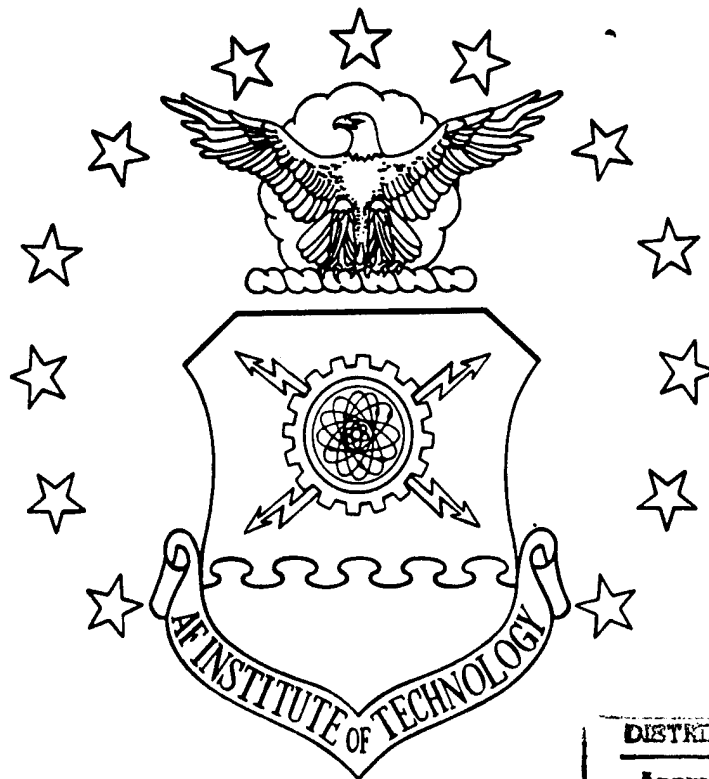




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**A FRAMEWORK FOR DEVELOPING MARKETING
PLANS FOR MILITARY TO CIVILIAN
TECHNOLOGY TRANSFER**

THESIS

Kenneth R. Hirlinger Jr., Capt, USAF

AFIT/GSM/LAS/96J-1

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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FOR MILITARY TO CIVILIAN TECHNOLOGY TRANSFER
THESIS**

Presented to the Faculty of the

Graduate School of Logistics and Acquisition Management

Air Force Institute of Technology

Air Education and Training Command

In partial fulfillment of the requirements for the Degree of Master of Science in

Systems Management

Kenneth R. Hirlinger Jr.

Captain, USAF

June 1996

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Kenneth R. Hirlinger Jr.

Table of Contents

	Page
Acknowledgment.....	ii
List of Figures.....	v
List of Tables.....	vi
Abstract.....	vii
I. Introduction.....	1-1
Research General Issue And Objectives	1-2
Definitions Related to This Research	1-2
Technology Transfer's Importance	1-3
Difficulties with Technology Transfer Partnerships	1-6
Marketing Can Help Technology Transfer	1-7
Summary	1-9
Thesis Overview	1-9
II. Literature Review.....	2-1
Introduction	2-1
Background.	2-1
Past Related Research	2-6
Overview of Strategic Marketing Planning	2-12
Composition of a Marketing Plan	2-15
Summary	2-20
III. Methodology	3-1
Introduction	3-1
Methodology Overview	3-1
Worksheet Development	3-3
Worksheet Case Study	3-6
Research Limitations	3-8
Summary	3-8

	Page
IV. Data Analysis.....	4-1
Overview.....	4-1
Worksheet Development Results.....	4-1
Worksheet Validation Results.....	4-7
Summary	4-16
V. Conclusion	5-1
Summary	5-1
Managerial Expectations	5-2
Recommendations for Future Work.....	5-3
Conclusion	5-5
Appendix A: Technology Transfer Marketing Plan Worksheet (DRAFT).....	A-1
Appendix B: Final Technology Transfer Marketing Plan Worksheet.....	B-1
Appendix C: Case Study Validation-- Armstrong Laboratory Crew Systems Directorate Technology Transfer Marketing Plan Development Worksheet.....	C-1
Bibliography.....	BIB-1
Vita.....	VIT-1

List of Figures

Figure	Page
1. The Value Chain	2-2
2. Technology Transfer Process	2-7
3. Strategic Market Planning	2-14
4. Steps in Preparing and Implementing the Strategic Marketing Plan	2-15
5. Product Market Planning	2-16
6. Marketing Planning Process	2-17
7. Advertising Management Process	4-4

List of Tables

Table	Page
1. Technology Transfer Decision Points.....	2-18

Abstract

The Government of the United States, in particular the Department of Defense, invests a significant amount of funding into the development of technology. This technology, as a critical component of its weaponry, allows the United States to maintain a world-wide qualitative superiority over potential adversaries who may have a quantitative advantage. As industry and government continue to downsize, the transfer of technology from the federal government to the private sector becomes important to ensure the industrial base can continue supporting the military. In addition, transferring technology allows the industrial base to gain international competitive advantages and increase the breadth of the industrial base supporting the Department of Defense. To ensure technology transfer is successful, the military must aggressively market its research and development capabilities and its applicability to the commercial sector. This research marries the efforts of technology transfer programs with the principles of strategic market planning. This paper outlines the motivational aspects of integrating technology transfer and marketing. In addition, considering the importance of objectives in market planning, this research postulates technology transfer objectives. The final product of the research effort is the development of a technology transfer market planning worksheet for use by organizations which desire to develop a market plan that meets their organizational goals.

A FRAMEWORK FOR DEVELOPING MARKETING PLANS FOR MILITARY TO CIVILIAN TECHNOLOGY TRANSFER

I. Introduction

“The world-wide demand for technology seems insatiable” (Dutchyshyn, 1994). Examples from the average American household and examples from the Gulf War confirm the point, both commercially and militarily. Commercially, computers rapidly become obsolete due to increasing power and capabilities at reduced costs. Militarily, Desert Storm heralded in a new era of warfare in which guided weapons have become advanced enough to target structural weaknesses such as air shafts. This technology revolution might not have existed without benefits accruing from the United States’ involvement in World War II, the mission to put man on the moon, and the need to develop advanced weapons for the Cold War.

In the last fifty years, the Federal laboratory system has developed many technologies which both private industry and the military have utilized in the production of commercial and war-fighting end-items. This end item use of advanced technologies has fueled the Government to promote the importance of transferring its technology into industrial markets. Government promotion has typically been done by enacting, and adhering to, legislation. However, the necessity to keep the industrial base strong is forcing the military to strongly endorse technology transfer programs. As the military’s involvement in technology transfer increases, it is experiencing the growing pains associated with a new process. This research will define how to tackle those growing

pains by delineating, for the first time, a systematic plan that utilizes well known marketing techniques.

Research General Issue and Objectives

The general issue of this research effort is to develop a marketing planning process which will allow applicable Department of Defense agencies to execute their technology transfer programs. In order to accomplish this, the following objectives are the thrust of this research effort:

Objective 1: Define the specifics of effective strategic marketing plans.

Objective 2: Develop a marketing plan worksheet that Department of Defense agencies can utilize to develop their technology transfer plan.

Definitions Related to this Research

Military (Government) technology transfer occurs when a technology is transferred from the military to the private sector. Technology transfer is a process defined as “the science of initiating, designing, and implementing cooperative, win-win value added exchanges between sources and adopters of technologies” (Lundquist, 30 May 1994: 4). Lundquist considers the process of technology transfer to be one of a facilitation between organizations (Lundquist and Wowczuk, 26 February 1994: 1).

Another important definition is one related to how technology transfer occurs. Technology transfer is a result of either a market pull, or a technology push. In a market pull, the industry initiates the action and is looking for something with high commercial success. In a technology push environment, the technology itself drives a breakthrough in the commercial market (Carr, 1992: 12).

Marketing is “a total system of interacting business activities designed to plan, price, promote, and distribute want-satisfying products or services to organizational and household users in a competitive environment at a profit” (Paley, 1991: 4).

Strategic Planning is the “managerial process of developing and maintaining a strategic fit between the organization and its changing market opportunities” (Paley, 1991: 4).

The preceding definitions are the macro level terminology required to understand the motivation for engaging in technology transfer programs and market planning. The motivation for marrying technology transfer and marketing follows. Specifically, technology transfer’s importance to industry, the importance of the industrial base to the Department of Defense, a discussion on the success of technology transfer and technology transfer’s limitations, and finally how marketing can help technology transfer programs succeed are presented.

Technology Transfer’s Importance

Technology transfer is important to the industrial base. Porter’s industrial value chain portrays why technology is vitally important to the success of industry.

Technology development permeates the entire infrastructure of a firm (Porter, 1986: 21).

Technology’s value ensures that corporations participating in technology transfer want a successful transfer and the resultant success of technology infused into a usable product.

Research demonstrates that technology transfer can work to the satisfaction of both parties, especially to industry. The Department of Transportation, in “Emerging Sources

of Foreign Competition in the Commercial Manufacturing Industry” substantiates that technology transfer can dramatically improve aerospace airframe development:

....technology transfer enables the firm to move down its existing experience curve, but not to match the experience of the firm providing the technology. The greater number of prior models developed by the established firm permits that firm to have its entire experience curve lower than that of the new entrant, and perhaps to have a steeper slope as well. That downward shift reflects the value of the corporate assets of design and production experience acquired on previous planes. (Griffin, 1989: 69)

Although technology transfer has been successful for industry, success by itself is not a substantial motivator for a bureaucratic, non-profit organization to engage in technology transfer. Other factors must drive the military to participate in marketing technology transfer. The main motivator is the military need for a strong industrial base.

Technology transfer is also important to the Department of Defense. The commercial industrial base, which the United States military relies on to maintain its technological war-fighting superiority, is dealing with significant change in the on-going period of reduced defense dollars. Major defense company mergers, corporate restructuring, defense company focus on commercial enterprises, corporate desire to avoid the defense/government bureaucracy, and commercial standards replacing military standards are some significant changes impacting the defense industrial complex. Past research determined these changes can be mitigated by transferring technology from the government to industry. The reason is that Government-owned technology is a significant economic force of seven hundred research labs and research and development organizations which employ approximately two and a half million scientists and

engineers and utilize a seventy-six billion dollar budget (Elwer-Dewitt, 1994). This Government-operated research infrastructure provides forty-six percent of the total United States R&D effort (Cohen and Noll, 1994: 72-77).

Transferring technology to the commercial sector can strengthen national industrial competitiveness (strong industrial base) and allow corporations to develop related technologies which could enhance future military weapon systems. General Fogleman, the Air Force Chief of Staff, believes technology development is so important, it was the focus of his February 1995 speech to the Air Force Association's Air Warfare Symposium. General Fogleman states, "every conflict involves the participants learning from the previous conflict and adding new technology to the fight." In fact, the word technology was specifically mentioned ten times in the five page speech, reinforcing his view that the military must have new technology to win future conflicts over an evolving enemy.

The General's views on the importance of technology leadership are backed by the Acquisition Undersecretary of Defense's similar views (Bolstering Defense Industrial Competitiveness):

There is a substantial body of evidence that technological leadership is irrevocably tied to manufacturing capacity and leadership. The revenues generated by successful manufacturing are essential to achieving and maintaining the levels of research and development required for technological leadership. Without technological leadership, the Department of Defense cannot count on industry's ability to produce affordable, high-quality, state-of-the-art weapon systems. (Griffin, 1989: 60)

The military need for technology transfer is well established. However, to satisfy the military need for strong military machines, comprised of the best technology, the military must have partners in its effort to strengthen the industrial base. The discovering of partners is one area in which technology transfer has floundered.

Difficulties with Technology Transfer Partnerships

The United States military relies on its industrial base to produce (develop and manufacture) the predominant amount of its weapon systems. As discussed earlier, the technological strength of this industrial base can pay dividends to both the private sector and the military. Therefore, it is important for the Government to share the leading edge technology of its research programs with its industrial partners. Despite the common realization that technology transfer requires organizational interaction, there have been problems identifying partners because "state-driven technological development does not work unless closely associated with societal participation. Both the industry and the military must be willing to participate" (Perruci, 1995: 388).

Rahm's research substantiates that problems exist in finding technology transfer partners. She found organizational culture to be the stumbling block to successful ventures. In particular, researchers, or their directors, did not want their work to be given to others for exploitation (Rahm, 1994: 275).

Lee and Gardner determined that finding partners is a difficult task. However, once accomplished, the translation of the technology to a useable product can be done with success. Lee's and Gardner's research of the Iowa State University R&D effort found that in the years 1987 to 1992, seventy-two projects resulted in 24 patents for new

products (Lee and Gardner, 1994: 394). Partnerships, once formed, can be a boon for both sides of the technology transfer relationship. A key to overcoming technology transfer process issues is the ability to identify and motivate potential industry partners to participate in technology transfer programs. This can be done by marketing technology transfer.

Marketing Can Help Technology Transfer

Marketing helps create success. "Marketing (investigates) markets, conveying impressions to R&D which in turn designs and develops new products" (Ayers and Gordon, 1992: 419). A study utilizing 500 firms concluded that, "the search for efficiency, success, a strong strategic and customer orientation, and profitability constitutes a core dimension of the management discipline in general and marketing management in particular. The current research indicates that marketing culture (given its relationship to profitability and marketing effectiveness) is a key ingredient for success" (Webster, 1994: 564-565).

Empirical research supports the profitability brought by marketing. McKee, et al, found that a company which could adapt its marketing orientation between external and internal factors will, in most cases, see financial success (McKee, Varadarajan, and Pride, July 1989: 21-35). Narver and Slater evaluated one hundred and ten strategic business units and found that those companies which had a very high market orientation showed the highest return on assets (Narver and Slater, October 1990: 20, 31, 32). These findings are further substantiated by separate research accomplished five years earlier by Cronin. Cronin concludes, "marketing performance measures contribute significantly to the

explanation of profit performance” (Cronin, Spring 1985: 256). Companies that utilize market planning techniques experience sales that are three and one-half times those of companies who are unsystematic in their approach to marketing (Ward, 1987: 84-86). In a capitalist society another indication that marketing is successful is the use of marketing firms. In 1985, marketing was a seventy billion dollar industry. Of this amount, approximately nine billion dollars were used to market industry (Hall, 1986: B-1).

Marketing can find technology transfer partners. A Congressional hearing found that the transfer process is cumbersome; which drives industry from participating in joint ventures (Hanson, 1988: 20-21). For this and other reasons, such as lack of trust, technology transfer has historically had problems with getting partners to accept military generated technology (Dawson, 1986: 31). To overcome this, a vision of a strong, globally competitive United States must be promoted (DOE’s Industrial Competitiveness Vision: Internet). In addition, effective marketing plans will help the Air Force assess the appropriate market segmentation for the technology. Further, market planning will allow for the specific assessment of the individual companies and persons whom will participate in the technology transfer process. These characteristics promote the success of the transfer effort.

Marketing attacks process and program pitfalls. Common marketing pitfalls are identified as overzealous managers using unrealistic marketing data, inadequate market preparation (Velocci, 1993: 29), no market need for the technology, and no plan on how to get there (Velocci, 1993: 59 and 61). These and other pitfalls are the direct cause for only ten percent of commercial products succeeding.

Problems that are faced in developing an effective marketing strategy include an ill-understood technology transfer process, and the lack of communication between developers and users. Further problems relate to the numerous agencies involved, low rate of technology utilization, no one transfer model offers all the answers, and the failure to understand the innovators are key to the process (Dawson, 1986: 8,9). By using marketing to define the relationships of a product, its developing organization, and the technology receiving organization, these problems can be systematically understood.

Summary

Technology transfer, required by law, will strengthen the United States industrial base by allowing the evolution of technology which can be used to develop superior weapon systems. To ensure this technology transfer program is successful, the military should treat this effort similar to how a corporation supports its own technology base: by establishing a marketing plan and measuring the success of that marketing plan (Scott, 1994: 55). This research effort will define typical objectives of a technology transfer program and articulate those objectives into an Air Force Material Command Technology Transfer Program Marketing Plan Worksheet. Organizations will be able to tailor the worksheet to meet the specific needs for each technology transfer market.

Thesis Overview

Chapter II, Literature Review, is a discussion of the literature related to the research goal of marrying technology transfer and marketing. The literature review documents the uniqueness of this research, since past research offers only hints of marketing technology transfer. The literature review then provides numerous concepts of what strategic

planning is and how to go about developing a strategic plan. This last portion will be synopsized in Chapter III, Methodology.

The Methodology Chapter (Chapter III) affirms the strategic planning concept chosen for this research. Subsequently, the methodology addresses the development of a technology transfer strategic planning framework. This framework was evaluated by personnel in the Air Force Material Command Technology Transfer Office and at Wright Laboratory. The results of this evaluation comprise Chapter IV, Data Analysis. In addition, an exploratory case study with the Crew Systems Directorate of Armstrong Laboratory was conducted. Findings of this exploratory case study are presented in Chapter IV. This research concludes with Chapter V, Summary, which identifies the managerial implications of this research and establishes follow-on research suggestions regarding technology transfer marketing plans.

II. Literature Review

Introduction

Technology transfer, in recent years, has been a heavily studied process resulting in prolific research on the topic. Marketing has received even greater attention within literature. Despite the amount of previous material, there is no research on how to marry the two topic areas with the result being a plan to effectively market technology transfer.

This research effort will concern itself with developing a generic marketing framework for technology transfer programs. The literature review begins with a discussion of the importance of technology transfer to industry. Additionally, the background addresses the literature findings regarding goals of technology transfer programs. This is necessary due to the importance of goals to marketing efforts.

Following the background material, previous research in fields related to technology transfer marketing is addressed to uncover what has been published on technology transfer and the marketing thereof. The literature review concludes with various viewpoints of the context and compilation of marketing plans.

Background

Importance of technology and technology transfer. As depicted in Porter's industrial value chain, technology development permeates the entire infrastructure of a firm, Figure 1 (Porter, 1986: 21).

