THE CHALLENGE OF INCREASING SCIENTIFIC AND TECHNOLOGICAL MANPOWER IN THAILAND

By

USANEE KULINTORNPRASERT

Bachelor of Science
Chulalongkorn University
Bangkok, Thailand
1988

Master of Science
Chulalongkorn University
Bangkok, Thailand
1992

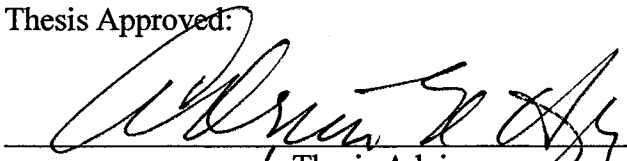
Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF EDUCATION
May, 2002

THE CHALLENGE OF INCREASING SCIENTIFIC

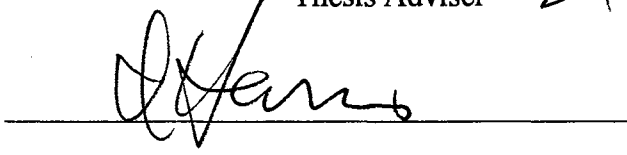
AND TECHNOLOGICAL MANPOWER IN

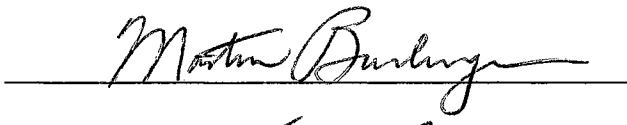
THAILAND

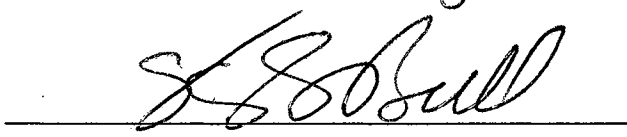
Thesis Approved:



Thesis Adviser







Dean of the Graduate College

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to Dr. Adrienne Hyle, adviser and committee chairperson, for her constant support, guidance and belief in my ability to write and complete this dissertation. In particular, her patience and continued efforts served as an inspiration throughout my doctoral experience. I would also like to thank the other members of my committee, Dr. Martin Burlingame, Dr. Kay S. Bull, and Dr. Edward L.Harris for their willingness to serve on my committee in addition to their many other responsibilities. Furthermore, I would like to express my gratitude to the faculty and staff of the Department of Educational Administration and Higher Education for their instruction and support.

A special thanks goes to President Pornchai Mongkhonvanit and Professor Twee Hormchong, Senior Vice President of Siam University, who paved the road to grow my professional development. To the other members of the Siam Cohort, my thanks to their constant assistance and input which allowed this study to be completed.

I would like to give all honor and glory to my heavenly parents who guided me and given me strength throughout my life as well as helping me know the value of education. Even if they could not congratulate my success face to face, they would feel proud of their daughter in the other world.

To my brother and sisters, friends, and faculty who have supported and encouraged me, I would like to give my special thanks to them. Without their patience and understanding throughout this entire process, it would be difficult or even impossible

policymakers, instructors and students, who were willing to provide me with the useful information for my research.

Last, but not least, I am eager to express my great love and appreciation to Mr. Ekachai, my husband and best friend, who fully supported and push me to persue this academic growth throughout the entire process. My half success should belong to you, my dearest friend.

TABLE OF CONTENTS

Chapter Page

I. DESIGN OF THE STUDY 1

Statement of the Problem 4
Purpose of the Study 6
Theoretical Framework 6
Dramaturgical Analysis 7
Procedures 8
Significant of the study 13
Research 13
Practice 13
Theory 13
Summary....14
Reporting 14

II. REVIEW OF THE LITERATURE 15

Some Aspects of the Meaning of S&T Manpower 16
The Contribution of S&T Manpower toward National Development...17
Science and Technology in Japan 18
Science and Technology in South Korea 19
Science and Technology in Singapore 20
Science and Technology in Malaysia 22
From Crisis to Sustainable: Strategy for Thailand 23
Science and Technology Policy and Plan 25
Scientific and Technological Manpower 27
Dramaturgical Analysis 29
Chapter Summary 31

III. DATA COLLECTION 32

Procedure 32
Participants 34
Policymakers 35
Educators 37
Students 39
Sites 41
The Ministry of University Affairs 41
Institute for The Promotion of Teaching Science and Technology 42
National Science and Technology Development Agency 43
Chapter Summary 45

IV. PRESENTATION OF THE DATA 46

Scene 47
Policymaker's perspective 47
Educator's perspective 52
Student's perspective 54
Act 56
Agent/Agency 62
Policymaker's perspective 63
Educator's perspective 69
Student's perspective 70
Purpose 72
Chapter Summary 75

V. ANALYSIS OF THE DATA 76

Scene 77
Act 77
Agent/Agency 78
Institute for The Promotion of Teaching Science and Technology 78
The Ministry of University Affairs 79
National Science and Technology Development Agency 81
Purpose 81
Chapter Summary 82

VI. SUMMARY, CONCLUSIONS, RECOMMENDATIONS, IMPLICATIONS AND COMMENTARY 84

Summary of the Study 84
Data Needs and Sources 85
Data Collection 85
Data Presentation 85
Data Analysis 86
Conclusions 87
Recommendations and Implications 88
Theory 88
Research 89
Practice 89
Commentary 89

REFERENCE 92

APPENDICES 96

APPENDIX A 96

APPENDIX B 98

APPENDIX C 99

LIST OF TABLES

Table Page

1. The ranking of factors influencing competitive science and technology performance of Thailand during 1992-2000 3
2. The variety of respondents can be seen from their statuses.....35
3. Participants and their sites.....45
4. The scene which performed the current situation of S&T capacity in each stakeholder perspective.....56
5. The act which conclude the main problem in S&T manpower in the perspective of each stakeholder.....62
6. The agent and agency which role to accelerate S&T manpower development strategies.....72

CHAPTER I

Design of the Study

Science and technology (S&T) play a vital role in a country's development either in economic, social or politic scenes. It is also recognized as a foundation for the long-term economic development of the country (Birasak, 2001). Currently, science and technology are described as the engine for sustaining the development of societies and the driving force in the development of mankind's future (Satoru, 2001). The creation of new scientific knowledge is a vehicle by which technical innovations in health, prosperity, and security of the country as well as the continual development of the human resources. Science and technology contribute to the raising of the standard of living of the population and lead to wealth distribution and improvement of the quality of life (Lagowski, 1994).

As the world heads irreversibly toward economic globalization, we are now faced with the unprecedented challenge upon which science and technology progress has a crucial influence. Competition of knowledge-base economies is becoming increasingly dependent on the development of leading-edge technologies and their rapid application by an economy's innovation system (Shin, 1997). As a result, building up global competitiveness in science and technology is the effective way to deal with competition in such other areas as economy, society, and politics (Birasak, 2001).

Throughout its long history of economic success from the late 1950s through 1996, Thailand had not experienced a single year of negative economic growth. In a very short time, she became a newly industrialized country (NIC) and benefited the people as per capita income increased from US $750 in 1986 to US $2,400 in 1996. Thailand had become a leading exporter of medium-high technology manufactured

goods and continues to supply the world market with her agricultural products (Chalamwong, 1998; Dixon, 2001).

While Thailand's economy traditionally has been agriculturally based, the industrial sector has begun to play a more significant role. However, growth in the industrial sector has been achieved largely through the successful use of imported technologies such as new machinery, equipment, product designs and managerial "know-how" (Chantramonklasri, 1997). However, there is very little evidence that Thailand-based science and technology have played a role in the industrial development. Furthermore, the country's data of scientific and technological capability, as measured by the amount and quality of manpower, and resources devoted to research and development (R&D) and technology transfer was still very low. It has been suggested that the purchase of inappropriate technologies and products contributed to the trade deficit of the country (Yuthavong, 1997).

The 1997 Thai financial crisis marked the end of a decade of remarkable economic growth and structure change. According to the study of the International Institute for Management Development (IMD), Thailand's level of scientific and technological achievement ranked 46th among 47 countries in 1999 and slipped down to the 47th or the lowest in 2000. As Table 1 shows, the weakness in Thailand's science and technology has remained until now (IMD, 1992-2000).

Table1. The ranking of factors influencing competitive science and technology performance of Thailand during 1992-2000

Factor/Year	1992	1993	1994	1995	1996	1997	1998	1999	2000
Overall performance	26	26	26	27	30	29	39	34	33
Domestic economic strength	7	7	8	9	12	12	16	40	38
Internationalization	37	33	28	29	33	25	37	34	21
Government	7	7	6	7	8	18	22	17	23
Finance	22	24	22	24	26	29	44	40	38
Infrastructure	30	34	34	39	42	42	41	43	43
Management	21	22	20	28	31	31	41	41	39
Science and Technology	39	40	43	29	44	32	43	46	47
Manpower	39	36	34	34	40	37	35	33	30

Source: IMD, The World Competitiveness Yearbook, 1992-2000

From the competitive position of Thailand as analyzed by IMD, Thailand is in need of great improvement in three significant areas: infrastructure, manpower, and science and technology. Congestion in the cities and continued poor communications in rural areas highlight the need for improvement in infrastructure. Likewise, the need for trained manpower has been acute for the last decade. For the industrial sector to move up the ladder to produce higher-value products, Thailand needs new technology and machinery, but most of all trained manpower, especially graduates in engineering and science (Bangkok Post, 1997, October 24).

Currently, Thailand is producing about 12,000 engineers and 6,000 scientists at the bachelor level per year, while the demand as quoted by National Science and Technology Development Agency (NSTDA) is for some 17,000 engineers and 10,000 scientists. Moreover, Thailand needs 35,000 more technicians per year. Then again,

the proficiency of graduates will be a matter that may solve some problems in the short run, but the quality of these graduates will be a matter of long term concern (Bangkok Post, 1997, October, 1).

Unfortunately, the country has witnessed an enrollment decline in the scientific and technological tracks. Fewer students choose to study science and technology, and to make matters worse, fewer teachers want to teach these subjects. Furthermore, the existing curriculum places greater emphasis on liberal arts and communications (Phromboon, 2001). In Thailand, less than 40 percent of graduates were majoring in natural science and technology. Whereas, in most other Asian countries (e.g., Japan, Korea, Singapore, and Taiwan), more than 60 percent of graduates were majoring in natural science and technology, including engineering (The Nation, 1997, August 20).

Additionally, the most important problem might be in creating science and technology linkages among the stakeholders, those who need and use science and technology. In the past, the Thai Government had both successes and failures in its early science and technology initiatives. Some of the early initiatives, however, did not achieve a significant degree of success partly because of the problems of centralized control, poor incentives, and inefficient management. Even though there were a great number of science and technology organizations established to support the infrastructure for research and development activities, the technology linkages, originating from public research institutes and universities, did not respond to the users of such technologies in industry (Birasak, 2001).

Statement of the Problem

For science and technology achievement, Singh (1991) suggests that the successful restructuring and development in newly industrializing countries (NICs),

such as Thailand, may be attributed to a number of factors, two of which have a direct bearing upon higher education institutions. The first is quantitative and qualitative scientific and technological manpower. The second is the research and development environment which enables the achievement and sustainability of indigenous industrial development. Higher education institutions play a singularly important role in the training of scientific and technological manpower because they are often the sole suppliers of high-level scientific and technological personnel. Research and development activity, though shared with other research and specialized institutions, is a crucial part of higher education as it strengthens and enhances training capacity (Thailand Development Research Institute Foundation, 1995).

Since the economic collapse, Thailand has realized that education is an important tool in training science and technology personnel. Developing only the economy was not the right strategy. The level of investment in public education, some four percent of the gross national product, and in research and development, two tenths of a percent of the gross national product, are far too low for the production of the knowledge-base economy, what Thailand needs for the future (Bangkok Post, 1997, October, 24). Many seminars, conferences, and studies have revealed that an unskilled manpower base has been one of the underlying factors causing the economic and financial crisis. Additionally, others have highlighted the lack of Thai graduates capable of independent analytical thought as one factor responsible for the country's economic downfall (Office of the National Education Commission, 1999). Business and industrial sectors, at present, are looking to employ knowledge manpower. No longer is cheap labor the only or best qualification (Chalamwong, 1998). As a consequence, Thai education institutions must produce the right portion of manpower

in science and technology relevant to national needs as well as enhance the research and development capacity.

The urgent need to reduce the scientific and technological manpower shortage must become an agenda at the national level and be linked to other dimensions of national development (Thailand Development Research Institute Foundation, 1995). According to dramaturgical analysis, the scene, act, agent, agency, and purpose; the actors and audiences; and front and back stage perspectives are essential components need to help understanding the "performance" of Thailand's challenges for S&T manpower capacity development.

Purpose of the Study

The purpose of the study is to examine the responses of Thai educators and other stakeholders in each organization to the challenge of increasing scientific and technological manpower for the future of Thailand's scientific and technological capabilities. Specifically, in this study, the following will be addressed:

1. Document the realities and perspectives;
2. Examine those realities through Dramaturgical analysis
3. Assess the usefulness of Dramaturgical analysis for understanding the phenomenon surrounding the development of scientific and technological capabilities in Thailand.

Theoretical Framework

As the name suggests, the central principle of this form of analysis is the concept of drama. Life is a stage upon which performers play. The public performance they make (where public is what is done in the present of other people or that affects other people—in other words, most acts are public) are what produce meaning. Thus meaning is produce in action.

Dramaturgical Analysis

Dramaturgical analysis is generally used to understand relatively private performances such as the execution of parent roles. The analysis includes not only the act itself but also and, more important, the meaning produced by the act or the messages that are conveyed by the act (Feldman, 1995).

Dramaturgical analysis may focus on the display or they may focus on what makes up the display. For instance, some dramaturgical analyses are about the meaning of public presentations or ceremonies such as the police funeral or the publication of arrest statistics (Manning, 1977). Other dramaturgical analyses focus on the elements of these performances such as the roles people are playing and the setting in which they are played. Burke's pentad of social action fits this latter sense of dramaturgical analysis. It divides social action into five basic elements: scene, act, agent, agency, and purpose (Burke, 1969). Of course, some analyses combine both the public performance and the elements that make it up. Erving Goffman (1959, 1967, 1974) is one of the best known users of the dramaturgical approach to sociological phenomena. He focused particularly on the concepts of role playing or role taking, front and back stages, ritual, and the control of meaning.

Dramaturgical analysis tends to have a function tone to it. The observation that dramas serve certain purposes should not, however, be taken to imply either that these purposes are necessary or that the particular means of fulfilling the purpose is the only way (Manning, 1992). For example, the budget (reserves) meetings discussed in the section on semiotic squares serve a number of symbolic purposes. They establish the authority and decision-making status of the people who attend them. They express the unity of concern about the buildings by the various organization units (e.g., Facilities, Food Service, Residence Education). This concern for the building helps to draw the

parts of the organization together with a common purpose. This sense of common purpose helps to legitimate all the units. This legitimation may be most helpful to Residence Education because its purpose is the most ambiguous. These symbolic purposes are not, however, necessarily essential to the organization and these meetings are not the only way to accomplish these end (Feldman, 1995).

