Academic Science and Innovation: From R&D to spin-off creation

Koenraad Debackere, K.U. Leuven R&D, Belgium

Introduction

The role of the university in fostering scientific and technological development is well established (Jaffe, 1989). Bibliometric assessment exercises of academic research performance in many countries have highlighted the importance attached by public authorities to high quality outputs from their academic system (Luwel e.a. 1999). In recent years, a new responsibility is being attributed to the academic institution. Increasingly, academic institutions are required to become active players in national and regional systems of innovation (Feldman, 1994 or Varga, 1998). This means that there is a demand toward academic institutions to turn their research activities to wider economic use through participation in regional innovation networks and clusters (Debackere, 1999). Different mechanisms (contract research, research consortia, active IPR-policy deployment and spin-off creation) can be used to achieve this end. In this paper, we analyze the case of K.U. Leuven Research & Development in order to demonstrate how an academic institution can participate in the innovation game, without loosing out in the international research arena.

University and innovation

Universities have had multiple roles in society. From institutions of education they have evolved towards major research institutions where new fields of science and technology can emerge. Their role as poles for new scientific and technological development is well-recognized today and public authorities demand from their university system to deliver value for money in this increasingly competitive world of science and technology (Luwel e.a. 1999). Research output is continuously evaluated and funding is made contingent upon the quality of the research performed. Individual researchers as well as complete research groups and institutes are evaluated and assessed at regular intervals. A dominant design of research performance definition, assessment and monitoring has emerged.

At the same time, the basis of competition in most of the world's economic systems has also changed (Thurow, 1999). Brain-intensive industries are emerging and the focus of competition has shifted from productivity (the 1960s), over quality and flexibility (the 1970s and 1980s) toward innovation (the 1990s). Productivity growth models have demonstrated the importance of knowledge and information as a third production factor, besides labor and capital. Evidence of the importance of innovation to economic growth has been presented at different levels of analysis. The firm level and the regional geographic level of clusters and networks (Debackere, 1999) both have received much attention in studying and examining the impact of innovation on economic performance. Firm-level studies on successful innovators have increasingly demonstrated the importance of R&D networking as well as make-and-buy decisions in fostering innovative performance (Debackere and Rappa, 1996). Studies on clustering and regional networks of innovation have demonstrated the significant contribution of various actors in an innovation system to the economic well being of a particular geographic area (Baptista and Swann, 1998).

In these studies, universities appear as important actors throughout the innovation process. Ever since Schumpeter described the role of the entrepreneur as a principal economic agent in bridging the gap between science, technology and their commercial application through innovation, technical entrepreneurs have received much attention. Ed Roberts' 1991 book, *Entrepreneurs in High Technology*, highlights this attention paid to technological entrepreneurship in bridging this gap. He examined their antecedents as well as the factors that made their ventures successful.

However, Ed Roberts' book is important from another perspective as well. It indeed demonstrates the important role that can be assumed by academic research and by academic researchers in this entrepreneurial process. Because of the very nature of their research activities, they are often ideally positioned to (help) bring new technologies to the market. As economic research is increasingly turning "production function" research into "knowledge production function" research (the inputs to which are to be defined in terms of R&D expenditures and R&D personnel), the role of academic research contributions to innovation and welfare creation starts receiving widespread attention. As a consequence, universities are demanded not only to play an active role in science and technology development, but also in turning those developments into useful innovations whenever possible and wherever possible. Given the generic failure of established firms in bringing new technologies to the market (Utterback, 1994), universities are increasingly looked upon as incubators for new venture creation. In other words, the traditional long transfer gaps between science, technology and utilization as described by Allen (1977), more and more become intertwined with direct, non-linear, and "rapid" linkages between science, technology and utilization.

New technology ventures originating at universities assume a bridging function between curiosity-driven academic research on the one hand and strategy-driven corporate research on the other hand. These new ventures have the potential to introduce technological disequilibria that change the rules of competition in existing industries. Academic entrepreneurship in biotechnology is probably the most striking example when it comes to describing these phenomena. However, other fields such as tissue engineering are in a similar situation today. As opposed to the well-known processes of industrial innovation, described by scholars like Allen (1977) and Utterback (1994), these ventures are at the basis of a process of entrepreneurial innovation.