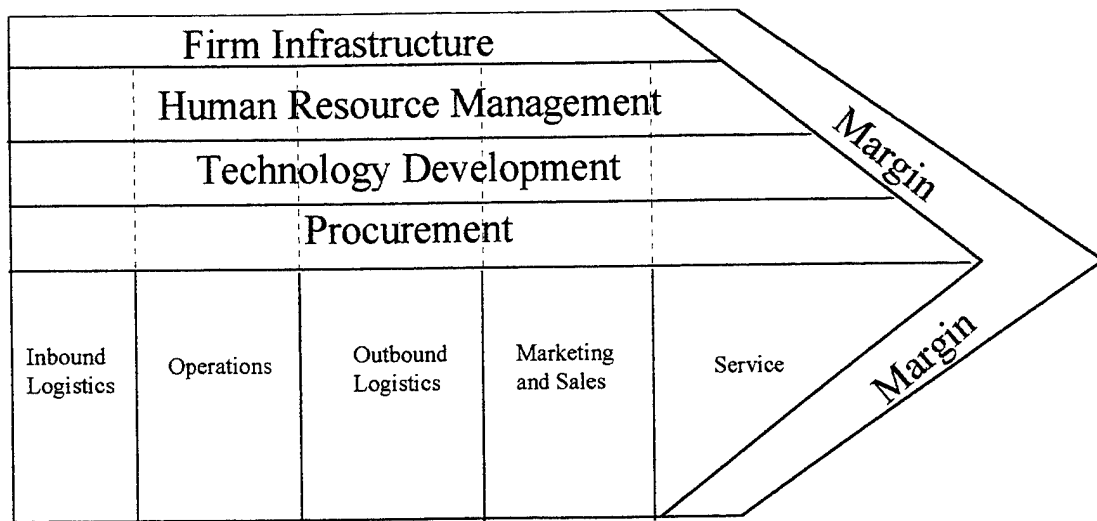


Figure 1
The Value Chain (Porter, 1986: 21)

Porter's view of the industrial value chain is a common-sense understanding of the importance of technology to a firm (and hence a rationale for companies participating in technology transfer). Some examples of technological improvements in each phase of the value chain are:

- Inbound logistics. Sophisticated computer systems allow suppliers to institute just-in-time distribution systems reducing expensive warehouse operations.
- Operations. Robotics and automation allow workers to be freed from dangerous/routine tasks. This allows humans to work in areas requiring the creativity of the human spirit.
- Outbound logistics. Major express delivery corporations can deliver any product to anywhere on the globe within a day and for the right price.
- Marketing and sales. Satellite communications allow participation in global markets.

- Service. Video-conferencing, computer networking, and faxing allow real time on-line help without providing expensive technicians locally.

The examples demonstrate the value of technology to each portions of the Value Chain and recognize technology's overall corporation impact to profits (margin). The relationship of profit margin to market survivability was researched by Varzaly and Elashmawi who state, "the survivability of the firm as regards its market position and profitability will to a great degree depend on its ability to assimilate (available) new technology" (Varzaly and Elashmawi, 1984: 61). Research by Rossener and Wise confirms the need of firms to keep pace with the number of technologies required to be competitive. In addition, their research recognized that R&D funding to develop these technologies is fiscally prohibitive. The result is that industry has been turning to outside sources to gain that technology they can not develop internally (Rossener and Wise, 1994: 349-358).

In addition to corporations' desire for technology to enhance market strength, there are major incentives for the military to be engaged in the process. As noted earlier General Fogleman states technology will allow the United States to win future wars. General Viccellio, Air Force Material Command Commander, is another believer in technology's importance to the military. His view is that transferring technology will allow the expansion of the industrial base which the military relies on and promote technology development returns to military applications. These activities benefit the military and the taxpayer, and are prime considerations for the goals of the Government's technology transfer program (Viccellio, 1995: 2).

Technology transfer program goals. To develop a marketing strategy framework for technology transfer programs it is important to understand the goals related to technology transfer (Royal, 1995: 120). The Air Force Material Command Handbook does not specify concrete goals for the Air Force Material Command Technology Transfer Program. However, previous research suggests the following goals which are commonly used throughout the technology transfer community:

- 1) Strengthen the industrial base (Dawson, 1986:7) (Heffner and Weimer, 1983: 7,12)
 - promote long term growth (Morrocco, 1993: 64).
 - minimize commercial risk of self-development (Leahy, 1989:22).
 - increase labor productivity (Zeniab, 1990: 27) (Farrel and Mandel, 1994: via Internet).
 - position the nation's companies for international growth/competition (Rivers, 1994: 20) (Cohen and Noll, 1994: 72) (NIST MEP Objective).
 - offset the effect of downsizing the Department of Defense industry base by sharing technology which can be utilized to create jobs in the private sector (Morrocco, 1993: 64).
 - strengthening of the industrial base with a resultant transition of enhanced R&M capability resulting in increased mission effectiveness (Dawson, 1986: 7).
 - grow the size of the military industrial base by removing technological barriers between primary contractors and smaller commercial (corporate) resources (Heffner, Weimer, 1983: 7,12).

2) Make the military stronger

- lower up-front R&D costs to win a technological race; i.e. keeping the military stronger than its enemies (Porter, et al., 1986: 187, 332) (Fogleman, 1995: speech).
- promote dual-use (civilian and military) technology (Air Force Material Command Handbook, 1995: B-1).
- strengthen the industrial base with a resultant spill over of an enhanced R&M capability which increases mission effectiveness (Dawson, 1986: 7).
- allow for purchase of off-the-shelf commercial components (Carey, 1994: 29).
- make military products more affordable (Scott, 1993: 44) (Defense Science and Technology Strategy, September 1994: 14 and 23).

3) Support the Federal Laboratories

- keep the laboratory inventors motivated in a time of research cutbacks (Browne, 1995: Internet).
- minimize the overhead required to accomplish a technology transfer program (West, 1994: 7).
- reduce Government red tape and its negative effect on the success of technology transfer (Bozeman and Crow, 1991: 35).
- generate Government return on capital investment (Crabb, 1989: 1,2).

Goals are fundamental in understanding the motivation for Government involvement in technology transfer. Further, goals are necessary to initiate the development of an

effective marketing as they provide something to “shoot at.” In other words, an objective and its goals are a standard by which to measure performance and to provide an indication of resource needs (Adler, 1967: 14). Goals provide the foundation for technology transfer programs. The literature review will now illuminate the previous research done on technology transfer.

Past Related Research

Previous research effort can be fit into five inter-related areas: the technology transfer process, technology transfer’s effect on the industrial base, the motivation for being involved in technology transfer, technology transfer return on investment, and measuring success of technology transfer.

Technology Transfer Process and Planning. The technology transfer process is outlined in the Air Force Material Command’s Technology Transfer Handbook as a six step process shown in Figure 2 (AFMC Handbook, 1993: C-2). In accomplishing a survey of 172 Department of Energy technology transfer cases, previous research identified that no two technology transfer strategies were identical (Deonigi and others, 1990: 328). The AFMC Technology Transfer Handbook accounts for this by describing the governing regulations and the process flow of technology transfer, but leaves the execution of the process to methodologies tailored to individual technology transfer offices.

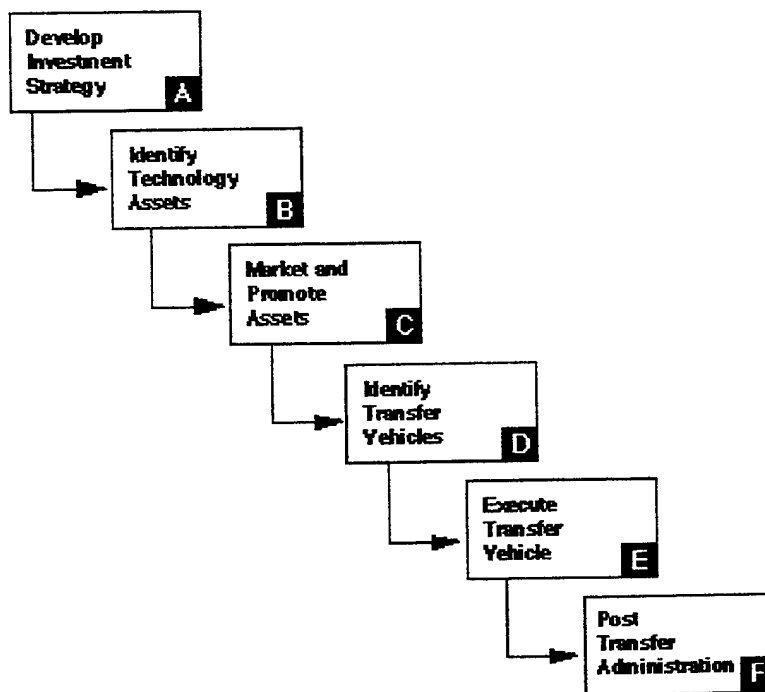


Figure 2

Technology Transfer Process (AFMC Handbook, 1993: C-2)

In addition to the AFMC process, Souder and others provide a framework of the technology transfer process as a sequence of four stages: prospecting, developing, trial, and adoption (Souder and others, 1990:5). “Prospecting” concerns the identification and screening of technologies that may satisfy user needs. “Developing” consists of refining and enhancing these technologies. During the “trial” stage field testing of the

developed technology is accomplished. The final stage "adoption" occurs after final development and implementation by the user (Souder and others, 1990:6).

Both "Step C, Market and Promote Assets" of the AFMC six step process and the "prospecting" stage by Souder (et. al.) identify the need to find technology transfer partners. Research conducted on 134 firms recognize the diversity of the market place and the barriers and incentives of technology transfer (Roberts, Wileman, Flynn, 1979: 21). Werner characterized 20 basic human needs and how those needs influenced the technology transfer process. An example from Werner's research which is relevant to a marketing plan development is the need to ensure harm avoidance through building trust between organizations and people (Werner, 1980: 17, 19).

Motivational factors. Research of the development of motivational factors for entering into technology transfer programs provides a critical reference regarding the factors required for a successful technology transfer program. Rauscher defines two motivational factors for industry to be involved with cooperative agreements (a form of technology transfer): expansion of markets into areas previously closed to the firm; and reducing cost or risk by capitalizing on another firm's R&D (Rauscher, 1986: 9, 10). The result of Rauscher's work is a delineation of the problems associated with technology transfer.

Other research regarding the motivational factors related to developing an effective marketing strategy plan was accomplished by West. West, building on research by Bozeman, provides a good summary of the motives for technology transfer. Motivation due to legislative requirements or statutory mandate are to be expected. However,

organizational motivation such as economic development emphasis of the laboratory and scientists' and engineers' personal satisfaction at seeing their ideas or technology developed were discovered to be important reasons for engaging in technology transfer (West, 1994: 18).

Typical motives related to the success of technology transfer programs are studied by Dawson. There are at least six typical factors which are critical to the successful accomplishment of a technology transfer program. These factors are technical community awareness of user community needs/desires, technical knowledge and sophistication of user community, technical knowledge and sophistication of supplier community, risk aversion environment (public mistakes hurt corporation profits), market disaggregation (can economies of scale be reached?), and federal program coordination (Dawson, 1986: 26). Weijo suggests other motivation as the willingness of all parties to dialogue and the influence of national priorities (Weijo, 1987: 45).

Return on investment. This area of research addresses the expectations transferring organization have when transferring technology. In other words, the identification of benefits received for products transferred. Griffin's research provides an example of the return on investment rationale for technology transfer, specifically with a foreign investor, United States' return on investment is the gain in the country's foreign relations. However, "the notion that cooperative programs may involve technology transfer to countries that may also be economic competitors of the US makes for an explosive issue" (Griffin, 1989: 3). This competition problem also occurs with technology transfer to a certain firm or firms who gain a competitive advantage over their US based competition.

The benefit of corporate competition is the military can drive towards maximizing military return on technologies transferred or transitioned.

Crabb suggests other return on investment concerns. His research effort regarding offset trade agreements shows that the government has invested a large amount of tax dollars to develop a particular technology (instead of putting the same money towards a social program). Therefore, the government should expect some return on investment, either economic or military (Crabb, 1989: 1, 2). Leahy states the US should not be so quick to share technology with Japan "without receiving something of equal technological value in return" (Leahy, 1989: 27). Despite these two pieces of research being focused with overseas technology transfer, there are amazing parallels with American corporate based technology transfer.

Measuring success. Measuring success is the last of the related areas where work has been accomplished. West states an objective of his research is to "determine measures used to assess the success of technology transfer" (West, 1994: 1). In the end, he was unable to develop a probable set of process metrics. However, he did define numerous pitfalls to a successful transfer program. These pitfalls are discussed later in relation to challenges to overcome when developing a marketing plan.

In his research on measuring technology transfer programs West, from various sources, including a survey of Wright Lab personnel, compiled the following as barriers to developing successful technology transfers and associated metrics (West, 1994: 27-29, 48):

- Tendency to measure the bottom line dollars versus the technology transfer

process

- Success is hard to define
- Priority of technology transfer to the organization's prime mission
- Technology transfer offices are typically middle men between the innovator and

the recipient

- Length of time from research to market success
- Transferred technology may end up in the market as a variant of the original,

masking the initial transfer and hampering the ability to measure the success

West's survey discovered that laboratory personnel felt their near term metrics and long term metrics were inadequate. They counted what was easy to count instead of tracking the process. As an example, they would track the number of CRDAs or phone calls. However, the technology transfer process was not measured (West, 1994: 51-53).

Due to its importance to the industry and the military, technology transfer receives significant attention in the literature. However, according to statements from the Technology Transfer Focal Point (TTFP) of the Armstrong Laboratory's Crew Systems Directorate, technology transfer within the military is still very new and considered by most a fad that will disappear with time and change in politics. In addition, he states there is no formal effort to approach industry, instead there is a reliance to push a technology in a blind market approach. This is done because government laboratories assume they know what industry needs (reference Appendix C). The reason this occurs is due to a basic lack of understanding of marketing, and market planning, within the Government

Laboratories. In fact, as represented in Appendix C, a systematic marketing approach has never been undertaken with any Air Force laboratory technology transfer office. This problem will be alleviated by this research understanding the basics of marketing and applying it to a worksheet. The literature review continues by addressing the second major concept being employed in this research, that of strategic market planning.

Overview Of Strategic Market Planning

Technology transfer organizations undertake the development of a strategic marketing plan as a valuable resource to the organization and its accomplishment of a technology transfer program. According to Weinstein, some of the expected benefits are:

- a. A marketing plan helps to establish the business direction and associated organization required to achieve that direction.
- b. A marketing plan acts as a planning and control tool which allows comparison of results to the forecast.
- c. A marketing plan provides focus as a management aide (Weinstein, 1994: 19).

Royal defines the tasks of a marketing plan as establishing the marketing issues which will determine long-term goals, focusing the marketing team on those goals, and tracking the success in finding customers (Royal, 1995: 120). Royal's research portrays goals, such as those identified earlier, as the foundation for an effective marketing strategy.

A pictorial description of Strategic Marketing Planning is provided in Figure 3 (Assael, 1985: 36, 38, 42, 44).

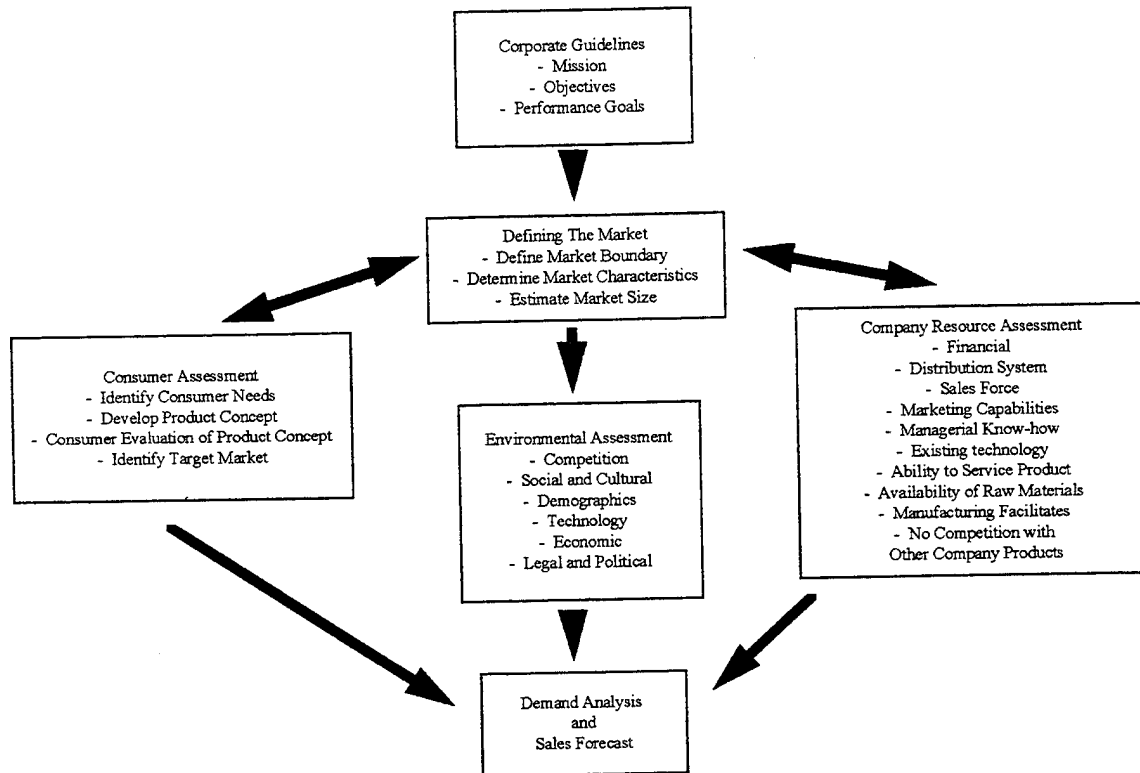


Figure 3
Strategic Market Planning (Assael, 1985: 36-44)

Assael's Strategic Market Planning demonstrates the importance of corporate guidelines (mission, goals, objectives). In addition, Assael represents the interaction of different planning steps by the use of two way arrows between various activities. Cravens provides a similar idea of what should be in a strategic planning effort although, he represents it differently. His pictorial representation is provided as Figure 4 (Cravens, 1987: 570).

