2 Invention, Innovation and Small Business

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"Where a new invention promises to be useful, it ought to be tried"
THOMAS JEFFERSON (1762–1826)

This chapter at a glance

- Introduction
- Distinction between invention and innovation
- The Interrelationships between invention, innovation and small business
- Conclusions

Introduction

Much has been written about invention and inventive activity – and today increasingly, about the concept of 'entrepreneurship'. Published work typically describes inventive activity on a historical-developmental basis or as a collection of case studies, presenting qualitative findings in relation to the inventive developments taking place. Indeed, the relationship between invention, innovation and entrepreneurship has involved much discussion. Innovation is defined by Kanter (1983) as involving 'creative use as well as original invention' and simply it is defined by Mellor (2005) as 'creativity plus application' or 'invention plus application'. According to Porter (1990) 'invention and entrepreneurship are at the heart of national advantage' and Burns (2007) reports that 'invention is the extreme and riskiest form of innovation'. In particular, Bolton and Thompson (2000) highlight creativity in the invention and innovation process and Burns (2007) posits that 'invention can be successfully exploited in the entrepreneurial environment'.

The inter-relationship between invention, innovation and entrepreneurship is both of theoretical and practical significance. It may involve inventors and entrepreneurs in all aspects of the process of product, process or service development but also it can involve them separately. The latter case is exemplified historically by Adam Smith (1776) who observed that 'all the improvements in machinery, however, have by no means been the inventions of those who had occasion to use the machines'. He also considered the way in which the division of labour promoted specialised inventions. This is articulated by Marx (1858) who notes 'invention then becomes a branch of business, and the application of science to immediate production aims at determining the inventions at the same time as it solicits them'. Freeman and Soete (1997, p. 15) develop this theme of invention as 'an essential condition of economic progress and a critical element in the competitive struggle of enterprises and of nation-states'. And that it 'is of importance not only for increasing the wealth of nations in the narrow sense of increased prosperity, but also in the more fundamental sense of enabling men (and women) to do things which have never been done before at all. It enables the whole quality of life to be changed for better or for worse. It can mean not merely more of the same goods but a pattern of goods and services which has not previously existed, except in the imagination'.

Freeman and Soete (1997, p. 16) remark that 'although most economists have made a deferential nod in the direction of technological change, few have stopped to examine it'. This paradox has been explained by Jewkes at al (1969) in terms of the ignorance of science and technology by economists, their pre-occupation with the trade cycle and employment problems, and limited statistics. This was demonstrated by Jewkes et al (1969) in their study of 'The Sources of Invention' and has been confirmed before and since by empirical studies. Freeman and Soete (1997, p. 17) develop this argument regarding the neglect of invention since it 'was not only due to other pre-occupations of economists nor to their ignorance of technology; they were also the victims of their own assumptions and commitment to accepted systems of thought. These tended to treat the flow of new knowledge, of inventions…as outside the framework of economic models, or more strictly, as 'exogenous variables".

Distinction between invention and innovation

The distinction between invention and innovation was originally owed to Schumpeter (1934, 1961) and has since become part of economic theory. Freeman and Soete (1997, p. 22) add, 'an invention is an idea, a sketch or a model for a new improved device, product, process or system. Such inventions may often (not always) be patented but they do not necessarily lead to technical innovations'. Also, 'the chain of events from invention or specification to social application is often longer and hazardous' (Freeman and Soete, 1997, p. 22). The crucial role of the entrepreneur in this complex process was recognised by Schumpeter (1934, 1961), although he did not consider the study of invention to be of significance in itself. He stressed that the decision of the entrepreneur to commercialise an invention was the decisive step and defined the entrepreneur as the 'innovator'. A summary of the inputs and outputs of this process, based on Ames (1961) and Freeman and Soete (1997) is presented in Table 2.1.

Process	Inventive inputs		Inventive outputs	
	Feedback Inputs from	Other inputs	Feedback output	Other outputs
Inventive work	Orders from entrepreneurs Inventive work development	Outputs of research	New technological problems Unexplainable successes and failures	Patents Non-patentable inventions

Table 2.1: Inputs and outputs of Inventive work

Adapted from: Ames (1961) and Freeman and Soete (1997)

In the nineteenth century inventor-entrepreneurs or individual inventors established new firms to develop and exploit processes which they had invented or helped to invent. During the 19th century and before that time invention was likely to have been carried out in geographical and social isolation through 'like minds' working on a similar problem (Blaikie, 1993; Naughton, 2007). The significance of the inventor-entrepreneur is noted by Radosevich (1995) and Djokovic and Souitaris (2004). Following this in the twentieth century, according to Freeman and Soete (1997), there was a shift towards large-scale corporate research and development (R&D). This is contrary to the interpretation provided by Jewkes et al (1969) in their classic study 'The Sources of Invention', as already mentioned. In this, they reduce the difference between the nineteenth and twentieth centuries and minimise the importance of corporate R&D. Moreover, they argued that important twentieth century inventions were the result of individual inventors similar to the nineteenth century. Inventors 'free-lancing' or working in universities achieved this. In fact, they concede that due to the extortionate development costs, large-scale corporations will often still be necessary to bring inventions into commercial exploitation. Indeed, out of 64 major twentieth century inventions, 40 were attributed to individual inventors compared to 24 from corporate R&D, and out of the 40 half of these were dependent for commercial development on large firms.

