive labour which is invisible to the formal market economy.

Secondly, critics of human capital theory would argue that the 'choice' women face to find the optimum balance between remuneration and the types of occupations where the value of skills will depreciate less, is a form of discrimination embedded in the value attributed to the role of women in society as carer, and dependent and subsequently as an employee. Despite recent changes, women's investment 'choices' are still limited as the necessity to strike a work-life balance prevails (women are still likely to be the main carer of children and relatives). Finding appropriate flexible work to match the levels of investment women have made can be problematic.

Part-time work is lower valued and is lower paid and many women end up working below their acquired and potential skill level, with few opportunities for promotion. Women will fail to see a substantial return on their investment in skills and that same investment will depreciate over the long term, as women will have less opportunity to 'top up' their skills and knowledge in the workplace. The 'choice' of working part-time in this respect results in women being deskilled and clustered into specific occupations as they strive to find the balance between doing a job that pays well and one where the skills levels are low enough so as not to depreciate as much during periods of absence from the labour market. If the market operated in a vacuum, free of sociocultural influence as neoclassical economists suggest, then employers are almost justified in discriminating against women or those who invest in 'women's work' or attributes.

The causes and consequences of occupational segregation

Occupational segregation has a negative impact on long term economic growth. The Women and Work Commission estimated that the cost of job segregation could be worth between £15 billion and £23 billion per year to the UK economy, which is about 1.3 – 2.0 per cent of gross domestic product (GDP) (Women and Work Commission, 2006).

The European Commission published research in 2009 into gender segregation and the labour market, which provides an insight into the causes and impacts of occupational segregation across member states of the European Union. The research also provided an analysis of occupational segregation using three separate measurements to enable comparisons to be made across European Member States. The paper considered data from 1992 until 2007 and focussed initially on the 15 European Union Member States (EU 15) and latterly on the EU 27. Occupational segregation was tracked from 1992 until 2007 and analysed using three measures of segregation; the Karmel and MacLachlan index (IP), the index of dissimilarity (ID) and the Hakim classification of occupations. The four most segregated countries are Estonia, Slovakia, Latvia and Finland. Interestingly, between 1997 and 2007 the UK was one of the countries desegregating at the fastest rate.

The IP and ID indices are similar in nature and consider the percentage change in relation to occupational segregation and sector segregation as a total of male and female employment. The IP index is interpreted as 'the share of employed population that would need to change occupation (sector) to bring about an even distribution of men and women among occupations or sectors' (European Commission, 2009, pg 31). The IP index is sensitive to the fluctuations in total female employment. The ID index is only indirectly dependent on the level of female employment and the measured change required is attributed to one sex only.

The Hakim classification is a descriptive indicator and measures are based on female-dominated, male-dominated and mixed occupations. Measurements are arbitrarily calculated by adding or subtracting 15 decimal points from the total share of female population. In this case Hakim is used as a supplementary indicator alongside the IP and ID measurements. Chapter two of the paper provides a more detailed description of each indicator and the Technical Appendix details the calculations. The European Labour Force Survey was used as the source to classify occupations using the International Standard Classification of Occupations-88 (ISCO-88).

The report found at a European level segregation is high; 25.3 per cent for occupational segregation and 18.3 per cent for sectoral segregation (European Commission, 2008, pg 37). Since 1992 there has not been a significant change in segregation at European level. However, at country level comparisons are more pronounced as the causes of segregation are shaped by social and cultural contexts. For example, analysis of the UK revealed that the structural component worked to increase segregation, meaning employment grew during the period from 1997-2007 and with it the female employment rate and as a result sector

segregation increased. However, over the longer period from 1992-2007, the decisive factor was the desegregation within occupations.

Analysis of the indicators found that employment growth and occupational desegregation are not always working simultaneously. As female employment rate increases there is likely to be a short term increase in segregation because it is deemed to be easier for women to enter female-dominated occupations. As employment growth continues then women have greater opportunities to move into male-dominated occupations, carving out niche areas. As a result a higher female employment rate will eventually lead to desegregation. At the same time the Hakim classification pointed towards an increase in mixed-occupations over the time period and a decrease in male-dominated occupations. This in part could be explained within the context of globalisation where the structure of the European economy has slowly changed from a reliance on heavy industry and manufacturing, both male-dominated occupations towards a service-based economy.