Fundamental to doing a dramaturgical analysis is the question of what performance is taking place or what meaning is being portrayed to an audience and how the elements that make up the performance contribute to that meaning. Burke's five elements are very useful in this process. The scene is the setting of the performance, the act is what is done during the performance; the agent includes the actors and the roles that they play, the agency is the means through which agents bring about their actions, and the purpose is the reason or motive for the performance. I find it helpful to consider explicitly the audience as well given that a performance may have many audiences and the meaning may be different for each.

Procedures

Tradition has progressed beyond qualitative versus quantitative debates to recognition that research must match research methods with research questions. The choice of qualitative methods is appropriate for some fundamental questions about education (Marshall & Rossman, 1989).

Researcher

I, the researcher, have formally worked in higher education for 10 years, teaching food technology in a private university, while at the same time, serving as the head department for 9 years. My bachelor and master degrees were in the science and technology field. I also worked as a researcher in the research and development

(R&D) division of a Japanese industry for one year. These experiences lead me to pay more attention in national science and technology capacity.

Through the institution of the National Educational Act of B.E. 2542(1999), education in Thailand is entering into a new era. This law recognizes science and technology as one of the five key components of education that the state must provide for all Thai citizens. Science and technological personnel development is key to success. Consequently, Thai higher education institutions must take a crucial role in producing the right portion of human resources (graduates) in science and technology relevant to national needs as well as enhancing research and development capacity.

I have chosen to use Dramaturgical analysis (Manning, 1977) as the theoretical framework. This framework will affect my data gathering and analysis process, as well as interpreting my findings.

Data Needed and Sources

Since this study will examine the responses of educators and other stakeholders to the increasing need of scientific and technological advances and experts in Thailand, I will need to gather perspectives about the new human resource development strategy. Three groups of stakeholders will serve as data sources: policymakers, educators, and students.

Policymakers:

1. Institution for Promotion of Teaching Science and Technology
2. Minister of University Affairs
3. National Science and Technology Development Agency.

Educators:

1. Faculty in nature and applied sciences both in public and private universities.

2. Science teachers in secondary schools

Students:

1. Undergraduate level
2. Graduate level

Data Collection

An open-ended format will be used to conduct the interviews. This format allows for dialogue and interaction. Within the structure of a series of questions, the respondent is able to reconstruct the past and interpret the future (Lincoln & Guba, 1985). Through the interviewing process, I will work at "understand[ing] and put[ing] into large context the interpersonal, social, and culture aspects of the environment" (Lincoln & Guba, 1985, p. 85).

Dramaturgical analysis will be used as the data presentation process in order to examine the stakeholders' reactions to specific roles within the scientific and technological human resource development strategy. Dramaturgical analysis focuses on social action, specifically the roles people are playing and the setting in which they are played. Burke (1969) divided social action into five basic elements: scene, act, agent, agency, and purpose. When these five elements are used as generating principle, it should provide a kind of simplicity that can be developed into considerable complexity, and yet can be discovered beneath its elaboration (Burke, 1969).

Data Analysis

Data will be analyzed simultaneously throughout data collection. This is necessary because it is through the analysis of data that a researcher decides where next to look, who next to interview, or what next to ask (Merriam, 1988).

Dramaturgical analysis is conducted to depict what is taking place or what meaning is being portrayed to an audience and how the elements that make up performance contribute to that meaning. Burke's five elements are very useful in this process. The scene is the setting of the performance, the act is what is done during the performance; the agent includes the actors and the roles that they play, the agency is the means through which agents bring about their actions, and the purpose is the reason or motive for the performance (Feldman, 1995, p. 42).

Research Criteria

Certain research criteria must be met for a qualitative study to be considered trustworthy. Four criteria for judging are credibility, transferability, dependability, and confirmability (Erlandson et al., 1993; Lincoln & Guba, 1985).

Credibility. The relationship between the constructed realities generated by the respondents and the interpretation and transmittance of those realities by the researcher is credibility (Guba & Lincoln, 1989). Thus a credible outcome would be one that "adequately represents both the areas in which these realities converge and the points on which they diverge" (Erlandson et al., 1993, p. 30). To establish credibility of the research data, I will work diligently to separate myself and my biases from that data, and will attempt to depict what the respondents have provided.

Moreover, peer debriefing and member checks will also be used to achieve credibility. Peer debriefing permitted an outside professional to analyze the process and provide feedback about the findings and conclusions in order to challenge, clarify, refine and redirect the study as necessary. Professor Dr. Adrienne Hyle, my dissertation advisor, will serve as this professional. In addition, member checks allow respondents to summarize the data and permit the respondents the opportunity to correct errors of fact or error of interpretation, offer additional information, or judge

the overall adequacy of the interview itself (Guba & Lincoln, 1989). In this study, member checks with stakeholding groups who serve as data sources will be conducted by the researcher throughout the process and upon completion.

Transferability. The degree to which a study's findings can be applied in other situations or with other respondents is transferability (Lincoln & Guba, 1985). Thick description and purposive sampling help facilitate transferability (Erlandson et al., 1993). To that end, data will be presented with enough details to allow the reader sufficient information about context, sample, and methodology to expose its transferability to other situations or similar groups. Three groups of stakeholders will serve as data source: policymakers, educators, and students. The interviewees will continue to be selected to allow the researcher to focus on insights until the point of redundancy of information is met.

Dependability. In a naturalistic study, dependability is the extent to which people not involved in the study, can track the research process and determine which raw data were used to reach corresponding conclusions. In this study, to provide for a check on dependability, keeping detailed records of the data collected and analysis procedures will be conducted. A transcript of each interview should be created from the audiotape of the interviewees for verification or amendment. All documents and notes should be retained for inspection.

Confirmability. The degree to which the results are the product of the focus of inquiry and not the biases of the researcher is confirmability. "The naturalistic researcher does not attempt to ensure that observations are free from contamination by the researcher but rather to trust in the `confirmability' of the data themselves" (Erlandson et al., 1993, p. 34). Confirmability can be addressed in this study by including detailed excerpts from the raw data that supported interpretation and

conclusions drawn by the researcher. An audit trail of interview transcripts, tapes, notes, analysis, and other documents will be kept and made available to committee members.

Significance of the Study

Thailand is looking forward to becoming a high-skill and high-wage country as well as adopting a productivity- and quality-driven approach to the economy. Hence, policymakers, educators, and students have great responsibilities in meeting the continuous demand for skilled and sophisticated manpower in science and technology. The findings of this study may yield significant results to the areas of theory, research, and practice.

Theory

Theoretically, this study carries out the use of Dramaturgical Analysis to expose and provide an explanation for the interaction among members of the sample group as they work toward development of scientific and technological capacities in Thailand.

Research

This study adds information to a limited knowledge base regarding networks diffusion in national policy practices. This study will add an understanding perspective to that knowledge base.

Practice

This study enhances the practice of education by providing policymakers with insight regarding stakeholders' networks. Through this recognition, practice can be enhanced by a concerted effort to recognize and minimize the effects that will have on the effectiveness of maintaining cohesive goals and purposes of the scientific and technological manpower development strategy in Thailand.

Summary

The purpose of the study is to examine the responses of educators and other stakeholders to the challenge of increasing science and its application technology capacity and future for Thai citizens. Qualitative methods allow for "insight, discovery, and interpretation rather than hypothesis testing (Merriam 1988, p. 10). Increasingly the policymaker and/or decision maker should look into the environments surrounding science and technology, through the different stakeholder perspectives. Only serious consideration will enable the country to employ science and technology as a basic for development.

Reporting

Chapter Two reviews the literature. Chapter Three provides the procedure of data collection. Chapter Four presents the data collection. Analysis and interpretation of the report will comprise Chapter Five. Chapter Six includes the summary, implications, conclusions and discussion.

CHAPTER II

Review of the Literature

Why have so many countries recognized the vital contribution of skilled and sophisticated scientific and technological (S&T) personnel to compete in today's economy? Is Thailand producing enough S&T manpower with training suitable for the economic needs? To what extent is Thailand's lack of global competitiveness due to the issue of S&T capabilities? Has the current economic crisis ultimately urged government and stakeholders to cooperate in undertaking their tasks and responsibilities to ensure sufficient qualifies S&T human resource for the ongoing development of Thailand? These questions need to be answered when discussing S&T manpower topics, particularly in the current financial crisis situation of Thailand.

To give the reader an understanding of the significance of S&T manpower to the nation, this chapter provides a review of literature in four sections. The first section provides the meaning of S&T manpower in several aspects. The second section discusses the vital contribution of S&T manpower toward national development in some countries, especially the Newly Industrialized Countries (NICs). The third section displays a brief introduction to Thailand's S&T capabilities in the past and present, the hurdles which Thailand faces in developing her future of S&T manpower capabilities, as well as the contribution of both education institutes and national S&T strategy. The last section of this chapter reviews the literature related to dramaturgical analysis.

Some aspects of the meaning of S&T manpower

Human resources have always been considered as the key element in S&T capabilities. There are several terms to signify the meaning of S&T manpower. UNESCO (1978) defines its "Scientific and Technical Personnel":

> The total number of people participating directly in S&T activities in an institution or unit and, as a rule, paid for their services. This group should include scientists and engineers, and technicians and auxiliary personnel (p. 16)

In the Organization for Economic Co-operation and Development (OECD) (1994), the "R&D Personnel" is defined in terms of employment/ occupation:

> All persons employed directly on R&D should be counted, as well as those providing direct services such as R&D managers, administrators, and clerical staff (p.18)

The Canberra Manual (OECD, 1995) proposes a rather wide definition for the "Human Resource for S&T" which more directly than the first two proposals combines the criteria of education/qualification and occupation:

> Human Resources for S&T are people who fulfill one or other of the following conditions:
>
> a) successfully completed education at the third level in and S&T field of study;
> b) not formally qualified as above , but employed in a S&T occupation where the above qualifications are normally required (p. 69)

These three concepts commonly similar concentrate on the most qualified categories of personnel already engaged in S&T/R&D. At various levels, they all draw on both education and occupation criteria, which sometimes, in practice, may be difficult to distinguish from one another.

In this study, however, the meaning of S&T manpower will be the people who successfully complete higher education in S&T fields and participate directly in S&T activities in an institution or unit.

The Contribution of S&T Manpower toward National Development

The rapid evolution of knowledge in the field of S&T recent decades has brought about substantial and unprecedented changes to today's society. S&T, the key to industrial development in advanced countries, can be effectively used for economic and social development in developing countries. The ability to master and apply S&T is therefore dealt with the process of modernization and development of economies (Lewin, 1992). Keenly aware of this fact, developing countries embarked a variety of programs to support the development of S&T capabilities. Many countries such as Japan, Korea, and Singapore, have been granted with their economic successes, due to the emphasis on the development of S&T capabilities over a period of time (UNESCO, 1991). However, S&T activities require high investment, tangible products from such investments are not certain within a short period of time as well. Therefore, the structure of effective S&T systems and S&T personnel policy need to be developed so that the investment made in research is worthwhile (Cooattanachai, 2000).

Moreover, radically new technologies of production and access to information have begun to permeate our developing world. With in this emphasis has more often than not been on the acquisition of scientific and technological skills and capabilities. Greater proportions of the labor force are being employed in occupations where scientific literacy is an advantage. As a result, S&T personnel development has become a central feature of most national development strategies.

For Thailand, which often relying mostly on the use of cheap labor and natural resources (UNESCO, 1998; Yuthavong, 1997; Nation, 1997), it is necessary to have much increasing in its S&T system for the country's development and needs. Considering the S&T system of other countries should help Thailand to accelerate her

pace of economic development. In this way, failure can be avoided and success may be adapted to Thailand local circumstances, when and where appropriate (Cooattanachai, 2000).

Science and Technology in Japan

Japan consciously opened up to the external world after the Meiji era (1850-1910). It was already well on her way toward being industrialized and then acquired foreign technology. The country's industrial capability was strengthened during the world wars. This laid the foundation for the development of its S&T capability after World War II (Cooattanachai, 2000; Chamarik & Goonatilake, 1994).

Development of S&T in Japan is carried out through various policies. Notably, the communication and transfer of research results within the country, they could be used effectively by industry. Several factors allow these policies to contribute to the successful development of Japanese industry. Moreover, very active and deliberate government policies restructure Japan's economic growth towards industrialization. The creation of a favorable investment climate for industry facilitates the willingness and ability of the private sector to shoulder a very large portion of research and development expenditures (OECD, 2000).

To increase the number of S&T manpower, Japan made a concerted effort to increase the number of S&T degrees awarded. Japan produces a quarter of a million S&T degrees each year (Johnson, 1993). Recently, Japan has introduced an employment system along the lines of the American tenure system, whereby young researchers will be hired by institutions for a fixed time period. Their performance during that trial period is then evaluated, and if it meets approval, they are given tenure, which mean they receive a lifetime position at the institution. This system is one of the strategies to increase the mobility of researchers and scientists. Moreover,

in order to create conditions where talented young researchers can fully exhibit their capabilities expanding, research funding targets at young researchers, and therefore, researchers at the level of associate professor or research assistant can independently pursue their own research (Satoru, 2001).

In conclusion, the Japanese example reveals the success of a carefully nurtured pragmatic technology and effective S&T manpower capability to meet the country's needs.

Science and Technology in South Korea

South Korea has been transformed from a subsistent agrarian economic into a NIC during the past three decades. It has long emphasized the use of S&T for national development. This commitment remains strong even today. Despite its current financial crisis, it still has a strong technological base to expand the modern sector efficiently (Kim, 1998; OECD, 2000).

With the growth of the economy, the Korean Institute of Science and Technology (KIST) was established in 1966. Its successful integration with industry was evident by the late 1970s, at which time about 80% of its funding came from industrial contracts. Another boost came about in 1967 with the creation of Ministry of Science and Technology (MOST) to manage and coordinate government research. Furthermore, in 1971 the Korean Advanced Institute of Science and Technology (KAIST) was established for the purpose of producing highly qualified personnel to support R&D in both the public and private sectors (Cooattanachai, 2000).

. There are several factors that contribute to the success of South Korea's technology building. Of prime importance is the development of human resources. Institutions, such as KAIST and KIST, provide training grounds for scientists and engineers. With the country's skilled and educated human resource base, the benefits

of technology transfer could be maximized to their fullest potential. South Korea's graduate education is expanding rapidly to overcome the shortage of high-level personnel trained beyond the bachelor's level. Whereas there were only 800 masters and doctorate recipients from natural science and engineering faculties in 1976, by 1990 there were 8,000, with 900 doctoral degrees (Chamarik & Goonatilake, 1994; Johnson, 1993).

To further upgrade the labor force, the government is expanding programs to send students abroad. The Korean Science and Engineering Foundation has enlarged scholarship programs to allow some 10,000 S&T students to receive postdoctoral training abroad by the year 2000. Expatriate scientists and engineers are returning as salaries and living and working conditions improved in the country (Johnson, 1993).

