

**FEMALE HIGH TECHNOLOGY ENTREPRENEURS:  
AN EXPLORATION OF THEIR PRE-ENTREPRENEURIAL CAREERS  
AND MOTIVATIONS FOR VENTURE CREATION**

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**ABSTRACT**

The changing business environment and its growing acceptance of women have influenced the motivations of women to consider entrepreneurship as an alternative career path. Women are well-represented as entrepreneurs in some sectors; however, they remain heavily under-represented in areas such as science, engineering and technology (SET). While studies have been conducted amongst female entrepreneurs in traditionally female sectors, such as retail and personal services, little attention has been paid the motivations and pre-entrepreneurial careers of women who establish ventures in technology-based areas. The pre-entrepreneurial career is important in influencing an entrepreneur's social, human and financial capital which plays a pivotal role in shaping the start-up venture and growth. Greater understanding of the motivations and pre-entrepreneurial pathways of women in technology might help identify ways of encouraging more women to consider taking that career-path. Research reported here addresses the gap in the literature by exploring the pre-entrepreneurial careers and start-up motivations of 18 female technology entrepreneurs in Northern Ireland, using data collected through an exploratory, interview-based study. Implications for theory, policy and practice are explored.

## **INTRODUCTION**

Women represent a relatively untapped source of potential entrepreneurial talent within many areas of the economy. Nowhere is this more apparent than in sectors based on the exploitation of science, engineering and technology (SET) opportunities, areas important for innovation, employment and wealth creation. While the business environment is becoming more accepting of women, the nature of the that environment and the extent of its acceptance of women, particularly in SET fields, to some degree play a role in influencing whether or not women are encouraged or are forced to consider entrepreneurship as a career path. Trends show that the percentage of women deciding to become entrepreneurs is increasing; however, the number electing to start a business within the SET domain continues to lag significantly behind that of men choosing a similar path.

Studies of have explored the experiences of women entrepreneurs in traditionally female sectors (Carter et al. 2003), such as retail and personal services; however, little attention has been paid to exploring the pre-entrepreneurial careers and motivation of female technology entrepreneurs. The pre-entrepreneurial career influences the nature, wealth and diversity of the entrepreneur's human, financial and social capital, which combine to help shape the start-up business and have an impact on subsequent venture growth (Cooper 2006a). Against the background of the current recession entrepreneurs in technology-based sectors may play an important role in helping drive the economy back into more positive territory.

The under-representation of women entrepreneurs in SET fields, and the untapped potential of women educated in relevant disciplines who have gained experience in SET sectors as employees is leading governments to turn their attention to ways of encouraging more women to establish their own ventures. A greater understanding of the positive and negative motivations which lead women to take the entrepreneurial step and appreciation of the role that their education and prior work experience play should be of value to a number of stakeholders and help to identify ways of encouraging more women to consider taking the start-up career route. To enhance understanding and address the gap in the literature, the research reported here explores the pre-entrepreneurial careers and start-up motivations of 18 female technology entrepreneurs in Northern Ireland. Issues identified within the broader entrepreneurship literature, related to entrepreneurial motivations and the role of prior experience, are discussed prior to consideration of the research approach adopted for the study. Insights into these and other related areas were gained through a qualitative, interview-based, in-depth study of women who had established SET-based ventures in Northern Ireland. Data analysis was conducted using NVivo software to enrich and facilitate data analysis. Its use permitted retention of much of the richness of the original data, thus, the discussion draws heavily on the words of the entrepreneurs themselves, reflecting directly their experiences and views. The characteristics of the sample are discussed prior to presentation of the research findings. Implication of the research findings for theory, policy and practice are considered.

## **HIGH-TECHNOLOGY ENTREPRENEURSHIP AND THE FEMALE ENTREPRENEUR**

A sizeable amount of entrepreneurship research and, more particularly, studies of female entrepreneurs have focused on their motivations for start-up (Carter et al 2003). Indeed, a number of studies have attempted to establish a link between the motivations for start-up and the performance of female-owned firms (Carter and Cannon 1988, Cromie & Hayes 1988, Goffee & Scase 1985). Although such work provides a basis for understanding, there has been relatively

little focus directed towards female entrepreneurs operating in male-dominated sectors such as those centred on the exploitation of technology-based opportunities (Anna et al 2000). Prior research among female entrepreneurs highlights a number of push and pull motives for start-up with some being the same as those of male entrepreneurs, and others being acknowledged as more gender-specific (Rosa et al 1996), such as those centred on aspects of the flexibility required to establish an effective home and work-life balance (Goffee & Scase 1985, Losocco & Leicht 1993). Two factors which appear to influence strongly the decision of women to follow an entrepreneurial career path are the 'sticky floor', responsibilities to their family, and the 'glass ceiling', which blocks advancement to more senior organisational positions (Welsh & Young 1984). Consequently, rather than being a choice entrepreneurship may be a last resort for women who face gender discrimination in employment.

At a generic level new venture creation is the culmination of entrepreneurial action by one or more individuals working together; some firms result from venturing activity by local, indigenous entrepreneurs whilst others are created by those who move into a region. The majority of entrepreneurs have worked for other employers prior to starting their own venture which enables them to draw on prior work experience and capitalise on social capital networks. The entrepreneur's previous work experience (Chandler 1996, Shane 2000) and types of opportunity to learn about business creation and the resources required for venture creation and growth, may influence the initial decision to found the firm and the breadth of experience on which they may draw (Harrison et al. 2004).

