

AD-A241 917



✓
②

NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

IMPROVING THE INDONESIAN AIR FORCE
TECHNICIAN SKILL THROUGH TECHNOLOGY
TRANSFER

by

Subandijo

March, 1991

Thesis Advisor:

Richard A. McGonigal

Approved for public release; distribution is unlimited

91-14272



91 10 28 030

Unclassified

security classification of this page

REPORT DOCUMENTATION PAGE

1a Report Security Classification Unclassified		1b Restrictive Markings	
2a Security Classification Authority		3 Distribution/Availability of Report	
2b Declassification/Downgrading Schedule		Approved for public release; distribution is unlimited.	
4 Performing Organization Report Number(s)		5 Monitoring Organization Report Number(s)	
6a Name of Performing Organization Naval Postgraduate School	6b Office Symbol (if applicable) 36	7a Name of Monitoring Organization Naval Postgraduate School	
6c Address (city, state, and ZIP code) Monterey, CA 93943-5000		7b Address (city, state, and ZIP code) Monterey, CA 93943-5000	
8a Name of Funding/Sponsoring Organization	8b Office Symbol (if applicable)	9 Procurement Instrument Identification Number	
8c Address (city, state, and ZIP code)		10 Source of Funding Numbers	
		Program Element No	Project No
		Task No	Work Unit Accession No
11 Title (include security classification) IMPROVING THE INDONESIAN AIR FORCE TECHNICIAN SKILL THROUGH TECHNOLOGY TRANSFER			
12 Personal Author(s) Subandijo			
13a Type of Report Master's Thesis	13b Time Covered From To	14 Date of Report (year, month, day) March 1991	15 Page Count 83
16 Supplementary Notation The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
17 Cosati Codes		18 Subject Terms (continue on reverse if necessary and identify by block number)	
Field	Group	Technology Transfer, Linker, Innovation, Technician, Adopter.	
19 Abstract (continue on reverse if necessary and identify by block number)			
The evolution in weapon system technology has led to the need of the innovative process. This thesis addresses the Technology Transfer as an improvement and development tool as it might be applied in development of skills for Indonesian Air Force technicians. Factors associated with the technology transfer process, aids and barriers to technology transfer, the innovative and creative processes, and managerial requirements for technology transfer are related to the job of the maintenance technician. From the relationship, a Paradigm is selected for the action for middle management and senior technicians as linkers and innovators to improve technical and skill capability by utilizing technology and the transfer concept.			
20 Distribution/Availability of Abstract		21 Abstract Security Classification	
☒ unclassified/unlimited ☐ same as report ☐ DTIC users		Unclassified	
22a Name of Responsible Individual Richard A. McGonigal		22b Telephone (include Area code) (408) 646-2755	22c Office Symbol AS/Mb

Approved for public release; distribution is unlimited.

Improving The Indonesian Air Force
Technician Skill Through Technology Transfer

by

Subandijo
Major, Indonesian Air Force
B.S., Indonesian Air Force Academy, 1974 Yogyakarta

Submitted in partial fulfillment of the
requirements for the degree of

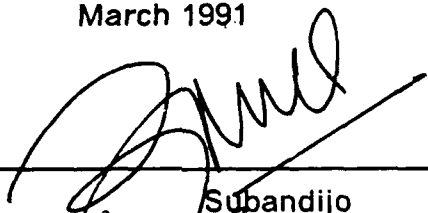
MASTER OF SCIENCE IN MANAGEMENT SCIENCE

from the

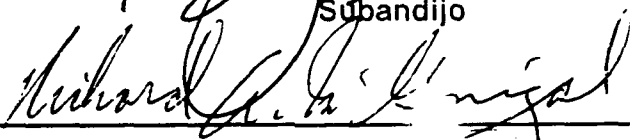
NAVAL POSTGRADUATE SCHOOL

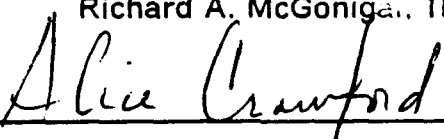
March 1991

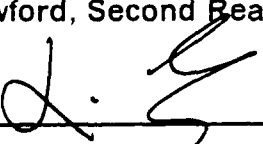
Author:


Subandijo

Approved by:


Richard A. McGonigal, Thesis Advisor


Alice Crawford, Second Reader


David R. Whipple, Chairman,
Department of Administration Science

ABSTRACT

The evolution in weapon system technology has led to the need of the innovative process. This thesis addresses the Technology Transfer as an improvement and development tool as it might be applied in development of skills for Indonesian Air Force technicians. Factors associated with the technology transfer process, aids and barriers to technology transfer, the innovative and creative processes, and managerial requirements for technology transfer are related to the job of the maintenance technician. From the relationship, a Paradigm is selected for the action for middle management and senior technicians as linkers and innovators to improve technical and skill capability by utilizing technology and the transfer concept.

ACKNOWLEDGEMENT

I would like to take this opportunity to acknowledge Professor Richard A. McGonigal and Professor Alice Crawford who have patiently advised me in finishing my thesis. Secondly I say thank you to all Academic Faculty and staff of the Naval Postgraduate School for giving the knowledge and administrative support throughout my study. I do not forget to say thank you to the Indonesian Government that gave me the opportunity to get a better education. Finally, I also say thank you to my wife Sestrini Hardiati, my son David Adhitya Wicaksono and my daughter Judith Selyna Arisepti who give me moral support, spirit and encouragement during my study.

TABLE OF CONTENTS

I. INTRODUCTION	1
A. BACKGROUND	1
B. PURPOSE	3
C. OUTLINE OF THESIS	4
II. THE TRAINING SYSTEM IN THE INDONESIAN AIR FORCE	5
A. OVERVIEW	5
1. Mission	6
2. Objective of the Training	7
3. Raw Input	7
4. Instrumental Input	7
5. Environmental Input	7
6. Skill requirements	7
7. Process	8
8. Output	8
9. Feedback	9
B. TYPE OF TRAINING	9
1. Formal Training	9
2. Non-formal Training	11
C. TRAINING INSTITUTION	11
1. Headquarters Level	12
2. Main Command Level	12
D. TRAINING DEVELOPMENT	12
1. Development Program	13
III. LITERATURE REVIEW	15
A. OVERVIEW	15
B. TECHNOLOGY TRANSFER PROCESS	16

C.	AIDS TO TECHNOLOGY TRANSFER AND INNOVATION	22
D.	THE BARRIERS TO TECHNOLOGY TRANSFER	31
E.	THE ROLE OF THE LINKER/INNOVATOR	36
F.	DIFFUSION OF INNOVATION	41
IV.	INNOVATION AND DEVELOPMENT PROGRAM	45
A.	OVERVIEW	45
B.	LINKER AND MEDIA SELECTION	46
1.	Linker Selection	46
2.	Media Selection	49
C.	REQUIREMENT DETERMINATION	50
1.	Organization Requirement	50
2.	Documentation Requirement	51
3.	Distribution Requirement	52
4.	Linker Requirement	52
5.	Project Selection Requirement	53
6.	Capacity Requirement	53
7.	Credibility Requirement	54
8.	Reward Requirement	54
9.	Willingness Requirement	54
D.	PROGRAM DEVELOPMENT	55
1.	Preliminary Program.	55
2.	Program Possibilities	55
3.	Program Initiation	56
4.	Program Execution	56
5.	Program Outcome Test and Evaluation	57
V.	CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH	58
A.	CONCLUSION	58
B.	RECOMMENDATION FOR FUTURE RESEARCH	59

APPENDIX A. PROFESSIONAL PREFERENCE CENSUS	60
APPENDIX B. COMMON TASK PERFORMED BY FIRST-ENLISTMENT	
A.P.G PERSONNEL(SAMPLE)	64
APPENDIX C. INITIATION DECISION REPORT (IDR)	66
A. PROGRAM DEFINITION	66
B. STATE OF THE ART ASSESSMENT	66
1. Level of interest	66
2. Direction	66
3. Rate of change	66
4. Alternative	66
C. TRAINING TECHNOLOGY GOALS	66
D. CAPABILITY GOALS	66
1. Systems Development	66
2. Component Development	66
APPENDIX D. SAMPLE OF TEST AND EVALUATION MASTER PLAN	
(TEMP)	67
A. MISSION (PLANNED USE)	67
B. SYSTEM (ITEM)	67
C. DEVELOPMENT GOALS	67
D. TEST SCHEDULES	67
1. Test Issues	67
2. Test data	67
E. RESOURCE SCHEDULE	67
LIST OF REFERENCES	68
INITIAL DISTRIBUTION LIST	71

LIST OF TABLES

Table 1. SELECTED CHARACTERISTIC OF ALTERNATIVE STRATEGIES FOR ADVANCING TECHNOLOGY	23
Table 2. PERCENTAGE OF DECISIVE EVENTS RATE	29

LIST OF FIGURES

Figure 1. Technology Transfer Process	2
Figure 2. Indonesian Air Force Training System.	10
Figure 3. The Innovation Process.	17
Figure 4. The expanded innovation process.	19
Figure 5. Technology Adopter Paradigm	21
Figure 6. Relationship Effectiveness, Human Tension & Technology Capacity	24
Figure 7. Linker-Stabilizer Categorization.	38
Figure 8. Adopter Categorization On The Basis Of Innovativeness. . . .	40
Figure 9. The Hypothesized Relationship of Innovators and Linkers. . .	41
Figure 10. Linker Position In The Flow of Knowledge.	47

I. INTRODUCTION

A. BACKGROUND

The Indonesian Air Force as a part of the Indonesian Defense Force has a responsibility to develop an internal force by utilizing all of its resources including manpower, money, machinery and methods as efficiently as possible. In its operations the Indonesian Air Force uses the sophisticated weapon system as its main aid in its operations. It requires certain strategic operating procedures (for long run operation periods) and standard operation procedures (for short run operation), and a technical maintenance planning and personnel development program (either short run or long term) for maintaining a high state of combat readiness. Maintenance technicians make up a small fraction of the Indonesian Air Force that might have the credibility for preparing the weapon systems operation. The Indonesian Air Force as the user of weapon system technology from other countries, (mostly from the United States and West European countries), *sometimes experiences a myriad problems* because the evolution of technology goes faster than the technology transfer information and skill development, which need improvement.

Technology transfer has been defined as a purposeful, conscious effort to move technical devices, materials, methods and information from the point of discovery or development to users (Gilmore, 1969). The process in its most broad sense consists of three major elements :

- The source of knowledge or idea (ie.,the invention or discovery)
- The linker or diffusion or dissemination of that knowledge (ie., transfer mechanism).
- The utilization of the knowledge (ie., the user function).

This general concept of the total process has been represented graphically by various authors. Although the names of the individual roles may vary from author to author, the functions of each role remain essentially the same. Figure 1 gives a representation of this model.

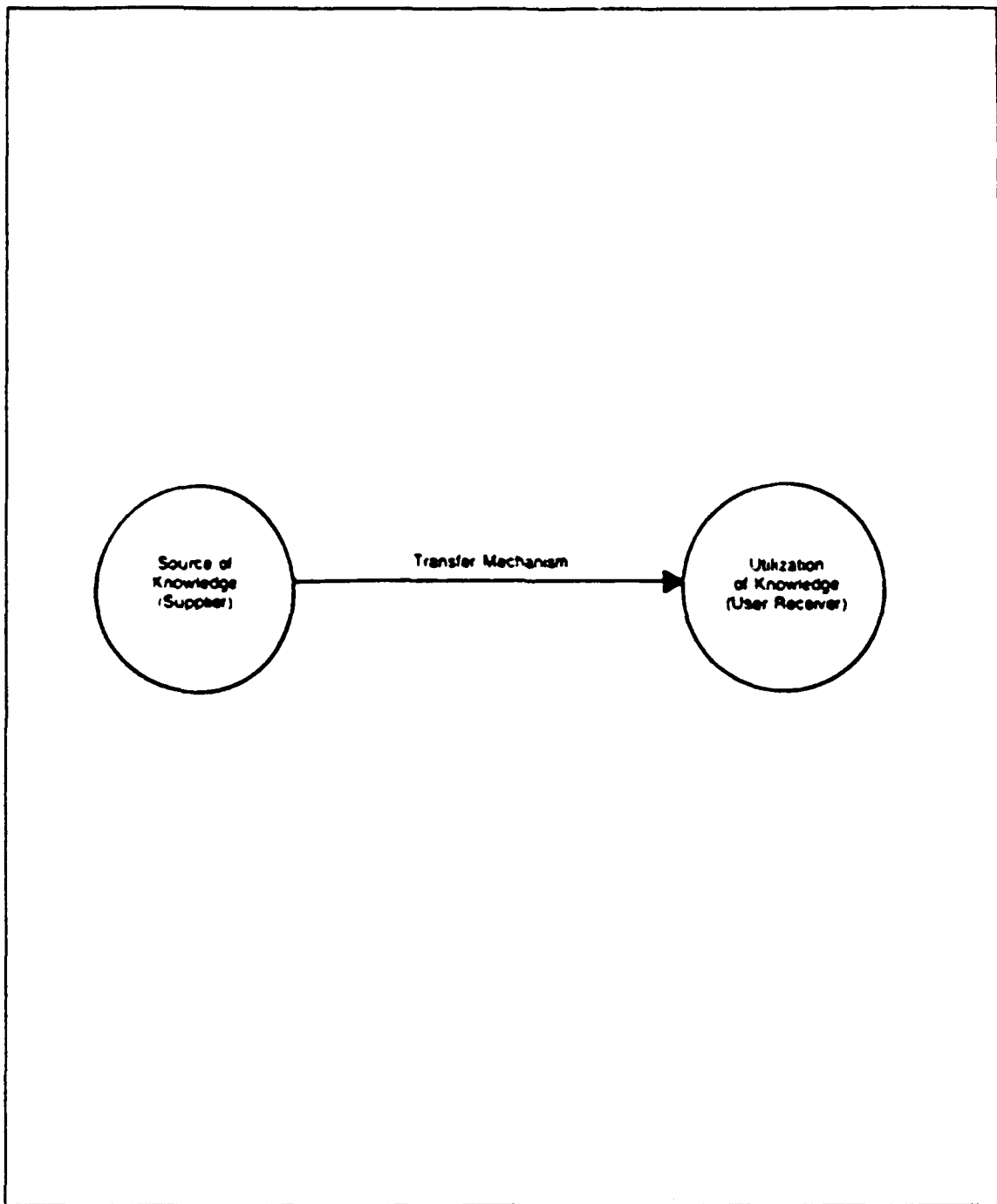


Figure 1. Technology Transfer Process

In this simplified scenario, the role of the "innovator" is that which corresponds to the "source of knowledge" and relates to the function of generating

new ideas, concepts, materials, etc. The role of the linker is that of transferring the product of the innovator, regardless of its form, to the potential user. The role of the "user", corresponds to utilization of knowledge. Quite naturally the goal is to apply the knowledge received. But while figure 1 adequately presents the broad concept of the technology transfer process, there are other essential roles that should be identified in order to insure a more accurate understanding of the process. The three such roles are those of the (1) the "gatekeeper", (2) the "opinion leader", and (3) the "innovator".

B. PURPOSE

The application of training technology within the Indonesian Air Force was started a few years ago when the acquisition of new weapons was conducted. Concerning this acquisition, new concepts in training technology also began to be adopted, but this new concept has not been well applied through all of the levels of organization as the user of the training technology. The marketing of the new concept is very important, but on the other hand the way to market must also to be considered. Technology transfer is one the concept that can be used to diffuse the marketing of the technological concept.

The purpose of this thesis is to discuss the various aspects of technology transfer and to identify the problems surrounding its application based on the opinions of authors and experts. The training system in the Indonesian Air Force is also a part of this discussion. Through the strength of technology transfer concept and the training system in the Indonesian Air Force, a new concept of application will be developed. This concept of application might be more feasible and have the capability to improve of the skill of the Indonesian Air Force maintenance technician.

C. OUTLINE OF THESIS

This thesis covers the training system in the Indonesian Air Force and the technology transfer concept as a tool for development and innovation.