Science and Technology in Singapore

As S&T has an immense impact in growth and development, the imperative for Singapore seems more crucial and urgent. It has often been remarked that, with no natural resources, Singapore's greatest resource is its human resources. As a result, it has attempted to develop its brainpower to its fullest potential. Singapore's ascendancy into a NIC is both intriguing and valuable as a lesson for developing countries. Singapore has achieved remarkable economic growth because of its strategic emphasis on, and effective policies for, the development of human resources and supporting S&T infrastructure (Johnson, 1993; Asia Pacific Business, 2000).

Singapore has enjoyed uninterrupted political stability after World War II. This atmosphere has allowed the government to focus on economic initiatives, especially in the development of S&T manpower. Education and training play central roles in this development. The National University of Singapore (NUS) is the leading public institution for R&D. It produces about 1,000 engineers annually. Although

most graduates go on to pursue positions with companies that offer attractive salaries, it also has strong postgraduate programs. In addition, Nanyang Technical Institute (NTI) is one of the fountainhead for human resources for the manufacturing industry, producing about 1,200 engineers annually (Cooattanachai, 2000).

The National Science and Technology Board (NSTB) was established in 1991 with the mission to develop Singapore into a center of excellence. NSTB has set up and provided funding support for several research institutes. The NSTB assesses technological trend, determines industrial needs, and supports company-based and consortia-based research by partnering local and multinational corporations in its wide-ranging activities. In sum, it helps to provide the physical infrastructure needed to support R&D activities (Asia Pacific Business, 2000).

Science and Technology in Malaysia

Since achieving independence in 1957, Malaysia has undergone economic and social transformation at the rhythm of successive five-year plan development plans. The country is fast entering an era of rapid industrialization. Like the NICs, Malaysia used policy to promote S&T as tools for economic development. It's policy, which focuses on scientific and technological self-reliance (UNESCO, 1998).

As a country with vast agricultural resources, industrial had a somewhat lately start in Malaysia. In 1971, 72% of Malaysia R&D budget was allocated for agricultural research while about 11% went to industrial research. Human resources for research are also lacking. Constraints in the career development of researchers have hampered S&T development so far (Cooattanachai, 2000).

Today, Malaysia is embarking on efforts to develop competitive and productive manpower in S&T in order to achieve its Vision 2020 plan and prepare for a future global economy (Mohamood, 1999). Several S&T strategies have been

adopted to improve this situation. First S&T had been accorded a high priority in the national development policy, with full support given to R&D in agriculture and industry. There are also incentives to promote R&D in the industrial and private sector. Local R&D efforts are encouraged through the acquisition and dissemination available S&T information. Also the use of computers in all activities is being encouraged.

Furthermore, the crucial issue of human resource is also being addressed. Training and long-term human resource development programs have been launched with and have an emphasis on the education system. To meet these challenges, the government has created strategies specifically designed to develop the country's future manpower. Some examples of these strategies include the encouragement of higher capital-intensive industries, an improvement education and training systems, an increase in S&T personnel, and encouraging the society to consider and participate in technical and skilled occupations (Mohamood, 1999).

From Crisis to Sustainable: Strategy for Thailand

Since mid-1997, Thailand has been trapped in her worst economic crisis since World War II. The economic crisis is a manifestation of deeper problems long suppressed in the Thai society, and people across the social spectrum have been affected. The scope and gravity of the crisis hence require intensive discussion, to seek ways out of the difficulties and more importantly, to lay the groundwork for future sustainable development. This will help prevent future crises, or at least minimize possible negative effects of future crises (Punyarachun, 1998).

Just a few years ago before the economic crisis, Thailand was hailed as a new economic 'tiger' in the East Asia region. Various factors have been pointed out as probable causes of the crisis, chief among which was Thailand's lack of

competitiveness in her business and industrial operations. The real cause appeared to be the fact that Thailand relied on cheap labor and imported raw materials, and there were little attempts to put higher added values through indigenous research and development. Most industrialists preferred to purchase ready made technologies rather than producing them on their own. (Chamarik & Goonatilake, 1994; Yuthavong & Wojcik, 1997; UNESCO, 1998).

The situations, alluded to above, point to the major concerns of Thailand S&T capabilities. The government has consequently been criticized for this distorted development and for its poor strategy in the use of S&T for national development. More or less, Birasak (2001) suggests, "Building up global competitiveness in S&T should be the effective way to implantation of more necessary competence to deal with competition in such other areas as economy, society, and politics" (p. 2).

Furthermore, in order to sustain future economic growth and increase international competitiveness, Thailand requires, among other things, a substantial upgrading of its industries, including adopting increased automation. Consequently, the days when companies would hire cheap and unskilled workers and keep them employed for years will soon end (Chalamwong, 1998). Yet, the country may not have enough educated and skilled people to serve higher knowledge-based work.

Chantramonklasri (1994) indicates before the crisis that Thailand had faced a severe shortage of S&T manpower, especially engineers, scientists and technicians. Moreover, most technical human resources in industry are used for routine production and maintenance rather than innovative activities. Taking into account the potential demands for manpower for broader and deeper technological development, the shortage will become even higher.

Besides, almost all universities are now facing problems in retaining their limited staff and hence are unlikely to be able to produce the needed manpower at a level that can fulfill industrial demands in the future. In addition, given that the momentum of technological changes will become increasingly rapid, formal education by itself may not be adequate in the long term to meet the changing and more specialized requirements of the production sector.

Science and Technology Policy and Plan

Thailand started the first five-year National Economic and Social Development Plan in 1961. In the first to the third Plan, S&T policy was implicit in the efforts to increase efficiency and expand production in agriculture, industry, and transport and communications. The Forth Plan (1977-1981) may be taken as the starting point to enhance the role of S&T development of the country. The Ministry of Science, Technology, and Energy (MOSTE) (the name was changed to Ministry of Science, Technology, and Environment in 1992) was established during this Plan in 1979. The Fifth National Economic and Social Development Plan (1982-1986) as well as two subsequent Plans contained a separate chapter on S&T development plan (STDP). STDP called for compilation of basic data and policy formulation, promotion of foreign technology transfer, development of R&D capability, and mobilization of S&T personnel. Specifically, the role of the state in strengthening S&T institutions and technical assistant from abroad were emphasized. A number of international cooperative agreements were signed, the most significant one being the US$ 49 millions Science and Technology Development Project with the United States which laid the foundation for the forthcoming S&T institutions. For the first time, the expenditure on research and development (R&D) was targeted at 0.5% of gross

domestic product (GDP) and the production of S&T personnel was to increase by 10% per year.

The macroeconomic reform in the Fifth Plan bore fruits in the Sixth Plan (1987-1991). The country was able to absorb massive foreign investment inflows and the economy grew at an unexpected rapid rate. STDP for the Sixth Plan called for building the mechanism to coordinate S&T works, develop S&T personnel at all levels, and formulate long-term national S&T policy. The target for R&D expenditure was set at 2% of government budget or 0.5% of GDP. National technology targets were identified as biotechnology, materials and electronics. The Science and Technology Development Project provided much needed research fund for university professors. In the same period, three national centers on the targeted technology areas were established at MOSTE.

The Seventh Plan (1992-1996) continued to ride the economic wave. The economy, industry, and export expand rapidly due significantly to the movement of manufacturing base from East Asia into the country. At the same time, the strain of infrastructure and the shortage of S&T personnel were becoming more apparent and Thailand comparative advantage began to slip because of rising labor, land, and infrastructure costs. STDP in this plan aims to stimulate the private sector to develop technology through the provision of incentives, utilize foreign direct investment for technology transfer, and link S&T development with industrial development, Targets were to increase industrial productivity by 2.6% and agricultural productivity by 1.8% per year. R&D targets were increased to 0.75% of GDP with government providing 0.5% and the private sector 0.25%. The production of engineer, scientists, agriculturists, technicians and researchers are to meet the demand.

The Eighth Plan (1997-2001) adopted a new approach to national development aimed at achieving the long-term vision of an ideal Thai society. It shifted the development paradigm from sectoral approaches of the past Plan to a holistic people-centered one. This approach emphasizing the cooperation and participation of all concerned saw S&T as a tool to support development in all sectors. To recovery from the current economic crisis, the real sectors need to be restructured and strengthen for competitiveness. The strategies are to enhance international technology transfer through cooperation, increase &D effectiveness, develop public sector institutions to be centers of excellence, and promote higher education institutions to be the depository of knowledge which can respond to the technological needs of the community.

The National Science and Technology Developing Plan (1997-2001) proposed by MOSTE is considered to be the long-term plan for S&T development. S&T are envisaged to be the intellectual assets which support the economic and social development of the country. The plan aims to develop S&T at both basic and applied levels in four categories, namely, personnel, R&D, technology transfer, and infrastructure.

Scientific and Technological Manpower

It is clear that the important problem faced by a developing country like Thailand is developing the human resources necessary to create new technology as well as to adopt and adapt imported scientific and technological skills to the prevailing socio-economic environment of the country. Although Thailand has a number of researchers working in various universities, government departments, and private organizations, the number is lower than in other more technologically advanced countries (UNESCO, 1998).

The "National Strategies for Solving Technical Manpower Shortage for Sustaining Future Economics Growth and Competitiveness" report found that the rapid changes in the present world have significant implications for the S&T manpower development. There is a requirement for greater flexibility and higher intellectual capacity. This implies:

1. The planning and production of technical manpower must relate closely with technological and industrial development.
2. The educational and knowledge base of the whole population must be greatly expanded, and
3. Training will be of great importance both for fine-tuning the outputs from the educational institutes and for upgrading those who are already in the work force. (p. 5)

Academic institutions are the major instruments for generating S&T manpower for the country's demand. The development process needs opportunity, infrastructure, and support systems. Nonetheless, universities have faced many problems, of which the most important are poor incentives and inefficiency management. In addition, Chalamwomg (1998) indicates that a close relationship with the private sector has been nonexistent where most of the technical human resources are expected to be deployed, this has become a serious concern because it reduces the ability of institutions to produce outputs that are responsive, quantitatively, and qualitatively, to the demand of user.

In sum, there is an urgent need to raise the issue of S&T manpower shortage to a policy level beyond that of academic institutions alone. It must become an agenda at the national level and be linked to other dimensions of the national development. A wide range of efforts must be launched, not in an ad hoc manner, but on a continuous

basis over many years to improve national manpower planning and to establish or promote new and innovative institutions for education and training. The government must play a prime role in initiating and fostering various measures to re-engineer and re-orient the production of S&T manpower to meet the growing and changing demands of the production sector. The experiences of countries like Japan, Korea, and Singapore clearly illustrate the importance of the role of governments.

Dramaturgical Analysis

In the attempt to understand the character and processes of social life, social scientists necessarily utilize the conceptual framework to which they are socialized. One of the useful frameworks with which to comprehend, describe, communicate and transform the character and processes of social life is dramaturgy: the analytic perspective that social life resembles theater or, more accurately, drama.

The literary critic, Kenneth Burke began to develop a "dramatistic" model of human behavior in his early writings in the 1930s. Burke maintained in his book Permanence and Change (1935) that human beings are active communicators who express themselves and relate to others much in the same way that actors do when playing roles in a play on a stage.

Goffman began his work on dramaturgy with The Presentation of Self in Everyday Life (1959). In this book he examined the ways in which a person gauged the responses of his/her behavior and altered it to create the kind of impression which s/he wanted an audience to take as an authentic representation of mood, a social identity or a social occasion. With minimum props, the actor can produce these moods, social occasions or a character in a performance sufficiently convincing to initiate a self-fulling prophecy of a given form of social reality.

Young and Massey (1977) indicate that dramaturgy is such an appropriate descriptive model for the reality construction processes of advanced capital-ism that

this phase of managed capitalism can be called the "dramaturgical society." The drama of the dramaturgical society, however, is of a particular, relative sort and the nefarious, exploitative uses can be opposed or replaced by more emancipatory interests. Under the right conditions, emancipatory dramaturgy can help transform such a society.

Dramaturgical analysis has raised a large number of issues about and made a variety of impressive contributions toward the understanding of the character, the social bases and the human consequences of dramaturgy. It has delineated some alternative uses of dramaturgy. One important use of dramaturgy is that it can contribute to the fundamental transformation of an entire society.

Throughout the Western industrialized societies and especially in the United States, the services of expert technicians, research institutes doing surveys, polls and samples, theatrical people, and mass communications are disproportionately available to large-scale organizations. Huge corporations, major universities, the military services, government bureaus and agencies, labor unions, as well as the major political parties hire specialized sets of functionaries. Their task is to use the accouterments of theatre, the findings of social science, and the facilities of mass media to generate an "in-formed" public...formed in the image of the purchaser of such services.

In sum, the dramaturgical society is one in which the interaction between an atomized mass of people and the major institutions and largest organizations is deliberately managed, marked by the images of service, quality, or agency, and the projection of these upon the population for whose benefit these organizations and institutions are ostensibly acting.

Chapter Summary

Science and technology play a key role in national development. The main point of S&T lies in the conduction of R&D and effective actions of getting technology transferred. Both need the critical mass with the substantial numbers of manpower to implement the activities. The proper and effective national S&T human resource development strategy needs to hand in hand establish among stakeholders.

CHAPTER III

Data Collection

Qualitative research is flexible, interactive, and continuous rather than static; allows participants the freedom to explain their particular view of the world; and adds rich, thick descriptions of reality to the body of literature (Rubin & Rubin, 1995). Thus, qualitative methodology was used in this study to investigate the social interactions among people who involved in the process of national scientific and technological (S&T) human resources production.

Procedures

Since this study was designed to examine the responses of educators and other stakeholders and their thought about the increasing need of S&T advances and experts in Thailand, the researcher needed to gather perspectives about the current S&T personnel strategy from the groups of people involved. Moreover, dramaturgical analysis procedure (Feldman, 1995) was employed as a way of presenting the data in order to explain the stakeholder's reaction to role the S&T manpower strategy.

Data Sources

The researcher chose policymakers from the institution/organization, who were in charge of the national S&T manpower policy. It consists of the Ministry of University Affairs; the Institute for Promotion of Teaching Science and Technology, one sector in the Ministry of Education; and the National Science and Technology Development Agency under the authorized of the Ministry of Science, Technology, and Environment. In term of educators, natural and applied science faculties from both public and private universities, as well as the secondary school science teachers were picked for the interview. Whereas in the group of students, undergraduate and

graduate candidates in S&T related fields, were also chosen for their views on S&T manpower capability.

Data Collection

Each group of individuals was contacted by phone (solicitation script attached in Appendix B) and asked to participate or designate a replacement, an individual knowledgeable about scientific and technology advances and available for an individual interview. The offices of the Ministry of University Affairs, the Institute for Promotion of Teaching Science and Technology, and the National Science and Technology Development Agency were contacted. The main offices of the natural and applied science faculties from both a public and a private university were contacted and asked to recommend faculty for individual interviews. Within the capital and rural areas of Thailand, two schools (selected at random) were contacted by phone and asked to recommend the names of faculty to be interviewed. The university faculties were asked to recommend students knowledgeable about scientific and technology advances for both individual and group interviews.

Interviews. The next step was to start interviewing those who were directly affected by national S&T manpower current situation. Qualitative interviews examine the context of thought, feeling, and action and can be a way of exploring relationships between different aspects of situation (Patton, 1990). In Arksey and Knight (1999) words, "Interview is a powerful way of helping people to make explicit things that have hitherto been implicit- to articulate their tacit perceptions, feelings and understanding" (p. 32). Therefore, the respondents in this study could provide important insights into national S&T manpower current situation.