The establishment of a high-technology venture requires the entrepreneur to take into account a range of factors which influence the ease or difficulty of starting a new firm. The nature of the technology on which the firms is based exerts influences on the venture creation process (Oakey & Cooper 1991, Oakey 1995 which include variable barriers to entry into the market which will differ through time and vary between sectors (Oakey 1995). New sectors may be less competitive and the niche opportunities in newly emerging markets provide commercial opportunities of an appropriate scale for new firms. As markets develop entrepreneurs wishing to grow their ventures have the chance to do so within the same market sector. In mature sectors, dominated principally by large firms, there may also be niches which are unattractive to larger incumbents which provide an environment for the new entrant. Another option is for small and larger firms to join forces, pool resources and collaborate, particularly where a specialist small firm complements the activities of the larger venture, permitting it to concentrate on its core business (Cooper 2001).

The length of the product development cycle is a key aspect which influences the emergence and growth of technology-based firms as it exerts strong pressures, particularly financial, on the start-up venture and its founder(s) (Oakey & Cooper 1989, Malecki 1981, Markusen 1985). To start a software company and take a product to market may require several months, whereas it may take many years to bring a biotechnology-based product to market. The entrepreneur's skill lies in balancing resource needs, personal/team skills and use of resources to capitalise on the opportunity. Maximising access to and minimising ownership of resources is an important strategy for the start-up venture (Sahlman and Stevenson 1993) and here the use of personal and professional networks enables entrepreneurs to access resources not directly under their control (Hampton et al. 2009). Networks which provide access to prospective customers, supplier, investors or technical specialists are frequently developed as a result of entrepreneurs setting up ventures in the same sector or a closely related sector to that in which they have worked previously (Cooper & Park 2008). In such situations entrepreneurs are able to build on

previous connections, reputation and credibility developed through experience and a track record, to leverage vital resources.

Thus, “the technical entrepreneur has to tolerate risk... has to generate support for a technology about which few people know, imparting his philosophy, spirit, vision and enthusiasm for his enterprise to all concerned with it. Surrounded by uncertainty, the financier is persuaded to place his money over a ‘black hole’ capable of swallowing thousands or millions of pounds with no guarantee of a return, and personnel are recruited, often from positions within other organisations. Thus, the technical entrepreneur is a risk taker required to persuade others to put their faith, finance and careers in his hands” (Cooper 2006b). Those who embark on the entrepreneurial journey need the skills and knowledge as well as persistence and determination to drive innovation and overcome the barriers and challenges which will confront them on their entrepreneurial journey.

The evidence is that while many opportunities exist in technology-related areas the majority of these are pursued by men so the female technology entrepreneur is a much rarer species than her male counterpart. Moore & Buttner (1997) characterise the female entrepreneur as ‘a woman, who has initiated a business, is actively involved in managing it, owns at least fifty per cent and has been in operation one year or longer’. Historically, little attention was afforded to female entrepreneurs until the early 1980s (Moore & Buttner 1997, Walker & Webster 2007), since when a greater focus has recognised women’s credibility as capable business founders. There is still much work to be done in the domain (Carter et al. 2001, Henry & Kennedy 2003), which is particularly true in the context of female-led entrepreneurship and business growth within technology-based sectors (Winn 2004).

Many governments are keen to encourage more women to become entrepreneurs and are targeting start-ups which are seen as important components in employment creation and economic growth (Reynolds et al. 2004). The numbers of women engaged in enterprise have traditionally been much lower than those of men who are three to four times more likely to start new ventures (O’Reilly & Hart 2003). Entrepreneurial women are well-represented in some areas of the economy such as retail and personal services but remain heavily underrepresented in technology sectors, despite increasing numbers of women studying relevant degree subjects at university (Loscocco & Robinson 1991, Mayer 2006, NFWBO 1999). A sizeable proportion of the women who study SET subjects to degree level do not take up jobs in related sectors when they graduate; as a result they do not gain experience which would enable them to develop effective networks and be in a better position to identify SET new venture opportunities (Anna et al. 2000).

## **ENTREPRENEURIAL MOTIVATIONS AND THE ROLE OF PRIOR EXPERIENCE**

### **Motivations for entrepreneurship**

It is suggested that differences exist between the start-up motivations of male and female entrepreneurs, arising from the differences they attach to different motivators (Cromie 1987). Change in the business environment and its greater acceptance of women has, partly, influenced more women to pursue an entrepreneurial career. According to Orhan and Scott (2001) only a small number of entrepreneurial motivations are gender-based (Rosa et al 1996), with research pointing to those such as career advancement and flexibility to balance dual roles (Goffee & Scase 1985, Loscocco & Leicht 1993). Some studies have attempted to establish a link between the motivations for start-up and the overall performance of female-owned firms (Carter & Cannon 1988, Cromie & Hayes 1988, Goffee & Scase 1985); indeed, this is an aspect which has

received considerable attention (Carter 2000a, b). Female entrepreneurship researchers have classified motivations into two categories: those which push women away from paid employment towards entrepreneurial careers and those which pull them towards business start-up (Alstete 2002, Brush 1990, Buttner & Moore 1997, Glancey et al. 1998). Orhan and Scott (2001), however, suggest that women are rarely motivated by just one factor and, instead, decide to pursue entrepreneurship on the basis of a number of inter-related factors.