The outline of this thesis is divided into five chapters: (1) the first chapter is comprised of the background and purpose of the thesis; (2) the second chapter discusses the Indonesian Air Force training system; (3) the third chapter discusses technology transfer by various authors; (4) the fourth chapter discusses the possible innovation and development as well as its application in improving the skill of the Indonesian Air Force technician skill, and (5) the last chapter includes the conclusion and recommendations.

II. THE TRAINING SYSTEM IN THE INDONESIAN AIR FORCE

A. OVERVIEW

The Indonesian Armed Forces operate one of the largest and most comprehensive training systems in Indonesia. Although some of the skills needed by military personnel can be provided from public or private schools, in special cases skills are unique to the military and public education cannot meet the need.

The continuing demand for technical, clerical and administrative and other common skills requires that the military services conduct their own training and skills development program. There are several other factors, however, that complicate the process of manning the military services with competent, highly skilled and well trained personnel such as :

- The general nature of the military mission requires that military personnel should be able to perform a variety of tasks in addition to their primary occupational specialities.
- The weapon systems used by all branches of the military have become more sensitive and sophisticated.
- The evolution of technology goes faster, while the technology transfer process sometimes lags behind.

These challenges resulted in a move to improve personnel skills by creating a new concept called the "Integrated Logistic System." It consists of command, logistic, system software and training and skill development systems that evolved as result of the technology development. These systems require high order skills for their management, operation, maintenance and repair. The consequence has been an increase in the number, duration, system and concept of training and skill development programs. The programs have evolved into comprehensive military training and skill development programs.

The Indonesian Air Force as a defense and security force is responsible for securing and defending airspace and is therefore concerned with the

aerospace and aviation matters that can be influenced by science and technology. The impact of technology on the Indonesian Air Force can be seen in the large acquisition of new weapon systems which began in the early 1980s. The management and operational readiness of these new weapon systems requires a maintenance technician who has skills and a training background quite different from the available personnel. These skills can be acquired by means of improving the skill development system. In fact, a new concept of training technology was introduced by the end of 1970s to overcome the need for skill development and training improvement. The application of training technology within the Indonesian Air Force started in 1970s when the acquisition of the new weapon system was conducted. The characteristics of the Indonesian training system are described below:

1. Mission

The Indonesian Air Force as a part of the Indonesian Defense Force has two missions namely : (1) as a social force in helping and supporting the legislative and executive branches to conduct the national development and economic growth of the nation and (2) as the defense force, in maintaining air defense force capabilities by utilizing the weapon systems technology. In conducting its operations, it must be supported by exploiting the training systems, equipment and manpower that have a high degree of reliability. The role of personnel skills is very important in this respect. But many problems have occurred because development of personnel skills does not meet the need of operational requirements. There is no balance between the operational requirements and capabilities of the of the personnel technician. Logically the mission of the training program is to develop a knowledge, positive attitude and improve the skills of the Air Force personnel so that they may efficiently and effectively operate and maintain resources that are used in performing the missions and functions of the Indonesian Air Force.

2. Objective of the Training

The objective of the training program in the Indonesian Air Force is to support the acquisition of skilled personnel according to the demands of the organization and the requirements of their operations.

3. Raw Input

The Indonesian Air Force recruits personnel who have potential talent, interest and the capability to develop their technical abilities.

4. Instrumental Input

The instrumental input that influences the training process are :

- a. National Ideology*
- b. Military Doctrine*
- c. National Development Guidelines*
- d. Defence and Security Policies*
- e. Indonesian Air Force Policies*

5. Environmental Input

Factors that should be considered in the training process are :

- a. The Level of Knowledge*
- b. Defence and Security Training System*
- c. National Education*
- d. Weapon Systems Technology*
- e. Air Force Mission Development*
- f. Transfer and Training Technology*
- g. Budget and Facilities*

6. Skill requirements

Skill requirements also play an influential role in conducting the training and development program. These should be considered in developing the training process because in recent years the evolution of the weapons systems has been relatively faster than the skill of the Indonesian Air Force personnel skills.

7. Process

The Indonesian Air Force Institution has the responsibility to conduct the conversion process. This process consists of :

a. Analysis

The first step of the process is the analysis. This activity consists of data collection, data analysis, the planning programming and budgeting system, determination of facilities and equipment, manpower assignment and determination of manpower, etc.

b. Design

Design of the system, media and methods are also important and should be considered before conducting the development program. Through this design, the flow of the process may be controlled more easily and corrective action may be taken if deviations occur.

c. Development

The development of the program is the way to improve the process. We believe even though the process is designed well, if the development is not conducted well it will have a tremendous effect on the further process. The development is necessary to adjust to unforeseen circumstances. The lack of development can jeopardize the continued success of the process.

d. Implementation

Implementation of the concept is recommended as a means for improving the original concept and encouraging further development.

e. Control

Controlling activities are an important part of any management principal. Especially in training, controlling is addressed to get the optimization and the effectiveness of the utilization of the training program, besides increasing the quality of the training output.

8. Output

The output targeted in the training process is the Air Force personnel who have the individual and group readiness to perform the Air Force mission and functions.

9. Feedback

Feedback from the officials in the Air Force who oversee maintenance technicians (the users of the training output) is needed for the future improvement of the training program. The Indonesian Air Force Training System is shown in Figure 2.

B. TYPE OF TRAINING

Training for maintenance technicians is conducted according to the requirements of the mission and organization of the Air Force. There are two major types of training :

1. Formal Training

a. Initial Training

The systematic development of skills is one of the primary tasks of any organization. This development includes skill observation, job assignment, and the occupational training, etc. Normally this development is started by the initial training or skills development program and is used as the foundation for future training development. Upon entering the service, all active duty personnel go through initial training which is designed to develop physical stamina, basic knowledge, skills to familiarize personnel with the organizational structure of the Indonesian Air Force and appropriate job behavior, and of special interest is the transition from a civilian life style to the military. In order to understand the nuances of the initial training it is necessary to take a look at the mission, strategies and functions of the Indonesian Air Force.

The Indonesian Air Force has many missions to perform. It must assist in securing the policy of the Defense and Security Service by establishing the management of the Indonesian Air force as a Defense and Security Service Force as well as providing Social Forces, and to support the establishment of the National Defense and Security System, in this case "The air superiority all over the Indonesian country." In respect to this mission, the Air Force uses one approach, that the Air Force is a full material and technology formidable force. On the other hand, as concerns the equipment, it cannot be operated well without qualified and skilled personnel. Based on this fact the

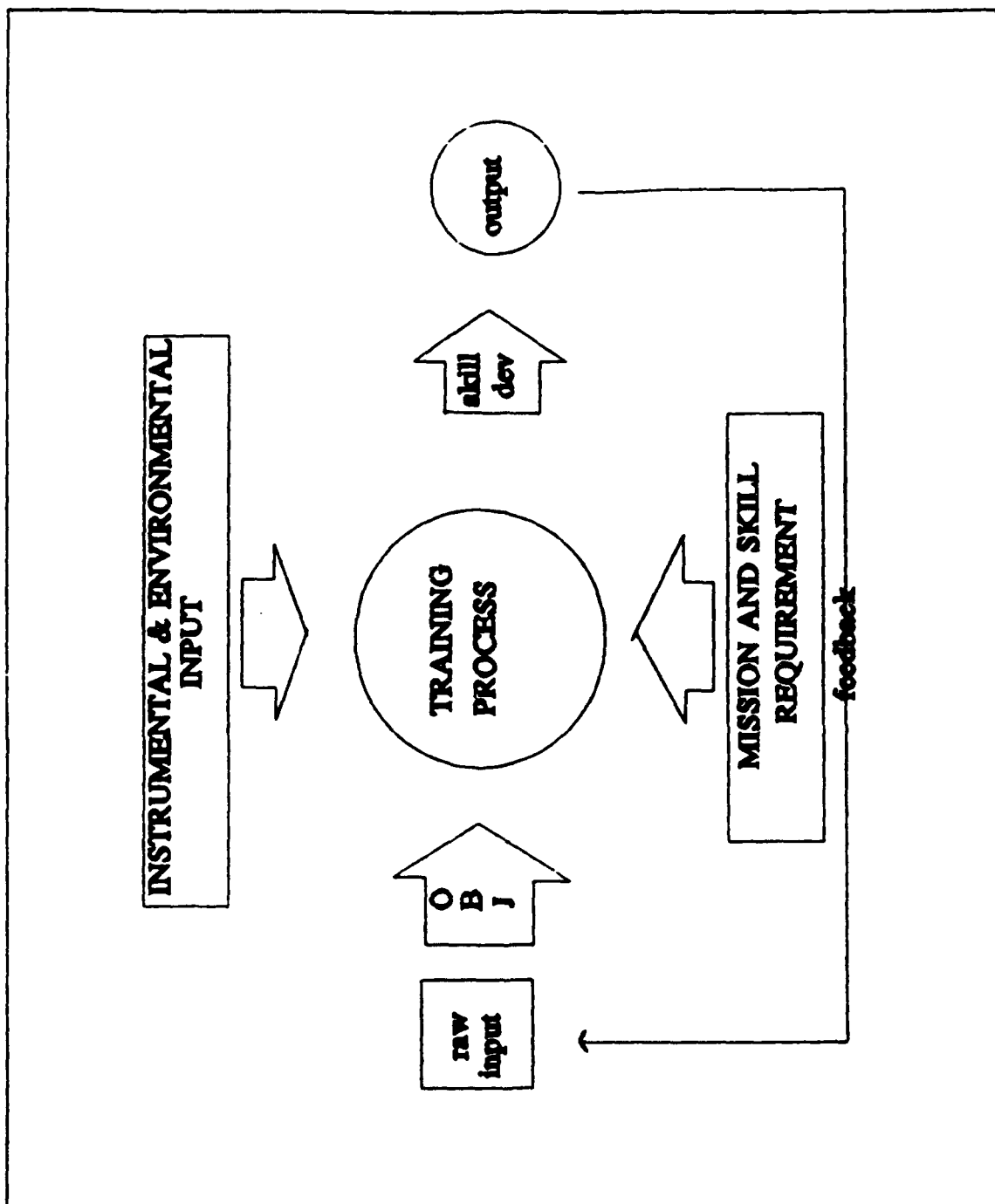


Figure 2. Indonesian Air Force Training System.

role of manpower management is very important and must have special effort to provide the guarantee that the Air Force has the quantity and quality of

maintenance technicians to man their aircraft, and support equipment and installation facilities.

b. Skill development Training

The Indonesian Air Force has developed an occupational structure which is called Military Occupational specialties (MOS). This training is conducted according to organizational needs, skill levels, educational background and areas of specialization. This program may be broken down in three major training categories:

(1) *Skill Level Training.* This type of training is used to evaluate and increase the skill of maintenance technicians from qualifications from skill level 1 to as high as 5.

(2) *Specific Rating Training.* It is mandatory for all technicians to receive a specific rating before they may operate the equipment or any type of system. These types of training are conducted by the "Mobile Training Team" during the acquisition process or at the local institution on further development.

(3) *Advanced Training.* The Air Force offers more sophisticated technical, supervisory, leadership and managerial training for career-oriented personnel. For senior technicians, they receive training in technical inspection, logistical, administrative and strategical subjects as well as leadership and managerial skill enhancement.

2. Non-formal Training

Non-formal training is also conducted for transferring new technology or type of weapon systems. This training is conducted through on the job training, up grading, and remedial tutorials. The role of linker is very important in this type of non-formal training.

C. TRAINING INSTITUTION

A formal Institution is needed for providing effective training and development. Such a training institution must adhere to specific structural and procedural requirements set forth by the Indonesia Air Force:

- The structure of the training institution must support the administration of training in achieving its goals.
- The structure of the training institution must support the flow of the administration support for the training program.

The training institution in Indonesian is divided into two levels:

1. Headquarters Level

There are three agencies at this level: The Training Board, which is responsible for determining the training policy; The Staff of Personnel, which is responsible determining manpower requirements; and the Training Service agency, which is responsible for planning, programming, coordinating, controlling and performing research and development in the training and skill development areas.

2. Main Command Level

There are three main type of commands associated with skill and training development program namely, The Air Force Training Command, the Air Force Operational Command, and the Air Force Logistic and Material Command. The Air Force Training command is responsible for training of the Air Force personnel in order to develop their knowledge, and skills, as well as creating a positive attitude needed by Air Force occupations. The other commands support the skill development process by using the facilities as training support or training aids, if necessary. They also have support on the job training process and give the evaluation and feedback of the training output.

The function and structure of the training system institution is set up according to the individual training process to be implemented.

D. TRAINING DEVELOPMENT

Training development is an important part of improving the skill of personnel in every organizations. The Indonesian Air Force adjusts its training programs according to the various mission requirements and type of weapon systems being used at any given time. For this reason, the training system has

been gradually changed over time. There are three major eras that influence the training activity in the Indonesian Air Force, namely:

- Before 1965. In this era The Indonesian Air Force received and operated the weapon system from the Soviet Union and East European countries. In this case the training behavior was influenced by a communist country's system, and that usually has a limited publication.
- Between 1965 and 1970's. The Indonesian Air Force was still almost entirely equipped by Soviet aircraft, but much of this equipment had reached the end of its usefulness, since the communist coup attempt in October 1965, no weapons system program has been provided in this era. By the end of the year of 1970, the major units of the Indonesian Force declined. This is the era of the transition era from the Soviet and East European system to the West European training system.
- After the 1970's. At the beginning of the first year of 1980's the Indonesian Air Force conducted the acquisition of the weapon systems from the United States and West European Countries. In this case the training systems are influenced by the United States and West European training systems. The distinction of this system is more available publication, information system and develop creativity and responsibility. But there still tended to be specialization.

1. Development Program

In the 1980's, the Indonesian Air Force made a contract with an American company (Telemedia) to improve its training program. The contract consisted of development plans, and suggested improvements in the existing instructional package program, training aids and training syllabi. The objective of the training development was to improve the instructional system according to the requirement of the new weapon system and training technology. Furthermore the primary objectives of the system of instruction are : to provide instructional packages, to provide adequate training media, to provide supportive infra-structure and environment, and to improve training management. In achieving those objectives the Air Force Training Command set up the following programs :

a. Instructor Training

An instructor training program was developed to enable senior technician to study either in Indonesia or abroad. But due to budget constraints, only some of the instructors were sent abroad. Especially for the in-

structors that were trained in another country, they has responsibility to adopt the training technology from the countries they visited to facilitate its application upon their return to Indonesia. They were assigned as Technology Transfer Agents and in special cases should act as linker or innovator.

b. Training Media

The acquisition of new training media was necessary for the improvement of training efficiency. Due to budget constraints, however the acquisition of training media is conducted according the given priority. (especially for adopting new technology purposes only).

c. Organization Development

An organization development agency was needed, to give the supportive infra-structure and environment for the training development. The Curriculum and Laboratory Development Departments were improved, and the Training Media Department was developed.

In summary the training program of the Indonesian Air Force needed to be developed in order to keep step with technological development, since the evolution of technology which has inevitably led to the use of more sophisticated weapon systems. Their successful operation requires a high level of skill and qualifications from technicians. In time , the program will be improved to keep pace with changing operation and maintenance trends. The Technology Transfer concept is one of feasible tools for adopting new technological concepts.

III. LITERATURE REVIEW

A. OVERVIEW

The benefits of the application and utilization of scientific and technical knowledge for as many as possible has long been recognized. Supervisors and managers are well aware of the need to improve employees skills. The implementation of "technology transfer" is the best way to transfer the new technological concept from modern country to a developing country.

What is "technology transfer"? The term is currently used to express the movement of information or technology into new application or use. There are however, almost as many meanings as there are authors. In this study, the term is defined as the process by which science and technology developed by one organization for a specific purpose becomes adopted and applied by another organization. For technology to be transferred, it must be actually applied by another user. A secondary application may take place as a result of a traditional diffusion mechanism or formal technology transfer program (Welles, 1973, p.422).

The Directory of Federal Technology (1975, p. v) offers another definition of technology transfer which adequately reflects the quality of the subject. It is :

- The process by which existing research is transferred operationally into useful processes, products, or programs that fulfill actual or potential public or private needs.