This process of academic entrepreneurship and new venture creation is to a large extent spontaneous. However, universities, as incubators, can create a context and structure that facilitates new venture creation. The case of K.U. Leuven Research & Development illustrates this approach.

K.U. Leuven Research & Development: a case on academic entrepreneurship

K.U. Leuven Research & Development was founded in1972 to manage the industrial part of the university's R&D portfolio. What started as a minor part of the university R&D activity has, over the past 27 years, grown into a significant part of the university's total R&D portfolio (1.4 billion BEF on a total research budget of 5.7 billion BEF). From the very beginning, K.U. Leuven R&D (further abbreviated as LRD) has received complete budgetary and personnel autonomy within the university. Researchers belonging to different departments at the university, even belonging to different faculties, can together create a division at LRD. Today there are 32 divisions, supported by about 175 faculty members and employing about 430 researchers. Whereas the incentive system within the departments and faculties is promotion along the academic ladder based on research quality (and to a lesser extent teaching quality), the LRD divisions have an incentive system that is based on budgetary flexibility and financial autonomy. LRD divisions are also entitled to participate in spin-off companies that have grown out of the division.

This system implies that the university has created a matrix structure: research excellence prevails along the hierarchical lines of the faculties and their respective departments, whereas excellence in entrepreneurial and industrial innovation is rewarded along the lines of the LRD divisions. This structure, with sufficient coordination between academic research and innovation, while guaranteeing sufficient autonomy as to the faculty and staff engaged in innovation activities, is at the basis of the university's involvement in science and technology development as well as their application to industrial and entrepreneurial innovation. In addition, the dual incentive structure enables the university to maintain a balance between striving for scientific excellence on the one hand, and gearing this excellence towards application on the other hand.

A historic analysis of the research groups involved in this matrix structure reveals that:
(1) only 10% of the LRD activities in which they are engaged can be labeled as consulting or routine analysis, the bulk being applied research and technology development,
(2) bibliometric performance is strongly correlated with the volume of the industrial innovation activities involved in via LRD, and
(3) the top-performers in terms of academic research also tend to be the top-generators of new technology ventures.

It is of course obvious that not all faculties are equally represented. The majority of LRD activities are done by the engineering, agriculture and bio-medical faculties, and to a lesser extent, the science faculty. Humanities are underrepresented.

However, in understanding the current performance of LRD in terms of participation both in industrial and entrepreneurial innovation, the matrix structure only explains part. Another major part of the present performance resides in the fact that LRD has a 27-year history on which it is built and developed. This history is perhaps the single most important learning effect that has occurred within the university as to the process of innovation. It has enabled several generations of faculty and staff to become acquainted with industrial innovation; to understand its strengths and weaknesses; and to evaluate the benefits of academic entrepreneurship as a complement to the more traditional and established processes of industrial innovation. History and learning have co-evolved in the case of LRD.

LRD: finding the right mix of mechanisms

Even with several generations of academic researchers involved in innovation, a university still has to find and balance the right mix of transfer and innovation mechanisms in order to be performing. At LRD, this mix of structural mechanisms has grown over time, comprising:

(1) a well-balanced system to manage and monitor contract research in the area of industrial innovation. A central staff of 18 collaborators, assisted by 12 innovation coordinators in the field, has grown in expertise and experience over time;
(2) an active intellectual property policy, including a patent fund and an intellectual property management advisory group, has been established and gains in expertise and experience as more cases are developed and managed;
(3) a venture fund has been created, including an advisory group, to assist academic entrepreneurs in creating their enterprise, taking into account up-to-date principles on corporate governance.

This mix of mechanisms has enabled the university to generate an increasing stream of patents, know-how licenses and spin-offs. As of 1999, the university has created 34 spin-off companies, 15 of which have been created since 1997. When taking into account the upcoming deal-flow, the coming year may result in 5-to-10 new spin-off creations.