In addition, post 1940s, the reproductive economy has been commercialised and domestic occupations, such as cleaning and caring now operate within formal economic spaces (Humphries and Rubery, 1995). With it female-dominated occupational spaces have emerged in caring, cleaning, catering etc. alongside a rise in female employment. However, as Hakim suggest there has not been a decrease in female-dominated occupations, but rather an increase in mixed-occupations, which would also support the macro-economic changes during this period.

The European Commission's research also documents the causes and impacts of occupational segregation. This particular report focused on four key factors; choice of subjects and area of study, stereotypes, the disproportionate burden of caring responsibilities on women who subsequently need shorter or flexible work hours and the barriers and biases in institutional practices, for example collective pay bargaining in trade unions. These findings resonate with findings in Scotland and the UK where we see a myriad of factors which sustain the segregation of women and men in the labour market (see for example, UKRC, 2010; TUC, 2008, Scottish Government, 2010).

Education and training

The relationship between choice of subjects, area of study and resultant occupation are intrinsically influenced by socially and culturally constructed gender stereotypes of girls and boys from a young age. In Scotland, we know that the choices school students make in relation to subjects are heavily segregated where girls dominate biology, social sciences, modern studies, arts, early years education, home economics, and languages, and boys tend to dominate physics, technology,

computing, craft and design (Scottish Government, 2010). The impact of these choices shapes the long term education, training and employment patterns of girls and boys further compounding gender differences. For example, in order to enter engineering it is often necessary to have a physics and maths qualification. As a result, decisions as to what subjects to do become more salient in the context of perpetuating occupational segregation.

In training and in further and higher education there is a higher representation of women in areas such as healthcare, education and arts and a higher representation of men in engineering, technology and computing science courses (see Table 2 for example).

The Modern Apprenticeship Scheme in Scotland, which is the key entry point to the labour market for young people who are not participating in tertiary education, reflects a similar pattern of occupational segregation, where young women and men are segregated into particular training schemes. Women are again significantly less likely to be involved in science, engineering and technology (SET) related programmes. Furthermore, the percentage of women 'in training' as part of an MA programmes is currently only 26 per cent (Skills Development Scotland, 2010). Table 1 provides a snapshot of the most segregated areas of the MA training programme.

Table 1: Representation of women and men in key MAs Frameworks in Scotland 2009-2010

MA Framework	% of Starts		% in Training		Achievements as a % leavers	
Framework	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Business and administration	80	20	81	19	84	84
Construction	2	98	1.5	98.5	64	65
Engineering	3	97	2	98	83	67
Hairdressing	95	5	95	5	67	65
Health and social care	87	13	87	13	68	57
Information and communication technologies	10	90	14	86	50	89
Plumbing	2	98	2	98	71	74
Early Years Care and Education	98	2	98	2	90	77

Source: Skills Development Scotland National Training Programmes Performance Report April 2009-March 2010 **http://www.skillsdevelopmentscotland.co.uk/media/141308/ma%20breakdown%20-%20all%20scotland.pdf** Accessed October 2010

In 2005 the then Equal Opportunities Commission undertook a General Formal Investigation (GFI) into occupational segregation in the MA programme. The investigation focused on the five most gender segregated sectors, construction, engineering, plumbing, childcare, and ICT (Information and Communication Technologies). Construction, engineering and plumbing are all traditionally male-dominated sectors and almost all childcare workers are women.

The GFI found that occupational segregation has significant economic and social costs to the economy. A key output of the investigation was the identification of the link between skills shortages in key sectors, such as engineering, and the underrepresentation of women within these sectors. Furthermore, the GFI also found a significant gender pay gap between the pay rates of female and male apprentices. In 2003 the pay gap for apprentices aged 17 was 31 per cent compared to a gap of 13 per cent for those aged 17 working full-time and not in a training programme (Thomson and Gillespie, 2009).

