COMMERCIALIZING RESEARCH: THE LEADERSHIP CHALLENGES FOR THE 21st CENTURY

P.L. Gardner* and Vijay Verma†
TRIUMF National Research Laboratory, 4004 Wesbrook Mall, Vancouver, B.C. V6T 2A3 Canada

Abstract

R&D today is a large industry that consumes vast amounts of public and private funds in most countries. It is becoming increasingly evident that technology transfer and the commercialization of research done at universities and government funded research laboratories must be a key element of their comprehensive strategic plan. It involves using a verified and organized knowledge and research to develop commercially viable products. It requires a visionary leader with effective project management skills to manage and motivate a team of scientists and engineers, otherwise even a top rated research will evervate and wither within the walls of research laboratories. This paper will highlight the importance, challenges and techniques of commercializing technology from accelerator research laboratories. It will provide an overview of the requirements of scientific leadership for both commercialization of research and technology, together with some case studies based on the experience at TRIUMF – Canada's national sub-atomic research facility in Vancouver. TRIUMF's experience with both research and commemrcial developments involving innovative technologies, along with some of the important leadership and management factors that lead to successful projects will be described.

1 INTRODUCTION

The past fifty years has seen a worldwide proliferation of scientific research facilities, established and funded by various levels of government. This government funded research at universities and publicly owned laboratories, now constitutes a significant component of the total amounts that are expended annually on research and development in most national economies. Over the past two decades, commercialization of technology from these publicly funded facilities has become an integral part of national policy. At the same time, industry has recognized the benefits of working with universities and other centres of publicly funded research expertise.

One such research institution in Canada is TRIUMF (**TRI U**niversity **M**eson **F**acility), which while funded by the federal government, is the result of a collaborative effort in the late 1960s, between the three universities in British Columbia. The primary facility mandate was established, and continues to be, the pursuit of excellence in fundamental research into sub-atomic physics. Since 1990, TRIUMf has operated a program, originally funded by the government of British Columbia, to commercialise the technology and scientific knowledge that is generated at TRIUMF.

The intent of this paper is to discuss the leadership and management methodologies essential for the successful commercialization of technological innovation from a research laboratory. It will look at case studies based on TRIUMf's own experience with technology transfer.

2 CHANGES IN THE POLITICAL ENVIRONMENT

Recently universities and other government institutions in North America, (The Bayh-Dole Act, USA 1980, the revised Intellectual Property Act, Canada 1991) have been given increased legal rights to exploit their technological innovations. In the USA since the Bayh-Dole Act has been passed, the Association of University Technology Managers (AUTM) has seen an increase in membership from less than 100 members in 1980 to nearly 2000 today. At the same time, sponsored research in both Canada and the United States has reached new heights.

Table 1: Total Sponsored Research Expenditures for Fiscal Year 1998 ($ millions)

	Industrial Sources	Federal Government Sources	Total
Canada	$193	$545	$1,119
United States	$1,965	$13,660	$21,386

Source: AUTM Licensing Survey 1998.

The European Union has also adopted a policy that intellectual property should remain with the investigator, which has led countries such as Britain to give universities more autonomy over their technologies. Governments have adopted such policies to provide an environment for universities and research facilities that is more conducive to the pursuit of technology commercialization. It also aids in the promotion of ties between industry and government organizations and protects against non use or unreasonable use of inventions.

3 THE ROLES OF THE VISIONARY AND THE MANAGER

Every project which involves innovative new technology requires a Leader with a sense of vision and purpose to motivate people past the immediate obstacles, both perceived

* email: gardner@triumf.ca
† email: verma@triumf.ca

and real. The Leader must possess different attributes than a manager, although she/he may have to evolve into the management role. Conceptually, the Leadership and Management skills that have to be available for the life of a successful enterprise are shown in the following Table II.

Table 2: Leadership and the Project Life Cycle

Phase	Major Attributes	Leadership Style
Feasibility Study	*Sense of vision *Conceptual *Analytical	*Visionary *Empowerment *Expansive
Formulation	*Listening *Analysis *Alignment	*Analytical *Change master *Convergence
Development	*Participate *Cooperative	*Team Builder *Integrator
Execution	*Re-alignment	*Decision maker *Team and synergy
Completion	*Transfer of product/knowledge	*Administrator

Source: V.K. Verma and R.M. Wideman, Project Manager to Project Leader and the Rocky Road Between. *Proceedings of the 25^{th} Annual Symposium*, Project Management Institute, 1994, pp. 627–633.