***Push factors:*** At a general level ‘push’ factors are negative influences, such as redundancy, job insecurity, poor job prospects, and animosity in the workplace, which push individuals away from paid employment or other activities towards an entrepreneurial career (Gilad & Levine 1986); however, Catley and Hamilton (1998) suggest that entrepreneurship, rather than being a choice, is a last resort for women who, because of their gender, face discrimination in employment (Deakins & Whittam 2000). Two factors, more than any others, appear to influence the uptake of entrepreneurship by women, their family responsibility (known as the ‘sticky floor’ concept) and the ‘glass ceiling’ which prevents them from rising through the ranks of many organisations. Research suggests that the necessity of earning a living and being able to ‘look after their children’, are push factors which commonly drive women into developing their own business (Alstete 2002, Orhan & Scott 2001) as entrepreneurship is viewed as making it possible to balance home and work-life situations (Carter & Anderson 2001). Some suggest that entrepreneurship is the only way in which women with family and domestic commitments can balance work and home-life roles (Cromie 1987, Fielden et al 2003). Several authors have highlighted the effect of the “glass ceiling” especially in the context of executive women who have been impeded from obtaining job progression to more senior positions (Carter & Cannon 1988, Welsh & Young 1984). Entrepreneurship is often considered an “easier way” to meet their personal need for achievement, success and self actualisation, than trying to move up a restricted corporate ladder (Moore & Buttner 1997) where organisational selection criteria, based on gender, age and level of experience, can influence the speed with which career movement is possible (Cromie & Hayes 1988). On a similar theme, Maclaran et al. (1997) use the term “glasshouse” to encapsulate the assumptions and misconceptions which constitute barriers to the advancement of women, restricted, contained and controlled by their environment and the *status quo* of male cultures.

***Pull factors:*** At a general level ‘pull factors are positive influences, such as the desire for independence, wealth, social status and power (Alstete 2002, Orhan & Scott 2001), which attract individuals towards entrepreneurship to fulfil ambitions and realise other desirable outcomes. Some suggest that pull factors tend to be more dominant than push factors for entrepreneurs (Keeble et al. 1992, Orhan & Scott 2001) as they are largely determined by choice (Orhan & Scott 2001) and entrepreneurial aspirations (Deakins & Whittam 2000). The central reason that both men and women start their own businesses is for independence, the challenge of business ownership and control (Brush & Hisrich 1988, Carter & Cannon 1992, Goffee & Scase 1985, Simpson 1991).

Some research has pointed to the possibility that women may not, generally, be motivated in the same way as men (Galloway et al. 2002). Evidence suggests that a sizeable number of women enter into entrepreneurship for flexibility and independence as they seek a greater balance between their working and their personal lives. According to McKay (2001), older women seek entrepreneurship for independence, as the perception of ‘working women’ has now

changed. These women may have experienced intense pressure during their younger lives to give up work and put family needs first ahead of their own personal goals, supporting their husband's career and/or bringing up a family. Thus, entrepreneurship is a route via which they can gain late recognition and reward. More recently research has considered that a growing number of women are motivated by professional freedom, self-direction and dynamic challenges (De Martino & Barbato 2003).

The importance of financial gain is often suggested as a motivating factor in deciding to move from paid employment (Baumol 1990) and that this will encourage some to accept the risk of giving up the security of a job in hope that it will pay off and reap financial benefits (Campbell 1992, Praag & Cramer 2001). Marlow (2002), however, suggests that this is not usually the case with female entrepreneurship as, typically, it is linked to low profit and growth aspirations. Rosa et al. (1996) suggest that women do not enter business for financial gain, but to pursue intrinsic goals such as independence and flexibility, to balance family and work commitments.

Despite evidence suggesting that women have strengths in business, some have questioned female motivations for entering into business, in particular their need for achievement and their risk-taking propensity: it is suggested that women are more motivated by the social contribution their business can make (Orhan & Scott 2001) and take a more customer-centred approach. Still and Timms (2000a, b) suggest that women's objectives are to do something worthwhile, thus, taking a more client-focused approach compared with their male counterparts (Brush 1992). Minniti et al. (2005) propose that the likelihood of failure has a major impact on a woman's decision whether to pursue entrepreneurial ambitions. With specific reference to Northern Ireland, the location of this research, the GEM report has acknowledged that fear of failure is a major an obstacle to business creation (O'Reilly & Hart 2005). Yet research by Hisrich and Brush (1986) claims that a 'fear of failure culture' is not as important to women; however, what is important, is the opinion of society and family regarding their pursuit of an entrepreneurial career.

Typically, there are likely to be a range of push and pull factors operating together. According to Walker (2000) push factors are becoming more prominent motivators for female entrepreneurs, and what has been seen in other research is the way in which it is a push factor which typically pushes entrepreneurs over the proverbial 'edge', to pursue an idea which has been attractive for some time, turning latent entrepreneurial interest into entrepreneurial action. In doing so, the personal and professional background of the entrepreneur play a key role in shaping the business which emerges. The following discussion explores the motivations of a group of female SET entrepreneurs and the relationship between their human and social capital at the point of starting their venture.

## **RESEARCH METHOD**

Entrepreneurship research lends itself to approaches which provide opportunities for discovery, exploration and theory building. Some suggest moving beyond conventional methods and adopting new approaches (Carson & Coviello 1995, Chell & Haworth 1992, Hofer & Bygrave 1992). Given the infancy of the research area and exploratory nature of the subject, a qualitative methodology was adopted for this study (Carson et al. 2001, Hill et al. 1999, Hirschman 1986, Miles & Huberman 1994). The paper draws on the findings from a sample of 18 respondents, who were female owner-managers of technology-based businesses operating in Northern Ireland (Table 1a and 1b). Over the previous 12 months, five nascent (pre-start phase) entrepreneurs had

been actively involved in starting new businesses which they at least part owned (Hart 2007) and five women were 'new venturers', who had been operating their businesses for five years or less, with a limited market/product range (Carson & Cromie 1991, Hart 2007). The final eight women owned and ran 'established companies', which had operated for more than five years. Table 1a provides further details of the SET-based businesses which the women operated in Northern Ireland. This study used a convenience sample which generated information-rich case studies, providing valuable insight into the phenomena being studied (Neuman 1997).