Freeman and Soete (1997) maintained from the standpoint of economics that it was innovation that was of central interest rather than invention. Although, they did not deny the importance of invention, or the vital contribution creative individuals make to invention. This has been highlighted by Johnson (1975) who recognised the economic significance of invention itself in terms of its process and relationship, to the size of the firm and the role of the individual inventor. Freeman and Soete (1997) see no inconsistency between Jewkes et al's emphasis on the importance of university research and invention and the interpretation they give. (The interaction of the inventor with universities has more recently been noted by Agrawal (2001) in terms of university-to-industry knowledge transfer). Nor do they deny that the 'lone wolf' and the 'inventor-entrepreneur' still play an important role. But they do note even on Jewkes et al's account of major inventions, that there has been a shift since the early twentieth century to a larger contribution from inventors associated with corporate R&D. Although the difference between nineteenth and twentieth century invention cannot be lightly dismissed a new pattern began to emerge in the twentieth century, in which the role of the inventor-entrepreneur became less important. Whereas the UK is perceived as being a nation of inventors (HM Treasury, 2004) it appears that the principal way to be successful commercially today is to be an 'entrepreneurial inventor' (Nicholas, 2003).

According to Freeman and Soete (1997, p. 169) 'the test of successful entrepreneurship and good management is the capacity to link together…technical and market possibilities…. Innovation is a coupling process and the coupling first takes place in the minds of imaginative people…. But once the idea has 'clicked' in the mind of the inventor or entrepreneur, there is still a long way to go before it becomes a successful innovation…. The one-(person) inventor-entrepreneur…may very much simplify this process in the early stages of a new innovating firm, but in the later stages and in any established firm the 'coupling' process involves linking and co-ordinating different sections, departments and individuals.'

The Interrelationships between invention, innovation and small business

A fundamental question regarding the role of the individual inventor is whether invention depends on individual inventors in terms of national and regional policies, which may aim to liberate individual 'inventiveness'. According to Norris and Vaizey (1973) this widely held view may be false. It is debatable whether this is the case since although most inventions are promulgated by individuals, due to a creative idea emerging from one person, it is possible for two or more people to get together to formulate an idea. This is contrary to Norris and Vaizey's assertion that 'groups of people do not tend to produce creative ideas' (Norris and Vaizey, 1973, p. 36). This leads to the possibility of co-invention and this is supported by the research reported by Thomas et al (2009) in a survey of inventors which provides evidence of inventors working together in a number of cases. Contrary to this, although inventors may work together, it is still the case that many will be individual inventors, nevertheless but not exclusively.

This leads to a number of possibilities regarding invention. Not only will there be individual and co-inventors, there will also be serial inventors (developing inventions one after another) and parallel inventors (developing a number of ideas at the same time). Ideas developed at any time may be linked or they may be separate. When exploring what is meant by 'individual inventor' Norris and Vaizey (1973) contend that there are two principal types. In the first sense, an individual inventor is someone who works by themselves (otherwise known as a 'lone inventor'), determining the direction of the work and financing the activity from their own resources. The results of the work will remain with the individual at this stage of development. In these terms, inventive activity will probably be carried out on a part-time basis or as a 'leisure' pursuit of someone employed. At the other end of the scale the corporate or institutional inventor may be a core tenured employee who is working in a specific area the results of which will be retained by the employer. Located between these two there will be many variations. Between the individual inventor and the corporate inventor there will be individuals who have characteristics of both. It will be a matter of judgement whether these are described as individual inventors. The relationships between invention, innovation and entrepreneurship, inventors, innovators and entrepreneurs, and micro, small and medium-sized enterprises (SMEs) and large corporations are illustrated in Table 2.2. There is also the distinction between profit orientation and societal orientation of entrepreneurs and entrepreneurship, but the latter has been excluded from this study due to being a discrete research investigation in itself.