Academic entreprises and entrepreneurs: becoming successful

The biggest disadvantage the academic entrepreneurs face is a lack of size, scope and complementary assets when they start their companies. As a consequence, and based on analysis of the evolution of the 34 spin-offs that have been created sofar, and that have been actively monitored by LRD management, we can state the following propositions as to what makes a spin-off company successful:

(1) Spin-offs should develop both "focus" as well as "complementary activities" as soon as possible. This helps them generating cash flow and developing a unique value network that charms investors. This is illustrated by cases like Leuven Measurement Systems, Materialise, Synes, … ;
(2) The development of complementary activities also allows spin-offs to adapt their behavior. As they develop these activities they learn by doing. This learning while experimenting with and in the market is more valuable than any well-developed business plan;
(3) Academic start-ups need to develop systems and structures, including mechanisms to coordinate activities, as soon as possible, with minimal delays;
(4) Academic entrepreneurs should be ambitious. Ambition generates momentum, charms investors, induces networking and creates strategic intent that fuels further growth of the company;
(5) The entrepreneurs further need to develop a long-term strategy. Long-term strategic thinking is necessary because it demonstrates the entrepreneur's power for abstract thinking and creative synthesis. It also enforces coherence and consistency, stimulates networking and builds reputation for the entrepreneurs and his or her team;
(6) Besides strategic thinking, implementation is yet another necessary and critical success factor. Strategy implementation is an asset since it forces consistent thinking. It also generates new experiences and capabilities and, as a consequence, it broadens the foundations of the venture's value network. Implementation also confronts the entrepreneur with real-life hardships, such as the necessity to negotiate and collaborate with large, well-established innovators. In other words, it does not only stress the complementarity between new ventures and large established innovators, but it also shows the new venture how to learn to "dance with an elephant without being crushed."

Conclusion

In this presentation, I have discussed and reviewed a host of mechanisms that universities can use to become active players in the game of science, technology and innovation. The development of these mechanisms needs careful attention on behalf of the university's management and, of equal importance, time is needed to develop them into an appropriate and acceptable structure within the university. A matrix structure coupled to a 27-year experience seems to do the job at K.U. Leuven. We are now learning how to turn industrial innovators into entrepreneurial innovators. Assistance and funding help in this process, though they cannot act as a substitute for the ambition, the strategic thinking and the strategy implementation to be done by the entrepreneurs themselves. For academics, those last lessons may be the hardest ones to learn since they require them to continuously move between processes of "thinking" and acts of "doing."

References

Allen, T.J. (1977). Managing the Flow of Technology, Cambridge, Mass.: The MIT Press.

Baptista, R. and P. Swann (1998). Do firms in clusters innovate more? Research Policy, Vol. 27: 525-540.

Debackere, K. (1999). Clusters as Innovation Mechanisms, Report and mimeo, IWT, Belgium.

Debackere, K. and M.A. Rappa (1996). Dismantling the ivory tower: the influence of networking on innovative performance in emerging fields of technology. Technological Forecasting and Social Change, Vol. 53, No. 2: 139-154.

Feldman, M. (1994). The Geography of Innovation, Boston: Kluwer Academic Publishers.

Jaffe, A. (1989). Real effects of academic research. American Economic Review, Vol. 97: 957-970.

Luwel, M., Noyons, E.C.M. and H. Moed (1999). Bibliometric assessment of research performance in Flanders: policy background and implications. R&D Management, Vol. 29, No. 2: 133-141.

Roberts, E.B. (1991). Entrepreneurs in High Technology, New York: Oxford University Press.

Thurow, L. (1999). Creating Wealth, London: Nicholas Brealey Publishing.

Utterback, J.M. (1994). Mastering the Dynamics of Innovation, Boston, Mass.: Harvard Business School Press.

Varga, A. (1998). University Research and Regional Innovation, Dordrecht: Kluwer Academic Publishers.