The fundamental difference between management and leadership is that:

Good Leaders *do the right thing;*
Good Managers *do things right;*

The first case study outlines TRIUMF's most productive licensing agreement, with a company, that has grown significantly in recent years through a series of successful, independent ventures. The success of the TRIUMF-MDS Nordion venture has been in large part a result committed visionaries in both institutions, combined with a high level of management skill at MDS Nordion.

Case 1– MDS Nordion, Radioisotopes for Medical Use

MDS Nordion began in 1946 as a division of a federal crown corporation established to market radium, widely used at the time to treat cancer. After being renamed in 1979 as The Radiochemical Company, it was privatised in 1991 as Nordion International Inc. It was later purchased by MDS Inc. and became MDS Nordion.

In 1978 a visionary manager from AECL approached TRIUMF about using its 500 MeV cyclotron to produce commercial isotopes. He had persuaded the Company to buy into the concept of utilizing TRIUMF's expertise as the basis for a new operation in Vancouver, some thirty-five hundred kilometres from the head office and other Canadian operations. Driven forward by the champion within AECL, and enthusiastically received by researchers at TRIUMF, a new Company facility was established adjacent to the TRIUMF laboratory. Both parties were committed to the objective of combining AECL's corporate entrepreneurial and business abilities with the technical and innovative skills of TRIUMF, to produce a world leader in the supply of commercial cyclotron isotopes. The project was championed by individuals on both sides, and moved rapidly forward. The synergy between TRIUMF and Nordion built on the combination of the researchers' scientific skills, and Company's business skills. the result has been the success that everyone hoped for. Nordion has become recognized as a world leader in the supply of a range of cyclotron based isotopes, with additional products being added at regular intervals, and both parties have enjoyed significant financial benefits.

A number of small companies have been based largely on unique TRIUMF invention and innovation, that otherwise may never have had any commercial development by established industry members.

Case 2- – RF Technology for agriculture

In 1993, a Canadian entrepreneur in Castlegar, British Columbia, established a company named Heatwave, with several former and current members of TRIUMF's technical staff. The company has designed and built a large High Frequency Vacuum heating unit that can dry up to eighty tons of wood, forage (hay etc.), and other non-conducting material. It can provide exceptionally fast and efficient performance, and, unlike conventional conduction, convection and radiation methods that depend on heat transfer from the surface to the interior of the material, it transfers the energy as heat directly to the interior. Without the traditional temperature gradient, drying efficiency is increased, and then further enhanced by the lower evaporation temperature effect of the vacuum. The design efficiency of the prototype dryer is about 70% , with each dryer designed to reduce the moisture content of the load to a pre-determined level. This is an exciting project that could radically change the approach to agricultural drying. As such, it has tremendous potential benefits from efficient drying of all non-conductive material. The unique success of the Heatwave–TRIUMF relationship has resulted from the presence of a visionary entrepreneur and manager and the availability of technical capability from TRIUMF. Optimistically, there is the potential for major sales of the product, with benefits to hundreds of people in Canada and throughout the world.

For the third Case Study TRIUMF scientists collaborated with Professor Anthony Glass of the Botany Department at the University of British Columbia, which is about two kilometres from the laboratory. Dr. Glass had realized the unique opportunity of using short lived isotopes from TRIUMF in his study of plant nutrition. The combination of Dr. Glass' vision and TRIUMF's production capability have yielded some very positive results.

Case 3— Nitrogen and Plant Nutrition

Professor Anthony Glass of the Botany Department at the University of British Columbia saw the opportunity for using the availability of Nitrogen-13 isotope from TRIUMF to examine the kinetics of nitrogen incorporation by plants. His research has increased understanding of how plants best assimilate and absorb nitrogen which they require to synthesize proteins, nucleic acids, and other compounds., Given that 100 billion kilograms of nitrogen based fertilizer are applied globally each year, this research has far reaching significance. The use of the N^{13} *isotope has resulted in Dr. Glass' group discovery of the existence of transport proteins in the membranes of root cells. They also determined that large amounts of* $^{13}NH_4$ *and* $^{13}No_3$ *leak out of the root after absorption, with this efflux being greater in some plant species than others. The results of Dr. Glass' research have included enhanced rice growth in the Philippines and improved selection of tree species in Canada.*

With the half life of ^{13}N *being only 9.98 minutes, the proximity of TRIUMF was crucial to Dr. Glass' ongoing work. While TRIUMF provided a key component for the research, it would not have happened without the vision of Dr. Glass, and his leadership of a talented, dedicated team.*

4 CONCLUSION

The preceding analysis and case studies have demonstrated the integral role of leadership visionaries and managers in the successful development and commercialization of new technologies.