In this study, a focused interview in which a respondent was interviewed for a short period of time was applied. Each interview was conducted around 45 minutes to

an hour. If more clarification was needed, the interviewee was asked to engage in a follow-up interview. This interview was less than 30 minutes. A copy of the transcript was sent to each interviewee to make correction (script attached in Appendix C).

In the introduction to each interview, I explained what I was interested in and why I was interested in it, so the participants would feel comfortable talking in depth on the topic. The interview protocol (see Appendix A) comprised of two parts. The first part was related to the interviewee's both educational and career background as well as his/her experience in science and technology. The second part comprised of a couple of questions, that invited the participants to describe their personal views in S&T manpower capacity in Thailand.

The techniques of probing, follow-up, reiteration and silence were employed in order to gain the rich descriptive data from the participants. Each interview was audio recorded and transcribed shortly after the interview took place. The interviews were conducted from the beginning of December 2001 to February 2002.

Participants

Of all 15 respondents, five individuals per category (policymakers, educators and students) were contacted by telephone, fax, and email directly to gain permission for the purpose of this study. I conducted interviews and follow-ups both through face-to-face interaction and by telephone. E-mail was also used to correspond with participants.

Pseudonyms were assigned to each participant. The names of the participants from the group of policymakers begin with the letter O. The names of the participants from the group of educators begin with the English letter S. The names of the participants from the group of students begin with the English letter U.

Table 2. The variety of respondents can be seen from their statuses:

Participants	Gender	Educational Level	Career status
Policymakers	2 females, 3 males	All Ph.D.	- Government officer - Faculty - Superintendent
Educators	1 female, 4 males	-All 3 faculties obtained Ph.D. - 2 Secondary school teachers gained master degree	- 2 secondary school teachers. - 2 public university faculties - 1 private university faculty
Students	3 females, 2 males	2 doctoral candidates 1 master candidate 2 bachelors	- 4 students from public university - 1 student from private university

Policymakers

Fives participants (two females and three males) in this category were from different organizations. All of them obtained their doctoral degrees in science area. Their ages ranged from 50 to 60. Their experiences are exhibited below:

Orapin was a female instructor in one of the famous public universities. She taught both undergraduate and graduate students, and researched in science area for more than 20 years. She was also in charge of making national S&T manpower capacity reports for the government. At this moment, she was a consultant in TGIST, which is a virtual institute organized jointly by Thailand's National Science and Technology Development Agency (NSTDA), the Ministry of University Affairs (MUA), and various Thai universities to help accelerate the number of graduates specifically at the master's and Ph.D. levels in specific areas of high technology.

Opal was a senior female administrator in one of the national research centers, under the National Science and Technology Development Agency (NSTDA). Her organization is involved in the policy studies, which are used in guiding the future direction of technology research and investment in Thailand, and is examined in the socio-economic impact of such technologies. In the issue of human resource

development, she possessed the authority to provide scholarships for higher education both in country and overseas.

Ohm, a high-ranking male administrator, had worked in the Institute for the Promotion of Teaching Science and Technology (IPST) for more than ten years. This organization has been responsible for science education at all school levels in the nation. It worked towards the goal to make science curricular more applicable to the needs of the modern economy, to increase the effectiveness of the methods of teaching and learning, and to offer various programs in human resource development for both teachers and students.

Opart was a male superintendent of the very first Science School in Thailand. This school had just established at the beginning of the year 2001. He used to work in the IPST since the original founding period until he moved to this newly Science School. He possessed high experience in the national S&T manpower strategy planning.

Ong-korn was a male government officer. He worked as an assistant deputy of the ministry, in the bureau of Policy and Planning in the Ministry of University Affairs. This bureau is mandated to advise on policies and plans on higher education, formulate manpower production and development plans, determine criteria for setting up and merging units, as well as criteria for project analysis and budget allocation. The bureau also monitors and evaluates the implementation of Higher Education Development Plans, promotes research and development in higher education institutions and set up information systems for administration purposes and public access.

Educators

Fives participants (one female and four males) in this category were interviewed. While all faculties from both public and private university obtained their doctoral degrees, the secondary school teachers held their master's degrees. The details of each educator were shown as follows:

Samorn was a female science teacher in a secondary school located in Bangkok for 25 years. She finished both bachelor's and master's degrees in biology at Srinakarin-tarawiroj University in Bangkok. She taught a science subject for lower secondary students for 15 years and turned to teach biology for higher-level students since she obtained her master's degree.

In her school, there are almost 2,700 students, around 1,700 students at lower secondary level and approximately 900 students at higher level. At the same time, the programs that students at higher level attended were divided into science and non-science programs. Only one-third of the higher secondary level chose the science program. In fact, there were more students who were interested in science program but in terms of their qualifications and the matter of lacking science teachers in the school, they were pushed to study other non-science programs.

Srivichai was a male science teacher at the secondary level for 27 years. His school was located in Nakornpratom Province, which is a rural area not far from Bangkok. He finished his bachelor's degree in science at the Rachapat Teacher College in Nakornpratom Province. After 5 years, teaching, he furthered his master's degree in science with the major of biology teaching at Srinakarintarawiroj University in Bangkok. He was the head of science department after his graduation. Srivichai was an energetic science teacher. He was also awarded as an outstanding science teacher in creative project by the government.

In his school, there were almost 900 students, more than 600 students at lower secondary level and the others at higher level. At the same time, students at higher level were divided into science and non-science programs. Only one-third of the higher secondary level chose the science program.

Sayan was a male instructor who had been teaching at one of the King Mongkut's Institutes of Technology in Bangkok for 11 years. He finished his bachelor's degree in physics at Srinakarintarawiroj University in Chonburi Province and his master's degree in Energy Technology at the King Mongkut's Institute of Technology. After teaching for a couple of years, he obtained a scholarship to further his master's and doctoral degrees of electronic physics at George Washington University. He was teaching about 30 master's degree students and supervised 15 students for their research thesis. Moreover, he had a high intention to do research in order to bring the invention for the industry.

Somphong was a male instructor who had been teaching in the Faculty of Science in a prestigious public university for 5 years. He finished his bachelor's degree in biochemistry at Chulalongkorn University in 1988, and his master's and doctoral degree at Michigan State University in 1996. He began to teach both undergraduate and graduate students. Meanwhile, he was supervising 7 master's degree students for their research thesis and co-adviser for 3 more master's degree students for the same subjects. He held some administration job in his department. He was also invited to be an external consultant for participating in reviewing Thailand Research Fund's proposals.

Sangthong was a male instructor in a private university for 9 years. He finished his bachelor's master's degrees in physics at Srinakarintarawiroj University in Bangkok. However, his doctoral degree was in the area of environmental science

from the same university. He worked in the general science department, which served the fundamental science courses for the undergraduate students from all science-related faculty, namely the Faculty of Engineering, the Faculty of Nurse; and the Faculty of Science. Despite he had to teach more than 15 periods per week, he tried to do his own research. His research won an award from the National Research Council in Thailand.

Students

Fives participants (three females and two males) in this category were from different organizations. Two of them were doctoral candidates. One was studying master's degree and the rest were bachelor's degree students. Their background were described below:

Uthumporn was a first year doctoral candidate in the Faculty of Agricultural Industry at Kasetsart University, an outstanding public university in Bangkok. She finished her bachelor's and master's degrees in Food Science in 1993 and 1996 respectively. After that, she had been working as an instructor in the private university. She had taught the courses which were related to food chemistry for food technology undergraduate students for 4 years before she furthered her doctoral degree.

Ukrit was a doctoral student in the same faculty as Uthumporn. He finished his bachelor's degree in Food Science from Cheingmai University. Then he obtained his master's degree in the Faculty of Agricultural Industry at Kasetsart University. After graduation, he got a scholarship from the consortium project. This consortium was organized jointly by the National Science and Technology Development Agency (NSTDA) and various Thai university departments selected by mutual agreement with the help of collaborating overseas universities. The object was to help Thai

universities establish and run graduate programs in the selected areas at the Ph.D. and M.S. levels. Therefore, he had to study one-year coursework at Kasetsart University and do research in an oversea university, which was the participants of this consortium.

Usa was a master's degree candidate in Environmental Engineering at Oklahoma State University. She obtained her bachelor's degree of biological science in 1996. She used to work in the food industry for 3 years. Most of her work involved in the matter of environment, for example, the wastewater treatment in the factory. She decided to further her study in order to develop her profession in the USA.

Ungkana was an undergraduate student in the faculty of science in a private university. Her major was Food Technology. She was a senior student and she had an enthusiastic mind in studying science. She also had a strong intention to further her master's degree after she finished her bachelor's.

Ug-kara, a male freshman, studied in the faculty of science in a public university. He finished his secondary level from the urban secondary school, which was the first ranking of that province. There were around 1,400 students in the upper secondary level. Sixty percent of them took the science program. There were scholarships from the IPST to support the talent students at least up to master's degree level in science area. Each year, approximately forty scholarships were granted to upper secondary students. Ug-kara was one of them.

Sites

In order to understand the setting of each stakeholder, the background of scientific and technological institutes were reviewed as follows:

The Ministry of University Affairs. The Ministry of University Affairs was established in 1982. The major role of it is to supervise and coordinate Thailand's public and private institutions of higher education with the exception of some

specialized professional training, which falls under the jurisdiction of other ministries. The Ministry is also responsible for formulating educational policy within the framework of the national education development plan. The other tasks include standardization of curricula, personnel management and recommending areas for budget allocations.

Due to the rapid growth of Thailand's economy over the past decade, there has been a large demand for qualified graduates. However, the numbers are still minimal compared to the demand on the job market. This has become an important issue for the nation as its economic development and prosperity depending largely on the next generation that needs to be better educated.

The Ministry of University Affairs has aimed to ensure the demand of qualified graduates, the educational provision among public universities and private universities will not only be of higher quality that meets the international standards, but also produce qualified graduates to meet the market's demand.

The MUA accordingly enacted policies under the Eighth National Higher Education Plan (1997-2001) to cope with the current education condition. Under this policy, the MUA aimed to produce graduates in the fields with high demands, along with some specialized areas of study that are important to industrial growth. The MUA also conducted research studies to determine manpower needs of the country utilizing either manpower requirement approach or quality approach to suit each particular area of study. Fields that are currently identified as shortages include Sciences, Mathematics, Engineering, Computer Science as well as Medical Science.

Institute for the Promotion of Teaching Science and Technology The Institute for the Promotion of Teaching Science and Technology (IPST) has been established since 1972 by the Royal Thai Government as a state-enterprise. It was within the Ministry

of Education under the cooperation and supporting of the United Nation Development Program (UNDP). Since 1998, according to the Act of the Institute for the Promotion of Teaching Science and Technology 1988, IPST was switched to be an autonomous organization.

The IPST is mandated to promoting science, mathematics, and technology teaching of Thailand to be excellent and equal to the international standard. The aims of establishment of the IPST were intended:

1.To initiate, conduct, and promote the study and research of curricula, teaching techniques, in science, mathematics, and technology at all school levels.

2. To conduct training programs for teachers and students on the teaching and learning; and

3. To promote and conduct the assessment of the standard of textbooks, exercises, academic document and teaching materials and equipment, as well as the assessment of science, mathematics, and technology education.

Moreover, the IPST is still in charged of several programs for science talent, for example, Development and Promotion of S&T talents project, Science and Mathematics Teacher Production project, and Science and Mathematics Olympiads project.

National Science and Technology Development Agency

In the eighties, the Thai government has increasingly realized the crucial need for the success of scientific development, in addition to adequate manpower, and now financially supporting research. Although it set up the National Research Council (NRC) specifically to fund research as early as 1956, the level of support was too low effectively to meet the need. Thus, this weakness was addressed by the creation of special funding programs administered by national centers established for specific

areas. These initiatives were the predecessors of those now administered by the National Science and Technology Development Agency (NSTDA).

The National Science and Technology Development Agency (NSTDA) was established under the Ministry of Science, Technology, and Environment, to be the main driving force for the rapid science and technology development in Thailand. A major role of the NSTDA since its establishment in 1991 has been to spur on that development even more through funding and research. Funding goes to support research and development in both private and public companies and institutions, and to provide scholarships for study locally and abroad, for developing human resources development.

In-house research is also carried out at NSTDA in three National Research Centers: National Center for Genetic Engineering and Biotechnology (BIOTEC), National Metal and Materials Technology Center (MTEC), and the National Electronics and Computer Technology Center (NECTEC). The Technical Information Access Center (TIAC) makes available worldwide databases for the information searches.

The NSTDA has many initiatives to strengthen the country's human resource base. The agency, in conjunction with the Ministry of Science, Technology, and Environment, and the Ministry of University Affairs jointly offered scholarships for study both locally and abroad in the field of S&T at the undergraduate.

Moreover, The Thailand Graduate Institute of Science and Technology (TGIST)

is known as a virtual institute organized jointly by the NSTDA, the MUA and various Thai universities, with the help of collaborating overseas universities. The TGIST is aimed to help accelerate the numbers of graduates specifically at the master's and

Ph.D. levels in the specific areas of high technology, in which the universities link their resources and those of NSTDA to produce the "critical mass" necessary to advanced research and education, and as an organization to link the needs of industry, the vision of government, and the potential of academic research to target the type of human resource development necessary. With the following components, the TGIST is being designed as a nimble organization that can move quickly to produce graduates in emergent areas of national and regional industrial interest.

Table 3. Participants and their sites

	Participants	Sites
Policymakers	Dr. Orapin	NSTDA (TGIST)
	Dr. Opal	NSTDA
	Dr. Ohm	IPST
	Dr. Opart	IPST (Science School)
	Dr. Ongkorn	MUA
Educators	Samorn	Science teacher in Bangkok
	Srivichai	Science teacher in Nakornpratom
	Dr. Sayan	Applied science instructor in public university
	Dr. Somphong	Natural science instructor in public university
	Dr. Sangthong	Applied science instructor in private university
Students	Uthumporn	Doctoral degree student
	Ukrit	Doctoral degree student
	Usa	Master's degree student
	Ungkana	Undergraduate student (senior student)
	Ug-karachai	Undergraduate student (freshman)

Chapter Summary

This chapter provides insight into the methods and procedures used to capture the worldview of the respondents. The data collection and the background of each interviewee and organization for the study were described. The data itself and the analysis procedure is presented in the following chapter.

CHAPTER IV

Presentation of the Data

The purpose of this study was to examine the responses of the educators and other stakeholders to the increasing need of S&T advances and experts in Thailand. Collective perspectives focused on the new human resource development strategy. Three groups of stakeholder were selected for the study based on their responsibilities to accelerate the national S&T manpower capability. Policymakers served as activators and supporters, educators as producers for the output, and students were the inputs of this process.