Jolly, Creighton, and George in "Technology Transfer Process Model" (1978, p. 1), also stated that " ...The term of research, should be interpreted in its broadest sense to include development in many fields ranging from Aerospace to Mental Health or education." The concern is that of taking an existing idea or body of the knowledge, from any of these fields, using it in different places and different ways.

As time goes on the situation and condition constantly change. Change occurring at such a fast pace that new methods are needed to adapt to the changes. Innovation is the deliberate planned change to improve a system or accomplish an objective. Most cases of technological transfer are technological innovation. In operational terms innovation is based on a systematic, organized leap into the unknown. Innovation utilizes scientific tools but it is as a process of the imagination. However, technology and technology transfer are basic tools of innovation that can be used to help bring about change.

The first step in the innovation process is to tap the full power of man's innovativeness, that is to develop the creative aspects of man and the use of imagination. The greatest potential source of innovation is probably in exploiting the creative talents with each individual.

In summary, technology transfer is a tool of the innovative process. The innovative process operates well if supported by both imagination and creativity. Finally technology transfer, imagination, creativity and innovation encourage the processes in accomplishing the change.

B. TECHNOLOGY TRANSFER PROCESS

To know what suggested action should be taken in the improvement program through a technology transfer concept Model, it is necessary to understand the technology transfer process. In this section we will present the basic principles of the technology transfer process.

Morton found that innovation is not just one easy or simple act to do. Also it is not just a new discovery or new understanding of the new phenomenon, nor just a flash of creative invention, nor just the development of a new product or manufacturing process. But innovation involves related creative activity in all of these areas. This process is a result of the creative acts, starting from the research stage through the service, combined and organized together in an integrated way, provide methods for accomplishing the primary goal (Morton, 1971, p.3).

The process of the innovation can be visualized as shown in Figure 3. (Goldhar, 1976, p. 52)

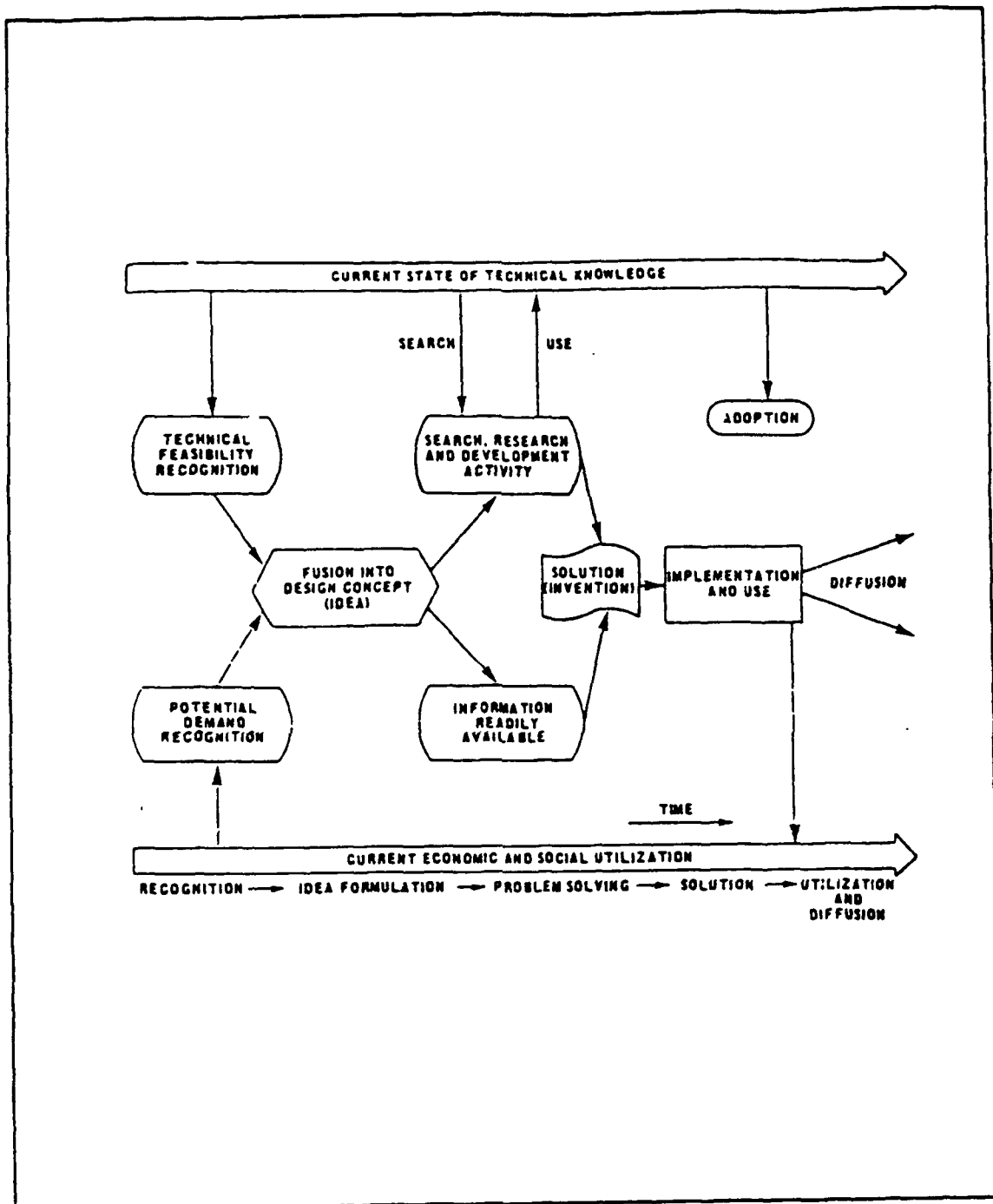


Figure 3. The Innovation Process.

According to Goldhar, Bragaw and Schwartz the innovation, can be either product or process innovation. For the purposes of the improvement or test

evaluation program, the innovation would be predominately a process innovation. The innovation will consist of several areas of knowledge, but would commonly be concerned with only one. Even though primarily concerned with the utilization of research and development (R and D), the model is equally pertinent to all aspect of technology transfer.

Technological change and innovation occur as a result of complex sets of individual and organizational risk taking and decision making. Each of these facets of the process involves human beings with their motivations, perceptions, attitudes, abilities, personalities, prior knowledge and experience which mold information seeking and use characteristics. These variables should be considered when attempting to improve the probability of successful innovation (Goldhar, 1976, p. 52), figure 4 is an expanded model by Goldhar, Bragaw and Schwartz of the process of technological innovation (Goldhar, 1986, p.53).

While individual steps were intended primarily for commercial use, they are easily applicable to a the personnel skill development as an individual or as a group. Recognition of potential demand could be replaced by recognition of potential need, market research and skill development activities could be replaced by research potential need, market development activities could remain the same. Additionally, marketing activities could be directed toward the Indonesian Air Force Technician Skill Development Institution, R & D activities leading to a prototype would be replaced by activities leading to prototype, etc. These change result as shown in Figure 3.

This process described above is similar to that described by Gartner and naiman (Gartner, 1976, p.25-26) as that identified by the Committee on Technology Transfer and Utilization. The process is a little more specific order of performing the steps. The process consists of the following steps :

1. Collecting, organizing and storing the results of research and development, i.e., the technology.
2. Publishing and disseminating the R & D information.
3. Identifying the need and developing the technological requirements that need to be met.

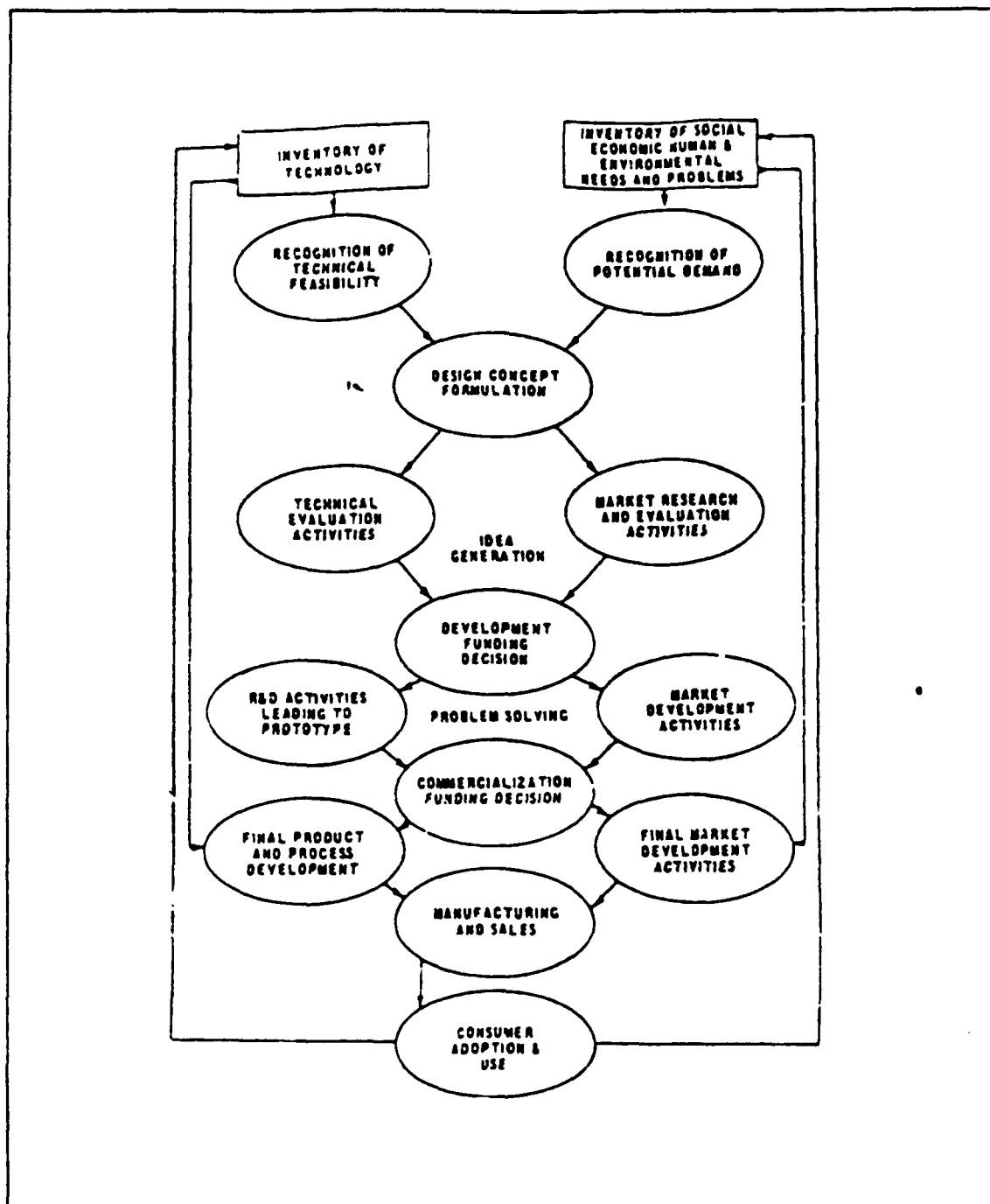


Figure 4. The expanded innovation process.

4. Matching of the available technology with the specific need or ultimate use, with the aid of the potential users.

5. Executing a continuing series of relevant cost benefit analysis.
6. Defining the market potential and other parameters that should help to determine the potential utilization.
7. Examining the possible consequences that may result from fulfilling the needs and their impact.
8. Location the potential "suppliers" who are able and available to translate the technical information into practical reality.
9. Determining the resources and other requirements necessary for suppliers to produce the product, service or process.
10. Associating the suppliers and users so they can agree on the standards, characteristics performance, and constraints of the product, service or process.
11. Performing the adaptive engineering necessary to develop the product or service or to acquire any missing elements.
12. Establishing a business or implementation plan to determine production and operation cost.
13. Acquiring the necessary financing.
14. Creating a marketing plan, production of the product, service or process and implementation.

Professor Everet M. Rogers developed a Paradigm similar as shown in Figure 5, which illustrates factors known to affect the adoption of new technology. Rogers divided the environment for innovation into adopter characteristics, elements of the situation, nature of the technology, form and reliability of information sources, and the outcome of actual trials (Hough, 1975, p. 58-59). These are related to the central process of awareness, interest, evaluation, trial and adoption.

As determined by analysis of the preceding models and processes, the technology transfer process is mainly a people process set in an organization. Therefore, many of the concepts and findings of human behavior and organization research can be used to understand technology transfer and innovative behavior. Succeeding sections will discuss the literature related to these findings as applied to the Indonesia Air Force Maintenance Technician Skill Development Program.

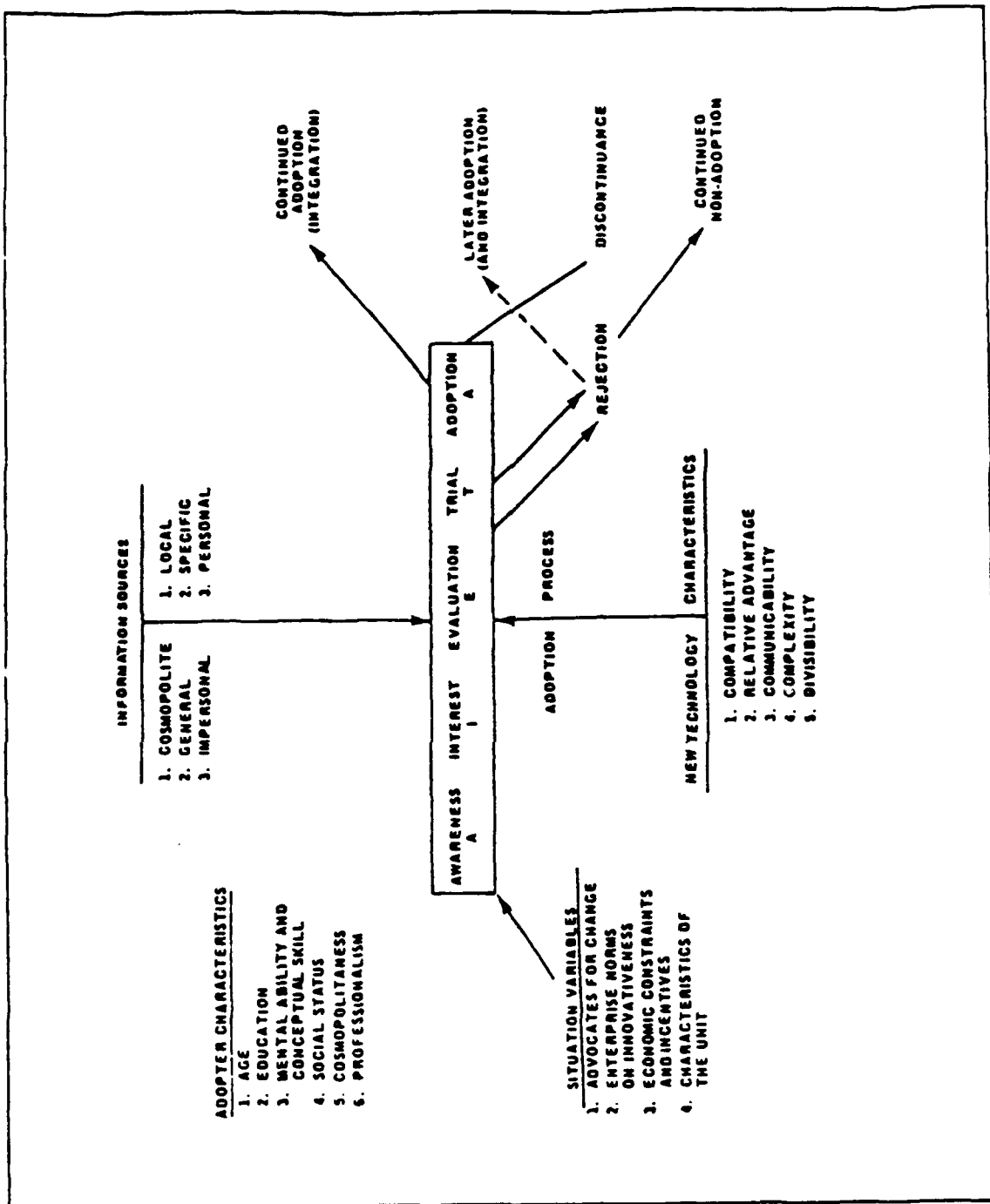


Figure 5. Technology Adopter Paradigm

C. AIDS TO TECHNOLOGY TRANSFER AND INNOVATION

The purpose of this section is to identify some factors that may be used as an aid in technology transfer and as the tool of innovation.