Data were collected using a two-stage process with 12 months between interviews. Unstructured, in-depth interviews were undertaken, with an emphasis on "informal", exploratory discussion as opposed to asking a series of specific and highly structured questions. Themes were identified to guide the interviewer and the relative informality of approach facilitated exploration of issues. The first round of interviews concentrated on business start-up while the second sought greater depth regarding the significance of motivations to pursue an entrepreneurial career. There was an emphasis on understanding issues associated with motivations either 'push' or 'pull' factors, as well as the pre-entrepreneurial background of these females to enter into a pre-dominantly 'male' industrial sector. Insights into the reasons for start-up emerged as they spoke in their own words (Carson et al. 2001, O'Donnell & Cummins 1999). Data were analysed concurrently (Merriam 1988), as interviews were conducted in three sets, each comprising six companies. Interviews at each stage in the primary research lasted an average of one and a half hours and were digitally recorded and transcribed.

Given the potentially messy and chaotic nature of qualitative data, a methodical and systematic approach to analysis was required (Easterby-Smith et al. 1991, Miles & Huberman 1994, Tesch 1990). Technology was used in the form of NVivo software to make the process of coding and analysis more efficient (Catterall & Maclaran 1996, Dey 1993). To generate confidence in the research findings once the data had been transcribed and analysed results were referred back to the interviewees for clarification, amplification, corroboration and amendment, if necessary (Guba & Lincoln 1994, Hirschman 1986).

## **RESEARCH FINDINGS AND DISCUSSION**

When starting a new venture, the entrepreneur must identify a market opportunity and bring together the necessary human, financial, intellectual and physical resources. Their ability to spot a viable opportunity will be influenced by factors linked to their knowledge, skills and personal/professional motivations. To understand better how the female technology entrepreneur is shaped by her pre start-up experience and personal context, and the impact these have on her business, the discussion begins by exploring the personal situation of the women when they decided to start their firm. The discussion then explores their motivations for establishing their ventures and considers how their personal and professional backgrounds helped shape the firms they created (Table 1).

### **Personal Context at Start-up**

**Age:** The amount of experience and level of skills required to start a venture may differ between sectors and even within sectors, placing barriers in the path of the would-be entrepreneur. There are notable examples of successful, young entrepreneurs, including Gates and Branson; however, the majority of technology entrepreneurs establish their business after at least several years as employees (Cooper 2006a, Harrison et al. 2004).

Table 1a: Characteristics of the female entrepreneur (FE) and her business

FE	Age at start	Marital status (no. of children)	Highest level of education	Business sector	Business activity Product = P Service = S	Years in business	No. of emps	Sector employed in pre start-up	Position in firm where employed	Lone (L) or team (T) start (current)	Skills of initial team compared with FE
AA	29	Married (2)	HND - Computers and Business	Technology	Computer Software Design (P)	12	20	IT	Member of Senior Mgt Team	L (L)	-
BJ	36.5	Married (1)	UG - Computer Science	Technology	E-commerce Solutions (S)	2.5	3	Banking	Business Account Manager	T (T)	Different
CK	30	Married (4)	UG - Business Studies	Technology	Computer Software Design (P)	5	18	Electronics	General manager in the family business	T (T)	Different
DR	29	Married (7)	UG – Politics	Technology	Data Cabling Provider (S)	15	17	Telecoms	Sales Executive	T (T)	Different
ER	42	Single (0)	UG - Computer Science	Technology	Software Development (P)	12	6	Software	Senior Manager	L (T)	-
FS	32.5	Married (0)	UG - Archaeology	Technology	Software Development (P)	4.5	14	IT	IT Consultant	T (T)	Similar
GM	30	Married (4)	O-Levels (GCSE's)	Technology	Data Management (S)	3	5	Care worker	-	T (T)	Different
HH	34	Married (3)	UG - Electrical & Electronic Engineering	Technology	Software Development (P)	14	6	IT Consultancy	Senior Consultant	L (L)	-
IC	36	Married (2)	PG– MBA	Technology	Software Development (P)	4	15	Telecoms	Business Development Manger	T (T)	Different
JB	23	Single (0)	UG - Bio-medical Science	Science	Clinical Analysis (S)	15	12	Bio-medical Science	Microbiologist	L (T)	-
KM	37	Married (2)	UG– Nursing	Science	Clinical Analysis (S)	8	26	Clinical Analysis	Clinical Manager	T (T)	Different
LP	33	Married (1)	UG - Electrical & Electronic Engineering	Technology	Software Development (P))	10	20	Education	IT Manager	T (T)	Different
MR	47	Widowed (1)	UG - Art and Design	Engineering	Bespoke Components (P)	9	3	Self employed in Catering Business	Owner/Manager	L (L)	-
NS	39	Married (2)	UG - Occupational Therapy	Science	Design Clinical Devices (P)	0	0	Occupational Therapy	Occupational Therapist	T	Different
OH	26	Co-Habit (0)	PG - Electrical and Mechanical Engineering	Engineering	Electro Magnetic Component (P) Manufacture	0	0	Engineering	Engineer	T	Similar
PT	27	Single (0)	PhD - Bio-medical Science	Science	Design Microbiological Devices (P)	0	0	Bio-medical Science Research	Research Associate	T	Different
QG	28	Married (0)	PhD - Bio-medical Engineering	Science	Design Medical Devices (P)	0	0	Bio-medical Research	Research Associate	T	Different
RC	26	Single (0)	PG - Electrical and Mechanical Engineering	Engineering	Design Electrical Engineering (P) Devices	0	0	Engineering	Engineer	T	Similar
	32.5			AVERAGE		6	9				