In this study, dramaturgical presentation and analysis (Feldman, 1995) was employed to research the problem in order to investigate the stakeholders' reaction to role the S&T manpower strategy. Fundamental to doing a dramaturgical analysis was the question of what performance was taking place or what meaning was being portrayed to an audience and how the elements that make up performance contribute to that meaning. The strength of dramaturgical analysis rested on Burk's (1969) five elements, scene, act, agent, agency, and purpose, which proposed for generating principle from the actor's performance. This study used these five elements to present the whole picture of Thailand's S&T manpower capability. The scene referred to the current situation of Thailand's science and technology capability in each stakeholder perspective. The act displayed various problems that were taking place in the setting. The agent meant the groups of people who were involved in the S&T manpower development process as well as their roles to accelerate S&T manpower development strategies. The agency described the projects that support those strategies. The purpose was the reason or motive for those mentioned strategies (Feldman, 1995). This chapter presents these five elements.

Scene

In this element, the perspectives of S&T capability in Thailand among the policymakers, educators, and students were displayed. It provided the reader an understanding of the background of the problems associate with S&T capability.

Policymakers

All of the policymakers agreed with the International Institute for Management Development (IMD) reports that Thailand's level of S&T achievement ranked almost the worst in the World Competitiveness Yearbook from 1999 to 2001. Dr. Ohm said, "This ranking indicated some facts of our country. We had to realize what had gone wrong? What could be done?"

In the perspectives of policymakers, most of them found that Thailand's S&T capability was not concerned with national economic development. Dr. Opart mentioned that industrial productivity had been low despite the high growth because of the use of a high level of imported capital. Thailand had developed or grown, from imported technology rather than from increasing our expertise and knowledge of technology.

For example, Dr. Opart said,

> Thai agriculture was the most inefficient in the region. For instance, rice production was 400 kg per rai (1,600 sq meters) compared with 633 kg in Vietnam and almost 500 kg in Burma. This was a chronic problem, but nobody in the government, in scientific circles or in the farming community showed any vision in tackling it.

In fact it was rarely discussed although this loss of competitiveness also meant the loss of traditional markets. Besides, the service sector, the financial and banking sector was incompetent at international competition due to a shortage of human

resource in S&T. Analysis and evaluation of various salient projects in the production sector had rarely been involved by qualified personnel with comprehensive S&T knowledge (e.g. the skills in information technology (IT) and facility automation) which were now the requisite experience needed in global competition. "Involvement of S&T personnel could assist Thailand in efficiently adjusting herself to the rapidly changing technology, thus utilization of Thailand limited resources could be fully optimized" (Dr. Opal).

Dr. Orapin explained,

> According to a report compiled by the National Science and Technology Development Agency (NSTDA), the embarrassing ranking was a result of the low number of scientists and researchers per capita, accompanied by insufficient science and technology promotion. Thailand presently had 2-3 researchers per 10,000 people, while the so-called Newly Industrialized Countries have about 20-30 researchers per 10,000 people.

However, Dr. Ohm described,

> Even our ranking was the worst, it did not mean that we had no talent S&T personnel. Actually, there were some experts who worked shoulder to shoulder with other foreign experts in some outstanding research centers. Yet, our problem was that the amount of talent people in S&T area with high experience was very scarce. As a result, the competitiveness of our country was still in low ranking.

As mentioned above, it was clear evidence that Thailand had encountered the significant problem of S&T human resource capability.

> Even though the economic turmoil was causing quite serious problems for the government at present, the more crucial question was after the crisis passed

> how could we develop our nation and by whom. So effective and sufficient human resources were the most important thing for the country at the moment (Dr. Opal)

Furthermore, in the issue of R&D capability, Thailand faced serious shortcomings in the existing patterns of policy for technology and industrial development. Dr. Orapin described,

> In the past time, indigenous technological development efforts had focused primarily on the establishment and development of R&D institutions outside the production sector, and had hardly stimulated technological development and supported the acquisition and absorption of foreign technologies by private sector firms.

Dr. Opal agreed,

> Thailand paid very little attention to R&D, particularly in the field of science and technology development. There were few private experimental labs. Most private companies preferred to import technology and materials from abroad rather than invent their own, because it was faster and cheaper. While our neighbor country, Malaysia's private sector invested 20 times more in R&D than Thailand's.

As a matter of fact, S&T is a long-term investment. It needs time to return the desired outcome. But most of the Thai politician did not pay more attention in this key role for the nation competitiveness. Dr. Ongkorn complained that, in the point of view of Thai politicians, Ministry of Science, Technology and Environment as well as Ministry of University Affairs were ranked as "C" grade while other ministries responsible for the national economic structure were honored as "A" grade. He also added,

> In the last century, only a few developing countries, namely, Japan, Singapore, and Taiwan could upgrade themselves to stand at the forefront of the developed countries. Such countries set the first priority and underline the progressive trends at continuous of their human resource development.

In another respect, one major factor that had been agreed upon by Dr. Ohm and Dr. Opart, who worked for and used to work for IPST, was the weakness in science education. The following described some aspects of the science education system in Thailand.

> IPST was responsible for the development of science curricular and instructional materials including teaching-learning activities corresponding to the prescribed structure and scope. At the primary level, there was no science subject. The science content was integrated into, the "Life Experiences" subject group. Therefore, it had created a misunderstanding that any teacher could teach science. For the lower secondary level (grade 7-9), common science curricular known as "General Science" was separated subject. Likewise, the upper secondary education branched into academic and vocational stream. On one hand, in the academic stream (grade 10-12), science students followed courses in physics, chemistry, biology, and environmental science. Their non-science peers were required to take physical science, which emphasized everyday and environmental science. On the other hand, science curricula for vocational students were designed to provide students with the appropriate foundation for their chosen professional courses (Dr. Ohm).

However, Dr. Ohm added, "Students were forced to see science as another boring subject that existed only in the classroom or laboratory rather than as a journey through the world where curiosity and senses reign."

In terms of science education, Dr. Opart also indicated "It could be concluded that there were limitations such as class sizes, lack of science equipment and shortage of qualified teachers that affect the outcome." Moreover, Dr. Ohm stated,

> The system of entrance examination to higher education was also a major hurdle to effectively teaching and learning science. The testing was intended to emphasize both content and the learning process, but students had demonstrated they were more interested in passing the examination only as means to being admitted to a certain university.

For the in-service teachers, most of the primary level teachers were not accredited in science. According to data obtained from the Office of National Primary Education Commission, only 7.7% of them had earned degrees in science. At the secondary level, only 25% of the teachers were accredited in mathematics and science. Dr. Opart concluded, "Most teachers did not possess adequate knowledge, understanding, and skills in organizing teaching-learning activities. Worse, they were unable to serve as a role model of a person with scientific mind."

In the issue of social awareness in S&T Dr. Opal stated:

> Science information and knowledge available through the media was limited in both quantity and quality. For example, in the topic of Genetically Modified Organisms (GMOs), most people still misunderstood about their utilities. Positive scientific attitudes reflected in the mass media also leave much to be desired.

This was one reason that communication for the purpose of developing scientific attitudes among the populace, and building a scientific society in Thailand, was moving at a snail's pace.

Educators

From the perspectives of Educators, some of them owned almost the same idea like the policymakers mentioned above. However, there were some additional perspectives to add up.

The pessimistic idea of Dr. Somphong, a faculty from one of the prestigious public universities, about Thailand lowly rank in S&T could be summed up, "I wonder that we had no need to think about the competitive with other nations. We just need to make survival for our country." He also mentioned, "S&T was now a matter of survival economically and socially for the country. There had been too much lip service in the past. Now we needed something real."

Dr. Somphong had some comments about the quality of secondary science teacher as well. He used to be involved in one of the science-teacher training program. He found that all of science teachers who attended for professional development program, failed the examination. This reflected some problems in the quality of science teachers.

All faculties (Dr. Sayan, Dr. Somphong, and Dr. Sangthong) supported Dr. Opal in the following statement

> The nation should make a determined effort to raise the standards of science and technology within the society. Among other steps, this would require much greater support for higher education as well as encouragement of much closer links between universities and the private sector.

However, right now, the university lacked the proper environment to support faculties to do research. Many obstacles were reported. Dr. Somphong mentioned,

> During the past three years, public universities had their budget reduced about 10% every year. Meanwhile, they were unable to replace retiring lecturers and

> professors. As a result, many S&T faculties in many public universities currently had to bring back outdated equipment for use in classes while existing lecturers faced the overload of work because they were asked to help to teach many subjects.

Additionally, Dr. Sayan argued, "It was not only the relationships between industrial and S&T organizations/institutions that were important, but also the government supports."

Over and above, Srivichai, a secondary science teacher, found that science had been promoted among a limited group of people with a specific object. He argued,

> Students had very few perceptions in science career paths. They did not know what they were going to be in the future if they chose the science program. They just realized that they might get more opportunity for being admitted in their higher educational institutions in various curricula than students in the non-science program.

In addition, the secondary school now faced the shortage of science teachers. Samorn said, "Due to the National Education Act of 1999, most of the old teachers were aware about their new roles, probable they were afraid with change. Thus they chose to early retire. But no more sub-position to replace the retired teachers. As a consequence, teachers faced the overloaded teaching.

Samorn stressed:

> Now each teacher had to teach more than 25 periods per week. It was such a hard work. Besides, the Ministry of Education had launched the "Quality Assurance" project to ensure the quality of teaching. Therefore, they were very overworked and time for preparing the lesson was less and less.

Students

The students' perspectives in S&T capability were not so varied as the policymakers and educators. Most of them had just realized from what they faced in their circumstances. Nevertheless, there were some interesting aspects.

In the opinion of two doctoral candidates, Uthumporn and Ukrit realized that at this moment S&T capacity was really weak and lacked of competitiveness. Most of the researches were not served the needs of the society. Other nations had been already conducted the same experiment that we have just begun to study. Moreover, this kind of experiment had brought to innovation for industry. Uthumporn explained "For instance, my project was regarding to the extraction of the jasmine rice's odor. When I searched my literature reviews, I found that this kind of experiment had already been done 10 years ago in many South Asia region."

In most of the student's point of views, it seemed to them that S&T personnel were not lacking in terms of quantity but probably in the quality skills essential to compete in the modern industrial world. Usa said, "Many S&T graduates were still unemployed. The industry sector did not provide them the jobs because in some industry hiring the technicians were enough for their technology capacities. Otherwise, the industry technology was much more complex rather than the skill of the graduates." Thus, when they could not get the jobs in S&T field, they decided to further their master's degree or doctoral degree. Worse, some of them decided to change to non-science field. This situation led to a great loss in national investment.

In the perspectives of two undergraduate students, one of them enjoyed the new S&T manpower development strategies of the country. Ug-karachai was a bright students and he obtained a scholarship from the IPST. This scholarship provided for his education from the secondary level to at least master's degree. However, he still

wondered about his future career because the scholarship did not ensure the certain career position for him, because the current government officer positions were freezing. Moreover, this kind of scholarship was limited just in some high-ranking secondary schools. It was not equally spread out.

On the other hand, Ungkana, who studied science in the private university, realized that students in science were not fully supported by government or the industrial sector. It was very hard for students who graduated in science to find job in the science area. Industry did not need scientist to develop their production potential. Once, she had an internship in one food industry, she found that R&D seemed to be a high- risk investment for the owner. It cost both time and money.

Summary

In terms of S&T capability in Thailand, all of the interviewees' perspectives could be categorized in five aspects. First of all, S&T capacities were really weak in terms of both quantity and quality. Second, R&D system lacked linkages with the economy. Third, science education was inadequate in nearly all levels of Thai education. Fourth, there was shortage of S&T manpower. Last but not least, social awareness in S&T was still unseen among Thai people.

Table 4. The scene which performed the current situation of S&T capacity in each stakeholder perspective

SCENE	Policy-maker	Educator		Student	
		F	T	G	UG
1. S&T capability was really weak in terms of quality and quantity.	X	X	X	X	
2. R&D system lacked linkages with the economy.	X	X		X	
3. Science education was inadequate.					
3.1 Shortage of lecturers/teachers.	X	X	X		

3.2 Lacked of science equipments.	X	X	X	X	X
3.3 Entrance examination was not suitable.	X	X	X	X	X
4. Shortage of S&T manpower					
4.1 Both quality and quantity	X				
4.2 Only quality		X		X	
5. Social awareness in S&T	X	X	X		

(F = faculty, T = teacher, G = graduate student, and UG = undergraduate student)

Act

In this element, I displayed the problems that were taking place in the S&T manpower situation in Thailand. This part divided into three aspects. First was the problem which related to the S&T career path including social status and economic reward for the S&T graduates. Second was the hurdle of the S&T personnel production process, which was faced by educators in terms of teaching and conducting research. Third was concerned about the output. It was still doubted that was S&T manpower well equipped and ready for their career path.

The first factor affecting the extent to which the country could generate and retain S&T manpower was the S&T field did not attract top students as much as they used to. From the perspectives of the policymaker, in the past to find the best and brightest of Thailand's S&T graduates all one had to do was to look in the engineering and medicine field. Nonetheless, in the period of bubble economy around ten years ago, one only had to look toward the area of languages and mass communication, specifically advertising. New graduates wanted a career in finance, as a result of which that sector had pulled a lot of them in.

Usa, a master's degree students, criticized,

> Many students chose their tertiary education in the area of which prospect for greater wealth was possible. The best engineers and physicists could not find a challenging job in the country, so many stayed back in the US to work rather than returning to work in poor lab conditions for poor pay at home. Some of them received Thai scholarships to study science overseas, and actually preferred to return the money to the government in order to seek better job opportunities as scientist abroad.

Somphong (educator) added,

> I, myself had a strong intention to study science since I was young. Although I obtained the medicine program admission, I chose scholarship from IPST to study in the faculty of science. But what was the outcome I received? When I studied in America, I got a research assistantship. I received around US$ 1,000 per month. But when I came back to Thailand with my Ph.D. and became a faculty five years ago, my starting salary was only 10,600 Baht (1US$ = 45 Baht). After five years working here, my salary had been only promoted to be 14,000 Baht per month. Right now, with the support of my parents, my life was not bad, but I could not imaging my future.

Both policymakers and faculty determined that unless technical human resources were well organized in the society and reasonably provided for their contributions, it was difficult to attract people of high caliber into this career path. Moreover, as was widely known, many of the well trained engineers, scientists, and technicians were likely to end up working in other fields--- a situation which led to a great loss in national investment. Therefore, without improving the career options for scientists and researchers, our brightest students would not commit themselves to the development of the nation's science and technology.

Secondly, in the process of producing S&T manpower, teaching and conducting research were a crucial task for the educator to accomplish. The infrastructure for production of S&T personnel might be built up at the early stages from elementary and secondary levels of S&T education and continued to the tertiary education. It was recognized by most of the policymakers that Thai schools and universities were unlikely to produce enough science graduates because there were simply not enough teachers and lecturers of science and technology. It might take as long as 20 years, according to a thumb-nail estimate, to match the demand.

In school level, Srivichai (secondary science teacher) stated,

> Teaching was still not the favorable attractive profession. Teachers had to be responsible for the students in big schools in the cities as well as those in smaller schools in the provinces. While the responsibility was high and very demanding, the payment remained relatively low.

Therefore, the teaching profession has long been unattractive particularly to the new generation. Dr. Ohm (policymaker) said, "The current 130,000 teacher were usually not the cream of the crop. Most teachers did not possess adequate knowledge, understanding and skills in organizing teaching-learning activities."