Schwartz (1975, p. 8) indicated that once an organization elects an innovative strategy, it must:

1. Make timely resource allocations to exploit opportunities or respond to threats.
2. Be selective so limited resources are appropriately invested.
3. Encourage risk-taking among employees who may be "risk averse."
4. Distribute risks so they can be managed and are at acceptable levels for each participant.

Boettinger (1970, p. 4-14) presents an interesting idea. He plots the relationship between effectiveness and human tension, Figure 6a. It is interesting that some amount of tension seems desirable. An increase in tension beyond that which is optimum for an individual will result in decreased effectiveness. He likewise plots effectiveness against technological capability, (see figure 6b). This curve plots effectiveness versus the technology used. Like the previous curve, effectiveness decreases beyond an optimum value. As an illustration, digging the Suez canal with spades would be represented at point D, whereas, using a bulldozer to cultivate the garden could be at point F. If two curves are combined, it will create three dimensional relationship, as shown in Figure 6c.

The inverted bowl's surface represents the possible states of combination. Both relationships must be controlled by management or supervision if overall optimal effectiveness, the top of the inverted bowl, is desired. Poor technological capability can be compensated for to some extent, with good leadership and poor leadership with superb technology. But peak performance can never be achieved without peaks in both domains, the human and technical.

Myers (1965,p. 91-96) feels that innovation requires long term planning which in turn requires the self discipline of delayed gratification. He also feels that the rate and quality of innovation depend on the interaction of three

management groups : lower management. middle management and top management. Each management level must be willing to innovate. "Somebody must continually push the innovation process against hostilities and inertia." Since innovation flourishes in an atmosphere of anticipation of innovation, an innovative climate is desirable and necessary.

Gold (1975,p. 24-27) states that technological development programs offer five primary benefits :

1. Attain competitive advantages through new or better product or processes.
2. Obtain knowledge which can itself be sold advantageously.
3. Keep up with, or avoid injurious lags behind competitors.
4. Minimize prospective disadvantages.
5. Provide the image of highly progressive management.

She presented the following table to compare five important characteristics for alternative strategies in achieving the above five benefits.

Table 1. SELECTED CHARACTERISTIC OF ALTERNATIVE STRATEGIES FOR ADVANCING TECHNOLOGY

Alternatives	Development Cost	Success Probability	Time to Fruition	Likely Rewards	Associated Disruptions
Evolutionary improvements	Low	High	short	Small	Small
Licensing	Low	High	Short	Moderate	Small/ Large
Scale Increases	Moderate	Moderate	Moderate	Moderate	Small
Major Advances	High	Low	Long	Large	Large

Gartner and Naiman (1976, p. 25) identify some suggestions of the requirement for successful technology transfer, in certain industrial cases. They lists these requirement such as :

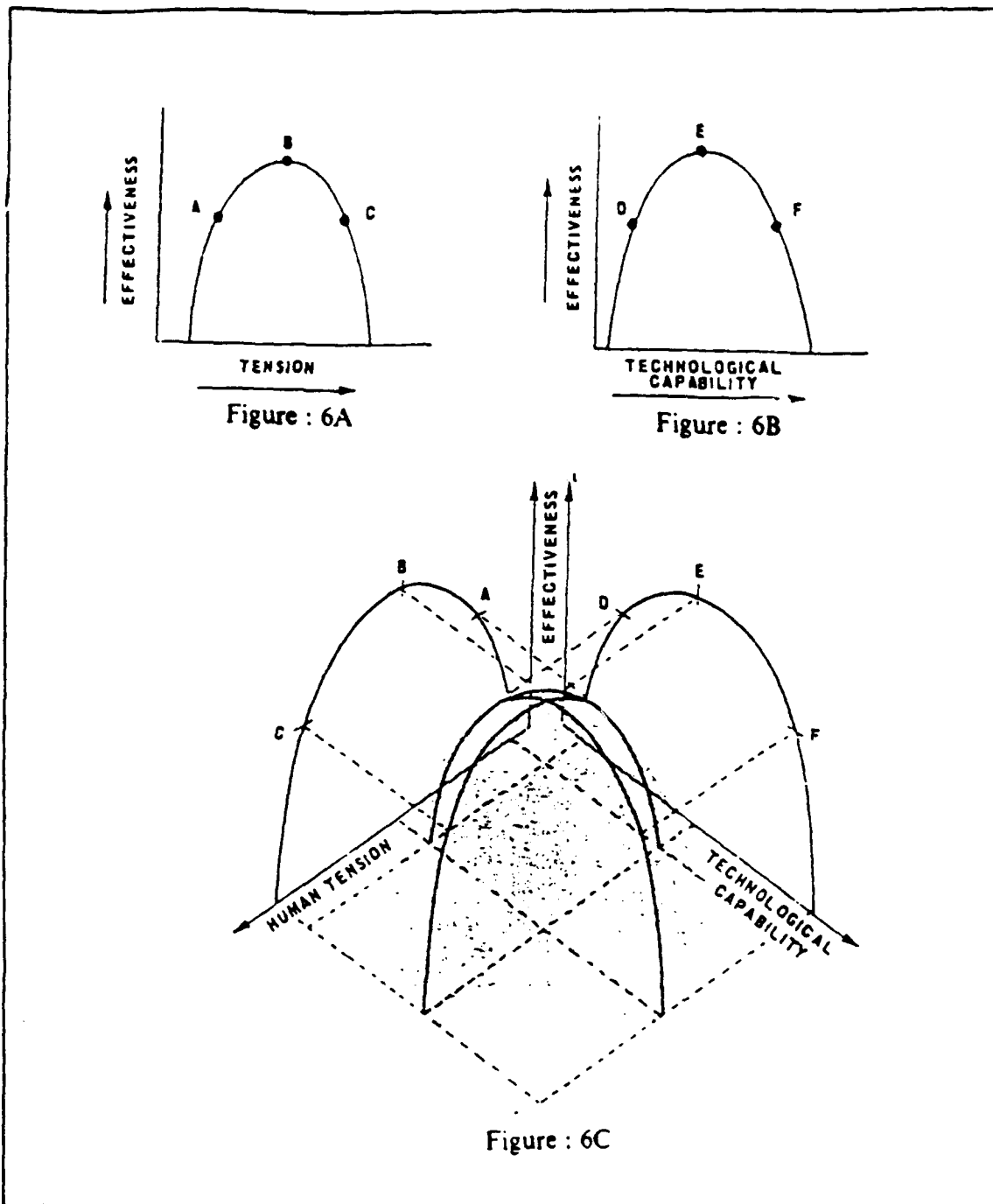


Figure 6. Relationship Effectiveness, Human Tension & Technology Capacity

1. The setting of specific and consistent goals and policies among parties involved in the transfer.

2. The adherence to specific criteria developed for technology transfer.
3. The development of a formal structure to bring the goals to fruition.
4. The elimination and minimization of barriers at the three levels of environment. (general system, subsystem and elements).
5. The designation and existence of an individual(s) to oversee and coordinate the transfer process.

Bright (1953, p. 55) feels that a diversity of talents and mental attributes is needed in an organization in order to achieve technology transfer.

We must also emphasize the necessity for diversity of talents, training and attributes of mind in those working cooperatively toward a complex technology objective. I should like to say a word or two about the significance of mental attributes. If we take a cross section of productive research workers, perhaps by studying the authors of articles in the better journals, we find at least five kinds of minds :

1. The promotion or creative
2. The critical and analytical
3. the cumulative and inductive
4. The cumulative and descriptive
5. The meticulous and the routine industrious.

History has shown that all these mental attributes have important roles to play in the birth and steady growth of the all branches of science and technology and we would be guilty of intellectual snobbery if we discounted any one of them."

Miller (1970, p. 54-55) feels that to develop a capacity to encourage change it is first necessary to concentrate on how to manage. Management training and skill development should include the following :

1. The manager's functions - planning, organizing, leading, controlling and innovating.
2. Managing of work - methods analysis work standards systems, work schedules and setting performance standards.
3. Managing the worker -selecting, training, disciplining, evaluating, etc.

After improving the managerial skills, it is necessary to develop a greater understanding of the innovation process such as :

- Principle and techniques of creative thinking - how to generate more and better innovative ideas.
- Learning the manager's role in innovating - developing proposals for innovations, facilitating innovations proposed by others, how to evaluate the potential of an innovation, techniques for implementing an innovation and development program.

The manager needs sensitivity and skill in handling of the human - change problems, resistance to change, facilitating adjustment to change.

In further reading, Miller feels that communications are important in facilitating change. This communication should include :

1. Announcing plans for developing the innovation.
2. Keeping people informed of the change - including reasons.
3. Maintaining effective communications barriers after the change.
4. Using communications to facilitate individual and group adjustment to the change as it continues in operation.

Another important additional skill the manager should develop is creating attitudes among subordinates that view change as a positive phenomenon.

All of the points made by Miller are very important in a technician skill development organization. Most of civilian and military managers have come up through the ranks. Consequently, they are almost exclusively trained as engineers or scientists. They may have had some training as supervisors and managers. But it is the author's opinion that most are still technically oriented at their heart. Training in all of the above areas should be mandatory. Probably the area most lacking in that of creative thinking and management of innovation.

It is of vital importance for managers to become leaders of change. This statement is supported by Miller, "It is clear then that the starting point of the innovation process is to tap the full power of man's innovativeness, that is, to develop the creative aspects of man-the use of imagination" (Miller, 1970 p.86).

A program that could result in more innovation would include :

1. Overcoming the forces inhibiting creative decision making.
2. Principles of creative decision making.
3. Techniques for generating creative decision making processes.
4. Determining the innovation potential of an idea.
5. Gaining acceptance of ideas as a basis for decision.

There are four ingredients a manager must have to be innovative : (1) Creative ability, (2) skill in evaluating ideas, (3) the ability to concretize the proposal for innovation and (4) the ability to prepare the program for implementing the innovation program and overcoming the obstacles to change.

Miller refers to Watson and Glasser who suggest that the following steps should be considered in making a change :

1. Make clear the needs for change and provide a climate to identify such needs.
2. Encourage group participation in clarifying and expanding these needs.
3. State the objectives to be achieved.
4. Establishing broad guidelines for achieving the objectives.
5. Leave the details of change planning to the parts of the organization that will be affected by the change and must implement the plan.
6. Communicate the benefit expected as result of successful change.
7. Materialize the benefits or rewards ; i.e., keep promises.

Cox (1976, p. 29 -32) suggests that successful innovation is a people process and depends on the top management and secondly on an entrepreneur. He feels, as many others do, that innovation depends on the people an organization employs, the environment in which they operate and their ability to plan and implement those plans to meet the organization's goal and strategies.

Jervis, using data collected during project SAPPHO studied the difference between success and failure in 70 innovations. The results show little support for the "Product Champion" but do suggest that the power, commitment, and

experience of the Innovation Managers are crucial factors (Jervis, 1975, p.15-25).

The study indicated that successful innovations could be distinguished from unsuccessful innovations by superior performance in five areas :

1. Strength of management and characteristics of managers.
2. Understanding user needs.
3. Marketing and sales performance.
4. Efficiency of development.
5. Effectiveness of communications.

Additionally, it was found that diversity of experience characterized managers of successful innovation projects. In these cases, user needs would then be the kind and quality of tests and techniques that are needed.

Globe, Levy, and Schwartz studied the Ten "outstanding" innovations to determine what events and factors played key roles in the innovation process (Globe, 1973, p.8-15). They studied 21 factors as to their degree of importance to each of the decisive events of the innovations. The factors were related to:

1. Various motivational influences.
2. Actions taken consciously.
3. Management involvement
4. Peer group forces on the R & D scientists.
5. Circumstances that are usually unplanned or accidental.
6. External factors that form the general environment within which the innovative process takes place.

Table 2 presents the percentage of all decisive events for which that factor was judged moderately or highly important. Ranking first is Recognition of Need. The external factors, in general, rank toward the bottom.

The technical entrepreneur was also a "characteristic" important in nine of the ten innovations. This is the strongest conclusion that emerged from the study. If any suggestion was to be made as to what should be done to promote innovation, it would be to find technical entrepreneurs. Early recognition of the need appeared in nine of the innovations. This confirms the high rating for the

Table 2. PERCENTAGE OF DECISIVE EVENTS RATE

Factors	Percentage of Decisive Event
Recognition of technical Opportunity	87
Recognition of the Need	69
Internal R & D Management	66
Management Venture Decision	62
Availability of funding	62
Technical Entrepreneur	56
In-house Colleagues	51
Prior demonstration of Feasibility	49
Patent/License Considerations	49
Recognition of Scientific Opportunity	43
Technology confluence	36
Technological Gatekeeper	30
Technology Interest Group	29
Competitive Pressures	25
External Direction to R & D Personnel	16
General Economic Factors	16
Health and Environmental Factors	15
Serendipity	12
Formal Market Analysis	12
Political Factors	5
Social Factors	4

corresponding factor in the analysis of the decisive events, and substantiates the importance attributed to "market pull" in other studies.

Enough funding emerges as an important consideration, both from the study of the decisive events. Seven of the innovations had government support, although this support was limited for one of them. Furthermore, where

all sources of funds were considered, availability of funding ranked near the top.

The situation with respect to confluence of technology was especially interesting. An unplanned confluence of technology influences to six of the innovations. But confluence of technology was present for the other five innovation as well, although it came about from deliberate planning rather than accident. For three innovations of improved grains, technology confluence occurred because agricultural sciences itself is an interdisciplinary field, and long been supported on that basis. The remaining innovation, made use of a deliberately formed interdisciplinary team. Technology also ranks near the middle as a factor influencing the decisive events. The lesson to be learned here is that the benefits of technology confluence should not be left to accident, but should be promoted through deliberate interdisciplinary research.

Much of the literature indicates the importance of the innovator's environment. Goldhar, Bragaw and Schwartz (Goldhar, 1976, pp. 51-60) felt that there are at least six identifiable characteristics of environments which are conducive to technological innovation :

1. Easy access to information.
2. Free flow of information both in and out of the organization.
3. Rewards for sharing, seeking, and utilizing "new" information.
4. Reward for risk taking.
5. Reward for accepting and adapting to change.
6. Encouragement of mobility and interpersonal contacts.

Cook (1974, p. 540), in discussing technology transfer in partially developed countries, identified the six elements that are essential for successful technology transfer. Five that would be pertinent to the Indonesian Air Force Skill Development Organization are listed below :

1. The transfer of knowledge and know - how
2. Availability of all the needed equipment and starting materials.
3. A real felt need, a conviction that the transfer must succeed.

4. An environment - political encouragement, legal, economic, cultural and social - of positive encouragement, a willingness to cut through man made barriers.
5. Taking full advantage of all beneficial local factors raw materials, people, location, etc..

Jolly (1975, p. 148-166) made a study of the technology transfer capability of the eleven organizations with the objective of attempting to measure the differences in each performance between the organizations that accept technology movement and utilization as a diffusion process as contrasted to organizations that make a purposive, conscious effort to communicate and utilize knowledge. A modified model of the Delphi process was utilized to arrive at the nine factors described below:

1. Documentation
2. Distribution
3. Organization
4. Project Selection
5. Willingness
6. Capability of Receiver
7. Linkers
8. Credibility
9. Rewards.

Several of the factors are similar to those appearing in the Distillation. However, the most important one added is the "linker." The combination of two "summaries" essentially encompasses most of the salient factors affecting innovation.

D. THE BARRIERS TO TECHNOLOGY TRANSFER

As already mentioned, technology transfer is a process of change or the adoption of a new concept or behavior. It is quite obvious that change is the way of life. In this case the barriers or handicaps are also a way of life. The only method by which a successful change effort can exist is to overcome the barriers to it and provide proven organizational situations and conditions to

enhance it. The middle manager, in particular must understand the organizational barriers to the change. This section discusses some literature issues concerning organizational and behavioral barriers.