The patterns of gender segregation in early education and in modern apprenticeships are also echoed in higher education courses in Scotland. Table 2 details the qualification obtained by women and men expressed as a percentage of the total in each SET subject area during 2008 and 2009.

[1] The EOC along with the Race Equality Commission and the Disability Rights Commission became the Equality and Human Rights Commission under the Equality Act 2007.

Table 2: Qualification obtained by female and male students on HE courses in Scotland by subject area and level of qualification in 2008/2009

Higher Education institutes in Scotland								
Qualification level	**Postgraduate (%)**		**First degree (%)**		**Other undergraduate degree (%)**		**ALL LEVELS (%)**	
Subject area	Female	Male	Female	Male	Female	Male	Female	Male
Medicine & dentistry	56	44	67	33	0	0	61	39
Subjects allied to medicine	71	29	85	15	89	11	83	17
Biological sciences	63	37	68	32	60	40	66	34
Veterinary science	50	50	77	23	0	0	74	26
Agriculture & related subjects	44	56	42	58	54	46	46	54
Physical sciences	35	65	45	55	44	56	41	59
Mathematical sciences	31	69	42	58	42	58	39	61
Computer science	22	78	16	84	25	75	20	80
Engineering & technology	17	83	14	86	10	90	14	86
Architecture, building & planning	43	57	30	70	26	74	33	67
TOTAL	*43*	*57*	*54*	*46*	*56*	*44*	*51*	*49*
Total Science (n=27575)	*3360*	*4500*	*8365*	*7215*	*2310*	*1825*	*14035*	*13540*

Source: Adapted from Higher Education Statistics Authority
http://www.hesa.ac.uk/dox/pressOffice/sfr142/SFR142_Table7a.pdf Accessed October 2010

In biological sciences, over two thirds of students are women across all the qualification levels, compared with engineering where only 14 per cent are women. Even within SET areas of study there is a clear divide between biological and health related sciences compared to engineering and technological sciences.

In relation to the MA programme, the recommendations of the GFI included promoting 'non-stereotypical' careers to women and men, encouraging positive action initiatives among employers and employer representative groups and the sharing of good practice among employers and other stakeholders.

It is necessary to promote 'non-stereotypical' careers and ensure that girls and boys are making informed decisions about their future routes into work. However, it is more difficult to establish how stereotypes about gender influence choice, reflect a heteronormative society, and how much they are used to replace and amend information. In relation to the rest of Europe, the combination of widening women's access to education and training on the whole has led to a de-segregation in employment, at least in the UK (European Commission, 2009). However, desegregation has slowed over the past 20 years in Scotland and the UK and this has implications for the sustained growth in some of Scotland's key economic sectors.

Occupational segregation in employment

The distribution of men and women in different occupational sectors and groups in Scotland is detailed in Table 3 and Table 4.

Table 3: Percentage of women across different occupational sectors in Scotland 2009[2]

Occupational sector	Total number of employees (000s)	% female
Agriculture, forestry and fishing	28	17.8
Energy and water supply	40	22.7
Manufacturing	200	22.3
Construction	122	17.4
Distribution, hotels, catering and restaurants	517	53.3
Transport and communications	123	26.9
Banking, finance and insurance	434	45.9
Public admin, education and health	751	73
Other	123	50.8
Total*	2336	51.3

Source: adapted from Scottish Government Social Research (2010) Tackling Occupational Segregation a Review of Key Evidence and National Policies, pg 4.

[2] Scottish Government Social Research (2010) Tackling Occupational Segregation a Reviewof Key Evidence and National Policies, Scottish Government, Edinburgh available **www.scotland.gov.uk/socialresearch**

This overview illustrates the concentration of women in public administration, education and health, hotels and catering and banking and finance sectors. Table 4 illustrates the low percentage of women as managers and senior officials within Scotland, despite accounting for half the overall workforce.