Source: Developed by profiling the interviewees



The average age of the women at start-up was 32.5 years (Table 1); the youngest was 23 and the oldest 47. Only two of the women were in their 40s. Interestingly, four of the five nascent entrepreneurs were under 30 years of age and so may have been encouraged to become entrepreneurs at a relatively early age by the changing culture towards women in business. A study of technology entrepreneurs in the United Kingdom (UK), who happened to be men, revealed a mean of 35 years at start-up and a range of 20 to 55, with a little under a third of entrepreneurs in their 40s (Cooper 2006a) so these findings suggest that this sample of women represent quite early entrants into the entrepreneurship space. This raises a question as to whether some of the women were pushed into entrepreneurship by barriers in their career path, an issue explored later in the discussion. It is important to note that MR had begun her entrepreneurial career at a younger age than that indicated in Table 1 as she had three businesses prior to this start-up.

**Family situation and marital status:** The work of Cohen, (1997), Johnson and Storey, (1993) and Goffee and Scase, (1985) suggest that there is no dominant trend for female entrepreneurs to be married. The majority of women in the sample were married (12) and one was a widow (Table 1). The majority of these 13 women had children (11), with numbers ranging from one to seven. While seven of the participants had no children, four of these women were nascent entrepreneurs and were four of the youngest in the study. It is apparent from this study that many of the women started their business once they were married and some had children. For some of the respondents the fact that they were married made business start-up possible because their husband's income reduced the financial risk. Indeed, Table 1 indicates that majority of female entrepreneurs had two full-time incomes in the household. A typical comment by nascent entrepreneur QG supported this view: *"I have a husband! It would be a huge financial risk, but I am fortunate that I am not the breadwinner in the house, so we could survive. God forbid that anything should happen but it wouldn't be the end of the world if it didn't work out, though it is a risk"*. HH, who ran an established firm, noted: *"From a money point of view...I had two young boys, I was married, we'd a mortgage, and my husband was just a newly trained teacher so he certainly wasn't the huge breadwinner...but we had another income and I thought well, if things don't work out by September I will always get another job"*. Of the 11 entrepreneurs with children, only one woman (AA) set-up her business prior to having a family, seven decided to set-up after the birth their children and three combined having their family and setting up their venture.

### **Venture Start-up Motivations and Triggers**

It was evident that many of the women had given up a good, well-paid and secure job, to start their venture. LP recognised that if she wanted to build a successful business she had to sacrifice other things in her life. The extent of some women's 'sacrifice' was clear from AA's comment: *"...they (previous company) offered me a directorship and all sorts of things and I was really quite young then...I'd had a successful career...I was earning a big salary and had all my perks...but I decided I'd had enough"*.

**'Push Factors':** The 'push' factors identified confirmed that some women had become entrepreneurs as a result of a lack of good job prospects, the 'glass ceiling' effect, and necessity. The lack of suitable job prospects in Northern Ireland was identified mainly by women who had set up their firms more than five years earlier. These women pointed to a lack of scope for them to be employed in quality, high-powered positions which were challenging, given the level of

skills and knowledge they possessed. They had responded to both the metaphorical 'glass ceiling' which they perceived restricted their career path in the SET domain, and also the nature of the Northern Irish employment market for women in SET. AA commented, "*I knew I had acquired a lot of skills...and to be honest with you I couldn't see a job in this region that would allow me to progress*" and MR noted, "*I came back here and all I was really qualified to do was to be a designer...but women in that business in Northern Ireland were not part of the scene nine years ago*". ER's experience illustrated an effect of the 'glass ceiling': "*I was working for a company where three companies were actually going to merge into one, there were too many managers...and the chap who became MD...he was elderly, old school and he didn't like women managers...he made three senior managers redundant and two of them were the only senior women managers he had...and I was one of them*".

The need to 'earn a living' also emerged as an important factor following redundancy, which in some cases acted not only as a trigger to become an entrepreneur but also what made start-up possible; for example, both BJ and GM used voluntary severance/redundancy payments to set up their ventures. ER sat tight in her job and kept quiet about the 'glass ceiling' which she encountered because she knew that her redundancy package was critical to the start-up of her business.

The need to survive was an important motivation as GM explained, "*We just had to do it because we needed to pay our mortgage*". Similarly DR claimed that she and her husband were, "*...accidental business people, we just had to put cornflakes on the table because I didn't work*". Necessity to survive is acknowledged in the entrepreneurship literature, but its relevance is sometimes questioned in the case of female entrepreneurs in general, because it is often assumed that they are not the 'sole breadwinner'. This implies an, arguably, somewhat dated view of women as subservient and supported, which this research suggests is not generally the case today, when many women are equally as responsible for supporting and providing for the home. It also tends to overlook women who do not have partners, which is the case with a number of women in this sample. It is relevant to mention here, also, that some of the women had been able to take the entrepreneurial step because of their husband's income acting as a safety net, so the picture is not 'cut and dried' across this group of SET entrepreneurs.