In general the technology transfer environment consists of three major systems :

1. The General System (total organization)
2. The Subsystems (department or Division)
3. The Elements (people in departments directly involved in technology transfer.)

Technology transfer can be initiated at any level if the goals are mutually consistent. If the goals are diverse, technology transfer will seldom be initiated. When the goals are mutually acceptable, goal directed behavior is started. In most cases specific barriers that may prevent transfer activity within the system are :

1. Within the General System
 - No formal transfer policies
 - Limited funds or cost barriers
 - Time horizon conflicts
 - Infringement problems
2. Between Subsystems
 - Inertia barrier
 - Lack of an incentive structure
 - cost barriers
 - Communication and information barrier
 - Time barriers
 - Geographic distance
 - Non existent transfer management structure
 - Technology barriers
3. Between Elements
 - Lack of incentive structure
 - high risk of being blamed for failure

- Insecurity of retaining job if not successful
- Mutual disrespect
- Unique requirement of each subsystem
- Updating of technology needs
- Time barriers
- Lack of transfer organization managers

Mock (1974, p.303) examined the nature of existing problems. He listed 26 barriers to innovation , and eleven of them seem equally important to a maintenance technician development environment :

1. The problem has constantly changing boundary conditions.
2. The criteria against which we can measure a successful solution may change while we are still working on the problem.
3. Solutions to many of the problems are exceedingly expensive.
4. There is a lack of consensus of goals and priorities.
5. There is an inherent dilemma in our political process with its emphasis on short range planning.
6. The highly fragmented nature of the public technology market.
7. A general lack of communications and effective working relationships between those groups which are generating new science and technology and the potential users.
8. Lack of sufficient funds.
9. Lack of personnel.
10. Lack of interest in the science and application of new media.
11. Lack of incentives for innovation or creativity.

Bright (1964, p. 133) makes five observations about the resistance to technological innovations :

1. The resistance will be somewhat in proportion to the extent to which institutions and individuals are threatened.
2. Resistance is lessened if only slight change in behavior on the part individuals, institutions, and organizations is demanded.
3. Innovations encounter less resistance in a firm, industry, or society where managers and workers are accustomed to frequent change in the technical environment.

4. Those advocating innovation often tend to be overly optimistic as to the time and feasibility of accomplishment, although not necessarily as to the ultimate impact on their concept.
5. Resistance is aggravated or encouraged if the innovator is sarcastic, contemptuous or insulting in his reference to this advocates.

Thompson (1965, p. 1-20) discusses the characteristics found in the bureaucratic organizations which serve as barriers to innovation :

1. The organization often is monocratic. There is only a single point or source of legitimacy.
2. Control over all resources is centralized.
3. Conflict is not legitimized and this depresses creativity.
4. It covers extrinsic rewards of money, power, and status, rather than to improve personnel skills capability and creating a new concept.
5. The reward structure places a high value on compliance and conformity.
6. In a monocratic organization, there is veto but no appeal, such an organization may allow new ideas to be generated, but in apt to veto them.
7. The characteristic psychological state in a bureaucratic organization is one of anxiety and chronic dissatisfaction, this creates conservative orientation in innovation and is perceived as threatening.
8. Bureaucratic organizations are staffed primarily with "desk classes" and only minimally by professionals.
9. In such organizations, where praise and blame attach to jurisdictions, one feels that he can only fail once.

Mostly in a military-civilian professional organization legitimate conflict does exist. However, it may not be as high a magnitude as required for innovation. The problem is caused by Civil Service Regulations and funding restrictions limiting supervisors flexibility in overcoming the obsolescence.

Jervis and Sinclair (1974, p.141) suggested some barriers to horizontal transfer of technology across mission lines :

1. Institutional barriers to information flow in the aerospace/weapon system industry.
2. Low rate of technological mobility from the aerospace/weapon system industry to the commercial sector.
3. Low value placed on the transfer function by scientific and technological personnel engaged in Federally sponsored R & D.

4. Political attitude of institutions for transfer.
5. Security restrictions.
6. Poor methods of information retrieval and evaluation.
7. Poor understanding of the transfer process.
8. The power structure of agencies themselves.

Miller (1970, p.168) identified four groups typically involved in change : Employees, staff specialists, managers, and first line supervisors. The general form resistance or barrier takes is an expressions of hostility which could be seen as aggression against the administrator or the change itself. Some expressions of resistance are found in all four groups. A significant human barrier to successful innovation sometime arises in the form of resistance of managers. In most cases the forms of resistance found in a manager are :

1. The negative view : One of the most common forms of resistance found in managers.
2. Unconscious dissension : An organization man type of unquestioning acceptance but with buried doubts or misgivings.
3. Apathy and indifference : A manager sees his role as merely implementing whatever changes are presented to him by top management.
4. Free translation : A manager bends a change into his own purposes and ideas without regard to the overall plan of top management.
5. Managers can cause resistance by : (a) the pet project attitude - push tactics on the part of the people who will be taking part in the change or, (b) the authorization approach - summarily demanding instruction of change into an organization without proper ground work.

In the case of staff specialists it is most likely that the form of resistance will be expressed by enacting barriers to the ideas of others regarding the change. Sometimes, the staff specialists bring certain blind spots to their work that will get them into trouble when they help initiate change with operating people. That is, he cannot see that his change is not perfect and could be made better.

Watson (1975, p. 15) lists the three barriers:

1. Laziness
2. Inability to perceive opportunities

3. The attitude or belief that one is incapable of becoming creative

Finally Pearson and Rickards (1974, p. 67) discuss two problems which are supposed to be the cause of barriers to the successful utilization of science and technology namely :

1. The Not-Invented- Here (N.I.H) syndrome, which affects the matching of the solutions to the problem.
2. Communications problems between those with the knowledge and those who may be able to put the knowledge to use. This barrier is often due to the inability to communicate in common language understood by both.

Almost everyone knows about the N.I.H syndrome. However, the barrier caused by the lack of the communication in typical language is not as widely considered. Each side's ideas are rejected because the other doesn't want to know or is afraid to show his lack of knowledge by asking.

There has been much literature published related to barriers to technology transfer or innovation. This section does not discuss all of it but, it is representative and provides a good base for middle managers , linkers and innovators who are interested in this subject. It is necessary to have a knowledge of the barriers before taking any action in order to be able to handle the situation ,i.e.,if the barriers to the change really happen.

E. THE ROLE OF THE LINKER/INNOVATOR

In this section some of literature of the role of the linker/ innovator the technology transfer process are discussed. Conceptually, the role of the linker/Innovator is to interact with the consumer or user of the technology and the source of the technology. According to Classen (1971, p.8) the linker was identified as "an individual who through his own initiation seeks out scientific knowledge and the individual or the organizations who put it to use. In essence the linker is the catalyst who can translate the needs of the consumer into stated problems which are potential candidates for application of the new concept of technology.

Creighton, Jolly and Denning in 1971 developed and applied an instrument to identify and isolate those individuals whom they classed as a linker.

They structured the topology of the linking roles of the leader (gatekeeper, opinion leader), early adopter of an innovation or Innovator, and early knower of innovation. Their self-assessment tools consists of 18 multiple-choice question, each with five responses. A Value of one through five points was assigned to each possible response. The value of five was given to the answer which identified the strongest positive linker attribute as indicated by prior research. A value of one was given the response indicative of the strongest non-linker or stabilizer attribute. The sum of the scores for all questions of the instrument was calculated. This composite score served as the means of classifying individuals in an appropriate category.

Creighton, Jolly and Denning divided the respondents to the instrument into five categories using the mean, positive and negative first and second standard deviations as break-points. The individuals whose composite score was greater than two standard deviations above the mean were classified as linkers. The individuals whose composite score between one and two standard deviations above the mean were classified as a potential linkers. The individuals whose composite score was *between one standard deviation above the mean and one standard deviation below the mean* were classified as non-discriminating majority. The individuals whose composite score was between one and two standard deviations below the mean were classified as potential stabilizers. And finally the individuals whose composite score fell beyond two standard deviations beyond the two standard deviations below the mean were classified as the stabilizers. This relationship is visualized by figure 7.

Rogers and Shoemaker (1969 p.174) developed a model of adopter categorization on the basis of innovativeness. They hypothesized that a large population would, when ranked by the measure of average time to adopt a new idea , concept or method, form a continuum which would be normally distributed. They classified the group falling more than two standard deviations below the mean as innovators, the group between one and two standard deviations below the mean as early adopters, the group between the mean and one standard deviation below the mean as early majority, the group between

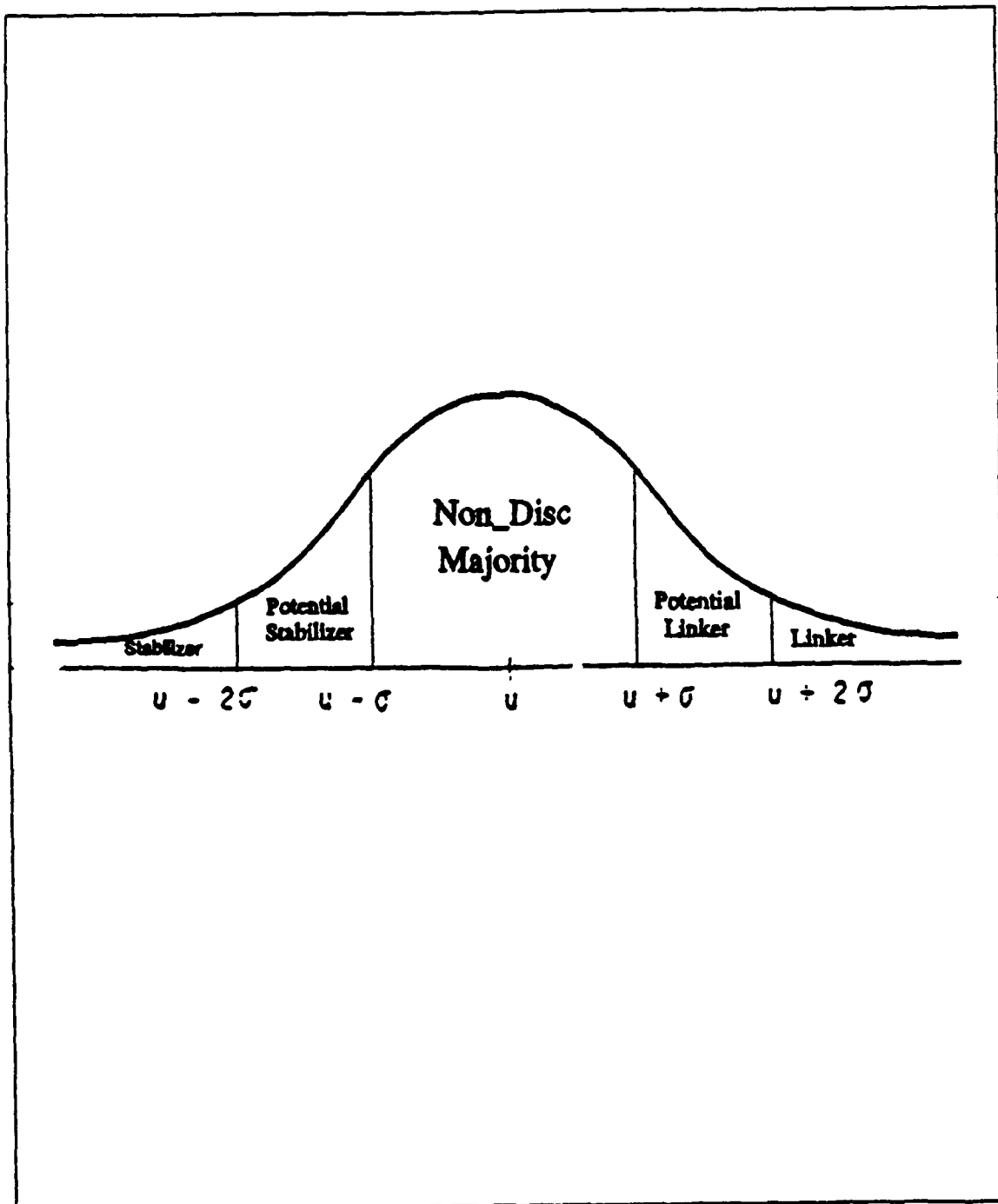


Figure 7. Linker-Stabilizer Categorization.

the mean and one standard above the mean as late majority, and the group above one standard deviation above mean as laggards. This relationship is shown in Figure 8.

The following discussed the application and analysis of the response. The breakpoints for classification were changed from two standard deviations to 1.83 standard deviation and from one standard deviation to 0.93 standard deviations. This method of the classification tended to create groups which were more indicative of the sample distribution than the arbitrary method base upon the assumptions of normally. The "linker" is identified as the intermediary between the source of knowledge and the individuals put in to use. While the "innovator" is essentially different type of individual. This does not mean that it is entirely different, but only in certain degree the characteristic of both of them were different. In general they are similar. The innovator is distinguished from the linker as being that individual who possesses the inherent capability to recognize a problem or needs, and through the new application of existing knowledge can effect and create a better solution. The diagram of the hypothesized relationship of these two categories of the individuals relative to the total population is shown in Figure 9.

As shown in the figure 9, there will be grouping of individuals who possess a high degree of linking characteristics, a group which will possess a high degree of innovative characteristics and a group which will possess a high degree of both characteristics, all as differentiated from the majority population. This concept of the two categories of individuals who though closely related were distinct onto themselves suggested that the method of differentiating between the two would contribute to a better understanding of the total technology transfer process.

Creighton, Jolly and Denning developed the professional preference census (PPC) for identifying the linker from the total population. The PPC Was very successful in identifying persons who had strong linker traits each time it was used. The intent of this research was to develop a method of identifying the innovator and incorporate it with an appropriate segment of the instrument

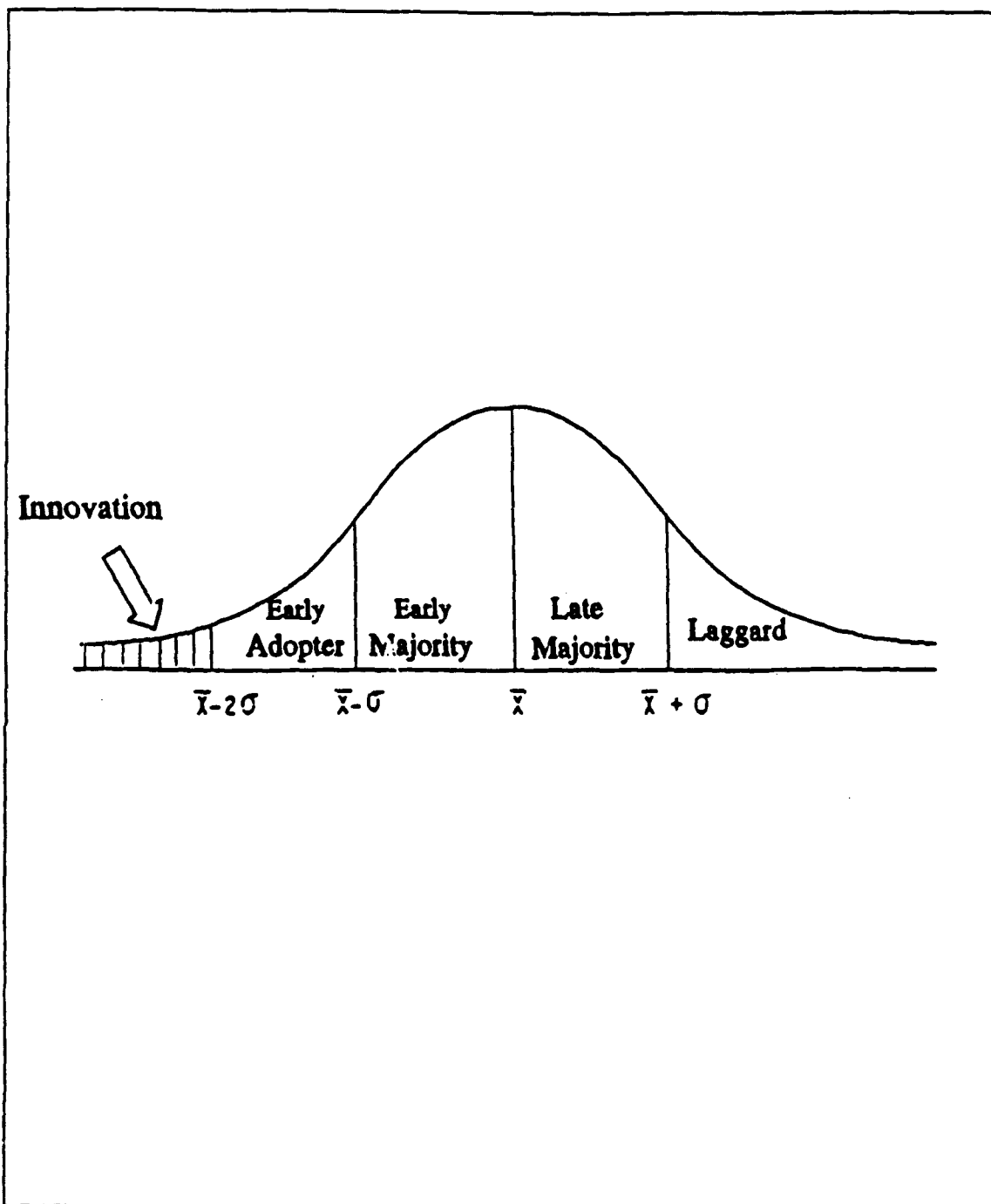


Figure 8. Adopter Categorization On The Basis Of Innovativeness.

developed by Creighton, Jolly and Denning. The complete data concerning the PPC is shown in Appendix A, (p.60).