With regard to this problem, a number of measures were being developed by IPST to support talent and improve teaching skills. At present, 60 secondary, 120 undergraduate, and a few more graduate scholarships were being offered for the talented, allowing them to be educated up to doctoral level. In 2010, 7,000 bachelors of science graduates from the Science and Mathematics Teacher Production Project would become government teachers. Nevertheless, "The incentives offered under this program, were not attractive enough and the prospects of a profession as a science teacher were by no means inspiring" said Dr. Opart.

Moreover, Dr. Ohm added some aspects of the learning styles of secondary science students:

> Our country science teaching-learning continued to focus on rote learning rather than on the development of the initiative and other desirable characteristics. The university entrance examination dictated upper secondary education. Most students, teachers, schools and parents agreed that the goal of this level of education was for the student to be subsequently admitted to a university. This was the cause of students' rejection of learning styles that stress process, skills, and development of attitudes. These students accord less attention to their in-school learning while devoting their time to tutorial classes to prepare for university entrance examination.

At the same time, IPST was in charged of the teacher professional development. However, when asked secondary school teacher, Srivichai felt that the program provided by IPST, seemed to be redundant in the content. On the other hand, Samorn mentioned the opportunity to attend this kind of professional development program was scarce due to the limitation of participants in each program. She had just attended only one training course in this year.

In the case of university faculty, it was found that faculties were overloaded with teaching tasks as well as the administration responsibility. Few research was conducted. Moreover, "It seemed that researchers in the country had performed research merely for academic purposes," said Dr.Sangthong. "They didn't really do research with the aim to build a knowledge bank for the country's long-term development" (Dr. Somphong).

Dr. Somphong described the current research environment in his own opinion. He said:

> I could not continue my research that I used to conduct in the US due to the lacking of up-to-date technology and equipment. Besides, because of the overload task, I could merely supervise the master's degree students' research. There was no research atmosphere in my faculty. And most of the old faculties enjoyed their routine jobs. Once, I urged them to set up a seminar in cooperation with the industry sector for our curriculum development. Most of them, especially the dean, did not agree. They were not concerned about students, who are the fruits of their production. They just let students to survive in their own ways.

Over and above, Dr. Opal mentioned the status between instructor and researcher in the university system:

> There was a culture in the university to separate the position between the instructors and the researchers. Whereas the instructor was classified as a first class officer, the researcher was the second ranking officer. Thus, the incentives for the researcher were not to satisfy. This might be a reason that the research environment was not strongly promoted in the university.

Nonetheless, there was a light in the tunnel, due to the National Education Act universities had to perform four main tasks including teaching, conducting research, providing community service and preserving Thai culture. Nowadays, most of the faculty had to conduct their own research in order to pass the evaluation. But what kinds of research did they produce? Were they still on the shelf of the library? (Dr. Somphong)

The last problem in S&T manpower in the current situation was a concern for the quality of the S&T graduates who were the output of the process. Despite the

government as well as other stakeholders was now addressing the under-production of S&T manpower, most of the measured so far had been consider in the matter of quality of graduates. Dr. Orapin described this problem through her experience. She said, "The industry sector did not want to hire the new graduates because they possessed limited skill in research and development or could not catch on to the new technology."

All of the faculties (Dr. Sayan, Dr. Somphong, and Dr. Sangthong), including Dr. Orapin, felt very frustrated with the quality of the current students. Dr. Sayan said, "Students in this generation had the insufficient knowledge of scientific process skills. They also lacked the curiosity. They could only present the result of the experiment, but could not analyze or criticize the data that they found."

Moreover, Dr. Orapin was much more upset with graduate students. She found that some of them could not find a job during the financial crisis, so they continued their master's degree with no strong intention to develop their S&T skills.

However, due to the demand for graduates in S&T still existed, a few private universities were now producing them. It seemed to lessen the problem in terms of quantity. In practice, the quality of graduates still did not meet the requirement of the industry.

Table 5. The act which conclude the main problem in S&T manpower in the perspective of each stakeholder

ACT	Policy-maker	Educator		Student	
		F	T	G	UG
1. Social status and economic reward in S&T career were not satisfactory	X	X	X	X	
2. The process of S&T manpower development faced hurdles for nurturing the outcome	X	X	X	X	
3. The output were not well-equipped	X	X	X		

(F = faculty, T = teacher, G = graduate student, and UG = undergraduate student)

Agent/Agency

In this category, the agent and the agency were performed side by side. The agent included the groups of people who were involved in the S&T manpower development process and their roles to accelerate S&T manpower development strategies. The agency was the means through which agents brought about their action. From the scene and the act, it could be concluded that there was an urgent need to raise the issue of S&T manpower shortage to a policy level beyond that of the academic institutions alone. There were at least three organizations/institutions at the national level to be in charge of the national S&T manpower policy. First, the Minister of University Affairs was responsible for tertiary education level to produce graduates. Second, IPST was mandated to promote science, mathematics, and technology teaching and to conduct training programs for teachers and students so that they can learn about the teaching and learning process at the primary and secondary levels. And third, NSTDA was a new agency with strong initiatives to strengthen the country's human resource development and to support R&D in the cooperation between academic and private sectors.

In this part, the roles of each organization were presented through the views of the interviewees.

Policymakers

Dr. Ohm had raised the major roles of IPST to improve and promote science education for the new century:

- To conduct and promote research and development in science, mathematics, and technology education, including teaching/learning approaches and materials

- To conduct and promote in-service teacher training on teaching/learning science, mathematics, and technology.
- To revise and update science, mathematics and technology curriculum and teaching/learning materials.
- To establish standards of teaching/learning and evaluating those standards

Additionally, there had been attempts to implement special educational programs for talents. Five national projects were currently being implemented.

1. Development and Promotion of S&T talents. This project placed high achievers in S&T from at least the upper secondary levels in well-equipped tertiary institutions that offer specially designed programs for these students. The students were awarded long-terms scholarships that enable them to complete at least master's degree levels so that they could develop their S&T competence to capacity. Graduates would be placed in suitable jobs. A policy-making committee, chaired by the Ministry of Education, administered this project.

2. Science and Mathematics Teacher Production Project. With a view of solving the problem of science and mathematics teacher shortage, this project aimed at producing highly competence science teachers who would be academic leaders in their schools. The project was a tripartite collaboration among the Ministry of University Affairs, Ministry of Education and IPST. Scholarships were granted to students consistently obtaining high grades. The target was to produce 7,000 teachers during the life of the project from 1996-2010.

Additionally, IPST recognized the importance of the teachers and had implemented the teacher-training scheme. In an attempt to provide nation-wide

teacher training, IPST trained the so-called "master teacher" who would return to their homes and teach teachers in their areas.

3. Science and Mathematics Olympiads. Thailand participated in the International Science and Mathematics Olympiads for the first time in 1989, by entering student representatives to the Mathematics Olympiads. Today, Thai students competed with their peers from other countries around the world in 5 subjects: mathematics, chemistry, computer science, physics, and biology. The medals and prizes from the Olympiads were by no means the main objective of IPST. It was considered more important to create an academic atmosphere conducive to science and mathematics study.

4. Development of Science and Mathematics Excellence Project. Students exceptionally competent in science and mathematics were selected to participate in this project in order to develop their full potential. Another objective of this project was to seek ways and means to recognize primary and secondary students who excel in science and mathematics.

5. Science School. The first science school in Thailand had recently been established in 2001 with an aim to administer, manage, and execute secondary level teaching-learning programs that focus on science and mathematics excellence. The school only caters to students with high potential in these fields.

Dr. Opart, the first superintendent of the newly science school, explained the need for the establishment of the science school, "Many countries used science school to inculcate in students with exceptional abilities the spirit of a researcher, developer, inventor, and academic leader. This kind of school needed unique curricula and methodologies that set it apart from other's school." Thus, the first science school was

established as an autonomous entity with an aim to offer secondary education for science and mathematics excellence.

Nonetheless, only a semester after operating, Dr. Opart found that many students still possessed a high concentration in the national entrance examination. Most of the students were the "cream of the crop" from their former outstanding school. The sense of competitiveness was really high. Furthermore, a number of students concentrated in the Science and Mathematics Olympiads competition.

Being optimistic, Dr. Opart believes that although the students are nurture to be keen in S&T capable, they might not choose science for their future careers. However, they were expected to continue their education through the Ph.D. level. Meanwhile, they could occupy some research spirits, moral characters, and responsible ability in their future careers.

Dr. Ongkorn, a high-ranking government officer from the Ministry of University Affairs, explained the MUA roles, which supported the process of producing these highly educated S&T personnel.

First, the MUA set up the working groups from both public and private sectors to make provision for the national manpower requirement. What were the areas of urgent need? Which universities were going to produce them suitably? How about the budgetary? Then, the strategy's plan was set up. At the same time, the professional development program had to provide to the faculty in these areas. This was the reason to increase the development potential of S&T manpower production. Scholarships for both master's and doctoral degree were allocated to public university faculties.

To move forward with these efforts, the Ministry of University Affairs in Thailand received a US $60 million Asian Development Bank loan for the procurement of discipline-specific laboratories and testing equipment in order to

develop technology-based growth in specialized educational fields. Its goal was to strengthen postgraduate education and develop research programs in cooperation with industry to establish a strong foundation for research and development in seven priority science and technology related fields. Targeted fields include agricultural biotechnology, chemistry, energy and environmental technology, environmental and hazardous waste management, environmental science, technology and management, petroleum and petroleum technology, and post-harvest technology.

But, only some selected universities with strong collaboration with private industrial sectors would receive support to implement sub-projects in the priority fields. These pilot projects were projected to become models of excellence, serving as examples for future government investment in higher education.

Likewise, NSTDA, a newly established organization, were mandated to support both public and private sector agencies, and conducts its own research in those areas of S&T deemed to be of strategic importance, including biotechnology, materials science and electronics/computer technology. The Thailand Graduate Institute of Science and Technology (TGIST) served as a 'virtue plus' institute of NSTDA, collaborating with all major universities in Thailand, and overseas universities, in development of S&T manpower at the graduate levels, and in continuing education at the professional level.

Dr. Opal, a senior administrator in one of the national research centers under NSTDA described her organizational activities, which provided for supporting S&T human resource development. She stated,

In the past, most of scholarships were given to individual. Students explored a variety of research and topics. As a result, the research was too diverse for specific national need. Nowadays, scholarships serve as a grant for R&D projects. In this grant, 30% of

resource is dedicated to human resource development. Thus an expert professor in the specific field could manage the project with his team, consisting of other professors, researchers, and graduate students. This kind of grant would be more practical than individual scholarships.

In addition, NSTDA joined with various Thai University departments selected by mutual agreement setting up a "Consortium Project" in order to help Thai universities established and ran graduate programs in selected areas at the Ph.D. and M.S. levels. Some collaborating overseas universities also supported this program. The areas of emphasis were those with clear industrial or public end-users. In each consortium area, appropriate university departments were welcome to join; the students from participating departments had the option of doing their thesis research partly in their universities, and partly at NSTDA, or in the other universities in the consortium or collaborating overseas universities, under joint supervision of the staff members of the participating institutes.

Dr. Orapin added that another S&T human resource development project, Royal Golden Jubilee Project existed. NSTDA, in collaboration with the Thailand Research Fund and the Minister of University Affairs, proposed this program to support the production of research work and 25,000 doctorate researchers in the next 25 years. The work plan would be divided into 2 phases. In Phase I (1997-2011) 5,000 articles of research and Ph.D. graduates would be produced (a four-fold increase from the present level). If the result of Phase I was satisfactory, Phase II would be initiated in hope of producing another 20,000 doctoral researchers. This project was approved as a program to commemorate His Majesty the King's 50^{th} (Golden Jubilee) year of reign.

Moreover, there were also some activities of NSTDA to support S&T skills for teachers and students in the secondary school level. They were called "Science in School" and "Science in Rural School" projects. They were set up for secondary schools in the city and the rural areas respectively. The objective was to promote S&T consciousness for the Thai youth. Several workshops had been organized for teachers and students. These projects were efficiency for the teacher requirement, particularly in rural areas.

In summary, every organization/institution tried to promote several activities for S&T manpower development. However, the outcome could not evaluate by itself. As a consequence, the responses from the educators and students would reflect its impact.

Educators

Srivichai, a science teacher, discussed the support from both IPST and NSTDA. He seemed satisfied with NSTDA's project, "Science in Rural School." He said,

> I received a valuable support from one of the universities in my province under the Science in Rural School (SIRS) program. More equipment and technology supports were provided. Students were able to go to the laboratory of the university and were familiar with the S&T environment. Besides, the professional development program was profitable for teachers.

On the other hand, he felt disappointed with the training program that was provide by the IPST. It was undesirable. The topics were not so attractive to persuade teacher to join. It wasted both time and energy to attend these kinds of training.

At the same time, Samorn, another science teacher, found that she and her colleagues possessed few opportunities to attend the IPST professional training because of its limited financial support.

Moreover, the "master teacher" project was an attempt to have nationwide teacher training by the trained-teacher. They were trained and returned to their homes and taught other teachers in their areas. Nevertheless, the objective of this project was not accomplished because no resource supported the network among teachers. Srivichai was a master teacher and he could not provide his training to other teachers because the overloaded tasks of teachers made them exhausted and felt not happy to be trained by colleague.

Dr. Sayan seemed to gratify the responsibility of NSTDA. He assumed that the 'cream of the crop' researchers and administrators in the NSTDA could see the whole picture of our country requirement. The budgetary was well distributed and the outcome quite clear. He also made a suggestion for more networking among the small research projects. Actually, there were lots of indigenous technology projects done, but they needed the process of pulling together and developing a big project to solve the nation's problems. In general, he was optimistic about the future of Thailand S&T capabilities. He added, "After the government sent a number of students to study abroad, they are now coming back and being the 'young new blood' of S&T personnel for our country development."

Over and above, there were some evidences indicated that the opportunities of public university faculty in applying research grants had priority over the private university faculty. Dr. Sangthong, a private university faculty said, "When I tried to propose a grant for my research, I faced a lot of burdens. The reason was only I was a private university instructor."

Students

Uthumporn was a doctoral candidate. She worked as a private instructor. Thus, she had problems obtaining a scholarship for her research. Now, she was seeking some grants for her study. However, it was not an easy task for her because she was a faculty from neither public university nor any government institution. It was a kind of discrimination.

In contrast, Ukrit studied in the same faculty as Uthumporn. He used to be the undergraduate student in this faculty. He received a scholarship from the "Consortium Project". Meanwhile, his research would be fully supported because he just continued the project that he used to do when he was the undergraduate student. So, the outcome could be accomplished soon. Moreover, he was also ensured to be a faculty in the public university after he graduated.

In addition, Uthumporn had mentioned some difference between the scholarships provided by IPST and NSTDA. She said,

> The scholarship from the IPST did not guarantee a future career. The incentives offered were not attractive enough. It was offered since the candidate studied in the secondary level. There was a frustrate example. One of her instructors, who previously received scholarship from the IPST, felt very upset with his career path. He was freezing in the mismatch position and could not move to other suitable position because his dean did not allowed. On the other hand, the NSTDA scholarships were flexible and there were several support systems providing to the students so that they can accomplish their research projects, for instance, the data base information systems and networking institutions, providing more equipment to make their experiments flow smoothly.