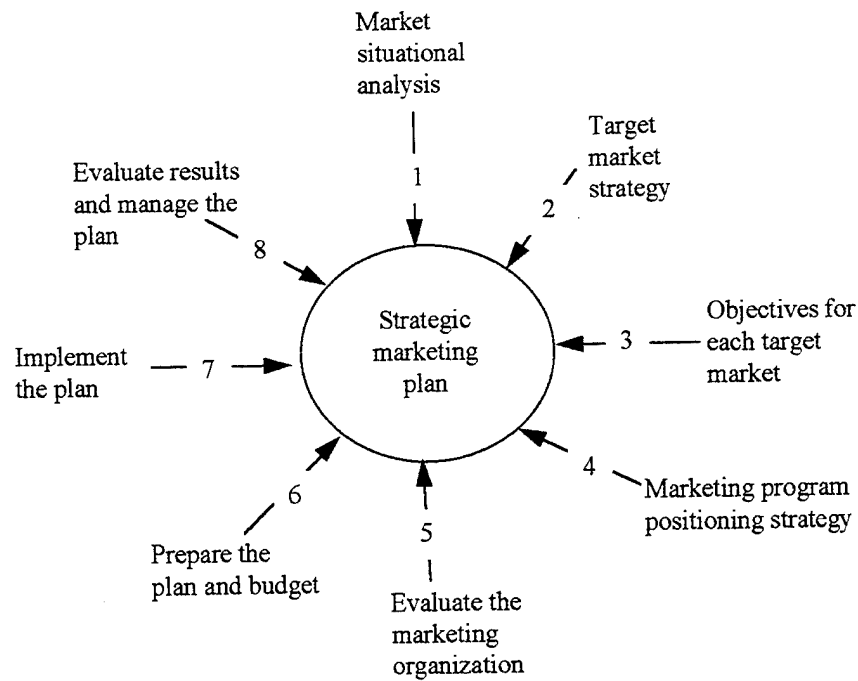


Figure 4
Steps in Preparing and Implementing the Strategic Marketing Plan
(Craven 1987: 570)

These figures depict not only the importance of goals to strategic planning, but also provide an overview of what comprises the strategic planning effort and its associated market plan. Figure 5 demonstrates another view of the importance of goals to the marketing of a product, or a technology at a tactical level (Assael, 1985: 16).



Figure 5
Product Market Planning (Assael, 1985: 16)

Composition of a Market Plan

Dimensions. The dimensions of a market include the products, types (segments and characteristics) of customers, geography, and the production-distribution system (Cady and Buzzell, 1986: 114). Each of these dimensions should be addressed during the development of a marketing plan. In addition, the items mentioned in Assael's Marketing Planning Process, Figure 6, are considerations for the steps and details which should be accomplished in the development of an effective marketing plan (Assael, 1985: 102).

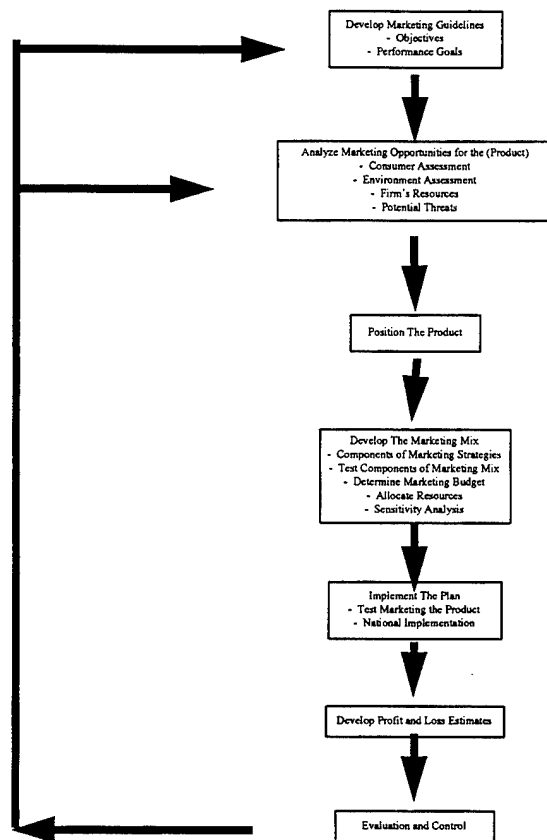


Figure 6
Marketing Planning Process (Assael, 1985: 102)

Peter and Donnelly provide a complementary vision of the items associated with a marketing plan. Their components are situational analysis, marketing objectives, target market selection (market segmentation), marketing mix (mix of product, promotion, pricing, and distribution strategies (place)). Further, they describe the key elements of the marketing plan as people (customer), profit, personnel, product, price, promotion, place, policy, and period (Peter and Donnelly, 1986: 21, 25).

Distribution Systems. The distribution system is an important consideration of a marketing plan. Rome Laboratory's Methods of Technology Transfer provides an overview of the available distribution avenues. These avenues are:

- Technology Assistance
- Licensing of a patent
- Cooperative Research and Development Agreements
- Education Partnerships
- Cooperative Agreements
- Grants
- Consortia and Regional Alliances (Rome Laboratory Technology Transfer Web

Page Internet)

Rossener and Bean add to the above list by defining ten interaction methods for technology transfer and marketing thereof. These are information dissemination, workshops/seminars, lab visits, technical consultation, company use of Federal laboratories, employee exchanges, cooperative research, sponsored research (commercial to Federal laboratory), contract research (Federal laboratory to commercial), and license agreement (Rossner and Bean, 1990: 5). They also state successful interactions require, and thus should be addressed in the marketing plan, person to person contact, flexibility in approaches to transfer technology, existence of champions, management support, and clarification of proprietary rights (Rossener and Bean, 1994: 9).

Decision Criteria. Planning agents may also consider for inclusion into their marketing plan go, no-go decision points. Bar-Zankay's Technology Transfer Model

(Bar-Zakay, 1970: B-3) defines some typical go and no-go decision points are provided in Table 1 (Dawson, 1986: 62, 63). These decision points are deliberately subjective to allow flexibility for each specific marketing case. Different markets, products, and customers will influence the specific criteria.

Table 1.

Technology Transfer Decision Points (Dawson, 1986: 62, 63)

Stage	Donor Decision	Recipient Decision
Search (look for partners)	identify capabilities	identify needs
	establish policies and procedures	establish policies and procedures
	develop incentives to search for recipients	develop incentives to search for donors
	provide communication channels	provide communication channels
Adaptation (technology to users needs)	learn environment of recipient	evaluate socio-economic implications
	evaluate adaptation requirements	evaluate effectiveness
	evaluate cost	evaluate other alternatives
	evaluate feasibility	evaluate desirability
Implementation (accomplish the transfer)	consider capital and hardware	consider people and emotions
	overcome prejudice	build cohesive organization
	provide training	provide support elements
	overcome resistance to change	ensure bureaucratic support
Maintenance (support the receiving organization)	delegate authority	ensure compatibility with supporting elements
	assist in trouble-shooting	evaluate side affects
	identify diversification possibilities	perform concurrent R&D
	evaluate net benefits	evaluate net benefits

Problem awareness. It is crucial to understand potential pitfalls which may impact the development of a marketing plan or a technology transfer program. According to Evan and Dawson, there are disparities in the transfer of technology caused by the “baggage that the organizations bring to the transfer table.” The first gap is between what the idea was and what the prototype is. The second gap is the normal communication gap

which is likely to occur between organizations because organizations, like people, are all different. The third gap is the disparity between the buyer's concept of worth of new technology and the seller's opinion of its value. The fourth issue is the refusal of buyers to recognize that outside technology can be valuable to them (parochialism). Fifth, because of American optimism there is a biased interpretation of the risk versus return axiom. Lastly, there is a tendency on the part of many organizations to discourage the sale of technology even when it would be to their benefit to do so (Dawson, 1986: 31) (Evan, 1976: 27-30).

The marketing plan development. Feinglass defines a basic marketing plan development effort as the following steps:

1. List all your options.
2. Step into your customer's shoes.
3. Study your markets.
4. Segment your market.
5. Observe your competition.
6. Match options with markets.
7. Write a marketing plan.
 - Describe current markets
 - How do you increase sales in your markets
 - List current products and services
 - List suggestions for improving your product line

- identify the costs of implementing your suggestions
- Develop a step-by-step timetable

8. Review the plan (Feinglass, 1993: 42, 43).

Understanding what is in a typical marketing plan is a valuable product of the above literature search findings. Turning this basic understanding into a systematic approach to marketing technology transfer programs needs a proven concept. Ziemke and Schroder provide a validated approach as the following eight phases (Ziemke and Schroeder, 1992: 26):

1. Select the target industry.
2. Canvas target industry.
3. Analyze response from the industry.
4. Conduct site visits to the firms.
5. Conduct on-site seminars at the firm's location.
6. Demonstrate technologies to the firms.
7. Conduct specialized training, tailored to the transferring technology.
8. Provide technical assistance (a long term partnership).

Summary

Technology is important because it allows companies to increase their market share and to keep economic pace in a rapidly evolving global economy. Technology is also critical to the success of military forces which must maintain superiority over any threats. To ensure a constant production capability, utilizing the latest technologies, the Government must transfer technology from its substantial research facilities to the

industrial base, while overcoming significant hurdles such as understanding the organizational intra-communication problems. As proven by past research, market planning can help minimize hurdles by ensuring a systematic approach in assessing the market, the market players, and the market potential.

In this literature review numerous market planning approaches were provided from various sources. In Chapter III, Methodology, one specific approach is chosen to combine the areas of technology transfer and market planning, something not previously attempted. The end result is a framework which can be utilized by organizations to develop their organizational level, directorate level, or individual technology marketing plans.

III. Methodology

Introduction

In Chapter 2, numerous market planning techniques, or processes, are presented. These descriptions of market planning satisfied the first objective of this research. In order to satisfy the second objective, one of these processes needed to be synthesized into a worksheet which could be a tool for organizations developing technology transfer marketing plans. This Chapter will describe the process by which this occurs.

The opening of this chapter is an overview of the methodology chosen for this research. This is followed by a discussion on how the various market planning ideas are developed into a worksheet. This worksheet is then tailored to apply to technology transfer market planning efforts. Following the development of the worksheet, a case study of the worksheet is used as the method of illustrating the worksheets applicability.

Methodology Overview.

Hillway provides an outline for research investigation (design) as: the problem statement, data collection and data evaluation, hypothesis or temporary guess, hypothesis testing, and conclusion (Hillway, 1964: 76-77, 129). He further states that a hypothesis is not required if the objective is to conduct fact-finding (Hillway, 1964: 130). In other words, for fact-finding, it is possible to utilize a management question with follow up investigative objectives in place of a hypothesis.

This thesis, which is concerned with defining a usable worksheet to accomplish a technology transfer marketing plan, is in reality fact-finding type research best defined as

exploratory. Exploratory research is comprised of the following research definitions which are related for applicability to this particular research effort (Green, et al, 1988: 97):

1) An investigation of an area in which the researcher has limited previous knowledge. Prior to entering into this research effort, the researcher had little to no formal or informal education or practice in the area of scientific research, technology transfer, or marketing.

2) There is no clear hypothesis. This research is fact-finding, exploratory in nature. This is the first research effort looking specifically at marrying the concepts of marketing with the practice of technology transfer. The goal of this research is to develop a worksheet tool organizations might use in creating a technology transfer marketing plan. Future work by others will assess the utility of the worksheet in helping organizations develop technology transfer marketing plans.

3) The research method is very flexible in the development and execution. Being the first attempt to bring marketing and technology transfer into a single research effort, there are numerous scope issues, background searches, and differences of opinion which drive the final formation of this research effort.

4) Methodology consists of information searches, interviews with knowledgeable individuals, and examination of like efforts and situations. This research included all of these activities.

The above research design is articulated into three steps for this research. First, the literature review established the basic worksheet to be utilized in the remaining steps. Next, a group of experts conducted a series of assessments regarding the effectiveness and completeness of the worksheet. These first two steps are accomplished to develop the

worksheet which is the objective of this research. The last step consists of a case study validation by Armstrong Laboratories. This final phase is accomplished to check the usability, efficiency, and cost effectiveness of the worksheet when tested by an organization working on marketing military technology.

Worksheet Development

Literature Review. A literature review was conducted to assess the management question and investigation objectives of this research. These items are covered in Chapters I, which also describes the motivational aspects for Department of Defense organizations and industry participation in technology transfer. Chapter I also describes how marketing can help this endeavor. The literature review continued in Chapter II by describing the importance of the process of technology transfer, the concept of marketing, and enumerating some previously accomplished research in areas similar to the concepts of technology transfer and strategic marketing.

The most important outcome of the literature review (reference Hillway's data collection and evaluation) was data to support the development of a basic worksheet. The literature review consists of a review of numerous strategic marketing planning approaches of which a select few samples were presented in Chapter II. These representative samples were evaluated (compared) for their comprehensiveness in describing market planning topics. Assael's Strategic Marketing Planning Process, Figure 3, was selected since it covered the major topical areas of marketing plans. Assael's pictorial format was modified into sections for the technology transfer marketing plan worksheet. These sections are:

- I - Developing Organizational Guidelines
- II - Defining the Market
- III - Environmental Assessment
- IV - Receiving Organization Assessment
- V - Transferring Organization Assessment
- VI - Demand Analysis
- VII - Market Plan Development

After the decision to use Assael's Strategic Marketing Planning Process as the worksheet framework, a more extensive literature review was conducted to research sub-topic information. This material was synthesized into a basic framework of material to be utilized by technology transfer personnel engaged in developing technology transfer marketing plans. The basic worksheet (Appendix A) underwent a number of assessments to verify its applicability and completeness.

Worksheet Assessment. To ensure the marketing plan worksheet is a usable product, it was evaluated by a group of experts utilizing concepts from Delphi Panel and Panel of Expert methodologies. This group of experts was comprised of the following:

- An Air Force Institute of Technology professor specializing in technology transfer research.
- An Air Force Institute of Technology professor whose is recognized for his contributions to the field of marketing.
- The head of the School of Logistics Research Department
- Two representatives from the Air Force Material Command Technology Transfer Office.
- A technology transfer expert assigned to Wright-Laboratories Plans Directorate.

- Armstrong's Laboratory's Crew Systems Directorate Technology Transfer Officer
- A Technology Transfer Industrial Manager from Dow Corning.
- An independent firm which specializes in technology transfer for the National Air and Space Agency.
- A local firm supporting technology transfer in the Miami Valley Ohio Region.

As stated earlier, the method in which the above group of experts were engaged included concepts found in Delphi Panels and Panels of Expert methodologies. The Delphi Panel Method strives "to obtain the most reliable consensus of opinion of a group of experts" (Dalkey and Helmer, 1951: 458, 459). Basu and Schroeder state the structure of the Delphi Methodology is "a sequence of rounds which successively refine the forecast; and ... controlled data input, including opinion feedback and ... analysis" (Basu and Schroeder, 1977: 25). The Delphi approach to research is often modified to fit the research question (Eschenbach and Geistauts, 1985: 103). A Panel of Experts Method is similar to the Delphi with the exception being the Panel of Experts is often a freely flowing, interactive environment. Both use an expert panel with years of related experience and associated responsibility and authority and require a limited number of sessions. Often the number of sessions is limited to no more than three to prevent burnout of the panel, and because experience has shown this number of rounds provides proper convergence (Basu and Schroeder, 1977:25-27).

Utilizing the diverse group of individuals ensured the worksheet incorporated "real" world inputs to the textbook findings used to formulate the initial worksheet. The experts

independently, or in small groups, provided an assessment of the items they felt were pertinent to the need for a technology transfer marketing plan worksheet. Further they identified additional considerations for inclusion into the worksheet. These comments, addressed in Chapter IV, Data Analysis, were researched and incorporated as appropriate. Then the worksheet was redistributed to a smaller subset of organizations.

For the final assessment of the draft worksheet, the reviewing experts were reduced to representatives at Air Force Material Command, Air Force Institute of Technology, Armstrong Laboratories, and Wright Technical Network. After this assessment was completed, a final round of one-on-one sessions with Wright Laboratories and Armstrong Laboratories was conducted. The decreasing sample group was defined by organizations willing to commit the manpower for additional reviews and the need to review it from an operational organization perspective vice a headquarters or academic environment. At each stage, the worksheet incorporated the comments of the preceding round of discussions. The end result of these three rounds of expert assessments was the final worksheet to be used in a case study validation.

Worksheet Case Study

After the worksheet elements were assessed for their applicability, the next phase was a case study validation of the worksheet using Armstrong Laboratory's Crew Systems Directorate. The case study method is appropriate for use in an exploratory manner to develop theories and provide insight into an uncharted area of study (Bryman, 1989: 174) while "finding out who, what, where, when, and how much" (Cooper and Emory, 1195:

16). The case study method also is used to develop hypotheses for analysis in later studies (Dane, 1990: 114).

During the worksheet assessment, comments and questions from the various organizations were independently gathered, researched, and incorporated into the worksheet as determined to be applicable. The worksheet validation was a one-sample case study with Armstrong Laboratory's Crew Systems Directorate Technology Transfer Focal Point (TTFP). This endeavor started with a step by step "walkthrough" of the entire worksheet to assess the validity of each step from the perspective of an organization tasked, per Air Force Material Command directives, with developing a marketing plan. The end result of this meeting was to validate the basic applicability of the worksheet and provided a basic training session for this Laboratory.

The TTFP then completed a technology transfer marketing plan using the worksheet as a framework. It is not expected that he would finish the development of a marketing plan as the definition of objectives alone could take months. Instead, he made progress towards developing a directorate marketing plan which a later researcher could then evaluate the effectiveness of the worksheet once the marketing plan is complete and possibly a technology successfully transferred.

Following the initial meeting, and the subsequent partial validation with Armstrong Laboratory, the worksheet was revised for inclusion into the final version to be submitted with this research. The results of the stages will be briefly discussed in Chapter IV, Data Analysis.

Research Limitations

During the conduct of the research, and the corresponding development of the worksheet, there are sources of error in the methodology caused by the researchers bias, sponsorship bias, unrepresentative sample (mainly due to number of participating experts), and how the experts viewed the worksheet statements (Hillway, 1964: 203-205). Attempts to minimize sources of error included reviewing the draft marketing plan with AFIT instructors, clarifying participants questions, and the using the highly motivated people of Air Force Technology Transfer Offices.

Summary

This Chapter covered the methodology utilized during this research. The methodology is exploratory in nature since this type of research allows for a large amount of flexibility when there is no clearly defined hypothesis. This approach allowed for Chapters I and II to define the motivation behind combining the principles of marketing to technology transfer programs. Further, Chapter II defined what should be covered in a strategic marketing plan. This material was synthesized into a basic draft of a worksheet which was then assessed by personnel from the Air Force Institute of Technology, the Air Force Material Command Technology Transfer Office, Wright Laboratory, Armstrong Laboratory, Market Engineering Incorporated, and Wright Technical Unit to ensure its applicability. Finally, the worksheet was provided to Armstrong Laboratory's Crew Systems Directorate for a case study validation. The results of these activities is addressed in Chapter IV, Data Analysis.