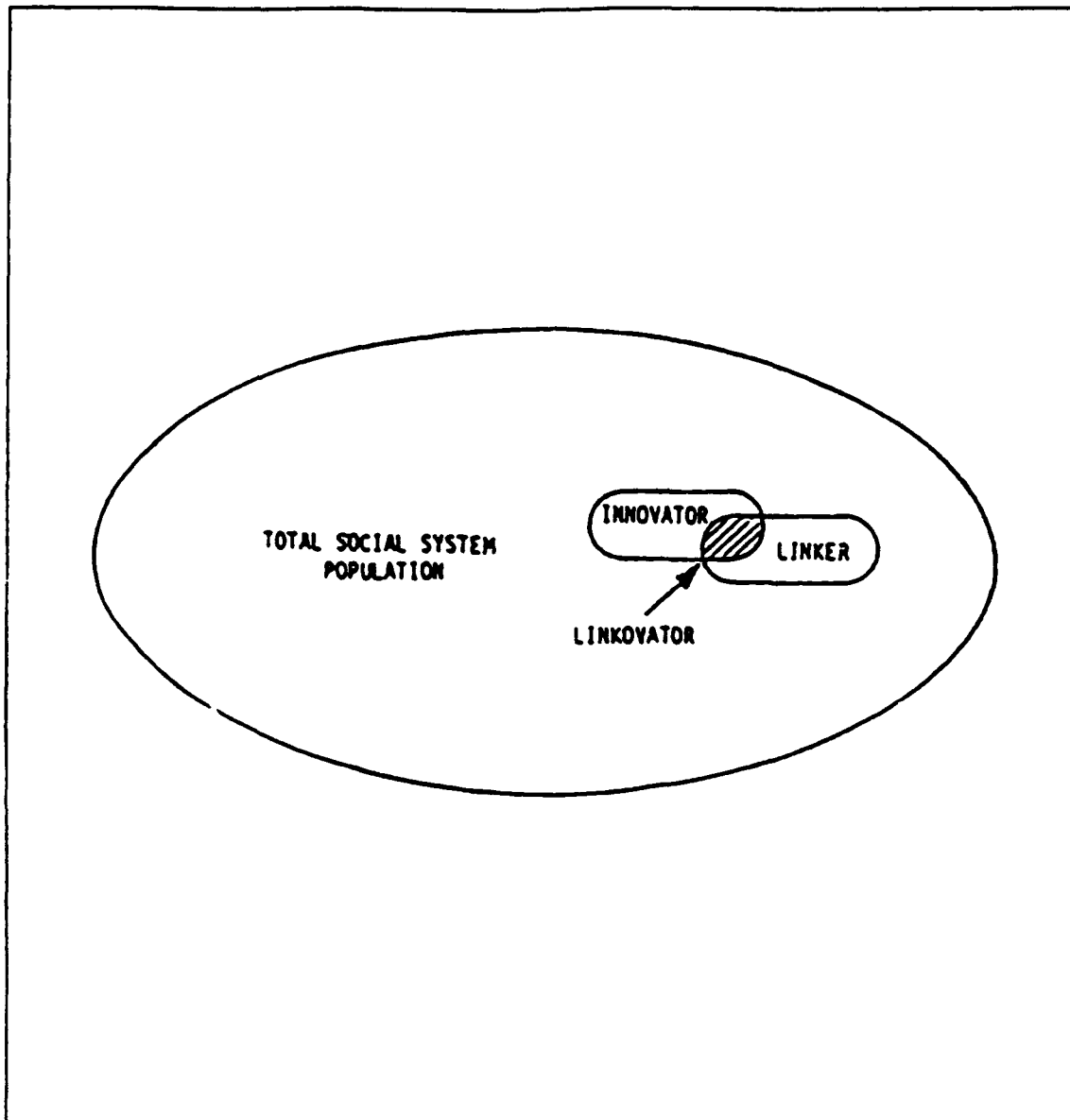


Figure 9. The Hypothesized Relationship of Innovators and Linkers.

F. DIFFUSION OF INNOVATION

After identifying the issues concerning the concept, aid, barriers and the Linker of the technology transfer it necessary to know what effects the diffusion of innovation. Everett M. Rogers (1983 p. 34) defined that the diffusion is a process by which an innovation is communicated through certain channels over time among the members of the a social system. He also identified that

diffusion is a special type of communication concerned with the spread of messages that are new ideas. Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. The degree of uncertainty is an important factor and should be considered (although this problem can be reduced by an individual obtaining information). Information includes a difference in matter-energy that affects uncertainty in a situation where the choices exist among a set of alternatives. By definition we can see that diffusion consists of four major elements such as : (1) innovation, (2) the communication channel, (3) over time, (4) in a social system. An innovation is an idea, practice, or object perceived as new by an individual or other unit of adoption.

Technology is also a design for instrumental action that reduces the uncertainty cause-effect relationships involved in achieving a desired outcome. In most cases the technology consists of two major components : (1) hardware, consisting of the tool that embodies the technology as material or physical object, and (2) software, consisting of the knowledge base for the lead. The dilemma of the technological innovation also creates another kind of kind of uncertainty because of its newness to the individual, and motivates them to seek the new information. Rogers called this term innovation evaluation information. In general there are five attributes of innovation : (1) relative advantage, (2) compatibility , (3) complexity, (4) trialability, and (5) observability.

A communication channel is the means by which messages get from one individual to another. Mass media channels are more effective in creating knowledge of innovations, whereas interpersonal channels are more effective in forming and changing attitudes toward the new idea.

Time is involved in diffusion in the innovation-decision method process, innovativeness, and an innovation's rate of adoption. Conceptually there are five steps in the innovation-decision process : (1) Knowledge, (2) persuasion, (3) decision, (4) Implementation, and (5) confirmation. An individual looks for information at the different kind of stages in the innovation - decision process in order to decrease uncertainty concerning the innovation. At the knowledge

in order to decrease uncertainty concerning the innovation. At the knowledge stage, an individual obtains software information that is embedded in the technological innovation. They want to know what the innovation is and how it works. But on the other hand at the persuasion and decision stages an individual tends to look for innovation-evaluation information in order to reduce uncertainty about an innovation's expected consequences. Besides these issues, the decision stage will lead (1) to adoption; in this case a decision is to make full use of the innovation as the best course of action available, or (2) to rejection, a decision not to adopt an innovation.

Innovativeness is also a factor to be known as early as possible. By definition innovativeness is the degree to which an individual or other units of adoption are relatively early in adoption. This would be a decision to make full use of an innovation. There are five adopter categories, (as shown in Figure 8), classification of the members of a social system on the basis of innovativeness such as: (1) innovators, (2) early adopters, (3) early majority, (4) late majority and (5) laggards. The last part of this approach is the rate of adoption or the relative speed with which an innovation is adopted by members of social system.

A social system is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal, (Rogers. p 37). There are six important points in this system, first is structure, defined as the patterned arrangements of the units in a system, which give stability and regularity to individual behavior in the system. The social and communication structure of the system facilitates or impedes the diffusion of innovations in the system. Second norms are the established behavior patterns for the members of the social system. In most cases norms are often exemplified in the behavior of the opinion leader. Third, opinion leadership is the degree to which an individual is able to influence informally other individuals' attitudes or overt behavior in a desired way with relative frequency. Fourth, a change agent is an individual who attempts to influence clients' innovation-decisions in a direction that is deemed desirable by a change agency. Fifth, an aid is a less than fully pro-

fessional change agent who intensively contacts clients to influence their innovation decision. And a final way in which a social system may as may function as an element in diffusion concerns *consequence*, the changes that occur to an individual or to a social system as a result of the adoption or rejection of an innovation.

Through the literature review, there has been discussion of some issues concerning the technology transfer process, the aid and barriers of to technology transfer, the role of the linker/innovator and the diffusion of innovation. This literature is a fundamental basis for the further discussion, and analysis for creating suggestions in determining the possible and feasible solution in conducting the innovation and development of the Indonesian maintenance technician skill. The following chapter will discuss some issues concerning the selection of the linker and the media associated with it.

IV. INNOVATION AND DEVELOPMENT PROGRAM

A. OVERVIEW

The previous chapter discussed some issues concerning the training system in the Indonesian Air Force and some literature related to the technology transfer concepts. Through the weakness of the training and skill development in the Indonesian Air Force and the strength and the benefit of the technology transfer concept, this chapter discusses the possibility of the utilization of the technology transfer concept as a tool of innovation and development program in improving the skills of the Indonesian Air Force maintenance technicians within the scope of the innovation and development program.

As mentioned in previous chapters, the Indonesian Air Force in its operations utilized of weapon systems from foreign countries. As importer or the user of foreign technology, it is necessary to adopt the concept and technological behavior from exporting countries to Indonesia. The evolution of the weapon system technology always seeks to improve according to the operational and battle requirement, and tries to build more sophisticated weapon systems. Up dating of concepts, systems in both hardware and software as well as operation/maintenance publication is conducted and connected with this improvement. This sometimes becomes a handicap for a country who imports technology from other countries like Indonesia. In most cases, the problem is caused by creating an unbalanced condition between the need of the technological requirement and the ability or personnel skill of the customers to use it. In order to maintain a balanced condition, we must conduct the feasible action for overcoming the present problem when it really happens by utilizing the adoption concept. Adopting the new concept is not easy for the Indonesian Air Force, because the source of technological information is usually published in a foreign language (mostly in English). Not all technicians have a good English capability.

The technology transfer concept is but one concept that might be feasible and can help to overcome this problem. As mentioned, technology transfer is made up of three major components namely : (1) sources of knowledge, (2) the linker and (3) user or receiver. It is easier in theory than practice, because the parameter of each problem varies. Problems always vary depending on the situation and, therefore, require a unique approach and options. The following paragraph analyzes and discusses the linker and media selection as well as some issues dealing with the innovation program.

B. LINKER AND MEDIA SELECTION

Linker and media selection should be considered in the technology transfer and innovation process. Since the linker will directly relate with the people/person who transfer the new concept through the media, it is quite obvious that these elements will influence each other in developing their capability and the flow of the technology transfer concept. The following paragraph identifies the selection of these two elements:

1. Linker Selection

As mentioned in the previous chapter, the linker is a person or a group who has the ability to act as a mediator between the source of knowledge and the receiver or user. The flow of knowledge, usually can be illustrated in the three positions, namely the linker is associated with the user or receiver, or he could be somewhere between, or the linker can be at either ends. (Creighton and Jolly, 1975 p.8). For selecting of these type of linkers, the following section will identify some of these issues that might be matched with the requirement of the maintenance technician. Visualization of the model is seen in figure 10 (adopted from Creighton- Jolly p. 8 1975).

a. *The linker from the source of knowledge*

These types of linkers come from the exporting technology. They act as a bridge between the Indonesian Air Force and the former operator, manufacturer and another body that has a relationship with the acquisition of the weapon system, including the hardware and software that are currently being used by the Indonesian Air Force. According to the function and type

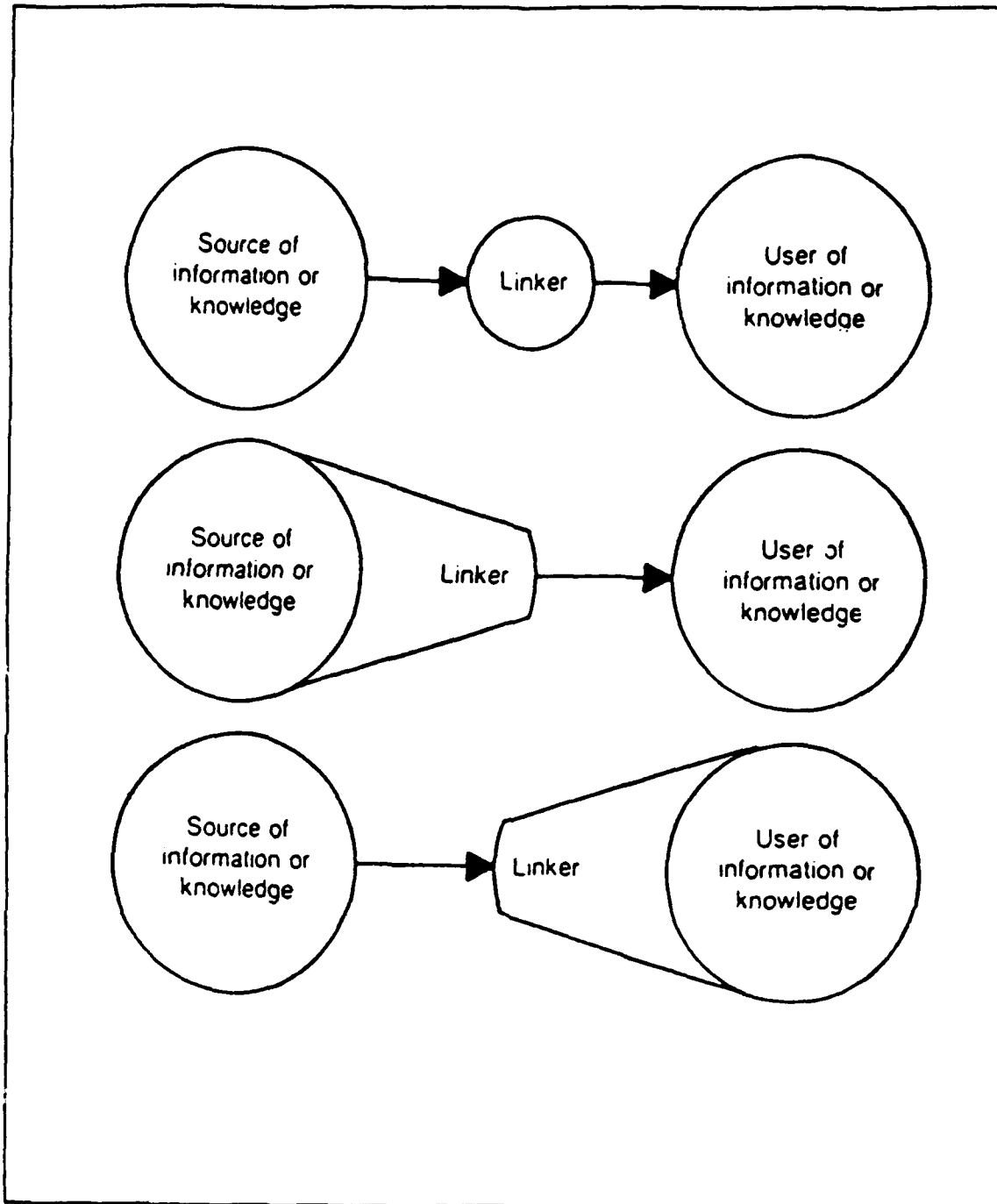


Figure 10. Linker Position In The Flow of Knowledge.

of the knowledge, there should be a technical representative who also acts as an advisor and in some cases can be pictured as a linker. These personnel usually come from:

(1) *Foreign Aircraft or Avionic Industry.* The foreign aircraft industry is a potential source of knowledge for the Indonesian Air Force, since almost all of its weapon systems are imported from foreign countries. According to the type of the aircraft that is currently in use, the possible source of linkers from foreign aircraft industry are : (a) Northrop Aircraft corporation, (b) Mc Donald Douglas, (c) General Dynamics, (d) British Aerospace, etc.