Table 6. The agent and agency which role to accelerate S&T manpower development strategies.

Organizations	Activities/Projects
Institute for the Promotion of Teaching Science and Technology (IPST)	1. Conduct and promote research development in science, mathematics, and technology education in primary and secondary level 2. Development and Promotion of S&T talents 3. Science and Mathematics Teacher Production 4. Science and Mathematics Olympiads 5. Development of Science and Mathematics Excellence 6. Science School
The Ministry of University Affairs (MUA)	1. Provide more budgetary in the urgent need field for the public university in the production process 2. Professional development for faculty 3. Joint with NSTDA in the Royal Jubilee Ph.D. Project 4. Asian Development Bank loan for upgrade quality of higher educational equipment particularly in laboratories for teaching and research.
The National Science and Technology Development Agency (NSTDA)	1. Big R&D grant including 30% budgetary for human resource development 2. The Consortium Project 3. Joint with MUA in the Royal Jubilee Ph.D. Project 4. Science in School and Science in Rural School Project

Purpose

The purpose of this category was to describe the reason or motive for those organization activities.

In regards to the IPST, Dr. Ohm asserted that the IPST responsibility for promoting science education in primary and secondary levels served as a foundation of the scientific knowledge for people in the nation. IPST attempted to make science curriculum more applicable to the needs of the modern economy, to increase the effectiveness of the method of teaching and learning, to develop training programs that give skills appropriate to the modern curricula, and to offer various programs suitable to different groups of learners. It was a big task to work towards a process to make all citizens become literate in S&T.

Additionally, Dr. Opart and Dr. Ohm satisfied the establishment of the Science School. Dr. Opart said, "There was an urgent need for our country to emphasis on the process of producing high quality S&T manpower. It had to start from the secondary education level."

Dr. Ohm gave a metaphor for urging the shortage of S&T manpower in Thailand. He said,

> At this moment, Thai people in the starvation of S&T capacity. Meanwhile, we had the limited resources. If we divided them for everyone, it would not be enough. But if we distributed to the appropriate people and then they could growth properly. Finally, they could build up more resource return to our country.

In another respect, Dr. Ongkorn's perspective in the main objective of the Ministry of University Affairs was to ensure the demand of qualified graduates, especially in the field of high demand. To meet this end, The MUA provide intense S&T manpower development by allocating efficient number of scholarships for lecturers to further higher levels of study within the country and abroad in order to ensure the efficiency of process for the creation of qualified graduates. Moreover, upgrading the quality of higher educational equipment particularly in laboratories for teaching and research was the aim for developing technology-based growth in specialized educational fields.

The NSTDA, an organization had established to develop manpower in S&T as well as supported research and development and finance to the private sector, In human resources development issue, NSYDA had placed emphasis on strengthening of postgraduate programs in S&T in universities. High-level personnel of high quality were urgently needed to enhance the competitiveness of the industrial sector.

Meanwhile, this special organization, outside the normal framework of state-enterprise and civil service, was to undertake a broad-based systematic approach towards enhancing the entire S&T system of Thailand in support of national economic and social development. NSTDA also maintained close associations with public and private research institutions and worked together to organize training courses and technical seminars for human resource and institutional strengthening. R&D was conducted with the purpose of developing new products and technologies for commercialization, and for promoting public welfare.

In the Royal Jubilee Doctorate Degree Program, Dr. Orapin stressed that the program did not simply allow students to further their education, but rather aims to produce doctorate-level researchers of the same quality found in other countries. "We would try to produce researchers who will be accepted internationally," Dr. Opal pledged. "And we would make sure that their research was published in international magazines."

Dr. Orapin said the reason the program would not send researchers to study abroad was that the country had lost a great deal of money over the past 100 years financing foreign education for Thais. “Every year, we faced a deficit of several billion Baht for education abroad," she said. "Now we have curricula which are equivalent to international standards. Our curricula also suite the needs of our country. Besides, it would also help strengthen the educational system for post-graduates."

Chapter Summary

In this chapter, the performance of current situation of S&T manpower capability in Thailand was going on. Dramaturgical analysis procedure was used to categorize the data into five components. In the scene or the setting of the

performance, all of the actors found that S&T capability in Thailand was extremely weak. The act presented a numbers of problems that cause to the quality and the quantity of S&T manpower. To remedy these problems, the agents (organizations/institutions) which involved in the S&T manpower development policy had launched several projects for the increasing of S&T manpower capacity. There were three organizations in charged with these projects. Their roles and means through which they brought their actions were exhibited as the agent and agency of this performance. Finally, the purposes of their actions were presented to assert their responsibilities.

CHAPTER V

Analysis of the Data

As noted earlier, dramaturgical analysis was used to help understand the S&T manpower capacity development in Thailand. Burke's (1969) five elements of scene, act, agent, agency and purpose were presented in Chapter IV to describe what is currently both publicly and privately believed to be happening in Thailand. In this chapter, those same elements will be used as organizational tools in the presentation of analysis. These elements will incorporate Goffman's (1959) role and stage presences as well as actor and audience analytical perspectives. The roles played and role taking of organizations and their front and back stage activities are used to analyze potential outcomes in the challenge to increase S&T manpower capacity. Definitions of actors and audiences support these understandings.

"Fundamental to doing a dramaturgical analysis is the question of what performance is taking place or what meaning is being portrayed to an audience and how the elements that make up the performance contribute to that meaning" (Feldman, 1995, p. 42). In this study, then, the performance that is taking place is that of re-building S&T manpower capacity in Thailand. We know from the data presentation that the scene and the act are present-day S&T capabilities in Thailand. The agent and the agency are specific activities and sets of policies that were designed to result in the remediation of the S&T manpower shortage. These included the Institute for the Promotion of Teaching Science and Technology's (IPST), the Ministry of University Affairs' (MUA), and the National Science and Technology Development Agency's (NSTDA) policies and projects. The purpose is the objective of these strategies.

Scene

The scene of S&T capacity in Thailand is where analysis begins. Clearly, evidence can be found to support the description of great weakness from the stakeholders' perspectives. All of the actors, policymakers, educators and students, reported weaknesses in three distinct areas. The first is that there was no networking among the S&T manpower workers: government, academy and industry sectors. Second, the policy alone was not enough to network diverse groups and individuals. The government did not and could not provide the support needed for this networking through policy. Finally, science education system in Thailand was inadequate; there were shortages of lecturers/teachers, insufficient science equipment, and the entrance examination is not suitable. The teaching and learning styles emphasized on theory adequate for passing examinations conducted by the instructors. Students and teachers had little exposure to practice. As a consequence, most of graduates (output) were required to be trained again by industry over an extended time before they became productive in industry sectors.

Act

The act is what is done during the performance. At front stage, a variety of strategies are launched to recover S&T manpower shortage capacity. At back stage, however, these opportunities cannot mobilize sufficient researchers and scientists due to the lacking of the proper environment to nurture this talent and fewer channels or incentives for potentially great scientists to pursue their passion.

At front stage, students are persuaded to join in the S&T cycle. At back stage, after graduation they cannot find the suitable job. The demand and supply do not match. Policymakers are working based on the supply system which seems to response to the country's need. But in reality, there are not enough jobs provided for

output of the process. Many higher education institutions still have little or no contact with industry or the service sectors. This causes the mismatch between the requirements of the industry and the academic institutions.

Agent/Agency

In this study, three national level organizations were selected to examine. They were all in charged of the national S&T manpower policies. The IPST was responsible for curriculum designed to shape the citizens of Thailand into S&T literate citizens and also chose to develop the talents of select S&T manpower students. The MUA was in charge of higher education's policies for producing the graduates as well as enhancing research and development in S&T areas. The NSTDA provided and/or conducted R&D projects, human resources development, management and technical services, technology investment, public awareness and information services. These strategies were designed to increase the networks, the knowledge bases and the general overall capacity of S&T in Thailand.

The agent includes the actors and the roles that they played in Thailand's effort to improve S&T manpower capacity. The actors were policymakers, educators (both university faculty and secondary science teachers) and students (university undergraduate students and graduate students). Their roles they played are as follows:

The IPST. At front stage, the IPST saw as its role to provide standards for citizens in terms of science education. However, for a long time the national entrance examination has been a problem. Students accord less attention to their in-school learning while devoting their time to tutorial classes to prepare for university entrance examination. Of highest interest to teachers, students and parents is the students' success in the university entrance examination. At back stage, IPST curriculum that tried to support scientific process skills through practical experience could not

accomplish this. Teachers did not satisfy the professional development scheme provided by the IPST. When they did try to communicate, there was no cooperation between the teachers, students and parents. There was an apparent problem with social value.

Furthermore, at front stage, IPST saw as its role the development of a select group of talented students. These individuals received funding and support unlike any other students in Thailand. At front stage, they were special nurtured and received resources from the hungry S&T capability pool. At back stage, the outcome was not satisfaction because most of these talented students did not get into the S&T tracks for their careers. It was the resource constraint and wastage.

The MUA. The MUA saw as its role to manage the educational policy within the framework of the national demand in higher education level. To this end, the Ministry is in charged of the budget allocation for the universities, particularly public universities, to produce S&T graduates to meet the country's need. In case of faculty professional development policy, a number of faculty were sent abroad to strengthen their own potential in order to support the process of production quality S&T manpower and to develop their research capacity. Hence, in the future these groups of faculty are assumed to be the new generation for the national S&T capabilities.

For the faculty's task, at front stage, they were expected to conduct the research to support the process of teaching and learning. The inventions from research are supposed to bring innovation into industry sections. Meanwhile, the faculty have their roles to response both teaching and conducting research. Owing to this, more budgets such as the Asian Development Bank loan are being pulled into this research circle. Additionally, Royal Jubilee Ph.D. and Consortium Project allowed faculty more opportunities to serve both the demand of increasing graduate students and

conducting research at the same time.

At back stage, due to the MUA's policy that the university has to generate more S&T graduates, more students (input) enter in this process. Most of the instructors are teaching more students in the undergraduate level and supervise more advisees in the graduate level. Teaching load and other responsibilities are very high. The amount of time that faculty devote to their own research or interaction with students was scarce.

In another respect, the culture of conducting research is dominated in some universities that have the strong relationship with the research fund institution. For instance, the prestigious university obtained the first priority to receive the grant from the funding organization. In contrast, private universities possess no opportunity to get support from these pools. When the research granting committees consider the research project to be supported, the name of the project's owner comes up as one of the criteria. Meanwhile, the grants are provided based on the status of faculty or institution not blind review.

In conclusion, the roles of networking between academic and the industrial sectors are originate supported that by the MUA that help the faculty to increase potential for the process human resource development in higher education system and to help industrial sector to develop technology capacities in their productions in the near future.

The NSTDA. NSTDA is seen as a new agency established for the purpose of meeting the urgent need for S&T development in Thailand. It is a juristic (self-governing) body that enjoys being part of the government system but outside the government administrative bureaucracy. This freedom allows great efficiency in research support. NSTDA's roles are seemed to support research as their first priority.

The role of human resource development, however, is found too.

In fact, NSTDA cannot provide educational degrees for students. Due to the relationship between faculty in various universities and the faculty in the NSTDA, the NSTDA was allowed to create numbers of higher-level graduates along with the research outcome. Additionally, NSTDA has taken its duties to promote the dissemination and use of research findings. These two crucial roles were the relevant strategies to promote S&T manpower development in the present-day situation to meet the urgent need of the nation.

Furthermore, the administrators in this organization are the elite scientists of the country. Most of them used to be faculty or administrators from universities. Their perspectives of national S&T capability are clear for guiding in their performances.

Purpose

From the review of literature, considering the S&T system of other developed/ developing countries should help Thailand to accelerate its S&T capabilities. The process needs S&T manpower development, R&D promotion, and strong support from the government.

The IPST's purpose can only serve to create the foundation of the future S&T manpower. Although the IPST tried to strengthen its own structure by supporting talented students to join its circle, these policies have no impact on the outcomes.

The MUA's purpose can serve both S&T human resource development and some R&D activities between academic and industry. In the latter task, it was seen just in the beginning step.

The NSTDA's activities serve the all purposes for fulfilling the national S&T capabilities. The close relationship among each stakeholder in academic area and industry field seem to strongly support their policies. The purposes of their policies

were relevant by their multifunction responsibilities.

The development process needs opportunity, infrastructure, and support. The organization which response for the monitoring the development of S&T capability must be composed of qualified leaders pertaining to high competency and intelligible vision.

Bureaucracy system seems to be not relevant for the process. However, the investment in S&T capability, especially in the process of production of S&T graduates need plenty of resources and time consuming. The results cannot see in the limited period. The long- term policies need to be support continuously.

Chapter Summary

In the attempt to understand the character and processes of social life, social scientists necessarily utilized the conceptual framework to which they are socialized. In this chapter, dramaturgical analysis was used to examine the policymaker's, educator's, and student's roles played and role taken in the current situation of S&T manpower capacity development in Thailand. Their front and back stage performances reflected to the realities of the present S&T manpower capacities.

Therefore, efforts of increasing S&T manpower development should be concentrated on the network among policymakers, educators, students, and outsiders. Put bluntly, the role of networking between academic and industrial sectors are the vital of developing Thai own S&T manpower. Thailand has many models to follow so as to accelerate its own S&T capability.

CHAPTER VI

Summary, Conclusions, Recommendations, Implications, and Commentary

This explanatory case study used a qualitative method to examine the responses of Thai policymakers, educators, and students in relation to the increasing need of S&T advances and manpower in Thailand. These realities were studied through the Dramaturgical analysis procedure. Simply put, this chapter is a summary of the purpose of the study, conclusions gathered from the data, implications and recommendations for further consideration, and lastly a commentary on what the study revealed.

Summary of the Study

The purpose of this study was to examine the responses of Thai educators and other stakeholders in each organization to the challenge of increasing scientific and technological manpower for the future of Thailand scientific and technology capabilities. The purpose was accomplished by

- Data collected from the policymakers, educators and students in Thailand. As a result, science education today was inadequate in nearly all levels of Thai education.
- Data presented through five elements, like scene, act, agent, agency and purpose. All the actors found that S&T capability in Thailand was extremely weak.
- Data analyzed through the categories of the five components, which helped to have a better understanding of S&T manpower capacity development in Thailand.

Data Needs and Sources

The sources of data were needed through three categories. Firstly, they were the policymakers who represented each Ministry in relation to national S&T

manpower development strategies. Secondly, they were the educators who were the implementers of the policy from the concerned ministries. Lastly, they were students who were the output of the existing policies. For this purpose, I have interviewed 15 participants, namely, five policymakers, five educators and five students.

Data Collection

Data was collected by means of qualitative interviews in order to obtain respondents' respective of S&T capability in Thailand, the important insights into the national S&T current manpower situation as well as the suitable way to increase S&T capability.