IV. Data Analysis

Overview

The primary objective of this thesis is to develop a worksheet which government organizations could use to generate a technology transfer marketing plan. The intent of the methodology is to satisfy this objective. The methodology is initiated by a discussion on the results of the literature search used to develop the initial worksheet. Upon completion, the initial worksheet was reviewed by a small group of experts comprised of the thesis committee, the sponsor (Air Force Material Command Technology Transfer Officer), and representatives from the Wright Laboratories Technology Transfer Office, Armstrong Laboratory's Crew Systems Directorate, Market Engineering Incorporated, Dow Corning, and Wright Technical Network. Following the initial reviews of the worksheet, the Armstrong Laboratory Crew Systems Directorate Technology Transfer Office accomplished a case study validation of the worksheet. This case study proved the worth of the worksheet and identified some weakness in the worksheet and in Air Force Technology Transfer Programs.

Worksheet Development Results

As stated in Chapter 3, the draft worksheet was produced by using Figure 3 to define the major categories of the worksheet. These sections are; Developing Organizational Guidelines; Defining the Market; Environmental Assessment; Receiving Organization Assessment; Transferring Organization Assessment; and Demand Analysis. These sections were then expanded into the draft worksheet provided as Appendix A by reviewing available marketing literature and "pigeon-holing" ideas found in the literature

into the six major categories of the worksheet. This draft worksheet then went through a series of reviews with the intent of tailoring the generic marketing concepts into a worksheet specifically meeting the needs of technology transfer organizations.

The use of a series of independent meetings with a group of experts confirmed the concept of the worksheet as a helpful tool for producing technology transfer marketing plans. This group of experts also provided research advice on how to tailor the worksheet from a product for any organization working on marketing plans, to something specifically meeting the needs of technology transfer agencies. The experts' comments which were incorporated, and how they were articulated in the marketing plan, are paraphrased in the following sub-paragraphs. The discussion is in relation to the steps of the worksheet.

General: The comments which were applicable to the entire worksheet and its instructions are;

- The draft worksheet could cause confusion by intermixing the instructions and the worksheet elements. To simplify the worksheet the instructions were placed in a separate attachment. This will allow technology transfer agents to proceed directly into the worksheet with references to the instructions only as needed to fill gaps in their knowledge base.

- The worksheet needs consistency in its use of definitions. The intent of this comment is to ensure the definitions used in the worksheet match the latest terminology mandated by the Air Force Material Command Technology Transfer Office. This organization provided the correct terminology to be placed in the worksheet instructions..

- The worksheet needs consistency with command directives. An attachment was added to the worksheet which describes the governing policies identified within the Air Force Material Command Technology Transfer Handbook.

- The worksheet must be able to create a product in a time of doing more work with less resources (i.e., simplistic to understand and use). The intent of the worksheet is to be tailored by specific organizations to meet any needs related to their efforts which may not be satisfied by using the existing worksheet. Organizational tailoring is necessary because no single worksheet could possibly cover all of the specific needs of technology transfer organizations.

- Due to the rapid pace of change the guiding documents must be dynamic and adaptable. To account for this comment, the worksheet was restructured into a form similar to a tax form, i.e., a basic worksheet with general instructions and supplemental attachments. This approach allows for any agency to tailor the document to meet their individual needs. In addition, a recommendation for future research is to validate this worksheet over time.

- Laboratories do not have all the necessary skills required to develop tactical worksheets or strategic plans. In addition, market planning requires resources laboratories may not have; thus, the approach should be easy and time efficient. The intent of this research is to develop a comprehensive, yet easily understood tool which will allow the laboratories (and others) to do this work without having to hire expensive contractors. The proof of this is provided in the Armstrong Laboratory's Crew Systems Directorate case study.

- Marketing methodologies are often learned by doing. This comment implies the need to have real world experiences to balance the theories learned from academia. With this in mind, a list of references was added to the worksheet. This approach allows those “from the school of hard knocks” to jump right into the worksheet. However, those requiring further study could seek further knowledge from available materials and local universities.

The following comments are provided relative to specific sections of the worksheet.

Mission: The worksheet instruction should specify the mission must be in relation to technology transfer efforts, and where the organization expects to be in these efforts over time.

Objectives: The worksheet instructions must clearly state some examples of marketing areas in which technology transfer objectives could be developed. A literature search of existing technology transfer goals was conducted and incorporated in the worksheet instructions to be referenced as required.

Potential Markets:

- A first cut at market segmentation is whether the transfer is going to be a transfer, transition, or transfusion. This comment resulted in a partial revision to the segmentation definitions.

- Which technology should be assessed for transfer? Should the laboratories have a prioritized list of spin-on technologies with direct military payback technologies? Should the focus be on spin-off technologies which will increase the strength of the industrial base? Or is the consideration to be based on higher management pushing transfers, or

general market pulling transfers? Tackling these tough questions is the point of doing a systematic marketing plan which includes an assessment of the market.

Environmental Assessment:

- Competition between federal laboratories and internal company research resources will influence the technology transfer activity. Adding this issue provides technology transfer agents a set of points on how to assess their competition.

- The technology transfer agent will need to comply with the laws which govern the technology transfer program.

Receiving Organization Assessment:

- Federal marketing must include an effort to understanding its customers; receiving organizations and end-product users. Unless the technology transfer organization assesses the customer, a significant amount of frustration and mistrust can result. An example provided by the experts was a receiving organization which is unable to turn a technology into a end-use product. The receiving organization will suffer financial loss, the transfer community will lose incentive because of another unsuccessful transfer venture, and the federal laboratories will have wasted a significant investment in time and possibly money. To address this trepidation, a comment was added within this section requiring the technology transfer agent to give consideration to the eventual customer of the technology once it is produced into a consumer product.

- Federal laboratories often forgo the need of the receiving organization's desire for exclusive development rights of the technology. The company penetrating a market will have a significant investment of resources to develop the technology into a product and

initiate the market. If the technology is provided to other companies, the technology leader will be under-bid by the technology follower. This tends to make companies shy away from federal laboratories and concentrate on internal developments. Federal laboratories engaging in market planning will be able to assess the environment and understand the customer allowing for successful transfer partnerships (Maj Cull, personal interview; 8 Feb 96).

Transferring Organization Assessment. Based on numerous comments in this area, it was sub-divided into two major areas. The first is a resource assessment which asks the technology transfer agent to define the resources require to engage in technology transfer efforts. The second area is a tactical assessment to be defined by the technology transfer agent. The tactical assessment is intended to ensure the transferring organizations has the "right bag of tools" for the job.

Demand Analysis and Sales Forecast. Few, if any, government technology transfer offices have experience in this area. The research in this area alone could take volumes and was outside the scope of this particular research. However, to allow technology transfer agents an understanding of this section, a brief description of what this entails was provided. In addition, the worksheet appendix incorporated numerous references which will allow technology transfer agents to gain knowledge through self-study.

Market Plan Development;

- Marketing plans must be implemented to be useful. Incorporation of this idea required adding this section to the worksheet. This addition defines the articulation of the

worksheet's collection of thoughts into a marketing plan tailored to the specific organization.

- Evaluate the results of the plan. Due to time constraints, this research was only concerned with the development of the worksheet. The case study could not be extended to determine what would happen if the worksheet comments were incorporated into a plan and subsequently implemented. This will be recommended for a future researcher to assess.

The use of three academic specialists, three commercial industry experts, and three military technology transfer offices, provided an excellent assessment that the worksheet was applicable towards helping military organizations develop technology transfer marketing plans. Their comments were incorporated into the final worksheet provided as Appendix B. This final product should meet the goal of providing a cost, and time, effective tool for military organizations to develop a technology transfer marketing plan. To prove this, a case study validation was conducted by Armstrong Laboratory's Crew Systems Directorate.

Worksheet Validation Results

The Armstrong Laboratory's Crew Systems Directorate agreed to accomplish a case study validation of the worksheet. The basic approach of this step was to have the Directorate's Technology Transfer Focal Point (TTFP) review the worksheet for its applicability and then start the process of developing a marketing plan (using the worksheet) for technology(ies) the Directorate was considering for transfer to the commercial industry.

The case study had three key results. The first was vindication that the worksheet is applicable for use at the directorate and the individual technology levels of marketing. In addition, it was postulated that the worksheet could be used to develop a marketing plan at all levels from the individual technology to a technology transfer office at the headquarters level. The second key result was the basic start of a technology transfer marketing plan via the use of the worksheet. The third result of the Directorate's work was an identification of the strengths and weakness of the worksheet. While the Directorate's completed worksheet is provided as Appendix C, the following is a discussion of the major inputs which identify where the worksheet is sufficient as a stand-alone tool and where the worksheet, or the technology transfer agencies, need improvement. The format of the discussion follows the seven steps of the worksheet.

Mission. The worksheet provided sufficient information to allow the description of a technology transfer organization's mission statement. This is evidenced by the mission statement drafted by the TTFP (reference Appendix C). A portion of this mission statement states the "Crew Systems Directorate of Armstrong Laboratory conducts research, development, and field support to integrate human operators with weapon systems and to optimize human combat performance, protection and survivability. The Technology Transfer efforts under this Directorate are aimed at establishing relationships with the private sector that will enhance the Air Force mission of the Directorate by leveraging resources to reduce research costs, reduce research schedules, improve research facilities, or augment technical expertise."

Objectives. Defining the objectives related to marketing technology transfer programs was also a strength of the worksheet. By using the worksheet, with instructions, the Directorate was able to define the basic objectives of their technology transfer marketing program. Examples of these objectives are;

- Strengthen the Air Force mission and the Directorate's ability to address those mission objectives.
 - Using influx of funds from direct reimbursements and royalties to offset budget cuts.
 - Exchange of personnel to offset personnel cuts and to help to maintain a technical competency.
 - Facility improvements to maintain a state-of-the-art capability in the face of budget cuts.
 - Exchange of technical products to enhance existing technologies.
- A secondary objective would be to establish a favorable and productive relationship with the private sector that would be highly sought after in future collaborations and found to be critical to economic competition.

Potential Markets. Using the worksheet, the Crew Systems Directorate was able to specifically delineate their potential market segmentation. In general, the directorate identified their markets as automotive/transportation, medical, entertainment, manufacturing, communication, and education. A major strength of the worksheet is it provided enough information to allow the Directorate the capability to begin defining the markets at a micro level. In the past they have usually dealt with an entire market instead

of keying on a single segment allowing them to isolate their technology transfers to a smaller group. This will benefit them by allowing close relationships with specific organizations. Over time, success will breed success and they will be able to expand their segmentation.

Within this worksheet section another major strength identified by the Crew Systems Directorate's case study is the need to include possible barriers to organizations engaging in technology transfer programs. A technology transfer agent, with the help of the worksheet, can delineate the possible deterrents that influence the transferring and receiving organizations in their desire or ability to work technology transfer.

Environmental Assessment. The worksheet provided a clear understanding of the items to be addressed in the development of the technology transfer marketing plans, and the subsequent execution of the technology transfer activities. However, the downside is that by defining the environment serious deficiencies, or weaknesses, regarding the manner federal organizations accomplish technology transfer were highlighted. Some examples and their significance include;

- Participants in technology transfer market planning and execution must compete with the normal day-to-day operations and the struggle to maintain status quo of their Air Force projects. The significance of this statement is that technology transfer activities often take a back seat to scientists' and engineers' "real" responsibilities. The case study suggests a mind-set change to how the laboratories treat technology transfer activities such that it becomes part of each person's responsibilities.

- Proper attention should be given for competing intellectual property, competing military organizations, or competing industry concerns. Most organizations will not participate in any activity unless they get some return on investment. Further, organizations must be allowed to receive compensation for being involved in the risky practices of bringing new technologies into commercial products. Specifically, the company penetrating a market will have a significant investment of resources to develop the technology into a product and initiate the market. Therefore, the transferring organization can not give subsequent organizations the same technology which would allow these follow-on organizations to break into the market and underbid the first organization. If this occurs, the initial receiving organization will suffer financial loss and, in the future, will seek internal research efforts.

- Local businesses are too small to invest in these technologies and usually are not in the business of marketing the technologies on a large scale. The practitioners are eager to see the technologies applied to their market segment, but are in no position to invest, develop, or market the technologies. Therefore, all organizations involved in market planning of technology transfer need to discover ways to overcome this type of limitation including out-sourcing.

- The technology transfer culture is one that consists of a close knit group of individuals that attend the same conferences, participate in similar development programs, and often serve on the same committees that review technologies. This is a weakness because the individuals often have a very narrow view of their technology and its true state-of-the-art market appeal. Often the technology is viewed by the private sector as too

expensive, too basic, or too impractical. To overcome this will require the transfer agent to properly segment the market and assess the receiving organizations. In this manner, the transferring agency will be provide a service while not being a burden.

- The normal research and development program advocacy process is plagued with politics influencing what programs are to be pursued. So often decisions are made on what programs are to be invested by what is the hottest topic in Congress. Depending on the expertise of Congress and depending on the need for Congressional "pork-barreling," this reality can adversely impact the ability of transferring organizations to work on the technologies needed by their markets. In other words, market pull will not occur. This weakness can only be identified by filling out the worksheet and attempting to be proactive in overcoming the limitations placed on technology transfer activities by legislative bodies.

Receiving Organization Assessment. Although the worksheet allowed the case study to satisfactorily complete a basic assessment of the receiving organizations (or markets), the worksheet highlights some deficiencies in current technology transfer efforts. It's the TTFP's opinion that "this has never been done by either Armstrong Laboratory or Wright Laboratory. As for Armstrong Laboratory, there has never been an assessment of consumer's needs in technology by the laboratory. Technologies that have been identified to have some commercial potential are "pushed" by a blind market approach." This organizational weakness in marketing approach is a weakness the worksheet was made to overcome.

Further, the case study identified that companies have never been approached to see what were their technological needs. Without doing this, transferring organizations blindly work in a technology push environment and may never see success because they have little to offer the market. A technology push environment can cause the receiving and transferring organizations to waste investments in time and money with a resultant negative impact to future technology transfer efforts by both parties. The worksheet will allow this to be assessed and potentially eliminate frustration and mistrust.

Transferring Organization Assessment. When reviewing the case study results, it is obvious the worksheet and its instructions are sufficient to define the characteristics of the transferring organization. While doing this, the TTFP hit on a key point which is often overlooked in the Government. He states, "a company cannot afford to be late due to the many distractions that the government may encounter over the course of its programs. Budget cuts, program reviews, congressional inquiries are not satisfactory excuses to the bank that might be holding the loan on a new product development effort in industry."

Basically the TTFP is stating a well known fact that the profit driven private sector can not wait for the public sector to make up its mind about its short and long term commitment to technology transfer relationships. If the Government begins a relationship with a company, its commitment must be until the end or the company may pull out of the effort. Once this happens, technology transfer efforts will be more limited as word spreads about the difficulties associated with working alongside Federal research and development organizations. This organizational behavioral weakness needs to be assessed while doing the worksheet and developing the marketing plan.

Demand Analysis and Sales Forecast. This step in the worksheet is the one area in which there were major weaknesses described in relation to the worksheet and to federal technology transfer agents. The reason for the failure of the worksheet is that demand analysis and sales forecasting require extensive explanation and use of a multitude of formulas. The best the worksheet is able to do is to provide a brief explanation and provide numerous references for self study.

Within technology transfer offices the bottom line, as stated by the TTFP, is that, "the technology transfer staff in a laboratory simply do not have the expertise," to accomplish demand analysis and sales forecast. To correct this lack of expertise there are two avenues available to organizations: out sourcing to experienced marketing companies and growing expertise by using the provided references for self study or taking classes at local centers of higher learning which teach these methods.

In addition, the case study research determined that often "management is not much more sophisticated than simply counting the number of agreements." Previous research regarding metrics was described in Chapter 2 and backs up this finding of the case study. Over time, demand analysis will have to relate to specific technologies and market segments. As one segment develops a long standing relationship with the transferring agent, additional segments can be developed. This ripple effect will ensure high public exposure based on systematically achieved success stories. The alternative is a hit or miss market push approach which may cause frustration by all.

Market Plan Development. The TTFP states that to the best of his knowledge a systematic approach to marketing technology transfer "has never been done successfully

by the staff of an Air Force laboratory technology transfer office. Several offices are in the process of paying contractors to develop a plan, but at a macro level." The major strength of the worksheet is that it helps organizations accomplish this work in-house with minimal financial expenditures at all levels of technology transfer. This researcher, based on findings, suggests that technology transfer market plans be developed early in programs and modified as the technology is developed. This will force organizations to work technology transfer activities as part of the normal systems engineering approach. Further, during early program milestones, organizations are typically young allowing new ideas to be taken in a better light than in established bureaucracies. Marketing technology transfer is a new idea and may not be well received in older organizations where the attitude is often "not my job."

Armstrong Laboratory's Crew Systems Directorate's case study did not require any modifications to the format or composition of the worksheet, its instructions, or its attachments. However, it did demonstrate the possibility of laboratory members accomplishing in-house market analysis. Further, it portrays the importance of understanding the companies, end-users, and transfer agents while identifying the inability to do demand analysis as a major laboratory weakness. Due to time constraints to support the completion of this research, the TTFP was not able to complete the assessment of these areas in terms of a particular technology (or technology family). A recommendation for future research will be to conduct a follow-up with this directorate. This follow-up should complete the process of developing a viable marketing plan from the data provided when the TTFP completed the worksheet.

Summary

Through a three step process, this research successfully accomplished its objective of developing a worksheet tool for Department of Defense organizations chartered with developing technology transfer marketing plans. A literature review comprised step one and resulted in a basic worksheet which was then assessed by a group of experts using techniques familiar to Delphi and Panel of Expert Methodology. Upon completion of this second step, Armstrong Laboratory's Crew System Directorate helped to validate the research by accomplishing a case study market assessment using the worksheet as their primary tool.

V. Conclusion

Summary

The general issue of this thesis was to develop a worksheet which Department of Defense agencies could use to execute their technology transfer programs via the use of marketing principles. To accomplish this, the following objectives were the thrust of this research effort:

Objective 1: Define the specifics of effective strategic marketing plans.

Objective 2: Develop a marketing plan worksheet Department of Defense agencies can utilize to develop their technology transfer plan.

The second objective was the primary purpose of this research. To meet this purpose required the development of a tool (in worksheet format) to help Department of Defense agencies produce technology transfer marketing plans. Prior to engaging in this, research was presented which identified the importance of technology transfer (to the industrial base and the military), addressed why it is difficult to find technology transfer partnerships, and how market planning can reduce barriers to finding partners. This basic overview was presented in Chapter I and provided the general motivation for the thesis.