(2) *Foreign Defense Force Agency.* The Foreign Defense Force Agency also can be used by the potential linker, since most of the publications, technical manuals, operation manuals and basic knowledge for operating and handling of the weapon system including the aircraft, ground support equipment, avionic, armament, etc. is coming from the Air Force, Navy or Army where the weapon systems are purchased such as: (a) United States Air Force, (b) Royal Air Force, (c) Royal Australian Air Force, etc.

b. *The linker between the source of knowledge and the user.*

In this contact the linker is the institution or the body that works in aeronautical and avionic or other weapon system areas, beside the body or institutional as mentioned above. The institution or the individual that who might have a relation with the maintenance technician skill development consists of :

- (1) *Technical institution*
- (2) *Research and development center*
- (3) *Civilian aviation companies*
- (4) *The Indonesian Aircraft Industry (IPTN)*
- (5) *Etc.*

c. *Linker within the organization*

The linkers within the organization of the Indonesian Air Force are made up of an individual or a group of Indonesian Air Force Personnel who have the ability and power to adopt the knowledge from external sources of

knowledge and transfer it into the internal potential user within the organization of the Indonesian Air Force. These type of linkers can be categorized into two categories :

(1) *Formal Linker*. In theory, the formal linker is the early adopter who is able to act as an innovator and in special cases his/her act can determine or has a direct impact to the innovation process. The types of linker are made up of : (a) technical experts, (b) former trainees from the Foreign Training Institution, (c) instructors of the Indonesian Air Force Educational and Training Institution (d) a groups of instructors, etc.

(2) *Informal Linker*. Informal linkers are an individual , a group or a body that has indirect effect in the innovation process. Opinion leadership is an important role in the technician skill development program. Opinion leaders have a responsibility to improve personnel skills capabilities according to the needs of the mission requirements. The opinion leaders include the : (a) Commanding Officer, (b) Officer in Charge (c) N.C.O in charge and (d) Senior Technician. etc.

2. Media Selection

The flow of knowledge is determined by the quality and the effectiveness of the communication process, in some cases the media acts as a carrier to transfer the information from the source of knowledge to the user or receiver. Timely communication media gradually improve, from the conventional to the modern ways, according to the situation and operation requirement. The important thing should be considered in its application. It must select the accurate channel according to the contact and situation where the process is to be applied. In general the communication media are:

- Face to face, through the informal training, briefing, interview, etc
- Non-verbal communication, through pictures, mime, etc.
- Visual aids, through video, slide projector, movie, TV program, etc.
- Voice, through radio, oral presentations, etc.
- Electronic mailing system, through distributed database systems and by utilization of computer based information systems.

We believe that there are now identifiable good ways to communicate in the world. However, in any action must find the feasible solution, by utilizing the certain concept for overcoming the presenting problem. The Indonesian Air up to now is on the way to develop forces by utilizing modern types of weapon systems technology, while allowing communication media to stagnate and fall behind in its development. This problem will generate a myriad of problems if the Indonesian Air Force does not carefully select the media which correspond to particular needs and certain conditions. There are two suggested mean of media selection :

a. Short Run

In the short run planning, we use the conventional medium, maximize the utilization and the benefits of informal training programs, and prepare the framework of the utilization of the modern communication medium.

b. Long Run

In the long run, our aim is to improve the communication and flow of the knowledge by utilizing computer-based information system and an expert system for solving the problem.

In summary, linker and media selection is one part of the technology transfer element that has direct impact in influencing the flow of the knowledge from the source of knowledge to the potential user. Conceptually there are three types of linkers if it is observed from changing positions. Especially in relation with the Indonesian Air Force Maintenance Technician skill improvement, the linkers consist of the linker that come from both the foreign and domestic sources. Media selection also an important thing to be considered.

C. REQUIREMENT DETERMINATION

Requirement determination is necessary before taking any action. The requirement can be determined by taking the following steps:

1. Organization Requirement

The organization is an important part of the innovation process, since the organization plays a decisive role in organizing and overseeing the proc-

ess of the technology transfer. Some authors saw that the organization is also becoming the important factor in maintaining the flow of knowledge. We know that there are many ways of thinking in determining the organization requirement, depending on the purpose and context of the organization itself. To insure consistent skill development, the organization requirement should have the capability to preserve the knowledge, to aid the process in accomplishing the objective, provide careers and create the innovation capability for the subordinate members. Besides these capabilities the organizational behavior is also important. Ideally this behavior should have the capability to manage in spite of its overwhelming complexity. Ultimately the organizational work gets done by the subordinate, individually or collectively on their own or with technology. Therefore, the management of organizational behavior is a control for the management task that involves the capacity to : (1) understand the pattern of the individuals, groups and organizations, (2) to predict what behavioral responses will be elicited by managerial actions, and (3) to use this understanding and to predict useful controls. The predictive ability model of technology transfer is a tool for overcoming the enigma in innovating through organizational behavior.

2. Documentation Requirement

The method of collecting information about both the information of the concept of technology and the applicant or the user also becomes part of the factors to be considered. Basically the requirement for the documentation is to maintain its capability to collect data that might prove beneficial to the further development. In the skill development of maintenance technicians, this documentation should include the information regarding the weapon systems technology currently being used as well as information regarding personnel skills and manpower.

Especially for the weapon system technology, initial documentation is made up of : (1) technical and maintenance data collection records , (2) flight manuals, (3) maintenance and repair manuals that consist of the general description of the weapons system itself and procedures for conducting the

maintenance and repair, and (4) the catalogs or illustrated part breakdowns for ordering the spare parts. These initial documentations may help the maintenance technicians in conducting their work and overcoming their problems. But on the other hand, since the evolution of the system usually improves, the documentation also needs to be up dated. This problem becomes a handicap for the importing technology countries like Indonesia if they do not have certain concepts to adopt the concept of technology. The application of technology transfer is an important role in improving the linker role to transfer and distribute this new concept.

3. Distribution Requirement

In the technology transfer concept the term of distribution is the way for marketing the new concept of knowledge or information. The specific requirements should correspond to the problem, and the implementation of the concept that is currently being used should be distributed by effective and efficient ways. The way to distribute the innovation can be done by (1) one to one/small group discussion within the organization such as a squadron, wing, air base etc, depending on the size and the authorization of this concept., (2) symposia, and (3) directories of the subordinate that are interested in technology transfer. As has already been mentioned, Indonesia is one of the importers or the users of technology. Language is therefore a primary handicap in distributing the information, beside the media and the technological concept itself. The role of the linker remains important in this activity. The following paragraph will discuss this issue.

4. Linker Requirement

In the previous chapter the role and characteristics of the linker were identified . Conceptually the requirement of the linker is quite different. The occupation of the knowledge that he/she has must also be adopted. In maintenance activity there are three types of linkers namely (1) the linker from the source of knowledge, (2) the linker between the source of knowledge and receiver/user and (3) linker within an organization. There is a positive correlation between "innovator and "linker", and through this correlation the linker

is valuable to the user organization. Besides this requirement, ideally the linker should have these characteristics : (1) be innovative, (2) have more information contact, (3) be able to accept risk, (4) have high credibility, (5) capable to adopt output into useful product, and finally be able to inject the user needs into the project selection.

5. Project Selection Requirement

In determining the project selection we adopted the Rogers and Jain opinion (Creighton and Jolly 1980 p.8). They have shown that ".... a basic reason for the lack of research utilization is that the process is often begun with the research process, rather than the clients' needs...". There is an obvious benefit or receivers become more committed much earlier to the technology transfer effort. It is important to integrate the technological information, and the maintenance information with the personnel skill or manpower information. There are two directions of the flow of information, i.e., research and development to the user and in reverse, potential user research and development. The certain requirement that matches with the maintenance technician skill development should have a potential to improve the capacity.

6. Capacity Requirement

In respect to the technology transfer concept, capacity refers to the ability and capability of the potential user to utilize new and/or innovative ideas. In general, there are three aspects to consider i.e., skills, education and traits. High technology ideas often require the practice of new knowledge. For the Indonesian Air Force maintenance technician skill development, the capacity refers to the ability and the capability of the technician as an individual or as a group to increase their knowledge and developing new concepts , procedures and the methods for overcoming the maintenance problem. It is quite obvious that the requirement of the capacity should be able to improve personnel credibility. These issues will be discussed in the following paragraph.

7. Credibility Requirement

Conceptually credibility is an obvious factor in the acceptance of information that relates to potential innovation. Especially related with the maintenance technicians skill development, the requirement of the credibility is the capability to improve : (1) the perception of the expertise, (2) reliability, (3) intention, (4) creativity, (5) and foresightedness. How the potential user reacts to the information and whether the potential user decides to adopt are greatly effected by the perceived credibility.

8. Reward Requirement

As Lingwood and Morris comment (Creighton and Jolly 1980 p.82) "rewards are the glue which hold organizations together and provide the response to individual needs for recognition and accomplishment."

Conventional wisdom demands that how the reward structure of the organization is perceived by an individual will have a great impact on an idea flow and the adoption of innovation. A manager's checklist of possible rewards to the individual must consider both extrinsic and intrinsic rewards. The intrinsic rewards are related to the work itself such as opportunity to use skills, intellectual challenge, freedom to follow ideas and peer recognition. The extrinsic rewards include good salary, higher administrative authority, and favorable working conditions. Intrinsic rewards apparently have considerably more strength in maintenance technician skill development, as means to motivate persons to consider and to introduce new concepts, and devices, and to create the individual willingness.

9. Willingness Requirement

Willingness relates to the individual's ability and/desire to accept change. Awareness,even firsthand knowledge of a new and /innovative idea, is not sufficient to assure its use. There must be a willingness and interest or, perhaps more significantly, an internal motivation to utilize a better method, process or device. In improving capability, this ability becomes the primary requirement, since willingness becomes the internal power for individual motivation.

In summary, the nine factors of the technology transfer concept are the powerful drives for creating motivation and the innovative habit.

D. PROGRAM DEVELOPMENT

As mentioned in previous chapters, the Indonesian Air Force in its operations utilizes the type of weapon systems that were imported from foreign countries. In this case the utilization of technology transfer concept also had been applied even though in informal ways. The following section will discuss the further development and its applications to improve the maintenance technician skill capability. Conceptually the program is made up of five stages : (1) preliminary program, (2) program possibilities, (3) program initiation, (4) program execution, and (5) program outcome test and evaluation.

1. Preliminary Program

Before the main program activities are undertaken, it is necessary to develop the preliminary program. This activity is addressed to design the concept which provide a basis for further innovation effort. Like a common activity this activity consists of : (1) determine the objective (2) Identify the aid and barrier (3) develop occupational survey report, and finally decide a further innovation program.

2. Program Possibilities

From the preliminary program will arise specific ideas for possible programs. They may be technical concepts for development that are possibly feasible. They may also be perceptions of the costumer who is interested in product or process changes. Costumer-oriented perspectives may originate with the training technology, personnel distribution, or managerial personnel who develop these ideas out of their own imagination or from direct contact with the operational unit or personnel user. Recently I identified that the possible program for improving the Indonesian Air Force Maintenance Technician skill is done by conducting the innovation program through increasing the role of the linker and job opportunities by application of the job task and proficiency guide, the common job task is depicted in Appendix B. These possibilities will be assumed as a base of the initiation of further programs.

3. Program Initiation

The initiation program is conducted as the consequence of the ideas that evolve through the training technology, personnel distribution discussion and explanation of training technology efforts. The activities during this phase include attempts to match the direction of training technology or skill development work with perceived personnel user or operational units. Inevitably, a specific of the planning, programming and budgeting system or (PPBS) and Initiation Decision Report (IDR) is determined in this phase. The IDR sample is shown at Appendix C.

4. Program Execution

The execution of the program should be conducted after the preparation activities have been accomplished. This program is conducted as the application program that consists of:

a. Increasing the role of Linker

The role of the linker is important in technology transfer and innovation processes. The improvement of the role of linker can be provided through the benefit of the former foreign trainees as the early adopters, technical representative from the former operator or manufacturer or the change agent to the linker.

b. The application of the Job Task or Proficiency Guide

The application of the Job Task or Proficiency Guide is also a feasible tool for improving the skill of maintenance technicians. The Job task is designed as a documentation tool that might be able to show what kind of assigned job and the remark for each technician carried out in the certain period or certain job possession. Through this documentation, the supervisor or officer in charge can identify the skill level for each member of maintenance technician and he/she can determine what kind of task should be carried out for further skill development. The sample Job Task is shown in Appendix B.

5. Program Outcome Test and Evaluation

After program execution is completed, the test and evaluation of the outcome is necessary for identifying the degree of the innovation improvement. The sample of the Master Plan of the test is shown in the Appendix D. This program is designed to know the results of the program and to compare it with the prior expectation and the current user perception. Through careful evaluation it should be able to predict more accurately the possibilities of re-training or redevelopment.

V. CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

A. CONCLUSION

From the previous chapter it can be seen that the Indonesian Air Force is the user of the knowledge or technology from the exporter technology countries. In this case the operational and the personnel capability is influenced by the quality and the flow rate of the information technology from the country or the former operator of its weapon system. Beside the factor of documentation, the distribution and the personnel skills for maintenance technicians are necessary if the innovations are to be implemented. Keeping the balanced condition between the technological need requirement and personnel skill occupation requires supervision. The possible and feasible skill development tools are also important to be considered. One of the possible and feasible tools is the technology transfer concept.

Conceptually, technology transfer is the process of transferring the new concept to the ultimate user/receiver, through the role of the linker. Theoretically, it matches as the needs of the Indonesian Air Forces technician skill development program, since the Indonesian Air Force is a user of foreign technology. An important consideration is the selection of predictive factors which match to the current situation and have a high success rate of innovative behavior. The discussion of the barriers, aids and the possible application of technology transfer to the Indonesian Air Force maintenance technician was conducted in the previous chapter.

In this discussion, it was concluded that technology transfer is a feasible tool for improving the skills of the Indonesian Air Force technician. The tool may be applied in the short-run development program through the application of the "Job Task or Proficiency Guide " and the increasing role of the linker. There are three types of linkers : (1) the linker from the source of the knowledge, (2) the linker between the source of the knowledge, (3) the linker within

the organization of the Indonesian Air Force. The effective utilization of communication and media/channels also becomes a vital tool in this program.

In the long run it might be feasible to use the tool for planning and further development through the improvement of the documentation and distribution system by utilizing the computer-based information. Beside improving the innovation program the Indonesian Air Force would be wise to incorporate the tool into the training program and finally into the Standardization Program.

B. RECOMMENDATION FOR FUTURE RESEARCH

Since the Indonesian Air Force in its operation utilizes the weapon systems that are imported from foreign countries, the improvement of the application of technology transfer is strongly needed. The way to apply this concept can be conducted by developing :

1. The body of the Technology Transfer Assessment Center.
2. A Knowledge Based Information System.
3. Innovativeness development through subordinates.
4. Change the agents to linkers.
5. A sequential, three step training program.
6. An "integrated logistic support program".

Finally, for the future research and skill development it is recommended, that the Indonesian Air Force conduct an innovation and improvement effort of the current training Syllabus for basic technical knowledge, on site and on the job training syllabus for improving skill as well as a job proficiency guide handbook for documentation and skill monitoring purposes, according to the technological improvement.

APPENDIX A. PROFESSIONAL PREFERENCE CENSUS

This Sample preference census adopted from (Creighton, Jolly and Denning 1972, pp 74-77), with a little modifications.

