Technology Transfer from Accelerator Laboratories (Challenges and Opportunities)

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Abstract

It is becoming increasingly evident that technology transfer from research laboratories must be a key element of their comprehensive strategic plans. Technology transfer involves using a verified and organized knowledge and research to develop commercially viable products. Management of technology transfer is the art of organizing and motivating a team of scientists, engineers and manufacturers and dealing intelligently with uncertainties. Concurrent engineering is one of the most effective approaches to optimize the process of technology transfer. The challenges, importance, opportunities and techniques of transferring technology from accelerator laboratories are discussed.

1 INTRODUCTION

R&D today is a large industry that consumes vast amounts of public and private funds in most countries. Successful transfer of technology from research laboratories to the market place is becoming increasingly important. The concept of technology transfer is to take the leading edge of verified, organized, and logical knowledge, which is science, and apply it to industrial activities where it becomes technology. It is a process of organizing and motivating scientists, engineers, manufacturers and all others involved to ensure that the process of discovery and innovation leads to a successful technology transfer. Concurrent Engineering is one of the most effective approaches to develop a team of designers and manufacturers to optimize the process of technology transfer. Teamwork is the key element of managing technology transfer projects. The project team leader must develop a cohesive team while encouraging the creative and innovating potential of each team member. This paper will describe the challenges, importance, and opportunities of transferring technology from accelerator laboratories. A few guidelines to achieve total quality management will be discussed. The concept of concurrent engineering and how it can be used to minimize technological uncertainties and minimize end user risk will be discussed.

2 ABOUT TRIUMF

TRIUMF (**Tri** University **M**eson **F**acility) is Canada's major national laboratory for research in sub-atomic physics. Its primary mandate is pure research, funded predominently through an annual contribution from the federal government of Canada.

In addition to significant scientific contributions to particle and nuclear physics during its twenty years of operation, TRIUMF has initiated an applied medical research program in the areas of cancer therapy, tomography and production of radioisotopes. To date, over 300 patients have been treated for brain and several types of pelvic tumours. Research and development using a positron emission tomograph (PET) scanner at UBC's hospital, focuses on functioning brains and is at the forefront of research in brain disorders such as Parkinson's disease, etc. Nordion International Inc., markets radioisotopes made at TRIUMF with a sales volume of over ten million dollars per year. The variety of fundamental and applied research programs at TRIUMF have led to technology transfer in the areas of electronics, tomography, medical research applications, robotics, RF, and industrial applications of cyclotrons.

3 TECHNOLOGY TRANSFER AT TRIUMF

The transfer of technology from a research facility like TRIUMF exists on both implicit and explicit levels. On the implicit level, technical knowledge is inevitably carried by any movement of staff and students.

On the explicit level, intellectual property is identified and transferred deliberately to selected commercial organizations for appropriate exploitation of the technology. TRIUMF recognizes and utilizes six approaches to transfer technology to the industrial economy.

i. Staff Secondments

ii. Consulting for Industry

iii. Spin-Off Companies

iv. Joint Ventures

v. License Agreement

vi. Facility Usage

For the process of technology transfer to succeed at TRIUMF, staff must bring forward disclosures of potentially commercial technology, and recognizes that a significant scientific or technological success does not necessarily translate into a significant commercial success. This is represented in Fig. 1. Many high profile commercialization failures have resulted from a "technology looking for a market". A research facility should not be focussed solely on commercial technologies. Barbalet has shown that the physics of accelerators at CERN has led to many commercial advances.[1]