Given the basic motivation for marrying the disciplines of technology transfer and marketing, Chapter II provides a detailed discussion of related research in these two areas. The technology transfer portion the literature review identified the technology transfer process, and further described the importance of technology transfer. The literature review continued with an assessment of strategic market planning by describing a few published concepts which defined this systems discipline. From the multitude of sources,

one concept was selected as the basic framework for the technology transfer marketing plan worksheet.

The basic worksheet was developed using the concepts presented in Figure 3. Additional literature review identified sub-topic areas and the initial worksheet was completed (reference Appendix A). This worksheet was then evaluated by a group of experts using methodologies similar to a Delphi Method and a Panel of Experts. Comments from this group resulted in a final worksheet (Appendix B) which was then validated via a Case Study.

The Armstrong Laboratory's Crew Systems Directorate Technology Transfer Focal Point (TTFP) agreed to accomplish a case study development of a marketing plan utilizing the worksheet. In the end, it was found that the worksheet was an effective, and efficient, tool to be used by their organization in support of developing technology transfer marketing plans. The Laboratory's data worksheet is provided as Appendix C.

Managerial Implications

The major success of this research was the case study validation. This validation demonstrated how one individual in a laboratory could begin the long process towards successfully implementing a technology transfer marketing plan. The end goal, as represented by the TTFP's comments, could be an unprecedented amount of technology transfer success due to characterizing the market segments.

The case study validation also established the possibility that government technology transfer offices could use the worksheet with little prior marketing knowledge. This produces benefits such as doing market planning in-house (saving money) and doing them

in a time efficient manner. A few days work to do the worksheet and then turn it into a plan probably takes less manpower than establishing a contract for an out-house organization and then working with that organization to iterate their product.

The use of the worksheet by in-house resources will eventually grow the government marketing knowledge base. With the marketing concepts articulated in a single worksheet tailored to technology transfer, agencies will not need to spend months learning the details of strategic marketing and how it relates to technology transfer. This combined with training being developed by AFIT will reduce the reliance of the government on outside experts to develop basic government planning documents.

Recommendations for Future Work

This thesis addressed the development of technology transfer program goals and the translation of those goals into a marketing plan. The next logical step is the development of a specific plan for a specific technology (or technology family) targeted for transfer. In addition, the subsequent execution of that market plan should be addressed.

A corollary suggestion is to do a large scale testing of the worksheet to ensure its applicability. One item resulting from this could be the validity of this worksheet to the various types of laboratories in the federal system. Further, a large scale test could determine if it can be used to develop technology transfer marketing plans at all levels of the military technology transfer hierarchy, i.e., at the headquarters, laboratory, directorate, or individual technology levels.

The success of technology transfer needs to be measured long term because it often requires years to take a technology and turn it into a consumable product. Future research

should evaluate if market planning enhances the success rates. These success rates should be measured by the transferred technology being embedded into a military or civilian end-product in its original form or some derivative.

Another possible area of future research is the sub-process involved with technology transfer strategic marketing. As an example, one of the activities in marketing execution is promotion, which can include advertising as one methodology. Figure 7 describes Assael's pictorial representation of the advertising portion of marketing which could be compared (analyzed) to how the military technology transfer organizations do similar activities (Assael, 1985: 384):

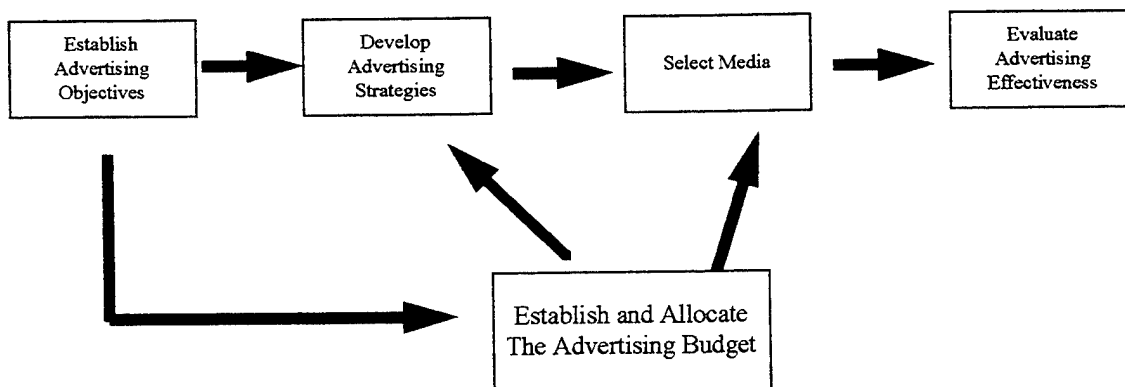


Figure 7
Advertising Management Process (Assael, 1985: 384)

Another item of possible future research is to assess the impact of communications activities on marketing (Bozeman, 1994: 331-333). As defined by Lundquist, tactical marketing consists of "a series of marketing communications including ads, public relations, brochures, user meetings, seminars, trade shows, and sales presentations"

(Lundquist, Oct 94: 4). Future research could attempt to measure the impact of these tactical marketing efforts on the success of technology transfer.

Conclusion

This thesis met both its objectives. First, understanding the concept of marketing and how it relates to technology transfer. Second, modifying strategic marketing principles into a worksheet tool specifically tailored to support organizations developing technology transfer marketing plans. Further, this research concluded with suggestions for future work by others.

Appendix A

Technology Transfer Marketing Plan

Worksheet (DRAFT)

Overview. This worksheet facilitates the development of a technology transfer marketing plan. By working through the various segments, and iterating where necessary, an organization will be able to develop its mission/objectives, its market segmentation, an assessment of the receiving organization, the constraints related to the program, the resources needed to execute the program, and the forecast of the market's future.

I. Developing Organization (or Technology) Guidelines. It is imperative to understand the guidelines of the technology transfer program as these can then be turned into an implementation plan for marketing. These guidelines will act as a referral point for all organizational work on technology transfer. Every individual action should relate back to the mission, objectives, and goals of the technology transfer program. Clearly stated the mission, objectives, and goals will provide a means to measure progress and focus attention on the critical key result areas that have been defined the technology transfer efforts.

Activity	Description
Technology Transfer Program Mission (or problem statement)	
Technology Transfer Program Objectives	

II. Defining The Market (Market Segmentation). Segmentation defines the main group(s) of the industry which will be the focus of the technology transfer program. The purpose of market segmentation is to develop the number of segments (maximum number of segments possible is equal to the number of receiving organizations), develop the profiles of those segments, measure the attractiveness of those segments towards meeting objectives, and allowing the transferring organization to use this knowledge to define its target market and position their organization and technology to penetrate that market. Segmentation puts potential customers (receiving organizations) into groups of similar needs, wants, or characteristics.

Typical market boundaries are defined by the technology's characteristics, within a specific geographical region, or within a specific portion of the industry base. Other segmentation philosophies include socio-economic considerations, psychological considerations, end-use considerations, or the stage of technology development. An example of market boundary for composite materials might be the entire aerospace

industry, or planes over 100 passengers. Another example could be the entire automobile industry or just the vehicle body manufacturers.

Activity	Description
Define Market Boundary	
Type of Technology Transfer	
Determine Market Characteristics	
Geographic Segmentation	
Demographic Segmentation	
Benefit Segmentation	
Psychological Segmentation	
Behavior Segmentation	
Cost Benefit Analysis Segmentation	
Other Segmentations	

II. Environmental Assessment. This assessment reviews the influences of the external and internal market surroundings on a defined market, a technology, a transferring organization assessment, and the receiving organization assessment.

Activity	Transferring Organization
Competition	
Social and Cultural	
Technology	
Economic	
Legal	
Political	
Environmental Impact	

IV. Receiving Organization (Consumer) Assessment. The market boundary and the environmental assessment define the basic arena to transfer the technology. The assessment of the receiving organization will characterize the specifics of the organization targeted for transfer efforts and will allow a proper writing of the contract which will specify the appropriate financial and political considerations for both the transfer and receiving organizations.

Understanding the frame of reference of the customer will help market successfully by capitalizing on knowledge of their strengths and weaknesses. Further, determining the

characteristics of the customer in terms of needs, wants, perceptions, preferences, and behavior will ensure the technology transfer effort occurs because the market wants it, not because the transferring organization forces it. The greatest benefit of understanding the customer will ensure that frustration does not occur on both sides of the technology transfer partnership. If a technology goes to a firm that can not turn it into a usable product, the receiving organization loses money and the transferring organization wastes effort in unsuccessful ventures. This will cause the loss of motivation to participate in future technology transfer ventures.

Terms to be understood;

The **need** for the technology, product, or service. Examples include the need for food, clothing, belonging and security.

The **want** for the technology, product, or service. This is in terms of transferring organization's reputation, cost, availability, ease of turning technology into a usable product, or service.

The consumer can be viewed as either the company/industry receiving the technology or the end user of the product, or service which incorporates the technology. In the latter case, a market-pull environment exists and the laboratory can specifically target technology transfer products which should have a guaranteed success. In terms of a technology transfer effort, it is assumed the consumer is the organization receiving the technology.

Activity	Receiving Organization Assessment
Target Market	
Who is the customer?	
Customer characteristics	
Customer Enticement	
Customer core competency	
Customer selection criteria	
Customer relationship	
Consumer evaluation of product, or service concept	
Develop Product, or service Concept.	
Customer assessment of transferring organization capability	

Working through the above has one purpose; to identify the technology consumer needs. "Satisfaction of customer need is the ultimate test of a business unit's success. Thus an effective marketing strategy should aim at serving customer needs and wants better than competitors do" (Jain, 1985: 205). Otherwise a technology transfer might end up an like an Edsel. The Ford Edsel is an example of the automotive industry giving the customer what they thought the customer wanted, instead of giving the customer what they wanted. Hindsight shows no identification of the customer's wants and a forecasting of those wants into market potential doomed the car (Chambers et al, 1974: 5).

An example of why this assessment is needed: assume the market boundary is technology to support shipbuilding. The market segment is the East and West coast Shipyards. The basic tenets of shipbuilding may be the same however, the cultural differences between the Coasts (and within the coasts) is significant and must be dealt with during the technology transfer.

Another example relates to the emerging technology which allows automated battlefield scouts and automated household goods. A preprogrammed vacuum cleaner and a pre-programmed lawnmower are targeting stereotypical customers of females and males, respectively.

V. Company (Transferring Organization) Assessment (Situation Assessment). This activity will work on developing a position for the target market and ensuring the receiving organization is capable of taking a technology and turning it into a successful product, or service. It is important to define the tactics of how to execute the technology transfer program. There are three major aspects of this assessment, a resource assessment, a tactical assessment, and a go, no-go decision assessment.

Resource Assessment:

Activity	Transferring Organization
Financial	
Demogra	
Sales For	
Managerial Know-how	
Existing Technology	
Ability to Service Product	
Availability of Raw Materials	
Manufacturing Facilitates	

Tactical Assessment (also called Marketing Capabilities and Marketing Mix):

Pricing	
Promotion	

Product, or service	
Distribution System (sometimes called place)	
Public Relations	

The last item the Technology Transfer Office may want to consider for inclusion into their marketing plan are the go, no-go decision points. Bar-Zankay Technology Transfer Model (Bar-Zakay, 1970: B-3) defines some typical go and no-go decision points, Table 2. (Dawson, 1986: 62, 63). Please note these decision points are deliberately subjective to allow flexibility for each specific marketing case. Different markets, products, and customers will have to influence the specific criteria.

Table 2. Technology Transfer Decision Points

Stage	Donor Decision	Recipient Decision
Search	identify capabilities	identify needs
	establish policies and procedures	establish policies and procedures
	develop incentives to search for recipients	develop incentives to search for donors
	provide communication channels	provide communication channels
Adaptation	learn environment of recipient	evaluate socio-economic implications
	evaluate adaptation requirements	evaluate effectiveness
	evaluate cost	evaluate other alternatives
	evaluate feasibility	evaluate desirability
Implementation	consider capital and hardware	consider people and emotions
	overcome prejudice	build cohesive organization
	provide training	provide support elements
	overcome resistance to change	ensure bureaucratic support
Maintenance	delegate authority	ensure compatibility with supporting elements
	assist in trouble-shooting	evaluate side effects
	identify diversification possibilities	perform concurrent R&D
	evaluate net benefits	evaluate net benefits

VI. Demand Analysis and Sales Forecast. Measure and evaluate the demand of industry for a technology, and the ability to transition the technology to them.

Market forecasting. Estimate the future size of the available market size, possible growth rate, and return on investment (royalties, technology spin-on). The ability to accomplish a market forecast will be based on how well you defined the market boundary and the market characteristics are. The return on investment can be qualitative (increase the industrial base) or quantitative (royalties, technology spin-on). Some techniques of market forecasting are provided below. Details on how to utilize the techniques can be researched by reviewing the literature provided as reference material to this worksheet.

Type of Forecast	Types of Models
Qualitative or Judgmental	
Time-series and Projection	
Causal Models	

Forecasting is a science onto itself and resources such as those listed in the reference material will help choose the exact model to fit user needs and will teach the user how to apply them. For example, Kress and Snyder will help you through this by assessing the length of the forecast period, the degree of accuracy sought, the pattern of past data, the cost of doing the forecast, the type of available data, the amount of available data, and the ease of use of the model(s). Forecasting is applicable to most phases of the marketing research such as market segmentation, market share, and consumer behavior. Another excellent source book is Davis' "Practical Sales Forecasting."

Market share can be gained by adding new technology, diversification into related technologies, modification of existing technologies, improving distribution, and improving organizational reputation to the end of altering patterns of existing receiving organizations, attracting non-participating organizations, or attracting organizations that receive their technology from other sources.

VII. Next Steps. Once the items are assessed, the next step is to write the final document. The recommended layout to gather the collection of thoughts into a marketing plan is:

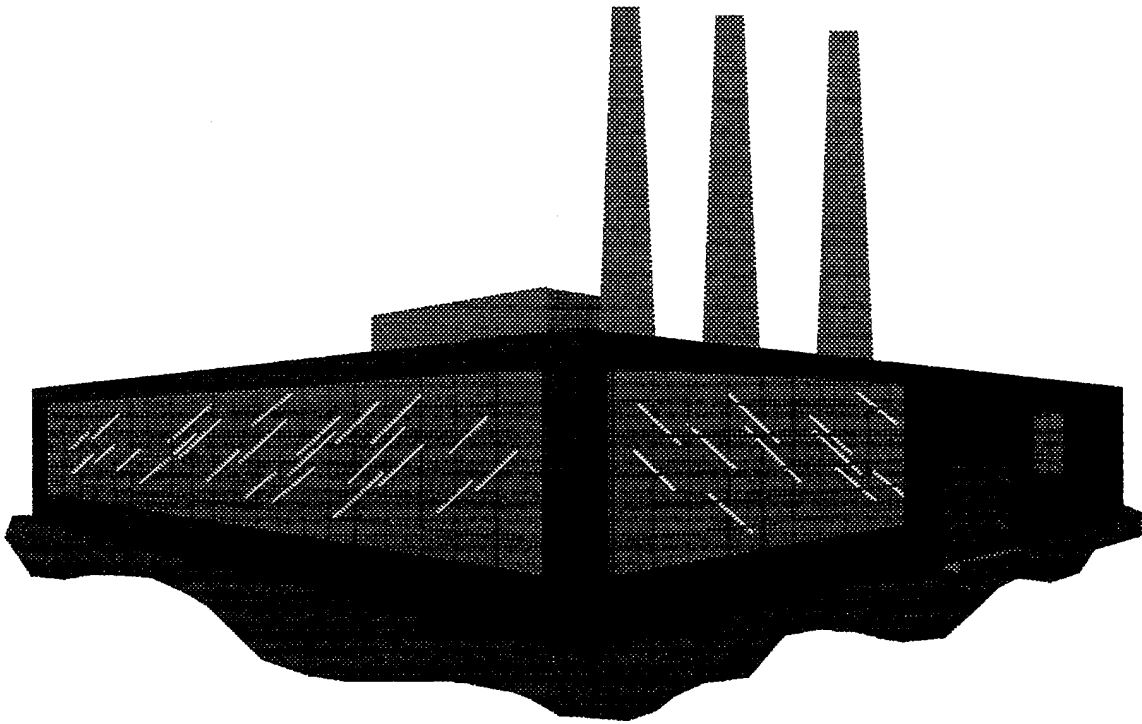
Market Plan Development

- Title Page
- Executive Summary
- Table of Contents
- Introduction
- Definition of Objectives
- Market Segmentation Definition and Analysis
- Market Segment Choice and Description
- Constraints and Environmental Factors
- Resource Needs (Company Assessment)
- Tactical Tools; Price Product, Place (Distribution), and Promotion
- Implementation and Control of the Marketing Plan
- Summary (including consideration to transfer the marketing plan with the technology; allows for the spread of success stories and eliminates reinventing the wheel when the technology is implemented into a product for the end-user)
- Appendix- Financial Analysis
- References

Appendix B:

Final Technology Transfer Marketing Plan Worksheet

Technology Transfer Marketing Plan Worksheet



MILITARY TECHNOLOGY TRANSFER

COMMERCIAL UTILIZATION

AMERICAN SUCCESS STORIES

Technology Transfer Marketing Plan Worksheet

Introduction

This worksheet will help technology transfer organizations merge the principles of strategic marketing, legislative requirements, and military need for technology transfer programs into a well defined approach to market federal technology to future partners in the industrial base.

Once developed a marketing plan can be a valuable resource to the organization and its accomplishment of a technology transfer program. According to Weinstein, some of the benefits to be expected are (Weinstein, 1994: 19):

- a. A marketing plan helps to establish the business direction and associated organization required to achieve that direction.
- b. A marketing plan acts as a planning and control tool which allows comparison of results to the forecast.
- c. A marketing plan provides focus as a management aide.

To achieve the market plan benefits suggested by Weinstein, the following worksheet is one process tool to develop such a plan. The worksheet is structured such that the user may write source material of all pertinent sections. Clarification to the keyword phrases is provided in an instruction booklet provided in the same order as the worksheet. Additional source material is provided in four attachments. Explanations and examples of each worksheet step are provided as Attachment 1. Attachment 2 provides a list of common technology transfer and market planning definitions. The laws which govern technology transfer are summarized in Attachment 3. Attachment 4 is a list of common references which can be researched for detailed information on any particular subject matter related to the worksheet.

Technology Transfer Marketing Plan Development

Worksheet

Step 1. Developing Organization (or Technology) Guidelines.

1.1 State the technology transfer program mission (or problem statement):

1.2 Define technology transfer program objectives:

Step 2. Defining The Market (Market Segmentation).