Table 4: Distribution of women and men in different occupational groups

Occupational group		
	% male (number)	**% female (number)**
Managers and senior officials	64 (213,900)	36 (121,900)
Professional occupations	54 (182,000)	45 (152,000)
Associate professional and technical	48 (175,500)	53 (194,000)
Administrative and secretarial	21 (57,300)	79 (221,500)
Skilled trades	92 (251,400)	8 (21,200)
Personal services	18 (39,800)	82 (186,200)
Sales and customer service	32 (65,600)	68 (140,800)
Process, plant and machine operatives	88 (157,000)	12 (21,100)
Elementary occupations	53 (152,000)	47(136,200)
All Scotland	52 (1,295,000)	48 (1,194,900)

Source: adapted from Scottish Government Social Research (2010) Tackling Occupational Segregation a Review of Key Evidence and National Policies, pg 6 which sourced data from *Scottish Government LabourMarket Statistics: Annual Population Survey (October September 2009)*

Furthermore, female and male working patterns are considerably different. Only 10 per cent of men work part-time compared to 42 per cent of women. In addition, women are more likely to be working flexi-time or job-share rather than nine to five, five days per week (Scottish Government, 2010, pg 6). Part-time work is also more likely to be within stereotypical female occupations, for example, administration, caring and personal services rather than male dominated sectors such as SET (Tomlinson et al (2009) cited in Scottish Government, 2010, pg 6).

This becomes problematic as a lack of part-time options, and a lack of wider flexible working options, at senior levels can prevent women, who are likely to be the main carer, from progressing within an organisation. This also has an impact on businesses, as employers will lose the skills and talent of women who are forced to leave individual companies, or are unable to progress, and this will increase recruitment and retention costs.

The 'glass ceiling' effect presents a problem to employers and to the economy. It stifles the utilisation of skills and talent and it prevents women reaching key decision making posts. The specific barriers cited by women working in the life science sector included a lack of obvious flexible working practices, a critical mass of female role models in senior scientific positions and a lack of transparency over career progression routes and pay (Greenfield, S., et al, 2002). The implications of failing to take action to address these barriers will have a wider micro and macroeconomic impacts.

Sector Focus: Engineering

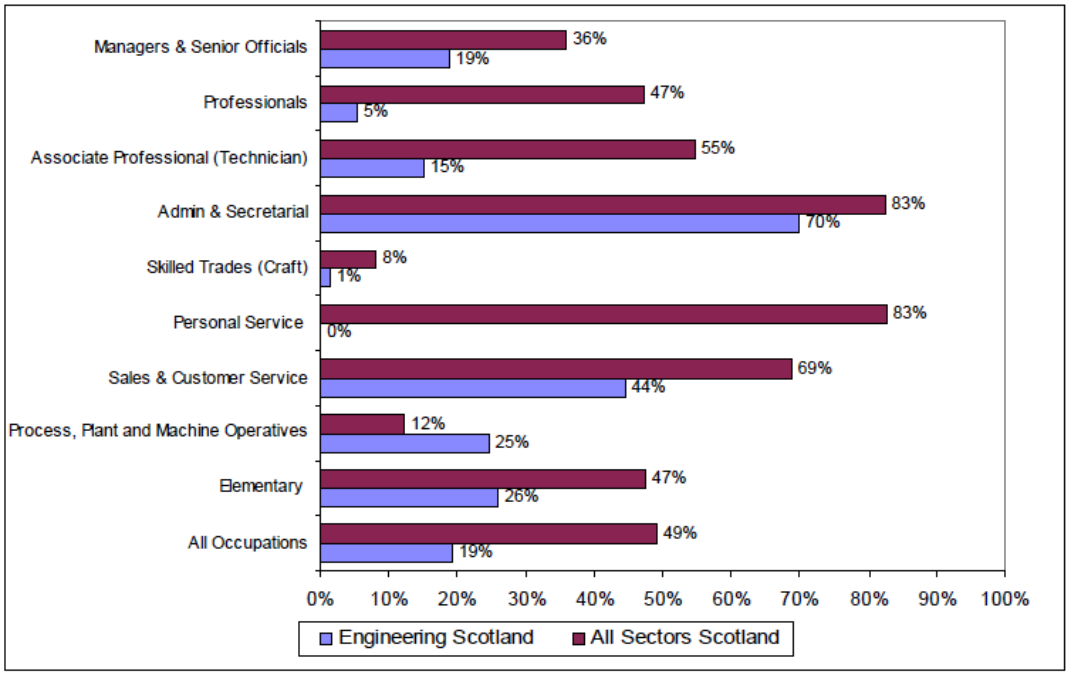
Engineering is an occupational sector which cuts across many industries. It is one of the most gender segregated sectors in Scotland and the UK, but is vital to economic growth. The sector's Gross Value Added (GVA) was estimated to be £56,200 per employee in 2007 compared to £31,700 average per employee for all other SEMTA sectors (SEMTA 2010).