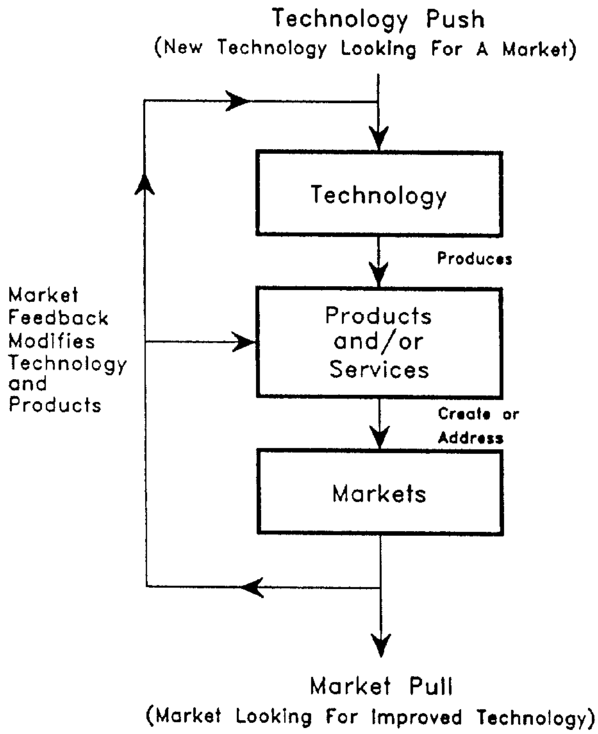

Fig. 1. The Relationship between Technology, Products and Markets.

Figure 2 shows a diagrammetic representation of the TRIUMF process. The test for technical viability is achieved through a review by a panel of technical peers, preferably including at least one representative from industry. At this early stage the panel can reasonably only focus on the question – "Is there any reason to reject the proposal?"

Patent searching is done effectively and efficiently through the UBC Patscan office, with its access to global patent listings. The first significant costs occur with the filing of a patent, so there must be evidence of commercial interest that would support such expenditures. The TRIUMF approach is to have the inventor(s) assign the patent rights to TRIUMF in return for a 50–50 split on future royalty income, after expenses (for patenting etc.) incurred by TRIUMF. In this way the inventor and TRIUMF have a joint interest in the success of the commercialization venture.

4 TECHNIQUES TO ACHIEVE TECHNOLOGY TRANSFER

The scientists, engineers and technicians at TRIUMF have technical expertise in their specialised fields. They are self-motivated and dedicated to their research. Peer recognition of research is highly rated, and staff in most accelerator laboratories have neither the interest nor the aptitude for negotiating the leap from scientific innovation to business enterprise. TRIUMF endeavours to provide an environment conducive to commercializing basic research, using some of the following common techniques.

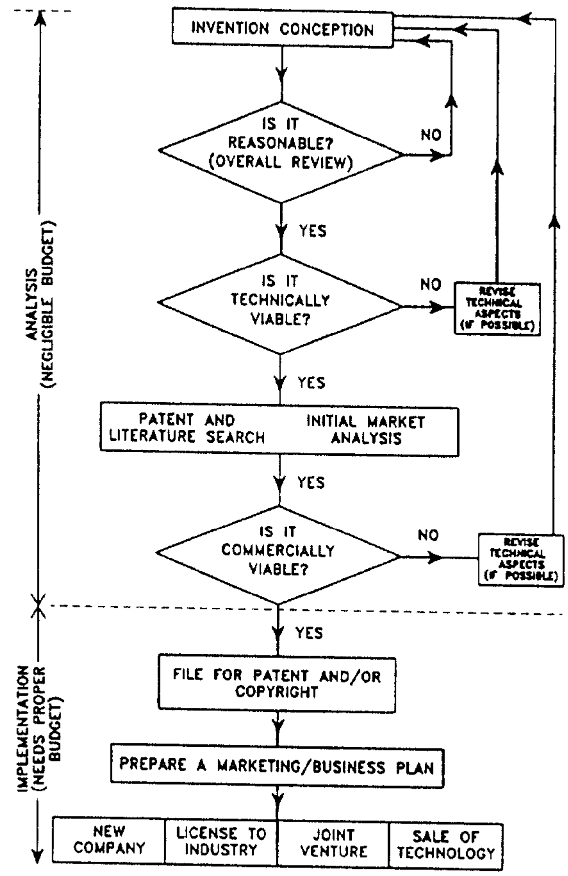

Fig. 2. A Typical Technology Commercialization Process.

4.1 *Set up a Commercialization Office[2]*

The culture that is inherent in a major research centre such as TRIUMF seeks knowledge and perfection. The commercial culture exists to return financial rewards to the participants. These are not opposing cultures, but they are quire different and distinct. This is why it is becoming increasingly prevalent for research institutions to establish commercialization offices which can help in the development and management of inventions.