1. Assuming that you were to make the Indonesian Air force career, what would be the highest rank to which you would aspire ?
 - a) Major
 - b) Lieutenant Colonel
 - c) Colonel
 - d) First Marshall
 - e) Vice Marshall
 - f) Marshall
2. Indicate the type of information upon which you would place the highest credibility.
 - a) Personal knowledge
 - b) Associated staff
 - c) Vendors and/or trade councils
 - d) Literature _ Journals, books, etc
 - e) Analysis and experimentation
3. Indicate which combination of words, when placed in the following sentence, would most accurately describe you: I feel that I hear about new work-related developments in my professional area _____ most of my colleagues.
 - a) considerably before
 - b) sooner than
 - c) at about the same time as
 - d) later than
 - e) sometime after
4. In the past year, how many non routine, related projects have been completed for which you supplied the original idea ?
 - a) 0
 - b) 1-2
 - c) 3-4
 - d) 5-6
 - e) More than the above
5. Indicated the number of technical and/ or scientific society meetings and/or conventions which you attended last year which involved personnel other than immediate circle of colleagues.
 - a) 0
 - b) 1-2
 - c) 3-4
 - d) 5-6
 - e) More than the above
6. When you are on the job, do you most prefer work is
 - a) concerned with accomplishing) concerned with accomplishing those
a specific task tasks for which I am individually responsible
 - b) concerned with attempting to solve a challenging but not specially assigned task
 - d) concerned with the efficient utilization of resources
 - e) None of the above.

7. In the past month how many times have you sought further information about a new idea or ideas which you thought to be useful to your work ?
 - a) 0
 - b) 1-2
 - c) 3-4
 - d) 5-6
 - e) More than the above
8. Indicated the frequency with your colleagues came to you in the past month for work_ related information and/or advice.
 - a) 0-2
 - b) 3-4
 - c) 8-12
 - d) 8-10
 - e) More than the above
9. Indicate the level within the social strata to which you aspire to be 10 years from now.
 - a) Upper
 - b) Lower-Upper
 - c) Upper-Middle
 - b) Middle
 - e) Lower-Middle
10. Indicate the dollar budget for which you have control at your present billet.
 - a) 0-500,000
 - b) 500,001 to 1,000,000
 - c) 1,000,001 to 5,000,000
 - d) 5,000,001 to 10,000,000
 - e) More than above
11. In your experience, which of the following do you tend to relay most heavily upon as source of technical information ?
 - a) Professional technical and trade journals.
 - b) Representative or documentation generated by suppliers of potential suppliers
 - c) Ideas which were previously used by yourself in similar situations.
 - d) Selected members of your staff.
 - e) Sources which do not fall into any of the above categories.
12. Indicate what you consider your primary reference group to be
 - a) Community associates
 - b) Officer within your specialized
 - c) Personal friend within the Air Force
 - d) Work-related colleagues
 - e) People other than those listed above
13. Indicate which the total number of journals, magazines, and newspapers which you regularly read :
 - a) 1-2
 - b) 3-4
 - c) 5-7
 - d) 8-10
 - e) More than above
14. Indicate which of the following best characterizes your approach to an innovative idea :
 - a) Venturesome-very eager
 - c) Deliberate for sometime before adopting

- | | |
|------------------------------|-------------------------------------|
| to try new ideas | a new idea. |
| b) Discreet use of new ideas | d) Skeptical and cautious |
| | e) Prefer to only use proven ideas. |

15. During the last month indicate the relative frequency with which you recommended a specific journal and/or magazine article to a colleague

- | | |
|--------|------------------------|
| a) 1-2 | d) 8-10 |
| b) 3-4 | e) More than the above |
| c) 5-7 | |

16. How many miles do you travel a year independent of any permanent change of station ?

- | | |
|---------------------|------------------------|
| a) 0-5,000 | d) 30,001 to 50,000 |
| b) 5,001 to 15,000 | e) More than the above |
| c) 15,001 to 30,000 | |

17. Mr. T, a maintenance technician, who is married and has three children recently decided to perform some major improvement upon his house (cost approximately \$ 1,000). Mr.T. realized that the improvements were not urgently required but would make life at home more comfortable for the T family. Consequently, Mr.T. was faced with a decision as to how he should finance the home improvements because such seemed to be the sole determinant as to when the T's could utilize these improvements. Indicate which of the following financial decisions you would advise Mr.T. to make his home improvements.

- | | |
|--|--|
| a) Borrow the necessary money immediately at 18% annual interest. | c) Save one year and borrow the remaining at 7 %annual interest. |
| b) Save for 6 months and borrow the remainder at 10 % annual interest. | d) Save for two years and pay cash for the improvement. |

18. Indicate Which one of the following does not describe a new product or new process.

- | | |
|--|--------------------|
| a) Biodegradeable plastics | d) Xeroradiography |
| b) ammi lift dock | e) Laser anodizing |
| c) recycled Plastics as concrete aggregate | |

19. Mr.E, an electrical engineer, who married and has one child, has been working for a large electronics corporation since graduation from college five years ago. He is assured of a lifetime job with a modest, though adequate, salary, and liberal pension benefits upon retirement. On the other hand, it is very unlikely that his salary will increase much before he retires. While attending a convention, Mr. E is offered a job with a small, newly founded company which has a highly uncertain future. The new job would pay more to start and would offer the possibility of a

share in the ownership if the company survived the competition of the larger firms. Imagine that you are advising Mr.A. Listed below are several probabilities or odds of the new company's proving financially sound. Please check the lowest probability that you would consider acceptable to make it worthwhile for Mr.E to take the job.

- a) The chances are 1 in 10 that the company will prove financially sound
- b) " " " 3 in 10 " " " " " "
- c) " " " 5 in 10 " " " " " "
- d) " " " 7 in 10 " " " " " "
- e) " " " 9 in 10 " " " " " "

20. Biographical data.

- a) Please indicate the type of organization you are working in at the present time.

- b) Please indicate the title of your billet and present rank.

- c) How many years have you held your present rank ?
- d) How many years did you hold your previous rank ?
- e) How many years of post_high school education have you attended ?

**APPENDIX B. COMMON TASK PERFORMED BY FIRST-ENLISTMENT A.P.G
PERSONNEL(SAMPLE)**

Name	: Subandijo
Job skill level	: 1
Starting Job Evaluation	: December 25, 1990
Finishing Job Evaluation	: March 24, 1991
Supervisor	: Richard A. McGonnical
Remark	: Excellent eligible to promote higher job occupation.

Task	Number Task Performed
I101 Walk Wing or Tail during Towing Operation	85
I102 Inspect Tires	90
I103 Ground Aircraft	95
I103 Inspect Access Panel	90
I104 Operate Maintenance Stand and Ground Support Equipment	74 74
I105 Remove Access Panels	90
I105 Inspect Landing Gear Struts	80
I106 Inspect Airframe Structure	90
I107 Inspect Seats, Seat belts Inertial reels, or Shoulder harness	75
I108 Inspect Access Doors and Latches	90
I109 Inspect Aircraft for Corrosion	65
I109 Inspect Wheel Assembly	95
G101 Operate Portable Light	60
G102 Jack Aircraft using Tripod Jack	60
G103 Remove Aircraft Hardware	65
G103 Marshall Aircraft	65
G104 Position A.G.E to Aircraft	60
G104 Perform Aircraft Launch Checklist Procedures	60
G105 Fueling and Defueling using single Point and Gravity Methods	65
G105 Stand Fireguard	50
G105 Perform Aircraft Recovery Checklist Procedures	90
A101 Annotate AFTO/AUNAVAIR Form dealing with Vehicle Inspection, Engine Data, Calendar Item Inspection and Delay Discrepancy Document	85
A102 Annotate Aerospace Vehicle Flight status and Maintenance Document	85
A103 Annotate Maintenance Data Collection Record	75
A104 Annotate Maintenance and Work Document	75
S101 Service Engine Oil and taking oil sample	90
S102 Service Hydraulic Systems	75
S103 Service Tire	65
S104 Lubricate Aircraft Component	65

S105	Remove Bulb	25
S105	Bleed Hydraulic systems	65
S106	Remove and Install Battery	45
S107	Remove and Install Drag Chute	80
S108	Service Oxygen Systems	50
SXX	Etc	XX

APPENDIX C. INITIATION DECISION REPORT (IDR)

Note: This concept is adopted from J. W. Crieghton, J. A. Jolly and
and Stephen Laner, 1985 p. 88.

A. PROGRAM DEFINITION

- Evidence
- Quantification

(extend, frequency, Duration)

B. STATE OF THE ART ASSESSMENT

- Current Practice
- Commercially available technology
- Track RDT&E by others

1. Level of interest
2. Direction
3. Rate of change
4. Alternative

(Risk, Pay-off, cost, Time to complete)

C. TRAINING TECHNOLOGY GOALS

- Define Target

D. CAPABILITY GOALS

- Integrated R&D Tasks
 - Technology Improvement
1. Systems Development
 2. Component Development

APPENDIX D. SAMPLE OF TEST AND EVALUATION MASTER PLAN (TEMP)

A. MISSION (PLANNED USE)

B. SYSTEM (ITEM)

C. DEVELOPMENT GOALS

- Performance (operational & Technical)
- Logistic (costs, People, Support, etc)

D. TEST SCHEDULES

- Developmental (Test Program)
- Operational (Application Program)

1. Test Issues

2. Test data

E. RESOURCE SCHEDULE

- Dollars
- People and Equipment

LIST OF REFERENCES

1. Boettinger, H. M., *"Technology in the manager's future"* Harvard Business Review, v.48, no.6, Nov.-Dec. 1970.
2. Cook, L. G., *"Technology Transfer in 'Partially Developed' Countries,"* Technology Transfer; Proceedings of the NATO Advanced Study Institute on Technology Transfer, 24 June, 1973, ed. H. F. Davidson et al, Leiden, The Netherlands, Nordhoff International, Publishing, 1974.
3. Bright, M. J., *"Research Development and Technological Innovation"*, Homewood, Illinois, Richard D. Irwin Inc., 1964.
4. Cook, L. G., *"Technology Transfer in 'Partial Developed' Countries,"* Technology Transfer: Proceedings of the NATO Advanced Study Institute on Technology Transfer 24 June-6 July, 1973, ed. H. F. Davidson et al, Leiden, The Netherlands, Nordhoff International Publishing, 1974.
5. Creighton, J. L., Jolly, J. A. and Denning, S. A., *"Enhancement of Research and Development Output Utilization Efficiencies: Linker Concept Methodology in the Technology Transfer Process"*, Naval Postgraduate School, Monterey, California, 1972.
6. Creighton, J. W. Jolly, J. A., *"Technology Transfer in Research and Development"*, Naval Postgraduate School, Monterey, California, 1975.
7. Creighton, J. W., Jolly, J. A., *"Technology Transfer Research Utilization and User Stimulation"*, Naval Postgraduate School, Naval Material Command, Naval Facilities Engineering Command, 1980.
8. Cox, L. A., *"Industrial Innovation : The Role of the People and Cost Factors,"* Research Management, v. XIX, no. 2, March 1976.
9. Gartner, J., and Naiman, C. S., *"Overcoming the Barriers to Technology Transfer,"* Research Management, v. XIX, no.2, March 1976.
10. Departement of Administrative Science, *"Student Guide for Thesis"* ,1983.
11. Gilmore, John S., *"The Environment and the the Action in Technology Transfer:"*1970-80,in a report of a conference sponsored by Denver Research Institute, University of Denver, Sept. 26 - 28, 1969, Washington, D. C. Dept. of Commerce N 70 - 26339, 1969.
12. Golhar, Joel D., *"Information, Idea Generation and Technological Innovations Technology Transfer"* by Davidson, Criton, & Goldhar. Noordhoff International, 1974.

13. Globe, S., Levy, G. W., and Schwartz, C. M., "Key Factors and Events in the Innovation Process," *Research Management*, v. XVI, no.4, July 1973.
14. Gold, B., "Alternate Strategies for Advancing a Company's Technology" *Research Management*, v.XVIII, no. 4, July 1975.
15. Goldhar, J. D., Bragaw, L. K., Schwartz, J. J., "Information Flows, Management Styles, and Technological Innovation" *IEEE Transactions on Engineering Management* v. EM-23 , no. 1 February 1976.
16. Hough, G. W., "Technology Diffusion, Lomond System Inc.", Mt. Airy, Maryland, 1975.
17. Jerwis, P., and Sinclair, T. C., "Conditions for Successful Technology Transfer and innovation in the U.K.", *Technology Transfer Proceedings of the NATO Advanced Study Institute on Technology Transfer*, 24 June - 6 July, 1973, ed. H. F. Davidson et al, Leiden, The Netherlands, Nordhoff International Publishing, 1974.
18. Jerwis, P., "Innovation and Technology Transfer - Roles and Characteristics of Individuals," *IEEE Transaction Engineering Management* v. EM-22, no. 1, February, 1975.
19. Miller, D. B., Miller, D. B., "The Older Technical Professional Managing for Long-Term Technical Vitality," *Research Management*, v. XVIII, no.4 July 1975.
20. Michael L. Tushman & William L. Moore, "Reading in the Management of Innovation", Second Edition, 1988. Dow Jones-Irwin, Homewood, Illinois, 1970.
21. Lyle K. Hochberger, and Bill G. Woolley, "The Roles and Identification of Innovators and Linkers in the Technology Transfer process", Master Thesis Naval Postgraduate School 1977.
22. Mock, J. E., "Barriers and Stimulants to the Transfer of Public Technology," *Technology Transfer: Proceedings of the NATO Advanced Study of Institute on Technology Transfer*, 24 June - 6 July, 1973, ed. H. F. Davidson et al, Leiden, The Netherlands, Nordhoff International Publishing, 1974.
23. Morton, J. A., "Organization for Innovation : A System Approach to to Technical Management", New York, McGraw-Hill, 1971.
24. Myers, S., "Attitude and Innovation," *International Science and Technology*, October 1985.
25. National Institute of Mental Health, " A Distillation of Principles on Research Utilization", v. 1, U.S. Dept. of Health, Education, and Welfare, Government Printing Office, 1972.

26. Pearson, A. W., and Richards, A., "*Current Problem in Transferring Science to Technology*", Technology Transfer Proceeding of the NATO Advanced Study Institute on Technology Transfer, 24 June - 6 July, 1973, ed. H. G. Davidson et al, Leiden, The Netherland. Nordhoff International Publishing, 1974.
27. Rogers, E. M., and Shoemaker, F. f., "*Communications of Innovation*" A Cross Culture Approach, N. Y. Free Press of Glendo, 1971.
28. Rogers. E. M., "*Diffusion of Innovation*", Third Edition, 1983.
29. Schwartz, J. J., "*A Strategy for Innovation*," University of Michican Business Review, XXVII, no. 6 November 1975.
30. Watson, C. E., "*Developing Creative People*", Research Management, v. XVII. no 3, May 1975.
31. Welles, J. G., "*Contributions to Technology and Their Transfer : The NASA Experience*, " Technology Transfer; Proceedings of the NATO Advanced Study Institute on Technology Transfer, 24 July, 1973, ed. H. F. Davidson et al, Leiden, The Netherlands Nordhoff International Publishing, 1974.

INITIAL DISTRIBUTION LIST

	No. Copies
1. Defense Technical Information Center Cameron Station Alexandria, VA 22304-6145	2
2. Library, Code 52 Naval Postgraduate School Monterey, CA 93943-5002	2
3. Chairman, Code 36 Department of Administrative Sciences Naval Postgraduate School Monterey, CA 93943-5000	1
4. Professor Richard A. McGonigal, Code As/Mb Department of Administrative Science Naval Postgraduate School Monterey, CA 93943-5000	1
5. Professor Alice Crawford Code As/Cr Department of Administrative Science Naval Postgraduate School Monterey, CA 93943-5000	1
7. Chief of the Defense Attache Embassy of the Republic of Indonesia 2020 Massachusetts Avenue N.W. Washington, D.C. 20036	1
8. Director of Education of the Indonesian Air Force Ditdik Mabes TNI-AU JI Gatot Subroto no. 72 Jakarta-Selatan, Indonesia	1
9. Director of Aeronautical of the Indonesian Air Force Ditaero Mabes TNI-AU JI Gatot Subroto no. 72 Jakarta-Selatan, Indonesia	1