SEMTA is the Sector Skills Council for Science Engineering and Manufacturing Technologies. It works with employers to 'improve performance through skills.' In February 2010, SEMTA reported on the future skills needs for the engineering sector in Scotland.

The segregation between women and men in engineering is one of the most pronounced, where 81 per cent of the engineering workforce are men. Although women are underrepresented in all areas of engineering, women are more likely to be employed in the electrical engineering sector compared to other sectors. Women also account for 70 per cent of administration and secretarial services within engineering companies (SEMTA, 2010, pg 14). Figure 1 details the distribution of women and men across occupational groups in the engineering sector compared to all other sectors.

[3] SEMTA works in the following sectors: metals, mechanical equipment, electrical equipment and electronics, automotive, other transport equipment, and engineering.

Figure 1: Percentage of women and men in different occupational groups in the engineering sector compared to all other sectors



Source: LFS 2008, ONS in SEMTA (2010) Skills and the future of engineering in Scotland SEMTA, UK pg 17

From Figure 1 it is clear that women are concentrated in administration, sales and customer services.

Despite forecasts that the overall workforce will decline between 2010 and 2016, the industry estimates a net replacement demand of 1400 per annum (SEMTA, 2010, pg 29). In particular, it is forecast that skills will be needed in the following occupational groups: skilled trades, elementary, managers and senior professionals, and associate professionals. With 44 per cent of the workforce aged over 45 in Scotland, and a need to maintain a sustainable workforce, the need for strategies to attract more women to, and retain more women in, engineering is becoming increasingly obvious.

SEMTA concluded that strategies to tackle occupational segregation and in particular the under representation of women should focus on demand side interventions. They perceive employers and employer representative organisations, and training providers, to have a greater role to play in order to attract women to the engineering sector than they are currently taking. This is a positive step which, with the right support, could lead to an increase in women working in the engineering industry. This will have the outcome of ensuring the widest pool of candidates to meet demand within the sector, as well as potentially increasing the diversity of engineering solutions available to the market.

Sector Focus: Bioscience

SEMTA also works with employers in bioscience sectors, including manufacturing. The bioscience and life science sector in Scotland is identified as one of the 'key sectors' in the Government Economic Strategy, as being a high growth area important to the economic success of Scotland. Scottish Enterprise suggests 'the life sciences sector growth rate is twice the medium term average growth rate of Scotland's economy' (Scottish Enterprise, 2010). Furthermore, Life Sciences Scotland, the organisation responsible for promoting and developing the sector, state that Scotland has the largest and fastest growing life science community in Europe. Nevertheless there are indicators that the sector may experience skills shortages, particularly in professional and associate professional occupational groups.

A recent labour market survey commissioned by SEMTA and Cogent Sector Skills Councils considered the skills needs in the UK for the life sciences, pharmaceuticals, biotechnology and medical devices. The research was based on 380 telephone interviews with organisations and companies within the appropriate Standard Industry Classification (SIC) codes throughout the UK. Of the 380 interviews 14 per cent were with companies based in Scotland, the second highest share in the UK after England (80%) (BMG Research, 2010)

The report is a representative sample and is therefore indicative of the concerns and needs of the sectors future labour requirements. Half of all employees within the sample are employed in managerial or professional engineering or scientific roles. Table 5 illustrates the pattern of occupational segregation drawn from a sample of 356 sites.