2.1 Define the market boundary.

2.2 Determine market characteristics.

2.3 List geographic segmentation considerations.

2.4 List demographic segmentation considerations.

2.5 List benefit segmentation considerations.

2.6 List psychological segmentation considerations.

2.7 List behavior segmentation considerations.

2.8 List cost benefit analysis segmentation considerations.

2.9 List usage segmentation considerations.

Step 3. Environmental Assessment.

3.1 Define the competition.

3.2 List social and cultural impacts or considerations.

3.3 Describe the state of technology and its market influences.

3.4 Detail the applicable economic environment.

3.5 Describe the legal influences to the market and/or the transfer process.

3.6 Are there political considerations? If yes, define them.

3.7 Describe the environmental impacts.

Step 4. Receiving Organization Assessment.

4.1 What is the target market?

4.2 Who is the customer?

4.3 Describe the customer's characteristics.

4.4 Define what will entice the customer to the technology, product, or service.

4.5 Describe the customer's core competency and its relationship to the transfer program.

4.6 List the customer selection criteria.

4.7 Describe the customer relationship.

4.8 Consumer evaluation of product, or service concept?

4.9 Develop product, or service concept.

4.10 Describe the manufacturing facilities.

4.11 Customer assessment of the capability

Step 5. Company (Transferring Organization) Assessment (Situation Assessment)

5.1 Resource Assessment:

5.1.1 Financial

5.1.2 Demographics

5.1.3 Sales Force

5.1.4 Managerial Know-how

5.1.5 Existing Technology

5.1.6 Ability to Service Product

5.1.7 Availability of Raw Materials

5.2 Tactical Assessment (also called Marketing Capabilities and Marketing Mix):

5.2.1 Pricing

5.2.2 Promotion

5.2.3 Product, or service

5.2.4 Distribution System (sometimes called place)

5.2.5 Public Relations

Step 6. Techniques To Accomplish Market Forecasting-- Demand Analysis and Sales Forecast

Type of Forecast	Types of Models
Qualitative or Judgmental	- Delphi (seeking consensus by a group of experts evaluated independently). - Panel Consensus (seeking consensus by a group of experts in an open forum). - Market research (testing product hypothesis). - Visionary Forecast (subjective guesswork). - Historical Data Analogy (extrapolated to the future). - Surveys of existing technology transfer organizations and receiving organizations. - Intention To Buy Surveys. - Scenarios building. - Simulations.
Time-series and Projection	Analysis of trends, cyclic activity, seasonality, and randomness; - Moving average. - Exponential smoothing (weighting moving average). - Box Jenkins. - Trend Projection. - Learning Curve. - Winter's Method.

Causal Models	- Regression. - Econometric. - Input-Output Analysis.
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Step 7. Market Plan Development. Once the items are assessed by the team, the next step is to write the final document. The recommended layout to gather the collection of thoughts into a marketing plan is:

Title Page
 Executive Summary
 Table of Contents
 Introduction
 Definition of Objectives
 Market Segmentation Definition and Analysis
 Market Segment Choice and Description
 Constraints and Environmental Factors
 Resource Needs (Company Assessment)
 Tactical Tools; Price Product, Place (Distribution), and Promotion
 Implementation and Control of the Marketing Plan
 Summary (including consideration to transfer the marketing plan with the technology; allows for the spread of success stories and eliminates reinventing the wheel when the technology is implemented into a product for the end-user)
 Appendix- Financial Analysis
 References

Utilizing the collection of thoughts from the previous worksheet steps, the development of a marketing plan can occur by collating the various information pieces into a market plan. The structure can similar to the one above or as required for the intended purpose.

Step 8. Transfer and Receiving Organizations' Assessment of Eventual Consumer Market (OPTIONAL)

Note that the accomplishment of this step is taken as further risk reduction in the technology transfer process. It will help to ensure a transferred technology will result in a successful product entering the consumer market; however, it is of secondary importance to the develop of the marketing plan targeting technology transfer to industry. If it is done, it can be documented in the marketing plan developed as part of Step 7.

8.1 Target Market

8.2 Who is the customer?

8.3 Customer characteristics

8.4 Customer Enticement

8.5 Customer core competency

8.6 Customer selection criteria

8.7 Customer relationship

8.8 Consumer evaluation of product, or service concept

8.9 Competition

8.10 Develop Product, or service Concept

8.11 Existing Technology which can satisfy the same need without substantial development

8.12 Ability to Service Product

8.13 Availability of Raw Materials

8.14 Manufacturing Facilitates

Attachment 1

Technology Transfer Marketing Plan Development Worksheet

General Instructions

Overview. This worksheet facilitates the development of a technology transfer marketing plan. By working through the various segments, and iterating where necessary, the user will be able to develop mission/objectives, describe market segmentation factors, develop an assessment of the receiving organization, describe the constraints related to the transfer program, detail the resources needed to execute the program, and forecast the market's future. The following instructions correspond to the various steps to the worksheet. In addition to utilizing these instructions to assess the technology transfer market planning, attachment 2 is a list of applicable definitions, attachment 3 provides a listing of the statutory requirements, and attachment 4 is a list of general references for the various marketing phases. These attachments are additional resources to be utilized only as needed for further clarification in the accomplishment of the planning effort.

Step 1. Developing Organization (or Technology) Guidelines. It is imperative to understand the guidelines of the technology transfer program as these can then be turned into an implementation plan for marketing. These guidelines will act as a referral point for all organizational work on technology transfer; every individual action should relate back to the mission, objectives, and goals of the technology transfer program. Clearly stated the mission, objectives, and goals will provide a means to measure progress and focus attention on the critical key result areas that are defined for the technology transfer efforts.

1.1. Technology Transfer Program Mission (or problem statement)	- Who we are (the XYZ technology transfer office)? - What we do, why do we exist (technology transfer)? - What industry are we involved with (Air Force to YYY Industry)? - Our broadly stated goal is to.... - Clearly stated in terms related to marketing of technology, feasible within the allocated resources. - Provides a vision of where the organization intends to be in 3 to 5 years (or longer). - Limited to a few sentences (or to a length sufficient for the organization).
1.2. Technology Transfer Program Objectives	Specific achievable parameters which can be measured to ensure the achievement of the technology transfer mission statement. For example, if the objective is to increase the number of "successful" transfers by 15%. - Concise statements, in terms of the key result areas, which specify market position and can be broken into quantifiable pieces (goals) for measurement. - Objectives may cover the own organizational structure, the transfer process, the distribution system, the development of technology, the exploitation of technology, and training. In other words, the total technology transfer effort. - Objectives can also be defined around a particular target technology that is being positioned within a specified market segment.

Example of Objectives of a Technology Transfer Program

The Air Force Material Command Handbook does not specify concrete objectives for the Air Force Material Command Technology Transfer Program; therefore, the following objectives, used throughout the technology transfer community, can be referred to as concepts for brainstorming objectives particular to a transferring organization and its technology transfer program. The objectives, in no particular order, are:

1) Strengthen the industrial base (Dawson, 1986:7) (Heffner and Weimer, 1983: 7,12).

- promote long term growth (Morrocco, 1993: 64).
- minimize commercial risk of self-development (Leahy, 1989:22).

- increase labor productivity (Zeniab, 1990: 27) (Farrel and Mandel, 1994: via America On-Line 3).
- position the nation's companies for international growth/competition (Rivers, 1994: 20) (Cohen and Noll, 1994: 72) (NIST MEP Objective).
- offset the effect of downsizing the DoD industry base by sharing technology which can be utilized to create jobs in the private sector (Morrocco, 1993: 64).
- strengthening of the industrial base with a resultant spill over of an enhanced R&M capability resulting in increased mission effectiveness (Dawson, 1986: 7).
- grow the size of the military industrial base by removing technological barriers between primes contractors and the other commercial (corporate) resources. Currently, the DOD has tended to concentrate business with a few prime contractors due to the high level of capital R&D investment required to develop the state-of-the-art technologies the DOD requires. (Heffner, Weimer, 1983: 7,12). Technology transfer helps to eliminate this investment barrier.

2) Make the military stronger

- lower upfront R&D costs to win a technological race; i.e. keeping the military stronger than the country's enemies (Porter, et al., 1986: 187, 332) (General Fogleman, 1995: speech).
- promote dual (civilian and military) technology (Air Force Material Command Handbook, 1995: B-1).
- strengthening the industrial base with a resultant spill over of an enhanced R&M capability resulting in increased mission effectiveness (Dawson, 1986: 7).
- allow for purchase of off-the-shelf commercial components (Carey, 1994: 29).
- make military products more affordable (Scott, 1993: 44) (Defense Science and Technology Strategy, September 1994: 14 and 23).

3) Support Federal Laboratories

- keep the laboratory inventors motivated in a time of research cutbacks (Browne, 1995).
- minimize the overhead required to accomplish a technology transfer program. West asserts that "technology transfer may be the only element of industrial policy that requires no active, centralized government planning...." This assertion is based on the premise that the technology which is developed for the military is developed for the primary purpose of satisfying a military need, and spin-off from that should be considered a bonus which should not be regulated (hence losing some of the returns due to an increase in bureaucracy) (West, 1994: 7).
- reduce Government red tape (Bozeman and Crow, 1991: 29).
- generate Government return on capital investment (Crabb, 1989: 1,2).

Step 2. Defining The Market (Market Segmentation). Segmentation defines the main group(s) of the industry which will be the focus of a technology transfer program. The purpose of market segmentation is to develop the number of segments (maximum number of segments possible is equal to the number of receiving organizations), develop the profiles of those segments, measure the attractiveness of those segments towards meeting objectives, and allowing the transferring organization to use this knowledge to define their target market and position their organization and technology to penetrate that market. Segmentation focuses potential customers (receiving organizations) into groups of similar needs, wants, or characteristics.

Typical market boundaries are defined by the technology's characteristics, within a specific geographical region, or a specific portion of the industry base. Other segmentation philosophies include socio-economic considerations, psychological considerations, end-use considerations, or the stage of technology development. An example of market boundary for composite materials might be the entire aerospace industry, or planes over 100 passengers. Another example could be the entire automobile industry or just the vehicle body manufacturers.

The importance of segmentation is it will allow the transferring organization to focus on a key group of receiving organizations. With a focus on this key group, the transferring organization will be able to better manage the transfer process resulting in more successful transfers. As the defined technology transfer market segmentation results in successes, other market segmentation's can be evaluated.

Activity	Description
2.1. Define Market Boundary	Accomplishing this assessment can help to define the boundary (and the segment) of the target market. - What does the customer want? - What can you offer the customer; how does the technology satisfy their wants? - Describe entry and exit barriers. -- Entry barriers prevent companies from getting into the technology transfer business, or a market, or partnering with an industry. -- Exit barriers prevent an organization from leaving the technology transfer business, or market, or the ability to partnership with an industry. -- Is it possible to develop potential partnerships upfront; allow for co-funding, or co-development, of a technology prior to its readiness for transfer? -- Does the potential partner want exclusive rights to the technology providing the partner financial guarantee to the market? - Minimum size and maximum size of the market. - Type of technology transfer; transfer, transition, or transfusion.
2.2. Determine Market Characteristics	- What are the characteristics of the industries (or users) of the technology to be transitioned? - What is the competitive structure of the industry receiving the technology (one company in the market, a few companies in the market, numerous

	competing companies)? - Other market characteristics include size, growth rate number of competitors, existence of captive customers, entry barriers, ability to achieve economies of scale, regulatory environment, and a specific desire of management to create a market segment (example being management orders a concentration only on electronic companies under 5000 employees).
2.3. Geographic Segmentation	States, regions, counties, cities, etc.
2.4. Demographic Segmentation	Number of companies, age of company(ies), type of company(ies), size of company(ies), available financial resources, available material resources, competency of individuals (and organization), company life cycle phase (start-up, on-going, declining).
2.5. Benefit Segmentation	Satisfaction of the receiving organization's wants and needs.
2.6. Psychological Segmentation	How people think is based on where the live, who they work for. This influences their decisions. - State of mind. - Willingness to take risks. - Rationale for being involved in technology transfer (willing participant or forced). - Assessment of company being a people caring or profit caring company.
2.7. Behavior Segmentation	Number of transfers participated in, success of transfers, loyalty to transfer organizations.
2.8. Cost Benefit Analysis Segmentation	How much to penetrate the market and stay in the market? How much to exit the market (sunk costs of R&D or technology transfer effort).
2.9. Usage segmentation	- Number of transfers, type of transfers, loyalty to a particular set of organizations.

Step 3. Environmental Assessment. This assessment reviews the influences of the external and internal market surroundings on the defined market, the technology, the organizational assessment, and the receiving organization assessment.

Activity	Transferring Organization
3.1. Competition	- There are numerous sources for industry to gain the technology required to satisfy their market customers. Understanding the competition allows an organization to position itself accordingly. - Competition is influenced by the technology, and the ability to market that technology. - Internal R&D; other military organizations may be providing the same technology to the same market segment. - External R&D; the industry and each company have R&D efforts which will compete for the same technology transfer market segment. - Brand loyalty; i.e. is the organization's reputation for successful transfers enough to keep industry coming back to the organization? Note: Competition can be done by a comparison of activities such as; technology features, organizational services, organizational warranty of technology, uniqueness of the technology, technology's utility, technology's reliability and durability, patent protection, cost, location of transferring and receiving organizations, transferring organization advertising (promotion and selling) of technology, organizational and individual reputation, and the flexibility to meet the receiving organization's needs. Other competition factors include state of the technology (or product), design factors, price, customer preference for one organization or another.
3.2. Social and Cultural	- Is the receiving market segment structured to handle technology transfer programs (organizational hierarchy and quality workforce issue)? - Will the market segment be able to utilize the transitioned technology (this is an issue of education, occupation, income, social classes of people involved in the transfer)?
3.3. Technology	- Is the technology leading edge, state-of-the-art, or state-of-the-practice? How will this influence the ability to market and transfer the technology? - Define the proprietary rights of the transferring technology and the products resulting from this technology.
3.4. Economic	- Are there economic pressures such as a rescission or downsizing which will influence the ability to market and subsequently transition the technology? - Is the long-term future of the industry stable enough to develop the technology into a marketable product, or service (estimated to take up to 7 years)?
3.5. Legal	The laws governing the transfer of technology. These laws are provided as an attachment to the worksheet.
3.6. Political	- The political sensitivity surrounding technology transfer must be assessed and accounted for prior to the execution of the technology transfer plan. - Congressional Districts may influence the ability to transfer technology. - Potential for foreign companies to gain critical US Technology needs to be accounted for.
3.7. Environmental Impact	- Has the organization considered the impact to the environment which will result from the technology being articulated into a product, or service? - Are there environmental laws which must be concerned with?

Step 4. Receiving Organization (Consumer) Assessment. The market boundary and the environmental assessment define the basic arena in which the transferring organization will operate to transfer technology. The assessment of the receiving organization will characterize the specifics of the organization being targeted for the transfer efforts and will allow a proper writing of the contract which will specify the appropriate financial and political considerations for both the transfer and receiving organizations.

Understanding the frame of reference of the customer will help the transferring organization to market successfully by capitalizing on the knowledge of their strengths and weaknesses. Further, determining the characteristics of the customer in terms of needs, wants, perceptions, preferences, and behavior will ensure the technology transfer effort occurs because the market wants it, not because the transferring organization forces it. The greatest benefit of understanding the customer will ensure that frustration does not occur on both sides of the technology transfer partnership. If a technology goes to a firm that can not turn it into a usable product, the receiving organization loses money and the transferring organization wastes effort in unsuccessful ventures. This will cause the loss of motivation to participate in future technology transfer ventures.

Terms to be understood:

The **need** for the technology, product, or service. Examples include the need for food, clothing, belonging and security. If a technology is critical to the success of the receiving organization, this technology transfer process will most likely be a success for both parties. The receiving organization survives and the transferring organization receives a willing partner.

The **want** for the technology, product, or service. This is in terms of transferring organization's reputation, cost, availability, ease of turning technology into a usable product, or service. The receiving organization "wants" the technology because it will make them more competitive or open new markets. Since technology "wants" are not crucial to company survival, there is a chance the receiving organization may walk away from the technology transfer partnership after significant investment of Government resources.

The consumer can be viewed as either the company/industry receiving the technology or the end user of the product, or service which incorporates the technology. In the latter case a market-pull environment exists and the laboratory can specifically target technology transfer products which should have a guaranteed success. In terms of a technology transfer effort, it is assumed the consumer is the organization receiving the technology.

Activity	Receiving Organization Assessment
4.1. Target Market	- Technology receiving organization. - Customer, end-user of manufactured product, or service. - Market demand (as forecasted).
4.2. Who is the customer?	- The industry being targeted for technology transfer. - The specific company involved in the transfer of technology. - The manufactured product, or service end-user.
4.3. Customer characteristics	- What industry or company characteristics are important to marketing this technology? Note: if the customer is the industry then the market segmentation done earlier covers this entire area. - What end-user characteristics are important to marketing this technology?
4.4. Customer Enticement	- Why does that receiving organization want the technology? - What will make that customer come to the transferring organization?
4.5. Customer core competency	- Does it matter if the company is an innovator of technology (technology use) or a follower of technology? Are they; -- First in. -- Follow-the -leader. -- Last-in. Note: if a company does not have the core competency to develop the technology and market the end product, their participation should be denied. This is similar to as done in government source selection where companies responding to sources sought synopsis in the Commerce Business Daily. Companies incapable of competing are excluded from participation to minimize the financial, time, and motivational impacts which would result if an unsuccessful transfer resulted (Cull, personal interview; 8 Feb 96).
4.6. Customer selection criteria	Will the transferring organization choose the customer based on the expected number of technology transfers, or on their willingness to engaging one (or more) transfers?
4.7. Customer relationship	Will the customer feel comfortable working with the organization.
4.8. Consumer evaluation of product, or service concept	Does the transferring organization expect to test market the technology?
4.9. Develop Product, or service Concept.	Is the transferring technology ready for development by the receiving organization? If not, is the receiving organization going to have the ability to develop the technology into a useful state?
4.10. Manufacturing Facilitates	The ability to turn a technological idea, or transferred technology, into a real product, or service.
4.11. Customer assessment of the transferring organization's capability	Is the transferring organization competent, trustworthy?

Working through the above has one purpose, to identify the technology consumer needs. "Satisfaction of customer need is the ultimate test of a business unit's success. Thus, an effective marketing strategy should aim at serving customer needs and wants better than competitors do" (Jain, 1985: 205). Otherwise the technology transfer might end up an

like an Edsel. The Ford Edsel is an example of the automotive industry giving the customer what they thought the customer wanted, instead of giving the customer what he wanted. Hindsight states that no identification of the customer's wants and a forecasting of those wants into market potential doomed the car (Chambers et al, 1974: 5).