Activity/Level	Invention	Innovation	Entrepreneurship
Micro	Individual/lone inventor	Innovator	Entrepreneur
Small and medium-sized enterprise	Company inventor	Innovation champions	Entrepreneur/ intrapreneur
Large company or organisation	Institutional/ Corporate inventor	Project champions	Intrapreneur

Table 2.2: The inter-relationships between invention, innovation and entrepreneurship
Source: Thomas and Gornall (2002)

The measurement of the relative magnitude of inventive activity by inventors is problematic due to the absence of expenditure on this type of activity. As a consequence, measurement is currently based purely on outcomes. The two main sources of information are therefore patent statistics and information on significant inventions. According to Kuznets (1962) there are four possible dimensions to an invention – a technical and an economic magnitude, and a past and a future. The technical past relates to the magnitude of the technical problem resolved by the invention. Consequently, some inventions are of a greater magnitude than others. The technical future can be measured according to the size of the invention, which is dependent on the inventions that follow. The economic past of an invention involves the cost and is measured according to the resources used. Lastly, the economic future of an invention involves the production of new goods or services and can enable cost reductions.

Although the above measures act as a conceptual framework, it remains an educated guess to determine the difference between significant and insignificant inventions. Jewkes et al (1969) in their work on the most important inventions in the twentieth century, as already described, assembled a list in their judgement of the most significant inventions. Out of these, as well as individual inventors, there was evidence that universities and government research laboratories produced a considerable number of inventions too. Factors affecting the individual inventor as a major source of invention include time, 'atmosphere', finance and technological resources. The complexities of finding finance by an inventor are explored by Hobbs (2006) in terms of the inventor-investor relationship.

With regard to time, small businesses will be interested in inventions that will yield a pay-off within a short period of time and many firms will expect expenditures to be paid off within five years (Norris and Vaizey, 1973; Freeman and Soete, 1997). Since five years will have to include the process of recouping spending on research, invention, innovation and marketing, this will restrict the magnitude of the scale of the advancement of knowledge. As a consequence, most company R&D is concerned with small improvements.

In a small business context, a factor working against invention is the problem of providing the right 'atmosphere'. Another major factor working against the individual inventor is the lack of finance and this is why they appear to have declined in importance in the twentieth century. Much invention will also require specialised technological equipment with a cost beyond the reach of many individual inventors. It could therefore be expected that the role of the individual inventor would be most significant in areas which do not need large amounts of expensive technological equipment. Norris and Vaizey (1973) state that since inventions can be a result of many highly trained personnel working methodically on problems with considerable financial backing, it is clearly the case that there can be both contentions that inventions have been the result of both team and individual work. They therefore surmise that the individual inventor will continue to play a significant role.

According to Spence (1995) innovation is often used to indicate something new, created or produced and it is commonly confused with invention. Whereas inventions can be seen as innovations because they are new, innovations are not necessarily inventions. Spence (1995) further says that innovations may be long-established ideas, products or services involving a new application and consequently may be considered novel. An interesting development of the classic distinction between innovation and invention is with regard to technical novelties (McKelvey, 1997). These may be hidden in an inventor's garage or in a research and development (R&D) department. They may also be mentioned in patents but remain unused, developed or sold and are therefore technical inventions. As technical novelties, they include a combination of techniques and knowledge, and technologies. In fact, inventions become innovations when they are used for marketable products or sold. Indeed, many innovations will have a degree of technical novelty and involve interaction with the market place.

'Collective invention' 'is the free exchange of information about new techniques and plant designs among actual and potential competitors' (Foray, 1997). This has been described in the case of the iron industry: 'If a firm constructed a new plant of novel design and that plant proved to have lower costs than other plants, these facts were made available to other firms in the industry and to potential entrants. The next firm constructing a new plant could build on the experience of the first by introducing and extending the design change that had proved profitable. The operating characteristics of this second plant would then also be made available to potential investors. In this way fruitful lines of technical advance were identified and pursued.' (Allen, 1983, p. 2) It is through this behaviour that cumulative advance takes place (Ehrnberg and Jacobsson, 1997).

It appears that individual entrepreneurship has become less important and collective entrepreneurship more important (Edquist and Johnson, 1997). Radosevic (1997) has identified 'enterprization' which is the process of building complete enterprises instead of production units (Jacobsson, 1997). The term was originally coined by Bornsel (1994). The proposition therefore is that there are not only explicit factors involved in the process of individual invention, as described in the literature, but also implicit factors including personal characteristics.

Conclusions

The fundamental difference that differentiates an inventor from an entrepreneur is that an inventor will develop a new product or service, but may not take it to market. Whereas an entrepreneur will take the risk of bringing together resources to take a good or service to market with the intention of making a profit (Gallagher and Hopkins, 1999). Indeed, the entrepreneur may not be an inventor and not all inventors are entrepreneurs. Moreover, innovation is the interaction of an invention into a use that has economic value. This will be what the entrepreneur adds. Inventors will design and develop new products and services and entrepreneurs will recognise the opportunities (Burns, 2007), take the risk of starting a small business, and accept the challenges. It should also be remembered that inventions solve problems and will lead to other inventions.

Recommended Reading

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