By contrast with findings of female entrepreneurship research cited earlier only two of the women in this study pointed to having set-up in business because of their role as primary carer for their children. GM reflected on what had motivated her, "*We thought...I would have more of a structured life, nine to five and come home. With four children, four boys, I thought this could give me more time to be with the boys*". BJ looked for similar personal benefits, "*The reason we wanted our own business, was for me – a strong part of that was for me and my daughter...she had been at nursery since she was four months old. I dropped her off every day at a quarter to eight and picked her up at a quarter to six...at this stage she was primary one...I felt there had to be more to life and I had to spend more time with her*". For this minority of women who sought an improved work-life balance the reality, however, was that their businesses had taken off and had come to dominate family life, as GM reflected, "*... in some ways it gives me less time with the boys ... we wanted to be our own bosses but we thought we would have more time to ourselves ... but at the moment we don't have*".

**'Pull Factors':** Two core reasons are suggested for women in general to enter entrepreneurship, social contribution (Orhan and Scott 2001) and independence (McKay 2001), whilst in the wider entrepreneurship literature recognition of an opportunity, self fulfilment and wealth are pull

factors primarily believed to motivate male entrepreneurs. Many interviewees cited pull factors which included social contribution and independence, so findings supports the importance of these factors, but they also identified the additional pull factors of recognition of an opportunity in the market, self-fulfilment and wealth which, although 'male motivators' are seen here to influence these female SET entrepreneurs.

Considering first the more traditional 'female motivators', a common theme to emerge amongst the women, especially those in science-based ventures set up to 'do good', was a desire to contribute something to society which would impact positively on peoples' lives. NS was typical, "*What's so special is, it's going to make such a difference to the quality of life for people who are so physically disabled and for me that's really, really important*".

For women who operated businesses in a more commercial setting, the main reason for start-up was different. Wealth and personal gain was more important, and the potential to become 'rich' was a strong motivating factor for risking the security of a steady job. However, in many instances this was combined with additional reasons such as job dissatisfaction and spotting a market opportunity. Reflecting this position KM stated, "*I have to be very honest...I wanted to make a whole lot of money because I could see from where I was working, that I was working exceptionally hard for someone else for not an adequate reward...so that was my prime motivation*". On a related note, JB commented, "*I think I realised at some point, it had always been my idea to build up and sell out... make some money because I put very, very little in cash terms into the business to start with*". Thus, although the literature suggests that financial gain is not a prime motivator for female entrepreneurs (Rosa et al. 1996) this research suggests that some women are motivated by financial gain. In addition, these women sought intrinsic goals such as independence (Rosa et al. 1996) along with the challenge of business ownership and control (Carter & Cannon 1992, Simpson 1991, Brush & Hisrich 1988, Goffee & Scase 1985).

This level of independence meant a certain amount of flexibility. Both AA and ER were drawn to entrepreneurship, by the lure of flexibility. However, this was not linked to family responsibilities but to a desire for a flexible lifestyle, as ER's reflection highlighted, "*One of the reasons for going out on my own was that I only wanted to work three days a week, I wanted a bit of time off to myself*". A related factor was the desire for self-fulfilment, and the need to achieve (Hisrich & Peters 1986). The quest for self-fulfilment and achievement are reflected in IC's comment, "*I'd been out trekking around the world for about 12 years...to bring back the experience that I was building up in an Irish setting...back to this sort of little microcosm of X (town established in), was pretty useful and I just found it really fulfilling...*".

Building on comments earlier about opportunity spotting, some of the women were motivated by opportunities they recognised in the marketplace. NS observed, "*The idea came from a real situation that I worked in and I could see the potential*". DR commented that her husband had been working in the market, getting experience when she realised it had potential. She remarked: "*We had no notion of starting a business...we were at a crossroads wondering what we would do next...but we were not thinking in terms of starting our own business...it was more a case of here's a job I can do...and it dawned on me that there was great potential there if there was a bit of structure*".

### **Prior Knowledge and Experience**

**Education:** Education is important in the development of entrepreneurial human capital as it has an impact on the individual's knowledge, skills and attitudes. The establishment of a technology-based venture requires different types of knowledge, associated with both the business/market

and technology dimensions of the enterprise. The women in this study were, generally, highly educated; all but two of them held at least an undergraduate degree and four had postgraduate degrees, two of these a PhD (Table 1). Of the two women who did not have a degree one had a vocationally-oriented HND in Computing and Business which provided a good background for her software design business and the other, who left school with O levels post-16, ran a data management business. Most of the women educated to degree level held degrees which were either directly related to their business or an aspect of the degree was related to the venture's SET focus. Whilst the numbers of women now studying for SET degrees is increasing HH reflected on her university experience some years earlier: *"I graduated in 1977...at that stage, I was the only one (female) in my year for three years, while I was at Queen's"*.

These findings contrast with those of Cooper's study of technology entrepreneurs (2006a) which revealed that more than 50% of the male founders did not hold degree, but around two-thirds had worked in a related sector prior to start-up. One interpretation of this could be that to gain credibility in a male-dominated field, women have to be equally if not better qualified than their male counterparts to secure an employment position from which they can go on to found a business and compete against men in a similar field.

