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ETHICS IN TECHNOLOGY TRANSFER AND DEVELOPMENT

Ch.SaiGowtham
K.B.N College

Abstract— The role of ethics in technology transfer and development is of great importance. The meaning of ethics and technology than are harvested, ethical values that have roles in the formation of modern technology. Another meaning of ethics and technology than is reached, that moral people who are dealing with technology, they must observe. It also includes technology to those that exist and sets it to those who apply and who are the analysis and criticism. In this article factors and ethical factors in the process of technology transfer and development. The technology transfer process has six interactive phases with key actions and indicators of transfer to distinguish progress through a flow-system model. The process is presented to promote awareness and understanding within the science community, any may enable scientists to take an active role in the successful application of their technology. Technology can result from the application of science to add value, simplification, diversification, and productivity to a management process or product. However, technology's value wanes unless it can be transferred to a user who can apply the technology to create a tangible benefit. Arising from this assertion, the vitality of public good science funding is critically dependent on technology transfer. This article attempts to clarify the technology transfer phrase by projecting it in a flow-system model. Such a flow-system model can serve as a strategic planning tool for scientists, business leaders, marketing people and other key decision-makers allowing them to make constructive interventions to facilitate progress in transferring technology to a tangible end use.

Keywords. ethics, technology transfer, technology change, flow-system model, science outcomes, science liaison, public good science funding.

I. INTRODUCTION

Technology transfer appears to be a simple communication process. However, in-depth analysis reveals a predictable learning pattern whereby, comprehension of the technology is first achieved, then comes the interpretation of how the technology can be used to solve a problem; finally, the actual application of the technology to solve a problem. Scientists can influence this pattern, once they obtain a basic understanding of the technology transfer process.

Technology transfer process is explained with six phases; technology innovation, technology confirmation, targeting technology consumers, technology marketing, technology application, and technology evaluation. Each of the six phases is briefly described with examples of key actions which demonstrate movement through the process and indicators of transfer which serve to document progress. Actual key actions and indicators of transfer for the six phases can take a multitude of forms, with phases at times overlapping. References are provided for further study.

II. TECHNOLOGY INNOVATION

In New Zealand research priorities are established by the combined wisdom of the Foundation of Research, Science and Technology, the Ministry of Research, Science and Technology, the Crown Research Institutes Board of Directors, and Committees on Science. The technology transfer process begins when a scientist starts communicating ideas of how science can be used to solve a problem or improve a situation in a research priority area. This technology innovation phase is represented by the exchange of information which takes place between the scientist, colleagues and administrators to advance ideas on the application of science. New Zealand's most lucrative sciencific assets are the ideas within scientists' minds. Therefore, any assistance which can be given to support other scientists in comunicating their theories will failitate the technology transfer process.

Such assistance can take the form of encouragement for scientists to communicate ideas with a diagram depicting how different factors (cell counts, hormone levels, chemicals, etc.) interact within a research project. A diagram is the first step toward communicating and refining ideas. The next step would be when the scientist starts discussing his or her theories with colleagues. This activity may aid the scientist in further refinement of the theories and gains suggestions for other possible commercial applications of the technology. In-house seminars and group discussions should be actively organised and supported by all scientists to encourage analysis and support or development of ideas.

After refining theories arising from the technology innovation, the scientist should submit research proposals communicating the concept to the appropriate funding agency. Such proposals should include plans as to how the research will in fact be applied. Scientists need to be proactive in suggesting end uses for the technology they have created (Risdon, 1992).

Examples of Key Actions:

•Idea of management practice or product innovation.
•Developing diagrams of technology innovation.
•Discussing theories with colleagues.
Examples of Indicators of Transfer:
•Display of technology diagrams.
•Presentations communicating technology.
•Research proposals advocating technology.