4.2 *Increase in the Birth Rate of Innovations[3]*

Commercialization is difficult without innovations. Since only about 25% of technologies brought forward by inventors have the potential for commercialization, it is important to increase the birth rate of new ideas. TRIUMF operates with two maxims:

a. Objectivity reduces fear of criticism
b. Search for alternatives provides an opportunity for new ideas

In fact, to encourage innovation, creative leaders will try to stretch their team members' minds and often say to them – "Can't we try a little harder to find a possible original solution".

4.3 *Include Technology Transfer in the Overall Strategic Plan*

Technology transfer can be stimulated if appropriate priorities and resources are allocated as an overall organizational strategy. Strategic planning must place more emphasis on "technology forecasting" and "opportunity seeking" than on "just pure research" and "managing resources".

4.4 *Creating a Desire to Increase Commercialization*

Commercialization and technology can be increased by taking definitive steps to create a desire to do so and a dissatisfaction with the status quo. The pursuit of increasing excellence must start with a creative chief executive or manager of technology transfer/commercialization. It should be remembered that successful technology transfer can be achieved only through effective team management and creative leadership. A survey of aggressive R&D organizations shows that an intrinsic desire to increase technology transfer leads to successful innovations which stimulate other innovations and build up the expectation that such innovations must continue.

4.5 *Favourable Working Climate*

Innovation thrives in an open atmosphere that stimulates people to express themselves freely. The researchers should be encouraged to develop their research ideas and not feel any fear of failure. The economic analysis should be left to the experts. The management should encourage researchers to collaborate actively with industries. It would reduce the risks of technological uncertainties and result in an effective team of "brain power" and "industrial and marketing knowledge". The ideal location for such cooperative development is at a nearby science park.

5 CONCURRENT ENGINEERING (CE) – A VEHICLE FOR TECHNOLOGY TRANSFER

Concurrent engineering (CE) approach has long been recognised as one of the most effective ways to achieve commercialization and technology transfer from basic research facilities. As opposed to the traditional approach to develop products in a series of steps, starting with R&D and conceptualization, design and engineering, then letting contracts for various materials, parts and services and then finally going to production, CE implies doing everything"concurrently". It is a nearly simultaneous, highly iterative process which generally leads to defect–free products. It is ideal for technology transfer where researchers, engineers and manufacturers must work together as a team to produce and market a commercially viable product on time to take advantage of the critical time window. Teamwork mut be emphasized and members must work side by side and compare notes constantly. This makes for more synergy, curbs late fixes, and achieves "the overiding factor" – getting products out on time.

In CE, no phase in the project life cycle is independent of the others. Although design is a tiny piece of the product development pie, design decisions are very critical because they lock in the bulk of later spending. On the other hand, the traditional engineering is very expensive and the typical cost of making each change during the development of a product increases drastically as the project progresses through its life cycle.

In the last decade, several large U.S. organizations such as NCR, IBM, American Telegraph and Telephone (AT&T), Eastman Kodak, Westinghouse, General Electric and Xerox, started to use CE and are now enjoying tremendous increase in their efficiency, quality and profits. CE emphasizes the quality of the manufacturing process rather than relying on assembly line inspections to weed out defects. The whole industrialized world is coming to the conclusion that something like this must be done. By the year 2000, proponents of CE believe a few companies will remain untouched and this will unleash the most wrenching cultural upheaval in manufacturing in 50 years.[4]

Since every major product contains purchased parts, CE must also encompass suppliers and sub–contractors right from the beginning so they get the same head start as the rest of the product development teams. Earlier calls for CE were thwarted by middle management fiefdoms and by the lack of computerized tools to speed cooperation between departments. Now that tools such as electronic mail, CAD/CAM, fax and compact storage facilities are available, top management is in favour of engineering, design, and manufacturing departments in particular, to collaborate the work side by side with support staff such as R&D, project management purchasing and marketing. This approach, applied under creative leadership, will certainly facilitate commercialization and technology transfer from research laboratories.

6 REFERENCES

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