Table 5: Distribution of women and men across occupational groups in life sciences, pharmaceuticals, biotechnology and medical devices

	Female		Male	
	Number	%	Number	%
Managers and senior staff	1,148	33	2,290	67
Professional engineers, scientists and technologists	1,525	35	2,783	65
Associate professionals and technicians	825	44	1,062	56
Skilled trades	157	16	795	84
Process, plant and machine operatives	420	24	1,308	76
Administrative and secretarial occupations	1,315	66	667	34
Sales and customer services	411	53	365	47
Elementary occupations	81	33	162	67
Personal service occupations	25	10	222	90
Total (Sample base 356 sites)	*5,907*	*38*	*9,654*	*62*

Source: BMG Research (2010) *Labour Market Survey 2009,* pg 13

From the table it is clear there are two issues relating to occupational segregation. The first concerns the concentration of women in administrative and sales roles and the second illustrates the underrepresentation of women in senior roles. We can see from the table that 37 per cent of the total number of employees are women, but at the same time 29 per cent of them are employed in administration and sales roles compared to only 10 per cent of the total number of men employed across the different areas of bioscience.

Despite women accounting for two thirds of those who qualify in biological sciences (see Table 2), this is not reflected in the sector and indeed in senior management roles within Scotland. The UKRC published figures which suggest that despite bioscience disciplines having a critical mass of female students, researchers and lecturers only 15 per cent of professors are female (UKRC, 2010, pg 12).

At the same time, in 2007 SEMTA reported that life science companies in Scotland are facing skills related challenges.

- 27% of companies cannot expand because they lack the skilled people they need.
- 26% of companies look outside the UK for the skilled people they need.
- 29% of companies report skills gaps in the current workforce.

The pipeline conveying women undergraduates to the labour market is leaking and, unless it is fixed, the sector will continue to face labour shortages and will not be able to capitalise on the best talent. All of the stakeholders in the skills and skills utilisation arenas must take action to remedy the barriers to women's progression into, and within, the biosciences labour market.

DISCUSSION

There is a plethora of evidence which clearly demonstrates gender segregation within Scotland's labour markets. We know that occupational segregation has a negative impact on individuals, businesses, and the wider Scottish economy. Tackling the causes of occupational segregation is a long term endeavour, which perhaps has historically concentrated on supply-side issues such as training and skills development targeted specifically at women. Much of this work has focused on building women's human capital, and 'confidence' to return to the workplace or enter non-traditional sectors, such as engineering. This supply-side thinking is also evident in work done by a range of stakeholders, including Careers Scotland and the Equal Opportunities Commission, around career choice.

Girls and SET careers

However, despite the valuable contribution of supply-side responses, there appears to be a gap in the understanding of young people, and perhaps their teachers and careers advisers, around what scientists and engineers jobs entail, what subject choices are required to leave such career paths open, such as maths and physics for engineering, and the nature of specific jobs within SET.

The Girl Guides Association 2010 survey found girls' career aspirations are heavily inclined towards gender stereotypes. The most popular careers mentioned included hairdressing/beauty therapy, veterinary science, fashion/artistic design, teaching and working in medical professions. The most popular career amongst those surveyed up to the age of 16 was hairdressing/beauty therapy. After 16 this preference changed to teaching and subsequently 44 per cent of the 16-21 year olds surveyed had undertaken work experience at a school (Guide Association, 2010).

Although both boys and girls require access to more information about the nature of STEM careers, girls are subject to a separate set of pressures around subject choice, career choice, and gender roles, which requires specific interventions. Girls are still less likely to choose STEM subjects, and also more likely to discover that the qualifications they have pursued will not enable them to apply successfully for STEM related occupations (UKRC, 2010).

Girls' engagement with technology

Research evidence on how girls and boys engage with technologies is a useful indicator to explore the complex relationship between gender stereotypes and the impact on wider educational participation. This is an important issue as many researchers suggest that some of those differences relates to the low representation of women working in Information and Communication Technologies (ICT) or in technology related occupations, and perhaps even STEM related occupations (Becta, 2008).