An example of why this assessment is needed: assume the market boundary is shipbuilding (i.e. transferring technology to the shipbuilding industry). The market segment is the East and West coast shipyards. The basic tenants of shipbuilding may be the same; however, the cultural differences between the coasts (and within the coasts) is significant and must be dealt with during the technology transfer.

Another example relates to the emerging technology which allows automated battlefield scouts and automated household goods. A preprogrammed vacuum cleaner and a pre-programmed lawnmower are targeting stereotypical customers of females and males, respectively.

Step 5. Company (Transferring Organization) Assessment (Situation Assessment).

This activity will work on developing the position for the target market and ensuring the receiving organization is capable of taking the technology and turning it into a successful product, or service. It is important to define the tactics of how the transferring organization execute the technology transfer program. There are three major aspects of this assessment, a resource assessment, a tactical assessment, and a go, no-go decision assessment.

5.1 Resource Assessment:

Activity	Transferring Organization
5.1.1.Financial	- Does the organization have the resources to support the technology transfer process? - Does the company have the resources to utilize the technology as envisioned?
5.1.2.Demographics	Listing of the organizational characteristics which will influence technology transfer programs. - Office location. - Assigned personnel. - Personal capabilities (manager, engineer, accountant, inventor, etc...).
5.1.3.Sales Force	- Does the sales force cover the market segment adequately based on the technology transfer objectives? - Personal confrontation to find new customers. - Cultivation of existing customers. - Information gathering to assess impacts of the efforts in industry and possible to assess new target markets and organizations.
5.1.4.Managerial Know-how	- Technical competence. - Marketing experience. - Plans to motivate the marketing sales force. - Plans to motivate the technology transfer team. - Technology transfer champions.
5.1.5.Existing Technology	- Is the technology an existing technology ready for transfer? - Does the company need the technology, or can they use existing technology to accomplish their objective (save their re-investment).
5.1.6.Ability to Service Product	- Will the transferring organization continue to develop and transition related technologies to the same receiving organization? - Will the transferring organization help in the receiving organization's development of the end product, or service?
5.1.7.Availability of Raw Materials	- If the technology is exotic (as with some DoD only technologies) will the receiving organization have access to the required resources? - If the technology employs a strategic resource which must be imported, will the receiving organization have access to the required resources? - Including times of increased threat to national interests?

5.2 Tactical Assessment (also called Marketing Capabilities and Marketing Mix):

5.2.1.Pricing	- Is the cost of doing business with the transferring organization worth the receiving organization's investment? - Is this cost competitive with others whom may offer similar technologies?
5.2.2.Promotion	- Advertising (communication through paid media). - Promotion (short term stimulus of the target market, example includes incentives). - Personal Selling (sales force actions such as confrontation and cultivation) or person to person contacts.
5.2.3.Product, or service	- Type of technology being transferred; product improvement, product development, process enhancing, new product? - Features of the technology, product, or service which the customer wants. - Ease in which the technology can be implemented into a product, or service.
5.2.4.Distribution System (sometimes called place)	- Does the distribution system allow for the growth commensurate with the marketing plan? - Are the contract strategies adequate (effective) based on the ability of the organization and the receiving firm's management structure and business operating procedures? -- Technology Assistance. -- Licensing of a patent. -- Cooperative Research and Development Agreements. -- Education Partnerships. -- Cooperative Agreements. -- Grants. -- Consortia and Regional Alliances. - Do the above contract strategies fit the market segment? - Ensure quality of the customer service. - Possible use of outside agencies to accomplish the technology transfer program. - Possible use of intermediaries between the organization and the receiving organization. - Other possible distribution systems for the technology to be transferred or contacts to be made: -- Journal. trade, or general media articles. -- Trade shows. -- Conferences. -- Laboratory open houses. -- Mailings. -- Workshops. -- Employee exchanges.
5.2.5.Public Relations	- Establishing a corporate image with the target market. - Technology transfer reputation. - Past history (# transfers, success rate, return on investment, share of technology transfer market, organizational expenditures on technology transfer). - Potential use of the Small Business Administration or the Commerce Departments (Federal, State, Local) utilizes their experience in dealing with the smaller companies likely to engage in transfer activities and can ensure wins are advertised.

Step 6. Demand Analysis and Sales Forecast. Measure and evaluate the demand of industry for the technology, and the ability to transition the technology to them.

Market forecasting. Estimate the future size of the available market size, possible growth rate, and the return on investment (royalties, technology spin-on). The ability to accomplish a market forecast will be based on how well the transferring organization defined the market boundary and the market characteristics. The return on investment can be qualitative (increase the industrial base) or quantitative (royalties, technology spin-on). Some techniques of market forecasting are provided below; details on how to utilize the techniques can be researched by reviewing the literature provided as reference material to this worksheet.

Type of Forecast	Types of Models
Qualitative or Judgmental	- Delphi (seeking consensus by a group of experts evaluated independently). - Panel Consensus (seeking consensus by a group of experts in an open forum). - Market research (testing product hypothesis). - Visionary Forecast (subjective guesswork). - Historical Data Analogy (extrapolated to the future). - Surveys of existing technology transfer organizations and receiving organizations. - Scenarios building. - Simulations.
Time-series and Projection	Analysis of trends, cyclic activity, seasonality, and randomness; - Moving average. - Exponential smoothing (weighting moving average). - Box Jenkins. - Trend Projection. - Learning Curve. - Winter's Method.
Causal Models	- Regression. - Econometric. - Intention To Buy Surveys. - Input-Output Analysis.

Forecasting is a science onto itself and resources such as those listed in the reference material will help choose the exact model to fit the needs and will teach the user how to apply them. For example, Kress and Snyder will help the transferring organization through this by assessing the length of the forecast period, the degree of accuracy sought, the pattern of past data, the cost of doing the forecast, the type of available data, the amount of available data, and the ease of use of the model(s). Forecasting is applicable to most phases of the marketing research such as market segmentation, market share, and consumer behavior. Another excellent source book is Davis' "Practical Sales Forecasting."

Market share can be gained by adding new technology, diversification into related technologies, modification of existing technologies, improving distribution, and improving organizational reputation to the end of altering patterns of existing receiving organizations, attracting non-participating organizations, or attracting organizations that receive their technology from other sources.

Step 7. Market Plan Development. Once the items are assessed by the team, the next step is to write the final document. The recommended layout to gather the collection of thoughts into a marketing plan is:

- Title Page
- Executive Summary
- Table of Contents
- Introduction
- Definition of Objectives
- Market Segmentation Definition and Analysis
- Market Segment Choice and Description
- Constraints and Environmental Factors
- Resource Needs (Company Assessment)
- Tactical Tools; Price Product, Place (Distribution), and Promotion
- Implementation and Control of the Marketing Plan
- Summary (including consideration to transfer the marketing plan with the technology; allows for the spread of success stories and eliminates reinventing the wheel when the technology is implemented into a product for the end-user)
- Appendix- Financial Analysis
- References

Step 8. Transferring and Receiving Organizations' Assessment of Eventual Consumer Market. The receiving organization must then turn the technology into a product, or service for a customer. Assessing the receiver of the technology will support the successful transfer of the technology.

Activity	Receiving Organization
8.1. Target Market	Customer , end-user of manufactured product, or service.
8.2. Who is the customer?	The manufactured product, or service end-user.
8.3. Customer characteristics	What customer characteristics are important to marketing this technology?
8.4. Customer Enticement	What will make that customer come to the transferring organization?
8.5. Customer core competency	Does it matter if the company is an innovator of technology (technology use) or a follower of technology?
8.6. Customer selection criteria	Will the transferring organization choose the customer based on the expected number of technology transfers, or on their willingness to engaging one (or more) transfers?
8.7. Customer relationship	Will the customer feel comfortable working with the organization?
8.8. Consumer evaluation of product, or service concept	Does the company plan to test market the end-product, or service?
8.9. Competition	- There are numerous sources for industry to gain the technology required to satisfy their market customers. Understanding the competition allows the organization to position itself accordingly. - Competition is influenced by the technology, and the ability to market that technology. - Internal R&D; other military organizations may be providing the same technology to the same market segment. - External R&D; the industry and each company have R&D efforts which will compete for the same technology transfer market segment. - Brand loyalty; i.e. is the reputation for successful transfers enough to keep industry coming back to the organization?
8.10. Develop Product, or service Concept	If not, is the receiving organization going to have the ability to develop the technology into a useful state?
8.11. Existing Technology	Does the company need the technology, or can they use existing technology to accomplish their objective (save their re-investment).
8.12. Ability to Service Product	Long-term relationship with the consumer. This is assumed and is not part of the technology transfer effort.
8.13. Availability of Raw Materials	Have the transferring organization evaluated the need for raw materials to transform the technology into a usable product? If the raw materials are exotic or of strategic importance, will they be available for the use in producing a product in the mass quantities required over the production scheduled envisioned?
8.14. Manufacturing Facilitates	The ability to turn a technological idea, or transferred technology, into a real product.

Attachment 2

Technology Transfer Marketing Plan Development Worksheet

Useful Definitions and Phrases

Technology Transfer Definitions.

Technology transfer is a process defined by Lundquist as “the science of initiating, designing, and implementing cooperative, win-win value added exchanges between sources and adopters of technologies” (Lundquist, 30 May 1994: 4). In plain terms, Lundquist considers the process of technology transfer to be one of a facilitation between organizations (Lundquist and Wowczuk, 26 February 1994: 1).

Types of technology transfer--horizontal or vertical. Horizontal transfer is usually for “secondary applications, wherein technology which originates in one sector is used in another sector” (Doctors, 1969: 6). Vertical transfer concerns “a new product, device, or process (is generated) within a given scientific or technical discipline, and generally within an organizational entity such as a single corporation or government agency” (Doctors, 1969: 6). For the purposes of this research effort, the definition of horizontal and vertical transfer is provided for general reference only. The difference between the two is considered to be a moot point because, in the development of a marketing plan it is necessary to segment the market based on customer needs. In addition, the customers location, and the state of the transferring technology are what define the technology transfer as either a horizontal or vertical application.

Occurrence of technology transfer. Technology transfer is a result of either a market pull, or a technology push. In a market pull, the industry initiates the action and is looking for something with high commercial success. In a technology push environment the technology itself drives a dramatic breakthrough in the commercial market (Carr, 1992: 12).

Technology spin-off occurs when an organization can take technology it was given and turn it into a product for its own use. **Technology spin-on** is when the receiving organization takes the transferred technology and turns it into a product useable by the donating organization.

Dual-use technology is that which can be used by both the industrial and civilian sectors.

The rationale for partnering with industry to develop dual-use is to lower R&D costs by sharing a common research and manufacturing base (Defense Science and Technology Strategy, September 1994: 14). The market planning effort will define the military and commercial need to have a technology as single-use (commercial or military) or dual-use.

Comparison of terminology is that of technology transfer, technology transfusion, and technology transition. **Technology transfer** is either a vertical or horizontal activity which occurs from the military partnering with a non-military organization; it can be a transfusion or transition. **Technology transfusion** is a horizontal movement of technology for direct use into another application and occurs in the DoD between military organizations. **Technology transition** is a vertical movement of a research technology into an application between military organizations. (Maj Franza, 29 Nov 95: personal interview. Modified by Steve Guilfoos, Linda Dameron, 10 Jan 96: personal interview). The market planning effort, in particular market segmentation, will determine if the effort is a transfer, transfusion, or transition.

The **Transferring Organization** is the government organization marketing the technology to industry.

The Receiving Organization is the targeted organization to receive the technology.

Marketing Definitions.

Marketing is "a total system of interacting business activities designed to plan, price, promote, and distribute want-satisfying products or services to organizational and household users in a competitive environment at a profit" (Paley, 1991: 4).

Strategic Planning is the managerial process of developing and maintaining a strategic fit between the organization and its changing market opportunities" (Paley, 1991: 4).

Market Strategic Planing is an assessment of the firm's offerings to the market's wants and needs as identified by market research.

Marketing research "is the systematic and objective search for and analysis of information relevant to the identification and solution of any problem in the field of marketing" (Green, et al, 1988: 2).

Market penetration-- takeover of market share.

Attachment 3.

Technology Transfer Marketing Plan Development Worksheet

Summary of Technology Transfer Legislation, Executive Orders, and Air Force Directives (As Referenced in the AFMC Technology Transfer Handbook)			
Yr	Public Law (P.L.)	Name	Major Elements (Purpose)
1966	P.L. 89-554	Freedom of Information Act (FOIA)	• Provided a vehicle to inform the public about Federal Government activities • Provided the right to request agency records and have them made available promptly
1980	P.L. 96-480	Stevenson-Wydler Technology Innovation Act	• Established technology transfer as a mission of the Federal Government • Established ORTAs
1980	P.L. 96-517	Bayh-Dole Act	• Superseded all previous laws that give small businesses and nonprofit organizations (including universities) certain rights related to inventions they developed under funding agreements with the Government (Did not give maintenance and operation (M&O) contractors right to elect title to its inventions.) • Protected descriptions of inventions from public dissemination and FOIA for reasonable period of time to file patent applications
1984	P.L. 98-620	Trademark Clarification Act	• Amended Bayh-Dole to permit M&O contractors to elect title to inventions in exceptional circumstances and national security funded technologies
1986	P.L. 99-502	Federal Technology Transfer Act (FTTA)	• Authorized CRDAs for Government-owned Government-operated (GOGOs) organizations • Established FLC • Provided a preference to U.S.-based business • Established technology transfer as a laboratory mission
1987	N/A	Executive Order 12591, Facilitating Access to Science and Technology	• Emphasized U.S. commitment to technology transfer • Required Government agencies to delegate authority to Government-operated laboratories to enter into cooperative agreements to the extent they are legally capable and provided authority to improve the global trade position of the United States

1988	P.L. 100-418	Omnibus Trade and Competitiveness Act	• Mandated the establishment of regional university-based Manufacturing Technology Centers for transferring advanced manufacturing techniques to small- and medium-sized firms
1988	DoD 3200.12-R-4	Domestic Technology Transfer Program Regulation	• DoD Response to P.L. 99-502 • Stipulates responsibilities for heads of DoD Components • Authorizes use of CRDAs • Stipulates use of awards and royalties
1989	P.L. 101-189	National Competitiveness Technology Transfer Act (NCTTA)	• Authorized CRDAs for Government-owned Contractor-operated (GOCO) organizations • Protects trade secret information brought into or developed under a CRDA from disclosure under FOIA
1990	Air Force Policy Directive (AFPD) 61-3	Air Force Domestic Technology Transfer Policy Directive	• Established Air Force policy for technology transfer • Provides procedures for CRDAs • Defines responsibilities of ORTAs
1991	P.L. 101-510	Defense Authorization Act	• Authorized federal laboratories and Federally Funded Research and Development Centers (FFRDCs) to award contracts to a partnership intermediary for services that increase the likelihood of laboratory success in joint activities with small business firms.
1991	P.L. 102-245	American Technology Preeminence Act	• Extended FLC mandate through 1996 • Allowed exchange of intellectual property between participants in a CRDA • Required a report on the advisability of CRDAs that would permit federal contribution of funds, • Allowed laboratory directors to give excess equipment to educational institutions or nonprofit organizations as a gift
1992	P.L. 102-564	Small Business Technology Transfer (SBTT) Act	• Established the Technology transfer program

Attachment 4

Technology Transfer Marketing Plan Development Worksheet

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Appendix C

Case Study Validation--Armstrong Laboratory Crew Systems Directorate

Technology Transfer Marketing Plan Development Worksheet

Step 1. Developing Organization (or Technology) Guidelines.

1.1 Technology Transfer Program Mission (or Problem Statement): The Crew Systems Directorate of Armstrong Laboratory conducts research, development, and field support to integrate human operators with weapon systems and to optimize human combat performance, protection and survivability. The Technology Transfer efforts under this Directorate are aimed at establishing relationships with the private sector that will enhance the Air Force mission of the Directorate by leveraging resources to reduce research costs, reduce research schedules, improve research facilities, or augment technical expertise. This would be accomplished by strategic planning to determine which Directorate programs would gain the interest from private sector to enter into collaborative research programs for mutual benefits.

1.2 Technology Transfer Program Objectives: The primary objective of a Technology Transfer program would be to strengthen the Air Force mission and the Directorate's ability to address those mission objectives. This would be accomplished through an influx of funds from direct reimbursements and royalties to offset budget cuts, exchange of personnel to offset personnel cuts and to help to maintain a technical competency, facility improvements to maintain a state-of-the-art capability in the face of budget cuts, and exchange of technical products to enhance existing technologies. The Directorate's Technology Transfer objective is viewed at a local level as a means of its own existence, both positive and negative.

A secondary objective would be to establish a favorable and productive relationship with the private sector that would be highly sought after in future collaborations and found to be critical to economic competition. These relationships would hopefully be elevated or lobbied to congressional leaders by the private sector partners and improve the Laboratory's position in future Base Realignment and Closure exercises.

Step 2. Defining The Market (Market Segmentation). The current understanding of markets and associated characteristics are at a macro level because of the degree of knowledge about the various potential markets. Many of the technologies found in the Directorate are viewed to have several potential markets, but each market may want a slightly different aspect of a given technology which may require repackaging of the technology as it exists for an Air Force application. The Directorate develops design tools

and prototype crew stations and equipment to provide a competitive advantage to military combat crews. It manages laboratory programs in anthropometry, sustained acceleration, workload analysis, helmet mounted systems, bioacoustics and biocommunications, biodynamic modeling, escape systems, life support, chemical defense, aeromedical evacuation equipment evaluation, high altitude exposure, sustained operations, spatial orientation and crew vulnerability reduction. It provides field support to solve related problems encountered in operational systems.

2.1 Define Market Boundary (s) - Two markets have repeatedly shown interest in the Directorate's technologies: automotive/transportation and medical. Others include entertainment, manufacturing, communication, education. For this exercise only the first two will be addressed.

Automotive/Transportation - Much of the Directorate's capabilities would be directed toward the internal design considerations to make the automobile (and other transportation systems) more comfortable, safe, economic and accommodating to a wide range of consumers. Other aspects of the automotive market that would take advantage of technologies would be the manufacturing facilities and dealership maintenance. In both market areas technologies would address safety of personnel, cost considerations and training/simulation.