Data Presentation

Scene. The evidence could be found to support the description of weakness in Thai science and technology capability. Put in detail, the weaknesses could be shown as the three areas: 1) There was no networking among the government, educators and industry sectors; 2) The policy alone was not enough to network diverse groups and individuals, and 3) The science education system in Thailand was inadequate.

Act. At front stage, a variety of strategies were launched to recover the S&T manpower shortage capacity and students were persuaded to join in the S&T cycle; and at the back stage, these opportunities could not mobilize sufficient researchers and scientists due to the lack of the proper environment to nurture this talent and so forth. And graduates could not find the suitable jobs after their graduation.

Agent/Agency. The first was IPST, which was responsible for S&T curriculum design at all school levels, and second was the MUA, which was in charge of higher education's policies and the last one was the NSTDA that provided and conducted R&D projects, human resources development, management and technical services.

Purpose. The IPST's purpose served to create the foundation of the future S&T manpower. The MUA's purpose could serve both S&T human resource development and some R&D activities between academic circles and industry. And the NSTDA's activities would serve the purposes for fulfilling the national S&T capabilities. In short, the purpose of their policies were relevant through their multifunction responsibilities.

Data Analysis

Scene. In this element, the perspectives of S&T capability in Thailand were displayed among policymakers, educators and students. The main concerns among the participants were the low quality and quantity of S&T education, the weak linkages between education and economy, the inadequacy of science education and poor social awareness in S&T education.

Act. This part was divided into three aspects. The problems relating to the S&T career path, the hurdle of the S&T personnel production process and the concern about the output of the science education. Indeed, many higher education institutions still have little or no contact with industry or the service sectors. This causes the mismatch between the requirements of the industry and the academic institutions

Agent/Agency. In this study, three national level organizations were selected to examine. The administrators in the above-mentioned organizations were the elite scientists of the country. They were in charge of the national S&T manpower policies. Moreover, the agent includes the actors of policymakers, educators and students

Purpose. From the review of the literature, the existing S&T system of other developed/developing countries should help Thailand accelerate its S&T capabilities. Consequently, the process of developing Thailand for its S&T manpower needs manpower development, R&D promotion and its strong support from Thai

government.

Conclusions

Life is a stage upon which performers play. Through the dramaturgical analysis, the conclusions of this study can be summarized as follows:

First of all, the long-established educational system is very bureaucratic. As a result, the policymakers from the government focus mainly on the teaching rather than R&D, particularly in the field of science and technology. Therefore, the solution should be conduced from the top-bottom performance, alone with the bottom-top activities.

Second, S&T is a long-term investment. The government can use the successful models of Japan, Singapore and Taiwan to make a long-term plan and implement this policy step by step.

Third, science curricula should be designed sufficiently so as to provide students with the appropriate foundation for their chosen professional courses. However, the current science students are in dilemma since it will be difficult for them to find jobs after their graduation.

Fourth, the universities should set up the proper environment to support faculties to conduct researches while teaching their students in the universities. This support would not only come from the universities, but also come from the Thai government, individuals and S&T organizations.

Fifth, the quality of education should be improved urgently due to the low competition among the current students. In other words, Thai universities were unlikely to produce enough science graduates. Part of solutions was to reduce teachers' overload and their research should be more practical rather than only academic purposes.

Sixth, the universities should find a suitable way of absorbing the "new blood" of the S&T personnel for the country development.

Last, but not least, the existing S&T curriculum should be revised toward the international standard.

All in all, the solutions for the current problems of low S&T education should promote faculty's both teaching and conducting practical research. Furthermore, the higher education institutions should have more contacts with industry and the service sectors. The problem of current science education should be solved from the roots by making the awareness among the government officers, educators and students as well as industries and others.

Recommendations and Implications

The findings of this study produced significant results in the areas of theory, research and practice. The following will examine how this study met each of these criteria.

Theory

Theoretically, this study carries out the usefulness of Dramaturgical Analysis to expose and provide an explanation for the interaction among members of the sample group as they work toward development of scientific and technological capacities in Thailand.

Research

This study adds more information to a limited knowledge base regarding networks diffusion in national policy practices. This study will also add a better understanding of the perspectives to the knowledge base.

Practice

This study enhances the practice of education by providing policymakers with

the insight in relation to stakeholders response. Through this recognition, practice can be enhanced by a concerted effort to recognize and minimize the effects that will have on the effectiveness of maintaining cohesive goals and purposes of the scientific and technological manpower development strategy in Thailand.

Commentary

The reason why I chose this topic was mainly due to the 1997 economic crisis, which many people, like the government policymakers, educators and others in Thailand, tried to find out the reasons and solutions for the current problems.

Some of the ideas for solving the problems were to borrow the loan from outside, especially from the IMF (International Monetary Fund). However, as the time passes by, people gradually realized that this was only the short-term solution to the problem. As a result, it only solved the current problems, but could not do it from the root of the problem or called "grass-root" problem.

Being one of the science educators in Thai higher education institution, I have realized that if the economic problem could be completely solved, it should focus on the international standard by means of increasing the S&T manpower development. This was the long-term investment. Therefore, I chose the topic of how to develop our own S&T manpower rather than fully relying on other countries.

As for the theoretical lens, I chose both the dramaturgical analysis procedure for presenting the data and Grannovetter's network theory as the data analysis frameworks. Nevertheless, after having an attempt to present the data and try to use Grannovetter's strong and weak ties, it did not work in terms of tie components, namely, time, intensity, intimacy and reciprocal services.

Furthermore, the Thai culture did not provide the channel to clearly link the ties among the stakeholders. For example, through my interviews, all my interviewees

mentioned that the budget for supporting S&T capability development should fully come from the government. Most of them had no ideas to link the ties both within and outside of their organizations.

Through my research, I gradually realized its limitations because of the limited selections of the participants. For instance, I only chose the participants who were involved in the S&T manpower development that related to the Thai educational system, the policymakers, educators and students. Further studies should emphasize the focus of participants who were not in the educational system, such as the industrial sectors who were the users of the output of the educational system. In other words, the theory or knowledge created or learned by the educators and students should be finally evaluated by the practitioner.

Therefore, if any country like Thailand wants to compete with other countries, especially with the developed countries in relation to the S&T development, we have to create the knowledge base, in particular the S&T base, which plays a vital role in the national development in terms of economic, social or political scenes. Thus, the creation of new scientific knowledge means to stress the technical innovations that will be the security of the country.

In a word, science and technology contribute to the rising of living standard of the population and lead to the improvement of the quality of life. So, science education should be heavily emphasized and linked to the survival and prosperous of the country.

REFERENCES

Birasak, V. (2001). White paper on Thailand 's science and technology. Unpublished manuscript.

Burke, K. (1969). A grammar of motives. Berkeley: University of California Press.

Coovattanachai, N. (1997). Science and Technology in Thailand in International Comparative Context. In Y. Yutawong & A.M. Wojcik (Eds.), Science and Technology in Thailand: Lessons from a Developing Economy (pp.115-127). Bangkok: NSTDA/UNESCO Publishing.

Chalamwong, Y. (1998). Recent economic performance and its impact on the labor market. TDRI Quarterly Review, 13(1), 12-21.

Chantramonklasri, N. (1997). The role of science and technology in Thailand's industrial sector. In Y. Yutawong & A.M. Wojcik (Eds.), Science and Technology in Thailand: Lessons from a Developing Economy (pp.31-44). Bangkok: NSTDA/UNESCO Publishing.

Dixon, C. (2001). The cause of Thailand economic crisis: the internal perspective. Geoforum, 32(1), 47-60.

Erlandson, D.A., Harris, E., Skipper, B., & Allen, S. (1993). Doing nationalistic inquiry. Newbury Park, CA: Sage.

Feldman, M.S. (1995). Strategies for interpreting qualitative data. Thousand Oaks: CA. Sage.

Goffman, E. (1959). Presentation of self in everyday life. Garden City, NY: Anchor.

Guba, E.G., & Lincoln, Y. S. (1989). Fourth generation evaluation. Newbury Park, CA: Sage.

Harsh reality about education in Thailand. (1997, October 1,). Bangkok Post. [www document]. URL http://www.nstda.or.th/newsroom/pr/pr011097a.html

International Institute for Management Development. (1992-2000). World competitive yearbook.

Johnson J.M. (1993). Human resources for science & technology: The Asia region. [www document]. URL http://www.nsf.gov/sbe/srs/.

Kim, L. (1998). Technology Policies and strategies for developing countries: Lessons from the Korean experience. Technology Analysis & Strategic Management, 10(3), 311-323.

Lagowski, J.J. (1994). Science in the national interest. Journal of Chemical Education, 71(11), 905-911.

Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic Inquiry. Beverly Hills, Ca: Sage.

Manning, P.K. (1997). Police work: The social organization of policing. Cambridge: MIT Press.

Marshall, C., & Rossman, G.B. (1989). Designing qualitative research. Newbury Park, CA: Sage.

Merriam, S. B. (1988). Case study research in education. San Francisco: Jossey Bass.

OECD (1994). Main definitions and conventions for the measurement of research and experimental development (R&D): A summary of the Frascati Manual. Paris.

OECD (1995). The measurement of scientific and technological activities, Manual on the measurement of human resources devoted to S&T :Canberra Manual. Paris.

Office of the National Education Commission. (1999). Thailand Education Reform: The National Educational Act 1999: Hope for a Better Thailand. [www document]. URL http://www.onec.go.th/move/news/nov_28a.html

Phromboon, S. (2001). Profile of science education in Thailand. Paper presented at the meeting of the First U.S.- Thai Education Roundtable, Bangkok.

Satoru, O. (2001, July). Sci-tech feature. Look Japan,47, 32-33.

Shin, T. (1997). Technology forsight: applications and its potential to the APEC region. In Y.Yuthavong (Ed.), Proceedings of APEC Symposium on Technology Foresight, Thailand, 37-55.

Singh, J.S. (1991). Higher education and development: the experience of four newly industrilizing countries in Asia. In Z. Morsy & P.G.Altbach (Eds), Higher Education in An International Perspective. (pp. 142-156). New York: Garland Publishing, Inc.

Tailoring the World Bank Loan. (1997, August, 20). The Nation. [www document]. URL http://www.nstda.or.th/newsroom/pr/pr200897b.html

Thailand Development Research Institute Foundation. (1995). The Strategy of technological manpower development for economics and competition capacity. Unpublished manuscript.

UNESCO (1978). Recommendation concerning the International Standardization of Statistics on Science and Technology. Adopted by the General Conference of UNESCO in 1978.

What Thailand needs to survive. (1997, October, 24). Bangkok Post. [www documnt]. URL http://www.nstda.or.th/newsroom/pr/pr241097a.html

Yuthavong, Y. (1997). Science and technology in developing countries. In Y. Yutavong & A.M. Wojcik (Eds.), Science and Technology in Thailand: Lessons from a Developing Economy (pp.1-16). Bangkok: NSTDA/UNESCO Publishing.

APPENDIX A

THE INTERVIEW PROTOCOL

Appendix A

The Interview Protocol

Part I: Background

1. Please tell me about yourself, including your education and your career.

2. Please describe your experiences, especially in S&T.

Part II: S&T Manpower Capability

1. What is the current S&T capability in Thailand?

    - Please talk to me about your perspective of S&T capability in Thailand.
    - What is the current situation of S&T manpower in Thailand?
    - What are you doing to increasing S&T capability?

2. What are the current problems for S&T manpower capability?

3. For policymakers and educators

    How can we remedy these problems?

3. For students

    How are teachers helping you to achieve your future career in S&T?

APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL FORM

Oklahoma State University
Institutional Review Board

Protocol Expires: 11/14/02

Date: Thursday, November 15, 2001 IRB Application No ED0246

Proposal Title: THE CHALLENGE OF INCREASING SCIENTIFIC AND TECHNOLOGICAL MANPOWER IN THAILAND

Principal Investigator(s):

Kulintomprasert Usanee
314 Willard
Stillwater, OK 74078

Adrienne Hyle
314 Willard Hall
Stillwater, OK 74078

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact Sharon Bacher, the Executive Secretary to the IRB, in 203 Whitehurst (phone: 405-744-5700, sbacher@okstate.edu).

Sincerely,

Carol Olson

Carol Olson, Chair
Institutional Review Board

APPENDIX C

CONSENT FORM

Appendix C

Consent Form

I, _____, hereby authorize or direct Usanee Kulintornprasert, or associates or assistants of her choosing, to conduct interviews with me about my perceptions and opinions about the challenge of increasing scientific and technological manpower in Thailand. I understand that I will participate in at least one interview, but no more than two interviews, each approximating about one hour in length. I also understand that my interview(s) will be audio-recorded and my identity will be held confidential. I have a better understanding of one fact that the records and transcripts of such interviews will be kept confidential and appropriately secured. I become aware that my participation in this study may generate practical knowledge to support the practice of new scientific and technological human resource development strategy as well as the educational change

I fully understand that it is voluntary for me to participate in this interview. There is no penalty for refusal to participate. Moreover, I am free to withdraw my consent and participation in this project at any time without any penalty after notifying the dissertation advisor.

I am certain that the interview and /or observation will be conducted according to commonly accepted research procedures. I am also certain that the interview and/or observation will not cover topics that could reasonably place to the subject at risk of criminal or civil liability or damaging to be subject's financial standing or employability or deal with sensitive aspects of the subject's own behavior such as illegal conduct, drug use, sexual behavior or use of alcohol.

I may contact the dissertation advisor, Professor Adrienne E. Hyle, Ph. D., Department of EAHED, College of Education, Oklahoma State University, OK 74078, U.S.A; Telephone number 001-405-744-9893 or 744-7246 or Usanee Kulintornprasert, Siam University, 235 Petkasem Road, Phasi-charoen, Bangkok 10160, Thailand; phone number 00662-4570068. I may also contact the Institutional Review Board (IRB) office. Dr. Carol Olson, chair of the IRB, or Sharon Bacher, executive secretary of the IRB, 203 Whitehurst, Oklahoma State University, Stillwater, OK 74078; telephone number: (405)-744-5700.

I have read and totally understand this content form. I sign it freely and voluntarily. A copy has been given to me.

Date: _____ Time: _____ (a.m./p.m.)

Signed: _____

Signature of Subject

I certify that I have personally explained all elements of this form to the subject before requesting the subject to sign it. Additionally, I have provided a copy for the subject's personal files.

Date: _____ Time: _____ (a.m./p.m.)

Signed: _____
Signature of student

I agree to abide by the language and the intent of this consent form.

Date: _____

Signed:

_____
Signature of dissertation advisor

VITA

Usanee Kulintornprasert

Candidate for the Degree of

Doctor of Education

THESIS: THE CHALLENGE OF INCREASING SCIENTIFIC AND TECHNOLOGICAL MANPOWER IN THAILAND

Major Field Higher Education

Biographical:

Education: Graduate from Strividhaya High School, Bangkok, Thailand in March 1984; received Bachelor and Master of Science from Chulalongkorn University in 1988 and 1992 respectively; complete requirements for the Doctor of Education with a major in Higher Education from Oklahoma State University in May 2002.

Experience: University instructor, Siam University.

1992-1993	Instructor in the Department of Food Technology
1993-2000	Head Department of Food Technology
2000-Present	Department of Planning and Development