In 2008 Becta, the government agency tasked to promote the effective use of technology in learning and education, explored the differences between boys' and girls' uses of ICT by reviewing key pieces of research in this area. In summary the evidence suggests there is nothing intrinsic about boys' use of ICT, but rather the nature of the activity i.e. social networking versus computer games, whether ICT is used in the home or school and the type of technology, for example mobile phones or game consoles, are where differences can be found (Becta, 2008).

According to Becta's review, girls are more likely to use ICT at school than the

home and primarily that use is for school work. Girls have a more limited access to ICT at home compared to boys, and that use tends to centre on socialising i.e. using mobile phones or networking sites. Boys' engagement with technology at school is higher, but this is a direct result of gaming during leisure time rather than instructed usage in the classroom. Interestingly, the evidence summarised by Becta found that girls view ICT as a means to pursue their interests or learning and tend to be 'de-motivated by the competitive and non-collaborative nature of computer games.' (Becta, 2008, pg 3).

Within the context of school the evidence found there are no differences in girls and boys ability to engage with technologies and in some cases girls are more competent than boys. However, boys are less dependent on school for their engagement with ICT and despite there being little evidence that boys are better at ICT, girls are found to be less confident in their ability to use technologies. This is further compounded by research which found that girls are reluctant to demonstrate their knowledge, and skill of ICT in a mixed group setting within the classroom, and defer to boys assumed knowledge and skill. This suggests that culturally constructed gender stereotypes, reinforced by parents, teachers and peer groups are shaping girls usage of technology which in turn confirms the false assumption that boys are more competent users of technologies (as reflected in the media) and that it is acceptable for boys to enjoy gaming or programming.

In general the evidence suggests that girls use ICT as a means to pursue existing interests or learning and this usage decreases as girls get older, which may point to the reason why fewer women are found working solely in technology fields (Becta, 2008, pg 3). Furthermore, although the emergence of Web 2.0 technologies perhaps aligns more closely with girls' interest in social and collaborative usage of technologies and may contribute to an increase in usage, it will not necessarily challenge the barriers which contribute to girls' lack of sustained engagement with technology or the barriers which prevent girls entering ICT as an independent area of study. The school context is crucial to challenge stereotypes and ensure girls have access to technologies as a tool for learning and leisure, but also as an independent area of study. Employers also have a role to play in promoting ICT and SET careers to girls and young women.

Demand-led strategies

Stereotyping at an early age and the lack of girls' engagement with technology are linked to the subjects and careers that women pursue. Even within areas of STEM, women are more likely to be found in bioscience, health and medical research as opposed to engineering, oil and gas and IT where representation is low. It is important for stakeholders to be realistic about the type of gains that are possible from supply-side work. At the point of qualifying it appears that women form a

critical mass in biological sciences, but this is not reflected in the senior management positions within related companies. Encouraging girls to 'do science' is just one piece of the jigsaw. The structural barriers, as evident in the biological science sector, such as inflexible workplaces, research grants which do not accommodate a maternity break, long hours cultures which impact on work-life balance, and where the criteria for promoted posts are incompatible with caring responsibilities all contribute to limiting women's full participation in the labour market. Even when strategies to encourage more girls and young women into SET areas are successful, the barriers at the point of entry to industry must be removed to ensure a critical mass of women progressing in SET careers. The reliance on supply-side initiatives targeting women's career choices, training opportunities and managing a work-life balance, for example, fails to address the undervaluation of female dominated occupations and women's participation in the labour market more generally (see for example, Scottish Government, 2010; European Commission, 2009).

It is perhaps time to concentrate on forging demand-side strategies, where employers and sector representative bodies take a more active role in ensuring the barriers which prevent women entering SET sectors in the first place are challenged. This will inevitable benefit SET economies as productivity increases, and associated human resource costs decrease. Indeed, unless the leaky pipeline is fixed and replaced with a more transparent and robust material, Scotland's SET economies will continue to fail to capitalise on talent, and will see growth capped by skills shortages. A shift in thinking, which is already evident in some of the organisations and programmes working on occupational segregation in Scotland, must occur, to create a labour market environment where it is no longer acceptable to justify occupational segregation as a natural outcome of fixed gender roles, but instead embraces a robust gender analysis to ensure long term economic growth.