Historically the automotive industry has been very difficult to develop relationships. Much of this is due to the complexity of the big three manufactures and their desire to protect their intellectual property, their liabilities to the consumer, and government regulations. The big three also seem to not deal in high risk technologies. If the technology is fully developed and a define cost savings to the company can be demonstrated, then the interest level is at a high. Acceptance of technologies by other organizations is a critical factor, such as acceptance by the Society of Automotive Engineers, SAE. The use of high fidelity mannequins in safety tests by the Air Force is paramount, but the automotive industry still uses very simplistic mannequins approved by SAE in spite of increased safety considerations and a desire to know more about the passenger and automobile interaction.

Medical - One area of medicine that has expressed interest in Directorate technologies has been in rehabilitation of the physically and mentally challenged. Specific areas of interest are in models to validate therapeutic practices, create prosthetic devices, design ergonomically correct work and living spaces; technologies to enhance the hearing and visually impaired that would normally be used by pilots to become more aware of the combat situation; cognitive learning tools to assist in learning challenges; and technologies that would integrate human senses with various assistive devices (both hardware and software) that would improve an individual's quality of life through independence.

Although there is an overwhelming desire to improve the quality of life for the physically and mentally challenged and the American Disabilities Act mandates more access to the challenged, technology improvements have been slow to be enacted. The rehabilitation market is relatively small compare to other markets and in the majority of cases, the

income level of physically and mentally challenged is too low to afford the more advanced technologies. The secret to success of entering into this market is to identify a parallel market that can use the same technologies and end products with little to no modifications.

Another area medical area would be in diagnosis. As medicine enters the twenty first century, practitioners are focusing more on quantitative measures and less on subjective measures. This is in-part driven by the insurance industry. Many models and assessment tools that the Directorate has developed to measure human performance show promise in more accurately performing diagnoses of medical conditions or identify treatment protocols.

The biggest hurdle for this market segment is the medical practitioners. Many are not trained or made aware of what new technologies can do for them. Many suffer from technophobia and are uncomfortable with using a personal computer in their practice. The insurance industry is also seen as a major barrier to introducing new technologies.

2.2 Determine Market Characteristics.

Automotive/Transportation

Manufacturing - Dayton and Southwest Ohio has long been a major region that supports the automotive industry, and in particular General Motors. General Motors has several vehicle assembly plants, parts manufacturing plants and engineering facilities in the Southwest Ohio. These facilities are updated and expanded on a regular basis to accommodate new vehicle designs, manufacturing improvements, increased production capabilities, etc. In almost every case, the changes will impact a human. These changes require rapid improvements and economic impacts. Many of these changes will filter down to thousands of businesses that support the larger General Motors operations. These are often industries referred to as "garage shops". The changes that are enacted by General Motors are perhaps more important to the small support industry if the changes cause economic impacts that could mean life or death of the company.

The technologies that could result from the Crew Systems Directorate range from simulation, training, and safety to displays, robotics, and unique facilities. Much of these technologies are being developed for use in major weapon systems to assure cost effective mission responsive systems. In addition to being applied to high performance tactical aircraft, these technologies are often used in the logistical support organizations that maintain these weapon systems. There is an incredible similarity of operations between Air Force systems and the manufacturing process and that of the automotive industry. Both have major manufactures that need to change on a frequent basis to engineering changes, be economically competitive, and rely on an extensive support industry. Thus, the technologies that exist in the lab are quite adaptable to both business sectors which would ultimately make the technologies more economical and more readily available. Most importantly, the product to the consumer or tax payer is more economic.

Medical

Rehabilitation - There are over forty million disabled individuals in the United States with 141,471 in Southwest Ohio. Although this seems like a significant number that would require numerous industries to serve the needs, the opposite is the case. There are perhaps no more than six major wheelchair manufactures in the United States with Invacare being the largest and located near Cleveland Ohio. Many of these deal in specialty wheelchairs that are manufactured to an individual's specifications.

One major driver impacting the rehabilitation industry is that the disabled cannot be categorized into percentile rankings like healthy people. Very few disabled can be categorized much better than a gross description like quadriplegic or paraplegic. Another agonizing factor to the potential size of rehabilitation markets is the economic well being of the disabled population. The vast majority of disabled are low income due to their inability to compete with the more healthy population. Many of the disabled are restricted in products available by the insurance that they may individuals are able to purchase.

Another factor that seems to be characteristic of the rehabilitation industry is that companies are regionally located and thus are usually small businesses. Many times these businesses are family businesses that have served a region for years and are often limited access to new technologies. Technology improvements often come from other resources outside of the region that the business serves. In the case of Dayton area businesses, they are very fortunate to have access to technologies found at the federal laboratories at Wright-Patterson Air Force Base, Mound Laboratory, National Air and Space Agency--Lewis, Wright State University, University of Dayton, and Sinclair Community College.

2.3 Geographic Segmentation - The technologies for both automotive and medical have immediate access to the Southwest Ohio Region. Once the technologies and relationships are established between business and federal labs in this area, the business opportunities should naturally flow to the rest of the United States. The market potential of the automotive arena is better than medical due to the vast profusion of automobiles across the nation and even the world. The automotive market reaches even the lowest of economic populations.

2.4 Demographic Segmentation - *(This section is a problem to define since the laboratories are not used to collecting this type of data even in the Defense system. Information would probably have to be obtained from other local resources such as Chambers of Commerce, Department(s) of Development, and other related agencies. In most laboratory technology transfer situations, this exercise would be the burden of the industrial partner in attempting to identify venture capital or other business decisions. If the laboratories are going to actively identify technologies to transfer, then this section would be helpful to make management decisions relative to investment in personnel resources, marketing resources, and continued program development.)*

2.5 Benefit Segmentation.

The benefits that most industries seek from technologies in the laboratory are economic in nature. These benefits vary from more cost effective operations to cost effective products. The customer satisfaction is a major benefit that those businesses in the medical industry seek too.

Cost benefits come in many forms. One that is often overlooked from laboratory personnel is the responsiveness to the transfer partner. Time to market often is a major factor that impact businesses from small to large. For this reason, it is important that agreements be struck that are integrated with existing laboratory programs to assure that resources are leveraged for both parties and not distracted at the expense of both parties.

The benefits realized by the private sector can significantly impact the success of the federal partner in many ways. Companies that seek the support of the federal partner make be the major cause for a business to competitively exist. This can mean more than success to the company alone. Success may impact a community or even a state. This success may be supported at the congressional level through lobbying activities that may impact funding authorizations or even Base Realignment and Closure activities.

In the case of automotive support, the automotive industry has significant influence in congress. The benefits realized in a successful transfer of technology can be supported from the corporate level to the very influence of the rank and file of numerous unions that work for the automotive manufactures. This satisfaction can come in the form of jobs saved, dollars saved, increased production levels, improved safety and more. All these factors can be impacted from technologies that exist within the laboratory.

Of the remaining issues impacting the market definition, Psychological, Behavior, and Cost Benefit Analysis, the latter is perhaps the most important to an Air Force laboratory trying to establish a market definition to "push" technologies from the lab into the private or commercial sector. It is laboratory management's primary concern that shrinking resources are not diverted to technology transfer efforts without the proper return to the Air Force or laboratory mission. The primary reason for concern by management is the lack of infrastructure to conduct a satisfactory Cost Benefit Analysis. Outreach organizations that exist to help bridge the gap between the military and private sectors would have the personnel with expertise and contacts to conduct this type of analysis for the military organizations. It is this one effort that can make the difference to military management to dedicate resources of personnel, funds, and facilities for a technology transfer venture. Without this analysis, any attempt to "push" technology into the private sector is highly speculative.

Step 3. Environmental Assessment.

The whole concept of technology transfer within the military is still very new and considered by most a fad that will disappear with time and change in politics. Most of the laboratory personnel that may consider a technology transfer effort give little thought to competition from any other source. Their biggest competition comes from the normal day-to-day operations and struggle to maintain status quo of their Air Force projects.

For those that have attempted to transfer technology, the approach has been primarily to throw the technology out on the table and see who might be interested in taking advantage of the situation. Little, if any, consideration is given to competing intellectual property, competing military organizations, or competing industry. The general attitude is one of trying to get anyone interested and hopefully leveraging existing Air Force resources.

For those technologies that have been developed within the Crew Systems Directorate of Armstrong Laboratory that have potential application to rehabilitation, there has been no effort to approach industry in a formal fashion to evaluate the technology and see if any interest exists from industry. This is in complete contrast to the approach that would be taken for a major competitive research and development program. In this situation, there would be an "industry day" for potential contractors to review the Air Force proposed program, ask questions about the program and "schmooze" the government program management.

In contrast, rehabilitation potential technologies have been presented to local businesses or practitioners. In almost every case the local businesses are too small to invest in these technologies and usually are not in the business of marketing the technologies on a large scale. The practitioners are eager to see the technologies applied to their market segment, but are in no position to invest, develop or market the technologies. The practitioner is more than eager to take whatever they can get and use, but for the most part are sitting on the sidelines waiting for someone to make things happen. The practitioner is similar to the Air Force user such as Air Combat Command.

Of the remaining factors influencing the Environmental Assessment, technology, legal and political are the most important to someone trying to transfer military technology. The civilian scientists and engineers found in the Air Force laboratories are very unique. The vast majority serve their entire career with a single laboratory from the time they graduate from college until retirement. This lifelong career often is dedicated to the advancement of a technology with one purpose or application. This culture is one that consists of a close knit group of individuals that attend the same conferences, participate in similar development programs, and often serve on committees that review technologies. The result is that they have a very narrow view of their technology and its true state-of-the-art. Often when their technologies are presented to the private sector, the technology is viewed as too expensive, too basic, or too impractical. Another factor that this culture fails to recognize due in-part to management is the value of the intellectual property that they may possess. In all too many cases, the Air Force scientist or engineer has failed to

protect the intellectual property in favor of publishing or presenting the technology in open forums.

Over the years the laws governing technology transfer have been changed to give a greater incentive and flexibility to both the military and industry to enter into collaborative efforts. Even with these laws and specific Department of Defense and Air Force policy directing organizations to conduct transfer efforts, there is a great reluctance and in a few cases complete refusal to participate. The excuse is that the military mission is of primary importance and resources cannot be diverted that would jeopardize the military mission. The fact is, if conducted properly, technology transfer not only has the legal authority to conduct technology transfer, it also gives an organization to use this process to its advantage to conduct the military mission. In the majority of cases, management and the scientist and engineer population has not been adequately trained in the various aspects of technology transfer and learned how to integrate the process into the conventional R&D programs planning process.

Politics has and will continue to be a major influence into the technology transfer process. The normal research and development program advocacy process is plagued with politics influencing what programs are to be pursued. So often decisions are made on what programs are to be invested by what is the hottest topic in congress. If the decision is made that robotics is not a program to be conducted within a particular laboratory because it appears to be in conflict with its mission, then technologies that may have an application in commercial robotics would not be favored for transfer. Decisions have been made to not pursue the transfer of human sensory feedback technologies into telemedicine applications since the Air Force does not do research in medicine. The fact is that human sensory feedback can be applied to the improvement of fighter flight controls to improve handling of control sticks and increase performance during combat maneuvers, but an agreement with a company that is developing control systems to allow a surgeon to conduct surgery through telemedicine is not an accepted venture because this is a medical application and relates to the actual development of medical procedures.

The remaining factors in the environmental assessment would be considered to be issues that only concern the collaborative partner. Factors such as social and economic impact have been viewed to be the partner's concern. Some within the technology transfer community have not shared this view. The military is a partner in these ventures and brings certain liabilities to the table and should assist the commercial partner in addressing some of the environmental assessment factors. One such case recently was a technology that was developed by Armstrong Laboratory that has a definite application to pain therapy. The need for a cooperative research and development agreement was not necessary since the technology was fully developed and a license agreement was the transfer vehicle of choice. The commercial partner wanted to conduct clinical trials of the technology, but the Air Force legal opinion was that the Air Force would be liable and not the commercial partner. In this case, both parties should work together to address potential liability issues since the Air Force was the technology developer and the commercial partner would be the distributor.

Step 4. Receiving Organization Assessment.

This has never been done by either Armstrong Laboratory or Wright Laboratory. As for Armstrong Laboratory, there has never been an assessment of consumer's needs in technology by the laboratory. Technologies that have been identified to have some commercial potential are "pushed" by a blind market approach. That is to say, that announcements are made in trade magazines, the technology is advertised at trade shows and they are presented at other open forums.

Professors from Wright State University and The University of Dayton have evaluated several technologies for their commercial potential. As part of that evaluation, companies were approached with information about the technologies and they were solicited for their opinions. Companies have never been approached to see what were their technologies needs. This approach would be similar to the Technology Products Integrated Planning TPIPT, process where the Air Force user identifies deficiencies that require technologies to meet the mission. If the laboratories want to transfer their technologies to industry, then they need to solicit needs from industry. Perhaps one of the biggest errors in judgment on behalf of the government laboratories would be to assume that they know what industry needs and what technologies are suitable to solve those needs.

To accomplish this step, very little would be required to solicit industries needs. Put simply, conduct an open house to allow companies to come and present their needs to the laboratory scientist and engineers. The most difficult part of the whole process would be to respect proprietary information so that companies did not reveal their weaknesses to their competitors. The information could be compiled and compared to existing technologies and aligned with existing programs to pursue leveraging of resources to further develop the technologies for the benefit of both parties.

Step 5. Company Assessment.

This factor is often argued by some within the Air Force technology transfer circles to be one that should not be of concern to the Air Force. An argument is that it is not the Air Force's responsibility to be concerned with the chance of success that might result from the transfer of technology by the collaborating partner. It is argued that it is the Air Force's responsibility to make the transfer possible in the most efficient manner possible and to meet all the requirements set forth in the agreement work plan. Contrary to this belief are those who transfer technology that view the process to be as successful as possible to both parties and perhaps even more so to the Air Force since the technology and associated resources were developed at the tax payer's expense. The latter is this author's opinion and when potential agreements are entered, every possible effort must be made to enter into agreements with reputable firms and develop a sound agreement that will benefit both parties.

Many of the activities mentioned in this part of the markets assessment process would include conducting a due diligence assessment of the potential collaborative partner. A sample questionnaire has been developed within the Crew Systems Directorate and is used to help assess potential partners, especially those that require the assistance of manpower or facilities that may distract from the normal mission if the venture is not a success. Once the questionnaire has been completed, it is highly recommended that both parties meet to discuss issues of concern to both parties and resolved any questions or concerns. This may include the review of technical publications, drawings, hardware or software. It may be suggested that additional teaming agreements be developed to add expertise or capabilities that may not exist to increase the chance of success.

On the flip side of this factor is the ability of the government to produce in a timely and cost effective fashion to the collaborative partner. In many ways, the government can be viewed as the contractor now by providing a product or service to the collaborating partner to make a good or service possible on the open market. The private sector is often working on a very tight schedule to bring a product to market so as to be competitive. A company cannot afford to be late due to the many distractions that the government may encounter over the course of its programs. Budget cuts, program reviews, congressional inquiries are not satisfactory excuses to the bank that might be holding the loan on a new product development effort in industry.

The investment that the government needs to make in evaluating the receiving organization is not only costly, it also requires a level of expertise not often found under normal circumstances for government operations. The source selection process for a competitive acquisition only requires the government to assess the offerors for their technical competency to delivery the products identified in the statement of work. In the vast majority of cases, a contractor will be selected for the level of effort invested by the government to conduct this source selection. The bulk of the risk in source selection is on the competing offerors. In a technology transfer transaction, there is not the level of certainty that either party will be satisfied at the end of a due diligence assessment and eventual negotiations. This could lead to considerable investment of resources by both parties with no return except the assurance of no further commitment of resources in a questionable transaction.

Step 6. Demand Analysis and Sales Forecast.

This is another area that the technology transfer staff in a laboratory simply do not have the expertise. Outreach organizations would be best suited to conduct this step. A potential collaborating partner could present the best business plan and marketing plan to the laboratory, and the staff would not be able to conduct an adequate evaluation.

At this point in the history of technology transfer and the measurement of success, management is not much more sophisticated than simply counting the number of agreements. There is no measure of how far the technology reached a certain market or how many different markets it is being applied. It is not certain what factors are

considered when those that negotiate agreements to determine such things as royalties, percentages of gross sales, etc.

With regard to outreach organizations that attempt to bridge the gap between industry and the federal laboratory, many are staffed with personnel that were once federal employees themselves. They may have a good knowledge of the technology being transferred, but they know no more than those still federally employed about marketing, business, or venture capitalists. To date they have served no more than a match maker that doesn't know what make a good marriage.

Step 7. Market Plan Development.

This has never been done successfully by the staff of an Air Force laboratory technology transfer office. Several offices are in the process of paying contractors to develop a plan, but at a macro level. Once one is accomplished for specific technologies and successfully implemented, it should be expanded to market technologies for the Department of Defense market.

Step 8. Transfer and Receiving Organization's Assessment.

This is the final grade card that can mean the difference for federal laboratories in the future...satisfied customers. Federal laboratories can no longer continue to live off their Department of Defense reputation to produce technologies (state-of-the-art or cutting edge technologies) and stay in business. With shrinking budgets, fewer personnel, fewer weapon systems to integrate technology, the need of the federal laboratory is in serious jeopardy.

The counter to cut backs and potential closure of facilities and organizations is to create a base of satisfied industrial partners that have become economically more stable through technology transfer insertion. These successful partners will also allow military technology continue to be developed at a fraction of the resources, and more importantly will lobby their congressmen to keep the federal resources in tact.

One of the other secrets to a successful industrial partner is for the federal negotiators to not be too greedy. Some have seen the pot of gold at the end of the rainbow in technology transfer opportunities. It is much better to get part of the part instead of none of the pie. The federal laboratories must remember that industry has the potential of seeking technologies from a number of federal sources.

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Captain Hirlinger, a 1985 graduate civil engineering of Virginia Military Institute, began his Air Force career with an assignment to Air Force Systems Command's Ballistic Missile Office, Norton AFB, CA. Duties at Norton included nuclear hardness testing of missile silos and missile basing options, missile flight testing, and test facility construction management. Following six years at Norton, Capt Hirlinger was reassigned to the B-2 Systems Program Office located at Wright-Patterson AFB.

During his three and a half years with the B-2 Program, Capt Hirlinger was assigned positions as air vehicle team deputy, program scheduler, and team lead for the largest software effort in the Air Force (Block 20). In addition, he initiated studies as a part-time AFIT student. In March of 1995, Capt Hirlinger joined the F-16 Program Office special projects as the manager/engineer for suppression of enemy air defense. Capt Hirlinger, in the summer of 1996, will return to his alma mater as the 400 Level Associate Professor of Aerospace Studies.

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