***Prior work experience:*** Education is important because it lays the foundations of an individual's career, but for the would-be entrepreneur the experience which they acquire post secondary or tertiary education is also important because it influences the potential to develop further technical know-how and also business/market awareness/networks. From analysis of Table 1 it is evident that the vast majority of these women worked in sectors which enabled them to develop both technical and business capability. The findings align with those of Mukhtar et al. (1998) which pointed to the role of prior industry experience in the development and survival of technology-based ventures.

More than half of the women worked in sectors where women had been in the minority (Table 1) so many of these women had become accustomed to working in male-dominated environments. HH noted: *"I would have been one of the few girls employed, certainly within engineering at that stage"*. ER's experience highlighted just how rare women were in the software sector where she worked prior to starting her own software development business, *"I was working in an office with about twenty-five men in it and I was the only woman and you just have to learn...not to expect anything extra and to work hard"*.

Despite the predominance of men the gender issue did not appear to have had much effect on these women's decision to start and grow a business within these sectors. Indeed, the majority of the women had never considered gender to be an issue or believed it had had an impact on their entrepreneurial experience. However, this may be because by studying for a degree in largely 'male-dominated' subject areas and pursuing prior careers in 'male-dominated' sectors they had already confronted and challenged gender stereotypes. These findings contrast with those of Beaver (2002), Brush (1992) and Hisrich and Brush (1984), but support results of US work which found that women are increasingly breaking with traditional perceptions and are gaining recognition in areas such as high technology (Langowitz & Morgan 2003).

Experience in a relevant field prior to start-up provides would-be entrepreneurs with the chance to identify opportunities and understand better the commercial context within which their business will operate (Cooper & Park 2008). These women entrepreneurs were generally at an advantage when it came to spotting businesses opportunities as most had a fairly thorough understanding of the market within which they were to operate their new venture (Table 1),

developed through varying years of experience. ER reflected: *“I’d been working for 20 years in computers before I went out on my own. Quite often a couple of years working for someone else in the same area can be very helpful. To go out and start a business straight from university is very difficult”*. FS recalled how she had identified a suitable opportunity, *“I was working in data base consultancy for ten years and I was having a lot of difficulty in sourcing certain tools and software...and basically I knew how to do it so I did and set up on my own”*.

Given their age at start-up these women most had worked for at least one employer and consequently had benefitted from, in many cases, a fairly sustained period of pre-entrepreneurial employment experience on which they were able to capitalise: others, including GQ and PT were quite recent graduates. Drawing on multiple sources of learning, NS talked of how she had developed a piece of technology to meet an identified need: *“I knew from my experience of disability and working in paediatrics, and my experience of learning difficulties, I could see a range of clinical scenarios that this (device) could be applicable to”*.

Some of the women had used some of their period of pre start-up employment very strategically. For example, AA returned to Northern Ireland after a period working away with the intention of starting her own business: *“I decided I would take it (the job) despite it being a third of the salary I had in London, because it would give me an opportunity to a) keep my hand in and learn some new skills because I hadn’t been involved in all aspects of IT, and b) it would give me a chance to see what was going on and to meet people and develop my networks in NI...so it would be a learning year, I could do the job fairly easily and I could also find out what was going on”*.

For those with a predominantly a technical background, largely as a result of their education, working for someone else prior to starting their firm helped them develop skills which proved invaluable when starting their own business. By working for a larger company ER developed knowledge and skills in, *“Man-management, people management, personnel management, budgeting, financial control in general and a bit of marketing...’cause in a small organisation, you have to do it all!”*. The financial side of the business often poses a challenge to the start-up entrepreneur: HH reflected, *“I didn’t do any formal accounts training in X (previous employer) but I built up such a knowledge of balance sheets and profit and losses, in an informal way that set me up very well with a lot of business background...which I wouldn’t have had if I had left and set up directly on my own”*. Entrepreneurs from a technical domain often find it hard to secure the first customer and experience difficult in closing sales, without which any business will ultimately fail. DR was grateful for her pre-start experience which had also enabled her to envision her venture beyond start-up, showing a potential path to help grow her business: *“It taught me a lot about the art of selling, you know making calls, getting stuff across, making appointments and, actually closing a sale. Very raw but I was able to see a larger business structure and processes”*. MR was the only women with prior start-up experience. She reflected, *“Before I set up this business I had three businesses so my past experience certainly helped in getting this business going day-to-day”*.

***Team composition and expertise:*** While the focus of this research is on the female entrepreneur, in 13 of the 18 cases the women had started their venture with others, and of the five who started on their own two had been joined by team members subsequently, bringing complementary skills and experience (Table 1). In only two of the 13 team starts did the fellow team members have the same skills as the female entrepreneur; in the majority of cases the background and experience of the women were complemented by their fellow founders who added a different dimension to the

skills and experience portfolio. The dominance of team start-ups in technology-based firm research has been noted in a number of studies, and there is evidence that team-based start-up perform better than lone starts (Cooper 2006a, Oakey 1995). Two women, who started ventures with a partner, identified their distinctive competences and division of labour. BJ noted “...because X (partner) and I have very different skills sets it works very well together, he’s PCs to his ears but that’s not necessarily what I’m about – yes I understand and I do them, but I’m more into the customer relationship side of things”, while DR indicated, “...it is me that runs the firm here, X (husband) has the technical expertise. That is the most potent business you get developing when the partnership is working and both partners have different skill sets”.. Interesting, in both of these example the partner is male and takes the technical lead while the female entrepreneur leads the management/customer side of the business.