REFERENCES

Arnott, Sarah, (2010) Revealed: The gender gap in British business. *The Independent, [online]* 14 August. Available at: **http://www.independent.co.uk/news/business/news/revealed-the-gender-gap-in-british-business-2052374.html.** Accessed September 2010.

Biddle, S., et al (2005) Sedentary behaviour amongst Scottish youth: prevalence and determinants Health Scotland, Edinburgh.

Becta (2008) How do boys and girls differ in their use of ICT? Becta [online] Available at: **http://partners.becta.org.uk/uploaddir/downloads/page_documents/research/gender_ict_briefing.pdf** Accessed December 2010.

Bettio, F. and Verashchagina, A., (2009) *Gender segregation in the labour market* European Commission, Luxembourg.

BMG Research (2010) *Labour Market Survey 2009,* Bostock Marketing Group, Birmingham.

Guide Association (2010) Girls' Attitudes: Education, Training, Skills and Career *Girl Guiding UK [online]* Available at: **http://girlsattitudes.girlguiding.org.uk/pdf/Girls_Attitudes_education.pdf** Accessed December 2010.

Greenfield, S., Peters, J., Lane, N., Rees, T., & Samuels, G. (2002). SET Fair: *A Report on Women in Science, Engineering and Technology* Department of Trade and Industry, London.

Humphries, J. and Rubery, J. (1995) *The Economics of Equal Opportunities,* Equal Opportunities Commission, Manchester.

McKay, A., (2010) Discussion presented as part of the *Economics for Occupational Segregation training materials,* Close the Gap 2010.

Office of National Statistics (2009) *Annual Survey of Hours and Earnings,* Retrieved from **http://www.statistics.gov.uk/downloads/theme_labour/ASHE-2009/2009_gor.pdf** accessed May 2010.

Scottish Government Social Research (2010) *Tackling Occupational Segregation a Review of Key Evidence and National Policies,* Scottish Government, Edinburgh available **www.scotland.gov.uk/socialresearch**

Skills Development Scotland National Training Programmes Performance Report April 2009-March 2010 **http://www.skillsdevelopmentscotland.co.uk/media/141308/ma%20breakdown%20-%20all%20scotland.pdf** Retrieved October 2010.

SEMTA (2010) *Skills and the future of engineering in Scotland* SEMTA, UK

SEMTA (2007) *Bioscience Sector Skills Agreement Stage 3: Gap analysis* Scotland Retrieved from **www.semta.org.uk** on October 2008.

Thomson, E. and Gillespie, J. (2009) *Accounting for Gender in the Modern Apprenticeship Programme in Scotland* Paper presented to the PSA 'Scotland: Ten Years On' Conference June 18th 2009.

UK Resource Centre for Women in Science Engineering and Technology (UKRC) (2010), *Statistics: women and men in science, engineering and technology the UK statistics 2010*, Bradford.

UK Resource Centre for Women in Science Engineering and Technology (UKRC) Discussions presented to the UKRC 'Women Mean Business' Annual Conference on 12 October 2010.

Women and Work Commission (2006) *Shaping a Fairer Future* Department of Trade and Industry, London.

Wittenberg-Cox, A., and Maitland, A., (2008) *Why Women mean Business* Wiley, Chichester.

Youthlink Scotland (2010) Being Young in Scotland 2009 Youthlink Scotland [online] Available at **http://www.youthlinkscotland.org/webs/245/file/Final%20BYIS%20Repor(a).pdf** Accessed December 2010.

WEBSITES ACCESSED

Highlands and Islands Enterprise is the economic and community development agency for the Highland and Island regions **www.hie.co.uk**

Life Sciences Scotland is an umbrella body representing the interests of the life sciences community in Scotland **www.lifesciencesscotland.com**

Scottish Enterprise is one of two economic development agencies in Scotland and aims to support business development and growth **www.scottish-enterprise.com**