III. Technology Confirmation

The technology confirmation phase is represented by the scientist first conducting research which provides data in support of the underlying theory about technology and then communicating the results to colleagues, peers and administrators. Indicators documenting progress could be in-house "Eureka" reports which communicate research success to colleagues and administrators. For further information see, Bhattacharya, Glazer, and Sappington (1992) and Hughes (1992) who have developed mathematical models balancing the economic benefits versus the deficits of sharing research progress or results with colleagues and competitors. Trotter and Risdon (1990) address the issue of morale benefits which accrue from colleague interaction, establishing the close relationship between morale and productivity. Indicators of transfer in this phase would be in-house reports, presentations and or publications substantiating research success, which aids science liaison within the science community.

Examples of Key Actions:
•Conducting research on technology innovation.
traits.
•Estimating number of prospective users.
Examples of Indicators of Transfer:
•Reports of research results to key business leaders.
•Communication with potential consumers. Negotiation of potential acceptance barriers.

Phase Four: Technology Marketing

The technology marketing phase of the process is concerned with disseminating the technology beyond the research centre. Key actions for science liaison involve the talents of scientists, business leaders and marketing specialists to educate potential consumers to the social, economic and environmental benefits of the new technology. Echeverria and Elliott (1990) suggest frequent interaction between research and marketing personnel; and the benefit of establishing a demographic profile of anticipated consumers before organising communication channels. Knowing where the potential client usually gains knowledge of specialised products and or services will influence the selection of communication methods. Kaimowitz, Snyder, and Engel (1989) counsel using a variety of communication channels to stimulate public awareness and understanding of science or technology.

Examples of Key Actions:
• Analysing demographic profile of anticipated consumers.
• Preparing information-educational materials.
•Transmitting information through mass media.
Examples of Indicators of Transfer:
•Organise and categorise market constituency.
•Production of educational materials.
•Contacts with a variety of communication channels.

Phase Five: Technology Application

The technology application phase concerns the understanding of users or consumers behaviour and establishing predictable steps to monitor the commercial application of technology. The talents and skills of social and financial consultants, and marketing personnel are required to identify consumers' behaviour and application patterns. Social, economic, and environmental factors which influence the rate of adoption of new technology are discussed in-depth by Arnon (1989). Chari and Hopenhayn (1991) have developed a mathematical model which weights social and economic factors and their influence on the diffusion of technology innovations. The ratio of the number of consumers applying the technology to the number of potential consumers needs to be carefully monitored, to establish the market share reached.

Examples of Key Actions:
•Identifying consumers' behaviour patterns.
•Establishing application criteria.
•Developing ways to monitor change and/or application.
Examples of Indicators of Transfer:
•Document steps leading to adoption.
•Monitor percentage of consumers changing.
•Document changes, adoptions or applications.

Phase Six: Technology Evaluation

The sixth phase of the technology transfer process documents the success or lack of success of the technology to be adopted. Key actions for the technology evaluation phase are to establish assessment criteria for authenticating socio-economic and environmental benefits or harm. Guidelines for evaluating different types of technology innovations are proposed by Cummings (1990). Assessing technology transfer effectiveness generally requires specific criteria which can provide a basis for measuring the extent to which key actions have been attained. The method of defining specific criteria for indicators of transfer is essentially moving from broad to specific actions. The stronger the indicator of transfer, the more useful the indicator is for making decisions on present and future public good science funding. The technology transfer process ends when the scientists reports the evaluation findings back to the funding agency.

Examples of Key Actions:
•Establishing socio-economic benefits.
•Establishing environmental benefits.
•Establishing evaluation criteria.
Examples of Indicators of Transfer:
•Document % of consumers satisfied with technology.
•Document benefits acquired from technology.
•Report evaluation results to funding source.

IV. CONCLUSION

The technology transfer process describes the linkages which integrates the adoption of new science knowledge, and the functional interrelations of the different specialists within the process. The flow-system model has been presented to encourage scientists to become more proactive in monitoring the understanding, interpretation, and application of the technology they have created.

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