**Reputation and networks:** An added benefit of starting a venture in the same field is “reputational capital” (Slatter 1992), which in the case of a woman entering a ‘man’s world’ was of even greater value. Reputation and good professional relationships helped to cultivate important networks which the women had utilised as they started and grew their businesses. Some, including QG, learned from their contacts about what start-up involved: “We did speak to a few people, like accountants and other people we knew. We did get outside advice and X (a contact from pre-entrepreneurial employment), has his own spin-out company and was able to give us some information about what we would have to consider if we were to establish a company. We did, therefore, take advice from certain people, with X being the key person, and also other people I used to work with”. Relationships developed prior to start-up also were actual and potential sounding boards for possible business developments, as AA highlighted, “There is nobody that I have worked with, prior to setting up, that I would feel I couldn’t lift the phone to and ask them or tell them what I’m doing and trust them enough to sort of confide in them, to see what they think”. The scope to call on the connections of those already in business was also valuable as ER noted, “Because you would hope that they (network members/contacts from previous employment) would have come across who it was that you were talking about and advise you”.

## CONCLUSIONS

In the absence of a detailed understanding of the female technology entrepreneur, this paper has sought to extend our knowledge of the types of women who have been attracted by an entrepreneurial career in the male-dominated SET arena in Northern Ireland, a part of the United Kingdom (UK) where rates of female engagement in venturing, let alone technology venturing, are around a third lower than the rest of the UK (Hart 2007). It has also focused on their motivations for pursuing such a career path. The above findings have shed some light on the career development paths which this group of entrepreneurial women have taken to start-up. The path to entrepreneurship of some of these women could be described as fairly pioneering. They enrolled in SET degree programmes when women were rare on such courses; they worked in male-dominated SET career roles when there were very few women in technical positions in the workplace, and they established their own firms at a time when, and in a socio-cultural context where, female entrepreneurship was not common. The fact that four of the most recent entrepreneurs were among the youngest in the sample suggests that perhaps the environment for entrepreneurship might be becoming more accepting of female entrepreneurs who are relatively new to the sector. The flow of women into SET entrepreneurship is still constrained by the

relatively low numbers who have studied for degrees which help open up the potential of an entrepreneurial career path. The fact that more women are now pursuing degree in these fields does mean that there are more potential female entrepreneurs being produced by our universities, only time will tell how many women decide to pursue that career path.

An important finding for our understanding of the female entrepreneur is the strikingly high level of educational attainment evident amongst the women in the sample, whether they were the younger or older women in the sample. These findings show a much higher level of attainment than some other studies of male technology entrepreneurs and as was suggested earlier, they raise the question as to why this might be the case. It could be that in order to secure employment in technical roles, which lay the foundation for an entrepreneurial career, women need to demonstrate higher levels of achievement than male candidates. It could also be that highly intelligent and talented women find that they are not able to advance to positions to which they aspire within employment, and therefore have little option other than to leave employment, as was suggested was the case by a number of the interviewees.

In common with other studies of SET entrepreneurs, prior work experience proved vital in helping these women prepare to start their own ventures, whether it was the knowledge gained, the skills developed or the networks which they were able to cultivate, there was widespread agreement and evidence of the importance of this phase of these women's careers. Those who start a business very soon after leaving university lack the depth of experience gained through the entrepreneurial apprenticeship. Many university SET degrees now include some element of enterprise education or business planning so this will help to fill some of the knowledge gaps, and degrees with work placements help to provide a window into the workplace (Lucas et al. 2009). It was evident that even the women with more professional experience prior to start-up tended to form a start-up team, which is in line with findings of previous research.

Previous work on the motivations of female entrepreneurs for opting to start their own firms have highlighted push and pull motives, and some of these were evident in this sample of women, with both types of factors often operating together. Necessity emerged as a key factor, with purely opportunity driven firms in the minority. There has been an increasing focus on the importance of the search for work-life balance as more women seek to pursue career paths which do not put the happiness of their family life in jeopardy. Even though many of the women had children only a small minority cited work-life balance as a motivating force, and for those who did, what was clear was that running an SET business did not permit time for the family in the way which had been envisaged – the image was illusory. This points to the challenge of running a professional business which needs to deliver to tight deadlines and requirements: some types of firm might be able to put things off until tomorrow, most SET firms do not fall into that category. Interestingly, quite a number of the women mentioned financial motivations, which is a finding more typical of male entrepreneurs. This is an area where these SET women were more like their male counterparts than female entrepreneurs in general.

It would be interesting to undertake a similarly study in ten years time to find out what the profile of the female SET entrepreneur looks like then. It would appear that the age at which some women are seeking to set up their first firm is reducing, and while this is positive it is important to understand more about how the lack of commercial workplace experience might have an impact on the development of their enterprise. There may be a role for universities and enterprise agencies to provide business support and training in aspects which the younger entrepreneur may lack. Also, linking young entrepreneurs to mentors may help younger entrepreneurs along the entrepreneurial pathway. Some of these women were pioneers in SET

fields when they were very much swimming against the tide of convention, when there were few role models for them to look to for inspiration and a sense of what could be achieved by a woman in a predominantly 'man's world'. Some of them represent valuable role models for the current and next generation of entrepreneurial women, and have important lessons which they can share. Given the increasing number of successful female entrepreneurs there is scope to use these women as mentors or more broadly to profile their cases as role models to encourage those who are considering entrepreneurship. While some of these women became entrepreneurs out of necessity they have demonstrated their abilities to develop and build successful ventures and in so doing have the potential to inspire more women to look at entrepreneurship as a positive rather than negative career response.

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